Nevada
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National Nuclear Security Administration

Corrective Action Decision Document/ Closure Report for Corrective Action Unit 551: Area 12 Muckpiles Nevada Test Site, Nevada

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November 2006

Environmental Restoration
Project

U.S. Department of Energy
National Nuclear Security Administration
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CORRECTIVE ACTION DECISION DOCUMENT/ CLOSURE REPORT FOR CORRECTIVE ACTION UNIT 551: AREA 12 MUCKPILES NEVADA TEST SITE, NEVADA

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

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CORRECTIVE ACTION DECISION DOCUMENT/CLOSURE REPORT FOR CORRECTIVE ACTION UNIT 551: AREA 12 MUCKPILES NEVADA TEST SITE, NEVADA

Approved by: APPROVED SIGNATURE Date: 11/15/2006

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Approved by: APPROVED SIGNATURE Date: 11/15/2006

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Table of Contents

Table of Contents *(Continued)*

Table of Contents *(Continued)*

Table of Contents *(Continued)*

Table of Contents *(Continued)*

Table of Contents *(Continued)*

List of Figures

List of Figures *(Continued)*

List of Figures *(Continued)*

List of Tables

List of Tables *(Continued)*

List of Tables *(Continued)*

List of Tables *(Continued)*

List of Tables *(Continued)*

List of Acronyms and Abbreviations

Am	Americium
AST	Aboveground storage tank
ASTM	American Society for Testing and Materials
bgs	Below ground surface
BN	Bechtel Nevada
CADD/CR	Corrective Action Decision Document/Closure Report
CAI	Corrective Action Investigation
CAIP	Corrective Action Investigation Plan
CAS	Corrective Action Site
CAU	Corrective Action Unit
CLP	Contract Laboratory Program
Co	Cobalt
COC	Contaminant of concern
COLIWASA	Composite Liquid Waste Sampler
COPC	Contaminant of potential concern
Cs	Cesium
CSM	Conceptual site model
CZ	Contaminated Zone
DOE	U.S. Department of Energy
DQA	Data quality assessment
DQI	Data quality indicator
DQO	Data quality objective
DRO	Diesel-range organics
EPA	U.S. Environmental Protection Agency
Eu	Europium
°F	Degrees Fahrenheit

List of Acronyms and Abbreviations *(Continued)*

FADL	Field Activity Daily Log
FAL	Final action level
FD	Field duplicate
FFACO	*Federal Facility Agreement and Consent Order*
FID	Flame-ionization detector
FSL	Field-screening level
FSR	Field-screening result
ft	Foot
GPS	Global Positioning System
GRO	Gasoline-range organics
H&S	Health and safety
hrs/yr	Hours per year
HWAA	Hazardous Waste Accumulation Area
ID	Identification number
IDW	Investigation-derived waste
in.	Inch
LabDup	Laboratory duplicate
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
m^2	Square meter
MDC	Minimum detectable concentration
mg/kg	Milligrams per kilogram
mi	Mile
mrem/yr	Millirem per year
MRL	Minimum reporting limit
MS	Matrix spike

List of Acronyms and Abbreviations *(Continued)*

MSD	Matrix spike duplicate
N/A	Not applicable
NAC	*Nevada Administrative Code*
NAD	North American Datum
ND	Normalized difference
NDEP	Nevada Division of Environmental Protection
NIST	National Institute for Standards and Technology
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NSTec	National Security Technologies, LLC
NTS	Nevada Test Site
PAL	Preliminary action level
PB	Preparation blank
PCB	Polychlorinated biphenyl
pCi/g	Picocuries per gram
PPE	Personal protective equipment
PRG	Preliminary Remediation Goal
Pu	Plutonium
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
Ra	Radium
RBCA	Risk-based corrective action
RCA	Radiation controlled area
RCRA	*Resource Conservation and Recovery Act*
RESRAD	Residual Radioactive
ROTC	Record of Technical Change

List of Acronyms and Abbreviations *(Continued)*

RPD	Relative percent difference
SAA	Satellite accumulation area
SCL	Sample collection log
SDG	Sample delivery group
SNJV	Stoller-Navarro Joint Venture
Sr	Strontium
SSTL	Site-Specific Target Level
SVOC	Semivolatile organic compound
TCLP	Toxicity Characteristic Leaching Procedure
TEDE	Total effective dose equivalent
Th	Thorium
TPH	Total petroleum hydrocarbons
TSCA	*Toxic Substance Control Act*
U	Uranium
UCL	Upper confidence level
UTM	Universal Transverse Mercator
VOC	Volatile organic compound
WM	Waste management
yd^3	Cubic yard
µg/kg	Micrograms per kilogram
%R	Percent recovery

Executive Summary

This Corrective Action Decision Document (CADD)/Closure Report (CR) has been prepared for Corrective Action Unit (CAU) 551, Area 12 Muckpiles, in Area 12 of the Nevada Test Site (NTS), Nevada, in accordance with the *Federal Facility Agreement and Consent Order* (1996). This CAU was created to address potential contamination of the B-, C-, D-, and F-Tunnel muckpiles and co-located aboveground storage tank and stain. Corrective Action Unit 551 is comprised of the following corrective action sites (CASs):

- CAS 12-01-09, Aboveground Storage Tank and Stain
- CAS 12-06-05, U-12b Muckpile
- CAS 12-06-07, Muckpile
- CAS 12-06-08, Muckpile

The purpose of this CADD/CR is to provide justification and documentation supporting the recommendation for closure of CAU 551 with closure in place with administrative controls. To achieve this, corrective action investigation (CAI) activities were performed from October 4, 2004, through May 10, 2005, as set forth in the *Corrective Action Investigation Plan* (CAIP) *for Corrective Action Unit 551: Area 12 Muckpiles* (NNSA/NSO, 2004). The purpose of the CAI was to fulfill the following data needs as defined during the data quality objective (DQO) process:

- Determine whether contaminants of concern (COCs) are present.
- If COCs are present, determine their nature and extent.
- Provide sufficient information and data to complete appropriate corrective actions.

This document was initially submitted as a CADD. However, during additional negotiations with Nevada Division of Environmental Protection (NDEP), it was decided that the document would be changed to a CADD/CR. To support this decision, closure activities, including a regrading of the access road, installation of runoff diversion berms and shunts, installation of use restriction signs and authorization of use restriction documentation, were completed from August to October 2006.

The CAU 551 dataset from the CAI was evaluated based on the data quality indicator parameters. This evaluation demonstrated the quality and acceptability of the dataset for use in fulfilling the DQO data needs.

The muckpiles in CAU 551 were suspected to contain radiological contamination based both upon the results of previous CAIs at other NTS muckpiles and upon radiological postings on and near the muckpiles. Corrective Action Site 12-01-09, suspected to contain total petroleum hydrocarbons (TPH)-diesel-range organics (DRO) based upon the diesel-like appearance of a stain beneath the tank, was identified during a site visit in late 2003. It was added to the CAU 551 CAI during development of the CAIP. Due to the steep slopes on the muckpiles and throughout the area, however, the typical approach for the investigation was modified to incorporate the results of previous muckpile investigations in lieu of both sampling on the steep slopes and sampling into the underlying native soil through use of a drill rig.

Analytes detected during the CAI were evaluated against appropriate final action levels (FALs) to identify COCs for the CASs. The FALs for all chemical COCs, and for the radiological COCs, in the Verification Sampling Area (downgradient from the Extended Decision II Area) and the Upslope Area (upgradient from CAS 12-06-07), were based on the preliminary action levels stated in the CAIP for CAU 551. Radiological FALs for the original CAS areas and Decision II areas were derived by the Residual Radioactive material code calculations.

Assessment of the data generated from CAU 551 investigation activities revealed the following:

- CAS 12-01-09, Aboveground Storage Tank and Stain, contained TPH-DRO exceeding the FAL.
- CAS 12-06-05, U-12b Muckpile, contained TPH-DRO, benzo(a)pyrene, dibenzo(a,h)anthracene, americium (Am)-241, Cesium (Cs)-137, europium (Eu)-152 plutonium (Pu)-238, and Pu-239 above FALs.
- CAS 12-06-07, Muckpile, contained TPH-DRO, Am-241, Cs-137, Eu-152, Pu-238, and Pu-239 above FALs.
- CAS 12-06-08, Muckpile, contained TPH-DRO, Am-241, Cs-137, Pu-238, and Pu-239 above FALs.
- The Initial Decision II Area – which consists of the washes downslope from the muckpiles, identified in the CAIP, and an area wherein contamination from all three muckpiles intermingles within a short distance downslope from the muckpiles – contained TPH-DRO, Am-241, Cs-137, Eu-152, Pu-238, and Pu-239 above the FALs. The lateral extent of TPH-DRO contamination was bounded at the lower end of the Initial Decision II Area. The lateral extent of Am-241 contamination above the FAL was midway between the muckpiles and the lower end of the Initial Decision II Area. The lateral extent of Cs-137, Eu-152,

Pu-238, and Pu-239 contamination above the FALs was midway between the upper end of the Extended Decision II Area, and the E-Tunnel access road in the wash south of the access road.

Based on the investigation strategy as discussed in the CAIP, all three muckpiles were assumed from the onset of the CAI to be contaminated with arsenic, lead, TPH-DRO, Co-60, Cs-137, Pu-238, and Pu-239.

Based on the evaluation of analytical data from the CAI, review of future land use of the CAU 551 area within Area 12 of the NTS, and the ability to control access to the area the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) provides the following recommendation:

Closure in Place with Use Restrictions, and road improvements to divert approximately one-third of the precipitation runoff, which is not impacted by CAU 551 or the Neptune crater area (pending assignment of CAS number). To support this recommendation, the following closure and inspection/monitoring activities for the four co-located CASs of CAU 551 were implemented:

- The E-Tunnel road, which also leads to the CAU 551 area, was graded to allow for smoother travel to the area (e.g., for personnel monitoring the water discharge at E-Tunnel, utility line workers, security personnel, personnel investigating the Neptune crater area, and personnel inspecting the site closure), and to divert runoff away from the draninage.
- Two water diversion berms were installed just above the last accessible portion of the access road (e.g., a few hundred feet above the B-Tunnel area), and the north side of the road was modified to allow runoff, not impacted by CAU 551 or the Neptune crater area, to return to its historical route into the watershed to the north.
- An inventory of historical artifacts in the area was completed by the Desert Research Institute.
- Use restriction signs were posted at thirteen locations along the access road and other locations where area visitors might conveniently park and walk into the area.
- Use restriction documentation was prepared and authorized for implementation of the use restriction for the site.
- Inspection of the use restriction signs to ensure all signs are in place and legible
- Inspection of the condition of the two runoff diversion berms to ensure they are in place and functioning as designed (i.e., to divert runoff out of the basin)
- Inspection of the E-Tunnel turnoff culvert. If visible evidence exists of sediment migrating past the culvert, the conditions at the culvert will be photo-documented.

- Inspection of the general condition of the access road and drainage below the E-Tunnel turnoff culvert. If evidence exists that sediment from within the use restricted area is migrating outside of the use restricted area, NDEP will be notified. In addition, a determination on the need for monitoring (e.g., sample collection and analysis) will be made based on current site conditions.

The activities undertaken to close CAU 551 will ensure that the site will not present an unacceptable risk to human health or the environment.

1.0 Introduction

This Corrective Action Decision Document (CADD)/Closure Report (CR) presents information supporting closure of Corrective Action Unit (CAU) 551, Area 12 Muckpiles, Nevada Test Site (NTS), Nevada. The corrective actions proposed in this document are in accordance with the *Federal Facility Agreement and Consent Order* (FFACO) that was agreed to by the State of Nevada, U.S. Department of Energy (DOE), and the U.S. Department of Defense (FFACO, 1996). The NTS is approximately 65 miles (mi) northwest of Las Vegas, Nevada (Figure 1-1).

Corrective Action Unit 551 is comprised of the four Corrective Action Sites (CASs) that are shown on Figure 1-2 and listed below:

- CAS 12-01-09, Aboveground Storage Tank and Stain
- CAS 12-06-05, U-12b Muckpile
- CAS 12-06-07, Muckpile
- CAS 12-06-08, Muckpile

A detailed discussion of the history of this CAU is presented in the *Corrective Action Investigation Plan* (CAIP) *for Corrective Action Unit 551: Area 12 Muckpiles* (NNSA/NSO, 2004).

1.1 Purpose

This CADD/CR provides justification for the closure of CAU 551 in place with administrative controls. This justification is based upon process knowledge and the results of the investigative activities conducted in accordance with the CAIP (NNSA/NSO, 2004). The CAIP provides information relating to the history, planning, and scope of the investigation; therefore, this information will not be repeated in the CADD/CR.

Corrective Action Unit 551, Area 12 Muckpiles, consists of four inactive sites located in the southwestern portion of Area 12. The four CAU 551 sites consist of three muckpiles, and an aboveground storage tank (AST) and stain. The CAU 551 sites were all used during underground nuclear testing at the B-, C-, D- and F-Tunnels in the late 1950s and early 1960s and have mostly remained inactive since that period.

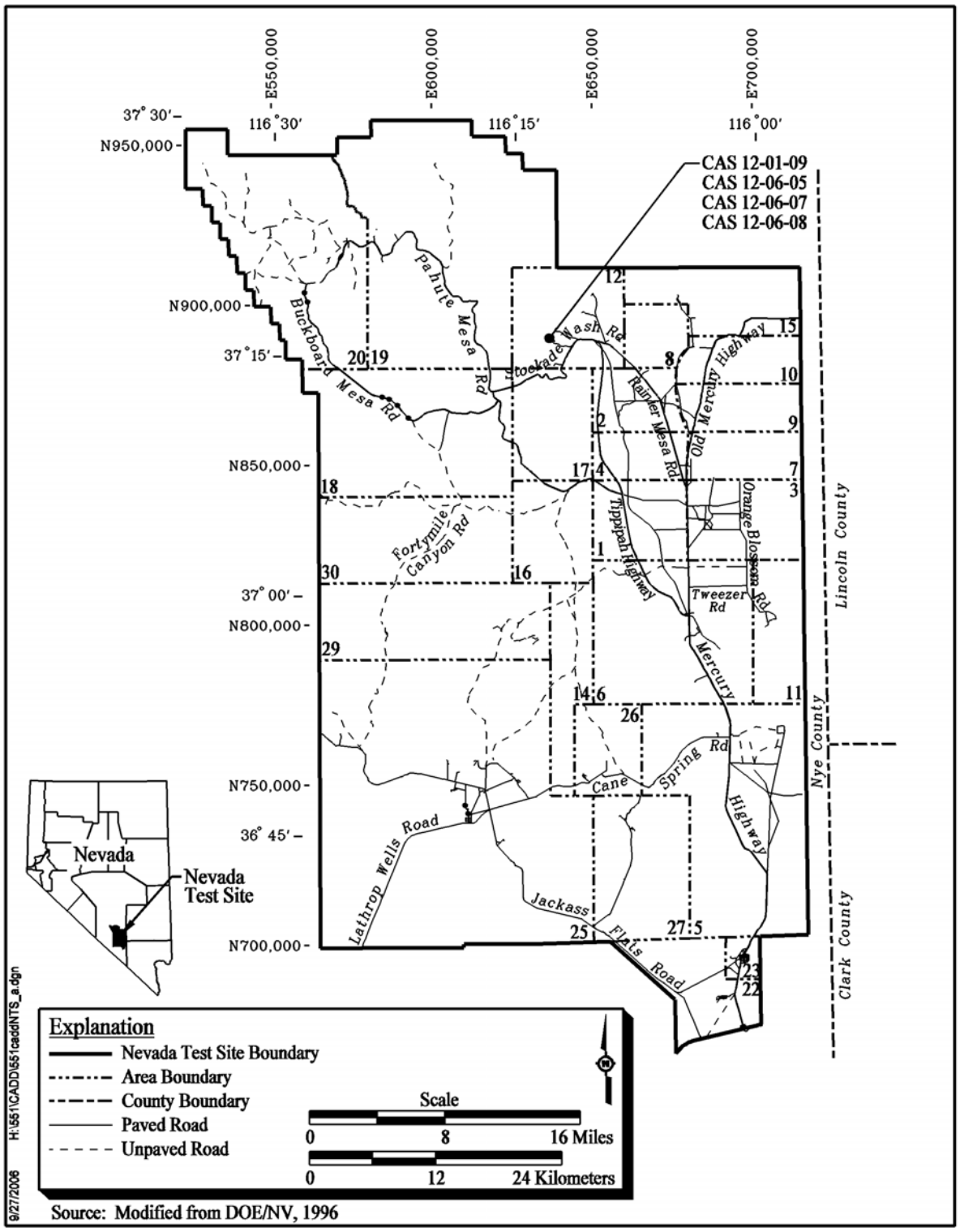

Figure 1-1
Nevada Test Site Map with CAU 551, Area 12 Muckpiles, CAS Locations

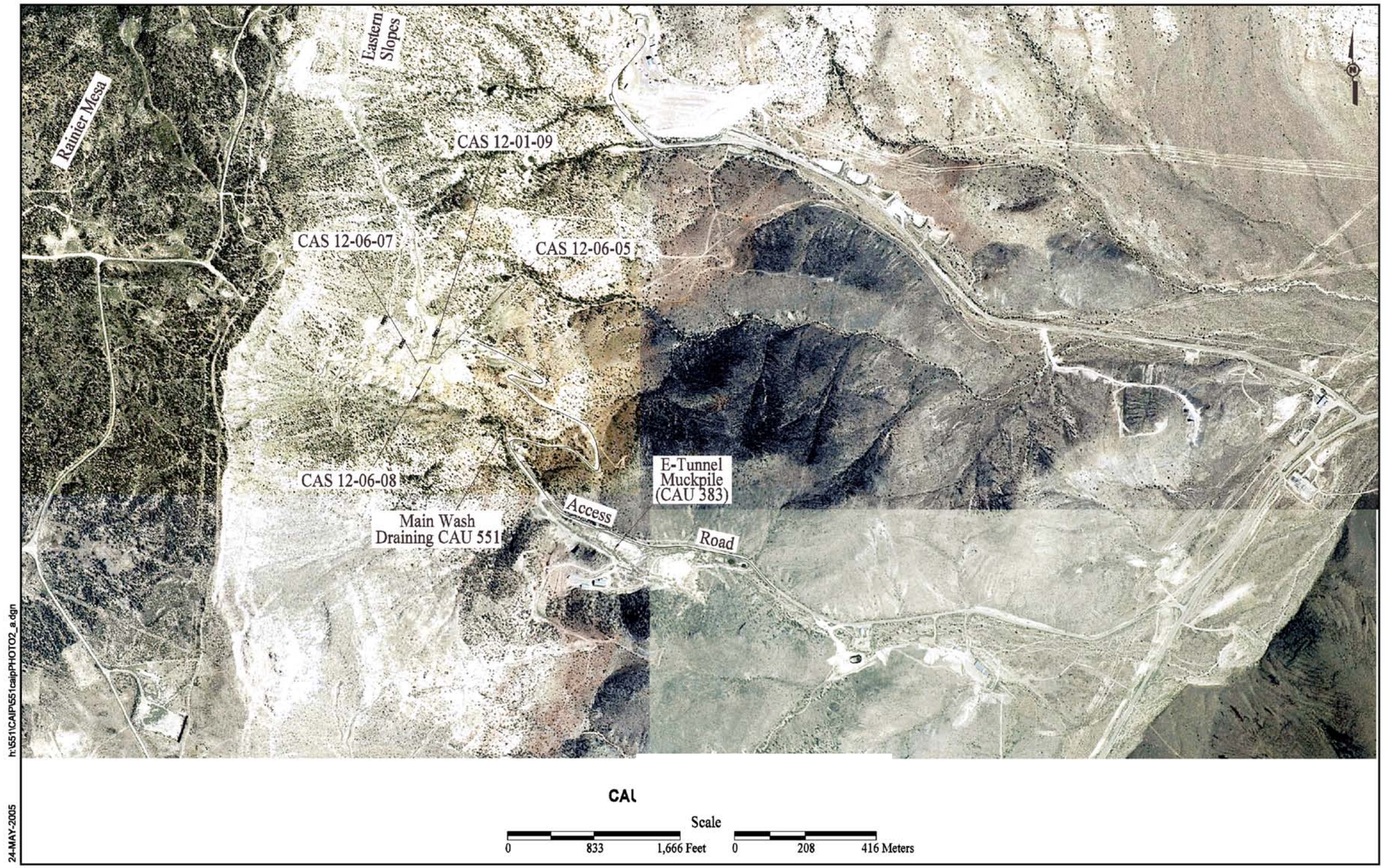

Figure 1-2
CAU 551, CAS Location Map

1.2 Scope

The scope of the activities used to justify and recommend that no further corrective action is required at CAU 551, Area 12 Muckpiles. The corrective action of close in place with administrative controls included the following:

- Evaluation of current site conditions, including the concentrations and extent of contaminants of concern (COCs).
- Activities completed in the CAU 551 area before closure include grading of the access road leading to the B-Tunnel area, installation of diversion berms and modification of portions of the access road to divert runoff on the road into the northern watershed, an inventory of historical artifacts at the site, posting of the use restriction signs, and completion of the use restriction documentation.

1.3 Corrective Action Decision Document/Closure Report Contents

This CADD/CR is divided into the following sections and appendices:

Section 1.0 - Introduction: Summarizes the purpose, scope, and contents of this CADD/CR.

Section 2.0 - Corrective Action Investigation (CAI) Summary: Summarizes the investigation field activities, the results of the investigation, the need for corrective action, and a summary of the results of the data quality assessment objective (DQA).

Section 3.0 - Recommendation: States why no further corrective action is required.

Section 4.0 - References: Provides a list of all referenced documents used in the preparation of this CADD/CR.

Appendix A - *Corrective Action Investigation Results*: Provides a description of the project objectives, field investigation and sampling activities, investigation results, waste management (WM), and quality assurance (QA). Sections A.3.0 and A.4.0 provide specific information regarding field activities, sampling methods, and laboratory analytical results from the investigation.

Appendix B - *Data Assessment*: Provides an assessment of data obtained during the investigation. The appendix also summarizes and compares the investigation results to the requirements set forth during the data quality objective (DQO) process.

Appendix C - *Closure Activity Summary*: Provides details on the completed closure activities and includes the required verification activities and supporting documentation.

Appendix D - *Sample Location Coordinates:* Provides investigation sample locations coordinates.

Appendix E - *Derivation of Residual Radioactive Material Guidelines for Radionuclides in Soil at Corrective Action Unit 551, Area 12 Muckpiles, Nevada Test Site, Nevada:* Contains the full report generated for the Residual Radioactive (RESRAD) material code computer analysis of the radiological results.

Appendix F - *CAU 551 Load Verification Forms:* Contains copies of the documentation for removal and disposal of the investigation-derived waste (IDW).

1.3.1 Applicable Programmatic Plans and Documents

All investigation activities were performed in accordance with the following documents:

- CAIP for CAU 551: *Area 12 Muckpiles, Nevada Test Site, Nevada* (NNSA/NSO, 2004).
- Record of Technical Change (ROTC) No. 1 for the CAIP for CAU 551, Area 12 Muckpiles (updates the CAIP with language to remove “hold” area where the main wash, draining the CAU 551 area, intersects with the E-Tunnel turnoff road, recognizing the need to collect samples further downgradient for bounding radiological contaminants).
- ROTC No. 2 for the CAIP for CAU 551, Area 12 Muckpiles (updates the CAIP with (1) language, and changes to two figures, to recognize the existence of the Neptune crater area and the possibility of radiological contamination in and around the Neptune crater area (pending assignment of CAS number); (2) language to clarify the use of C-, D-, and F-Tunnels to conduct safety experiments; and (3) correct several unrelated errors in the CAIP).
- ROTC No. 3 for the CAIP for CAU 551, Area 12 Muckpiles (updates the CAIP to base the radiological preliminary action levels [PALs] on a 25 millirem per year [mrem/yr] exposure dose).

- *Industrial Sites Quality Assurance Project Plan* (QAPP) (NNSA/NV, 2002).
- FFACO (1996).
- Approved standard quality practices and detailed operating procedures.

1.3.2 Data Quality Assessment Summary

The DQA is presented in Appendix B and includes an evaluation of the data quality indicates (DQIs) to determine the degree of acceptability and usability of the reported data in the decision-making process. The DQO process ensures that the right data type, quality, and quantity will be available to support the resolution of those decisions at an appropriate level of confidence. Using both the DQO and DQA processes help to ensure that DQO decisions are sound and defensible. The DQA process is presented in Appendix B.

Based on the results of the DQA presented in Appendix B, the nature and extent of COCs at CAU 551 have been adequately identified to implement corrective actions. The DQA also determined that information generated during the investigation support the CSM assumptions, and the data collected met the DQOs and support their intended use in the decision-making process.

2.0 Corrective Action Investigation Summary

The following sections summarize the investigation activities, results, and justification for why no further corrective action is needed at CAU 551. Detailed investigation activities and results for individual CAU 551 CASs are presented in Appendix A.

2.1 Investigation Activities

Corrective action investigation activities were performed as set forth in the CAU 551 CAIP (NNSA/NSO, 2004) from October 4, 2004, through May 10, 2005. The purpose of the CAU 551 CAI was to address the decision statements in the project-specific DQOs by:

- Determining whether contaminants of potential concern (COPCs) are present in the soils associated with CAU 551.
- Determining whether any of the COPCs found in the muckpile CASs were expected COCs, and if so, determining whether their concentration(s) fell within or outside of the expected range (NNSA/NSO, 2004).
- Determining whether the COPCs not expected, if present, at any CAU 551 CASs exceed action levels, thereby becoming COCs.
- Determining the lateral and vertical extent of all identified COCs.
- Ensuring adequate data have been collected to close the sites under NDEP, *Resource Conservations and Recovery Act* (RCRA) (CFR, 2003a), *Toxic Substance Control Act* (TSCA) (CFR, 2003b), and DOE requirements.

The scope of the CAI included the following activities:

- Review historical data from similar NTS muckpile investigations.
- Determine survey and sample locations that can be safely accessed.
- Perform radiological land area surveys at CAU 551 to document the radiological condition of land within the site boundary.
- Field-screen soil samples for volatile organic compounds (VOCs) and alpha and beta/gamma radiation at all CASs.

- Collect and submit a sample of source material from the AST at CAS 12-01-09.
- Remove and properly dispose of the source material in the AST to prevent further leakage.
- Collect and submit environmental soil samples for laboratory analyses from accessible, biased locations to determine the nature and extent of potential contamination.
- Collect quality control (QC) samples for laboratory analyses to ensure that the data generated from the analysis of investigation samples meet the requirements of the DQIs identified in the CAIP.
- Collect additional samples, as necessary, to estimate volumes and determine disposal options for potential corrective action waste streams.
- Stake sample locations and record coordinates.

A judgmental (non-probabilistic) sampling scheme was implemented to select sample locations and evaluate analytical results. Judgmental sampling allows the methodical selection of sample locations that target the populations of interest (defined in the DQOs).

Because individual sample results, rather than an average concentration, will be used to compare to action levels, statistical methods to generate site characteristics (averages) will not be necessary. Section 0.4.4 of the U.S. Environmental Protection Agency (EPA) *Data Quality Objectives Process for Hazardous Waste Site Investigations* (EPA, 2000) guidance states that the use of statistical methods may not be warranted by program guidelines or site-specific sampling objectives. The need for statistical methods is dependent upon the decisions being made. Section 7.1 of the EPA DQO guidance states that a non-probabilistic (judgmental) sampling design is developed when there is sufficient information on the contamination sources and history to develop a valid conceptual site model (CSM) and to select specific sampling locations. This design was used to confirm the existence of contamination at specific locations and provide information (such as extent of contamination) about specific areas of the site.

Confidence in judgmental sampling results will be established qualitatively by: the validation of the CSM developed and concurred to by stakeholder participants (DOE, National Nuclear Security Administration Nevada Site Office [NNSA/NSO] and NDEP) during the DQO process, based on investigation results, and performing an assessment to determine whether DQO requirements have been met.

Waste characterization activities were conducted to gather sufficient information and data to support waste disposal decisions. Information regarding waste characterization is presented in Appendix A.

The following sections describe specific investigation activities conducted at each CAS or group of CASs, and in the Decision II area for the muckpiles.

2.1.1 Aboveground Storage Tank and Stain (CAS 12-01-09)

This CAS consists of a 550-gallon AST attached to an underlying concrete pad; an underlying stain; and associated piping near the B-, C-, D-, and F-Tunnel portals in Area 12. The scope of the CAI was to define the organic contamination associated with the potential release of diesel containing total petroleum hydrocarbons (TPH)-diesel-range organics (DRO) from the tank. The following sections summarize the Land Area Radiological Walkover Survey, Field Screening, and Intrusive Investigation Activities conducted at CAS 12-01-09.

2.1.1.1 Land Area Radiological Walkover Survey

A land area radiological walkover survey (Figure A.2-1) was performed over the unpaved soil surrounding the AST concrete pad to protect worker health and safety (H&S) and to support WM activities. Determination of radiological contamination was not included in the original scope of the CAI for CAS 12-01-09, and the walkover survey did not reveal elevated activity at this CAS.

Decision I samples were analyzed for alpha- and beta/gamma-emitting radionuclides in conjunction with the overall CAU 551 CAI; because the walkover survey did not reveal elevated activity in the area, subsequent sampling and analysis of the first set of Decision II samples was conducted without specifying an analysis of identified radiological constituents. After analytical results from samples taken for Decision I determined that two locations (A01 and A02, Figure A.3-2) did contain radiological contaminants above preliminary action levels, all subsequent Decision II samples were analyzed for gamma- and alpha-emitting radionuclides.

2.1.1.2 Field Screening

Field screening was conducted on soil samples using the headspace method for volatiles and handheld portable instrument surveys for alpha and beta/gamma radiation. Field screening was

conducted for VOCs using a flame-ionization detector (FID) and for alpha and beta/gamma radioactivity using a handheld alpha, beta/gamma radiological survey instrument. The field-screening results (FSRs) were compared to field-screening levels (FSLs) to guide subsequent soil sampling decisions and to determine which samples were submitted for laboratory analysis. After determination that VOCs were not present in samples from this CAS, field screening for VOCs was discontinued. Results for the field screening are presented in Section A.3.1.1.

2.1.1.3 Intrusive Investigation

A total of 22 samples from 9 locations (Figure A.3-2) were collected and submitted to the laboratory for the analyses listed in Appendix A (Table A.3-1). Surface and shallow subsurface soil sampling activities were conducted at CAS 12-01-09. Soil samples were collected using grab sampling and hand auger methods.

Surface soil samples were collected from 0.0 to 0.5 feet (ft) below ground surface (bgs) at all sample locations. Two locations were specified for Decision I sampling; five locations were specified for the first set of Decision II sampling; and two locations were specified for the second set of Decision II sampling. Decision II sample location selection was impacted by the proximity of a steep slope and the generator building to the tank and stained area.

Subsurface soil samples were collected for Decision I sampling from 1-ft depth intervals beginning at 1 ft bgs, and for Decision II sampling at the lowest depth that contamination was previously found (2.5 to 3.0 ft) or at refusal.

2.1.2 Muckpiles (CASs 12-06-05, 12-06-07, and 12-06-08)

The three muckpiles located outside the B-, C-, D-, and F-Tunnels consist of the three original muckpile CASs, which are evaluated separately from the downslope (Decision II) areas in the CAIP for CAU 551. The two muckpiles outside of B-Tunnel (CASs 12-06-05 and 12-06-08) may have been joined at one time; a drainage presently exists between them. The six underground tests conducted within B-Tunnel were all weapons-related experiments. Additionally, one high-explosives test and one confirmed accidental explosion occurred within the tunnel (NNSA/NSO, 2004). The six tests conducted within C-, D-, and F-Tunnels were safety experiments. The muckpiles received

muck and materials from activities conducted at the tunnels, including drilling, tunnel development, cutback operations, and re-entry mining. The following sections summarize the land area radiological walkover survey, field screening, and intrusive investigation activities conducted at CASs 12-06-05, 12-06-07, and 12-06-08.

2.1.2.1 Land Area Radiological Walkover Survey

A land area radiological walkover survey (Figure A.2-1) was performed over accessible areas on and around the muckpiles to protect worker H&S and to support WM activities. Radiological contamination was believed present at the three muckpiles based upon the presence of radiological postings and upon knowledge of historical operations at the tunnels. Additionally, CAS 12-06-07 was posted as a "Radioactive Contamination Area." Two of the identified locations with elevated radioactivity were associated with what appeared to be "Trinity glass" in CAS 12-06-05. The presence of elevated radioactivity were correlated with suspected disposal of radioactive material taken from the tunnels during re-entry mining.

2.1.2.2 Field Screening

Field screening was conducted on soil samples using the headspace method for volatiles and handheld instrument surveys for alpha and beta/gamma radiation. Field screening was conducted for VOCs using an FID and for alpha and beta/gamma radioactivity using a portable handheld alpha, beta/gamma radiological survey instrument. The FSRs were compared to FSLs to guide subsequent soil sampling decisions and to determine which samples were submitted for laboratory analysis.

Results for the field screening are presented in Section A.4.1.1.

2.1.2.3 Intrusive Investigation Activities

A total of 77 samples from 37 locations (Figures A.4-2 and A.4-3) were collected and submitted to the laboratory for the analyses listed in Appendix A (Tables A.4-1 through A.4-3). Surface and shallow subsurface soil sampling activities were conducted at these three CASs. Soil samples were collected using grab sampling, and hand auger methods.

Surface soil samples were collected from 0.0 to 0.5 ft bgs at all sample locations (Figure A.4-1). Fourteen locations at 12-06-05 (Figure A.4-2), 16 locations at 12-06-07 (Figure A.4-3) and 7 locations at 12-06-08 (Figure A.4-2) were sampled at the surface.

Subsurface soil samples were collected for Decision I sampling from 1 to 3 ft bgs, depending on slope steepness and depth of refusal. Subsurface samples were collected at 13 of the 14 locations at CAS 12-06-05, 14 of the 16 locations at CAS 12-06-07, and 6 of the 7 locations at CAS 12-06-08 (Figures A.4-1 through A.4-3).

2.1.3 Initial and Extended Decision II Area, and Verification Sampling Area, Muckpiles, and Upslope Area

The Initial and Extended Decision II and Verification Sampling areas (downslope) lie downslope along the drainages from each of the three muckpiles (Figures A.4-4 through A.4-6). The areas define the extent of any lateral migration of COCs originating from the three CAU 551 muckpiles, primarily in washes draining the area that may carry contamination to or beyond the E-Tunnel muckpile (CAU 383). Contaminated sediment moving off of a single muckpile during a precipitation event will join sediment and material from the other muckpiles within a short distance. Identifying contaminants within this area as originating from a specific muckpile is not possible; therefore, the Decision II areas are considered an extension of all three muckpiles and were investigated as such. The Verification Sampling Area was designated and investigated to verify radiological contamination had not moved downslope beyond the intersection of the B-Tunnel and E-Tunnel area roads near the locations where radiological contamination was bounded.

During the CAI, radiological contamination was found at levels above the PALs at both CAS 12-01-09 and in background samples taken upslope from that CAS. These findings were unexpected for the area. Following further investigation (interviews and review of previously classified documents), the Neptune crater and surrounding areas were identified as a possible source of this contamination. The area upslope from CASs 12-01-09 and 12-06-07 were added to the CAI for the purpose of determining whether the Neptune area was contributing radiological contamination to CAU 551, and if so, whether a boundary could be established between this area and CAS 12-06-07. The Neptune crater is in the process of being added to the FFACO and assigned to the Soils Project.

The following sections summarize the land area radiological walkover survey, field screening, and intrusive investigation activities conducted at the downslope and upslope areas.

2.1.3.1 Land Area Radiological Walkover Survey

A land area radiological walkover survey (Figure A.2-1) was performed over accessible areas in the washes below the muckpiles and downslope to the E-Tunnel area to protect worker H&S and to support WM activities. During this walkover survey, no areas of elevated radioactivity were identified.

2.1.3.2 Field Screening

Field screening was conducted on soil samples using the headspace method for volatiles and handheld instrument surveys for alpha and beta/gamma radiation. Field screening was conducted for VOCs using an FID and for alpha and beta/gamma radioactivity using a handheld alpha, beta/gamma radiological survey instrument. The FSRs were compared to FSLs to guide subsequent soil sampling decisions and to determine which samples were submitted for laboratory analysis. After determination that VOCs were not found in samples from the downslope area, field screening for VOCs was discontinued. Results for the field screening are presented in Section A.4.3.2.

2.1.3.3 Intrusive Investigation

A total of 65 samples from 45 locations were collected from the downslope area, including the Verification Sampling Area, and 19 samples from 12 locations were collected from the upslope area. Surface and shallow subsurface soil sampling activities were conducted in this area. All samples were submitted to the laboratory for the analyses listed in Appendix A (Tables A.4-19 and A.4-20). Soil samples were collected using grab sampling and hand auger methods.

Surface soil samples were collected from 0.0 to 0.5 ft bgs at all sample locations. Subsurface soil samples were collected from 10 of the 13 Initial Decision II locations, 6 of the 17 Extended Decision II locations, and 6 of the 12 upslope locations.

2.1.4 Waste Characterization

Waste characterization activities were conducted to gather necessary information and data to support waste disposal decisions for nine 55-gallon drums containing IDW. One drum was characterized as hydrocarbon-impacted waste (e.g., personal protective equipment [PPE]/plastic); six drums were characterized as sanitary waste (e.g., rinsate); and two drums were characterized as low-level waste (e.g., PPE/plastic). No soil, equipment or buildings at the site were identified for waste. Additional information regarding this investigation activity is presented in Section A.5.0.

2.1.5 Laboratory Analysis

Laboratory analysis of soil samples provided the means for the quantitative identification of COPCs. Samples sent to the off-site laboratory were analyzed for the following analytes in accordance with methods stipulated in the analytical program defined in the CAIP: total VOCs, total semivolatile organic compounds (SVOCs), total RCRA metals, total beryllium, polychlorinated biphenyls (PCBs), TPH-DRO, isotopic uranium, isotopic plutonium, strontium-90, and gamma-emitting radionuclides. Tables A.3-1, A.4-1 through A.4-3, A.4-19, and A.4-20 list the specific analytes for each sample collected. Specific analytical methods are given in the CAIP for CAU 551, Table A.1-6.

2.1.6 Conceptual Site Model Validation

Two CSMs were developed to represent the release mechanisms and potential migration pathways for suspected contaminants at CAU 551 CASs. The CSMs and associated discussion for this CAS are provided in the CAIP.

The CSM for CAS 12-01-09 (AST and stain) addressed the suspected contamination of surface and shallow subsurface soils potentially impacted by diesel fuel leaking from a rusted pipe weld. Because the length of time that the diesel fuel was leaking from the tank was unknown, the lateral and vertical extent of TPH-DRO contamination required determination. The results of the CAI validated the CSM.

The CSM for CASs 12-06-05, 12-06-07, and 12-06-08 (muckpiles) addressed the likely contamination of the muckpiles, and any potential lateral movement of radiological contamination from the muckpiles during precipitation events, into the washes draining the area. Contaminant

migration to regional aquifers was not considered to be a likely scenario at CAU 551 based on the low annual average precipitation rates, high evapotranspiration, and low mobility of expected COPCs. Investigations of other muckpiles at the NTS have indicated that contamination has not migrated vertically into the native material underlying the muckpile but has migrated laterally due to erosion.

Because many areas of the muckpiles were deemed inaccessible for sampling, historical information from past NTS muckpile investigations were used to establish contamination levels for seven chemical and radiological COCs as described in Table A.1-4 of the CAU 551 CAIP (NNSA/NSO, 2004). The results of the CAI validated the CSM.

The migration pathways and release mechanisms identified during the CAI were consistent with the CSMs, and all information gathered during the CAI support and validate the CSM as presented in the CAIP.

2.2 Results

The summary of data from the CAI provided in Section 2.2.1 defines the areas within the CAU 551 CASs where the COPCs exceeded action levels. Section 2.2.2 summarizes the assessment made in Appendix B, which demonstrates that the investigation results satisfy the DQO data requirements.

Decisions made during the planning of supplemental field work for determining the placement of sample locations were conducted by evaluating preliminary results against the PALs identified in the CAIP for CAU 551 (NNSA/NSO, 2004).

2.2.1 Summary of Analytical Data

Chemical and radiological results for environmental samples collected at each of the CASs are summarized in Sections 2.2.1.1 through 2.2.1.3. Environmental samples are evaluated against final action levels (FALs) to determine the presence of COCs and the extent of contamination, if present.

The PALs for the CAU 551 investigation were established during the DQO process and are discussed in Section 3.3 of the CAIP (NNSA/NSO, 2004). The FALs used for identifying the presence of COCs and for evaluating the need for corrective actions are defined in Section 2.3. The methods used

during this investigation and a comparison of environmental sample results to the FALs are detailed in Appendix A.

The CAIP for CAU 551 established the approach for evaluation of the results from the investigation of the muckpiles (e.g., combined use of historical muckpile investigation results and the CAU 551 investigation results). The CAIP also specified the area in which initial Decision II samples were collected, which consisted of the washes downgradient from the muckpiles that may possibly be impacted by contaminant. This Initial Decision II area is also distinct because utility workers that service the power and communications lines need access to this area, but not the muckpile areas.

Because the constraints imposed by the CAIP on the evaluation of the muckpile results do not apply to the Initial Decision II area, a separate set of FALs were established for each area. Results from samples taken from locations on the muckpiles are discussed separately from those taken in the downslope and upslope areas.

2.2.1.1 Aboveground Storage Tank and Stain (CAS 12-01-09)

Before sampling the soil at CAU 551, the liquid contents of the AST were sampled and analyzed. The results of the analysis were consistent with those for diesel fuel. The tank contents were subsequently removed for disposal.

The stain beneath the AST at CAS 12-01-09 was confirmed to contain TPH-DRO. The highest concentration of TPH-DRO was at the surface, directly beneath a leaky weld, (98,000 milligrams per kilogram [mg/kg]), with the concentration decreasing steadily through three other samples taken at depth, to a TPH-DRO concentration of 17,000 mg/kg at 2.5 to 3.0 ft (Table A.3-3). Surface and subsurface samples taken from four other locations also gave TPH-DRO results above the FAL of 100 mg/kg.

The area of contiguous TPH-DRO contamination at CAS 12-01-09 was bounded 11 ft to the south (location A05) of the tank, approximately 2 ft to the west (location A06), and approximately 26 ft to the north (locations A12 and A13) by surface and subsurface sample results showing no detectable concentrations (Figure A.3-2). The contamination was bounded approximately 5 ft to the east by the

cliff overhanging the B-Tunnel portal area, and in the vertical direction by repeated refusal from underlying rock at 2 to 3.5 ft bgs.

Radiological contamination was not detected at levels above FALs in soil samples taken from around the tank area (Tables A.3-6 and A.3-7).

2.2.1.2 Muckpiles (CASs 12-06-05, 12-06-07, and 12-06-08)

Samples collected from numerous locations on and around the muckpile were found to contain one or more chemical and radiological contaminants at concentrations exceeding the FALs (Figures A.4-2 and A.4-3). The highest detected concentrations from the investigation for each muckpile CAS and the Decision II area are listed in Table 2-1.

The CAU 551 CAIP stipulated that each muckpile is considered to be contaminated at the highest concentrations of either (1) contaminants identified above PALs during previous (historical) investigations of muckpiles at the NTS but not identified in samples taken at each muckpile; or (2) contaminants identified above PALs during previous investigations of muckpiles at NTS but having higher concentrations found in samples taken at each muckpile; or (3) newly identified contaminants for each muckpile with concentrations above the FALs. For purposes of this investigation, CASs 12-06-05 and 12-06-08 are considered to be contaminated at the highest levels assigned to either.

The contaminants assigned to each muckpile, the highest concentration assigned to each muckpile, and whether or not the contaminant extended downslope into the Initial Decision II Area (discussed in the following section), are presented in Table 2-2.

Table 2-1
CASs 12-06-05, 12-06-07, and 12-06-08, and Decision II Area COCs,
Highest Detected Concentrations from Investigation Results

Contaminants of Concern	Highest Contaminant Concentration			
	CAS 12-06-05	CAS 12-06-07	CAS 12-06-08	Decision II Area
Americium-241	478 pCi/g	3,370 pCi/g	370 pCi/g	487 pCi/g
Cesium-137	318 pCi/g	101 pCi/g	108 pCi/g	48.7 pCi/g
Europium-152	26.6 pCi/g	60 pCi/g	--	1.74 pCi/g
Plutonium-238	28.6 pCi/g	127 pCi/g	17.4 pCi/g	6 pCi/g
Plutonium-239	1,440 pCi/g	13,200 pCi/g	1,210 pCi/g	329 pCi/g
Diesel	250 mg/kg	2,600 mg/kg	5,200 mg/kg	980 mg/kg
Benzo(a)pyrene	1,600 µg/kg	--	--	--
Dibenzo(a,h)anthracene	330 µg/kg	--	--	--

mg/kg = Milligrams per kilogram
pCi/g = Picocuries per gram
µg/kg = Micrograms per kilogram
-- = Not detected

2.2.1.3 Initial and Extended Decision II and Verification Sampling Areas

As stated in Table 2-2, all COCs identified in samples taken from the CAU 551 muckpiles (e.g., TPH-DRO, americium (Am)-241, cesium (Cs)-137, europium (Eu)-152, plutonium (Pu)-238, and Pu-239), except the SVOCs, were found above FALs in the washes draining CAU 551. The Initial Decision II Area was targeted for concurrent sampling during Decision I activities; samples were analyzed for the same suite of analytes as were Decision I samples. In both the Initial Decision II and Extended Decision II areas, material from the muckpiles and from surrounding areas of the watershed become intermixed in a manner that identification of a specific muckpile source for the contamination is not possible. These areas were therefore investigated with the purpose of identifying the extent of potential contamination from all three CAU 551 muckpiles and not for defining a particular CAS boundary.

Table 2-2
CASs 12-06-05, 12-06-07, and 12-06-08 COCs,
Highest Concentrations Assigned, and Extent

Contaminants of Concern	Highest Contaminant Concentration			Final Action Level[a]	Contaminant Extends into Initial Decision II Area?
	CAS 12-06-05	CAS 12-06-07	CAS 12-06-08		
Arsenic	38.8 mg/kg[b, c]	38.8 mg/kg[b, c]	38.8 mg/kg[b, c]	23 mg/kg	No
Lead	59,700 mg/kg[b, c]	59,700 mg/kg[b, c]	59,700 mg/kg[b, c]	750 mg/kg	No
Benzo(a)pyrene	1,600 µg/kg	N/A	1,600 µg/kg	210 µg/kg	No
Dibenzo(a,h)anthracene	330 µg/kg	N/A	330 µg/kg	210 µg/kg	No
TPH-DRO	10,000 mg/kg[b]	10,000 mg/kg[b]	10,000 mg/kg[b]	100 mg/kg	Yes
Americium-241	478 pCi/g	3,370 pCi/g	478 pCi/g	79.63 pCi/g	Yes
Cesium-137	3,050 pCi/g[b]	3,050 pCi/g[b]	3,050 pCi/g[b]	72.07 pCi/g	Yes
Cobalt-60	5.3 pCi/g[b, c]	5.3 pCi/g[b, c]	5.3 pCi/g[b, c]	0.13 pCi/g	No
Europium-152	26.6 pCi/g	60 pCi/g	26.6 pCi/g	1.42 pCi/g	Yes
Plutonium-238	28.6 pCi/g	127 pCi/g	28.6 pCi/g	3.00 pCi/g	Yes
Plutonium-239	1,440 pCi/g	13,200 pCi/g	1,440 pCi/g	311.91 pCi/g	Yes

[a]Chemical FALs from CAU 551 CAIP PALs; radiological FALs from RESRAD Land Parcel 1
[b]Historical high value from previous NTS muckpile investigations
[c]Expected contaminant of concern, not detected above the FAL in CAU 551 muckpile samples

DRO = Diesel-range organics
FAL = Final action level
mg/kg = Milligrams per kilogram
N/A = Not applicable
PAL = Preliminary action level
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive computer code
TPH = Total petroleum hydrocarbons
µg/kg = Micrograms per kilogram

Overall, contamination was bounded along the western border of CAU 551 by clean samples taken at the western most location of (CAS 12-06-07) (Figure A.4-3) and by samples taken midway between the muckpiles and the lower boundary of the Initial Decision II Area, from a location upslope to the west of the area that could have been impacted by the muckpiles or historical operations at the tunnels (Figure A.4-4). The two muckpile sample locations that had samples exceeding SVOC PALs were bounded laterally. Bounding of COCs identified in the Initial Decision II area is reviewed in the following discussion.

Total petroleum hydrocarbons-DRO was detected at concentrations above the FAL in many samples in the Initial Decision II Area. It was bounded laterally in the Initial Decision II Area, as results from analysis of samples taken from three locations in the wash on the south side of the access road, before the E-Tunnel turnoff (Figure A.4-5), were below the FAL.

Americium-241 was detected at a concentration above the FAL in one sample in the Initial Decision II Area. Americium-241 was bound laterally, as samples from further down the wash in the Initial Decision II Area, and throughout the Extended Decision II and Verification Sampling areas, did not exceed the respective FALs for Am-241.

Cesium-137 was detected at concentrations above the FAL in two samples from different locations in the Initial Decision II Area, and in two duplicate samples at a location in the upper portion of the Extended Decision II Area. Cesium-137 was bound laterally by the results of samples taken further down the washes on both sides of the access road that were below the respective FALs throughout the rest of the Extended Decision II Area and all of the Verification Sampling Area.

Europium-152 was detected at concentrations above the FAL at two different locations in the Initial Decision II Area, and in both duplicate samples from the same location in the upper portion of the Extended Decision II Area that contained Cs-137 above the FAL. Europium-152 was bound laterally by the results of samples taken further down the washes on both sides of the access road that were below the respective FALs throughout the rest of the Extended Decision II Area and all of the Verification Sampling Area.

Plutonium-238 was detected at concentrations above the FAL in seven samples taken in the Initial Decision II Area, and one of the same duplicate samples in the Extended Decision II Area where Cs-137 and Eu-152 exceeded the FALs. Plutonium-238 was bounded laterally by the results of samples taken further down the washes on both sides of the access road that were below the respective FALs throughout the rest of the Extended Decision II Area and all of the Verification Sampling Area.

Plutonium-239 was detected at concentrations above the FAL in the same seven samples, as was Pu-238, taken in the Initial Decision II Area, and in the same duplicate sample, as was Pu-238, in the Extended Decision II Area. Plutonium-239 was bounded laterally by the results of samples taken

further down the washes on both sides of the access road that were below the respective FALs throughout the rest of the Extended Decision II Area and all of the Verification Sampling Area.

2.2.2 Data Assessment Summary

The DQA is presented in Appendix B and includes an evaluation of the DQIs to determine the degree of acceptability and usability of the reported data in the decision-making process. The DQO process ensures that the right type, quality, and quantity of data will be available to support the resolution of those decisions at an appropriate level of confidence. Using both the DQO and DQA processes helps to ensure that DQO decisions are sound and defensible.

The DQA process as presented in Appendix B is comprised of the following steps:

- Step 1: Review DQOs and Sampling Design.
- Step 2: Conduct a Preliminary Data Review.
- Step 3: Select the Test.
- Step 4: Verify the Assumptions.
- Step 5: Draw Conclusions from the Data.

Conclusions about the presence and/or extent of contamination at each CAS, for the data presented in Appendix A for each location, are reviewed in Appendix B to ensure the CAI objectives were met. Based on the results of the DQA presented in Appendix B, the nature and extent of COCs at CAU 551 have been adequately identified and close in place with use restrictions was selected as the closure alternative. The DQA also determined that information generated during the investigation supports the CSM assumptions, and the data collected met the DQOs and support their intended use in the decision-making process.

2.3 Justification for No Further Action

No further corrective action is justified based on an evaluation of risk to ensure protection of the public and the environment in accordance with *Nevada Administrative Code* (NAC) 445A (NAC, 2003), feasibility, and cost effectiveness. The closure activities that were undertaken will ensure that the site will not present an unacceptable risk to human health or the environment. In addition to the COCs identified at the muckpiles (Table 2-2), CAS 12-01-09 contained TPH-DRO above the FAL. Because the lateral extent of the COCs has been determined and the CAI demonstrated that migration

of COCs has been limited to the wash upgradient from the E-Tunnel area, closing the area in place with administrative controls is justified at all four CASs.

Before closing the area in place, the diversion of the portion of precipitation runoff that is presently eroding the access road, from the turnoff near CAS 12-01-09 down to the section of road, at the lowest large turn (at location X14, Figure A.4-6), has been completed. The access road was carrying runoff water from approximately one-third of the watershed in which CAU 551 is located and represents an area that is not impacted by the presence of either CAU 551 or the Neptune crater area. This runoff had historically flowed into the watershed to the north but was brought into the watershed around the B-Tunnel area by the presence of the access road. By diverting this portion of the runoff into the watershed to the north, the potential for this runoff to mix with runoff from CAU 551 and the Neptune area, and carry potential contamination down towards the E-Tunnel area, is alleviated. Road repair will also assist in managing this runoff.

The administrative controls implemented for CAU 551 include posting of radiological signage along the accessible borders of the CAU 551 area, and the posting and implementation of the use restriction for the affected area. An annual inspection of the Use Restriction signs and conditions of the site (e.g., sediment movement past the E-Tunnel turnoff and weather damage to road) is required. The use restriction and closure activities are discussed in Appendix C.

2.3.1 Final Action Levels

The CAU 551 FALs are the risk-based cleanup goals that, if met, will ensure that each release site will not pose an unacceptable risk to human health and the environment and that conditions at each site are in compliance with all applicable laws and regulations. The risk-based corrective action (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 NAC Section 445A.227, which lists the requirements for sites with soil contamination. For the evaluation of corrective actions, NAC Section 445A.22705 requires the use of American Society for Testing and Materials Method E1739-95 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 (i.e., FALs) or to establish that corrective action is not necessary."

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 CAIP). 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 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 TPH concentrations 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 E1739-95 that consider site-, pathway-, and receptor-specific parameters.

The FAL determinations are grouped together as either chemical or radiological COPCs and discussed in Sections 2.3.2 and 2.3.3.

2.3.2 Chemical FAL Determinations

A Tier 1 evaluation was conducted for all chemical COPCs to determine whether contaminant levels satisfy the criteria for a quick regulatory closure or warrant a more site-specific assessment. This was accomplished by comparing individual source area contaminant concentration results to the PALs established in the CAIP. The FALs for all chemical constituents detected at CAU 551 CASs or assumed to be present at CAU 551 muckpiles (based on detections in other similar muckpile CAUs) are the PALs established in the CAU 551 CAIP (NNSA/NSO, 2004). No Tier 2 or Tier 3 evaluations were conducted for chemical constituents that did not pass the Tier 1 evaluation.

2.3.3 Radionuclide FAL Determinations

A Tier 1 evaluation was conducted for all radiological COPCs to determine whether contaminant levels satisfy the criteria for a quick regulatory closure or warrant a more site-specific assessment. This was accomplished by comparing individual source area contaminant concentration results to the

PALs established in the CAIP. The Tier 1 action levels for all radiological constituents detected at CAU 551 CASs or assumed to be present at CAU 551 (based on detections in other similar muckpile CAUs) are the PALs established in the CAU 551 CAIP (NNSA/NSO, 2004).

Separate Tier 2 evaluations were conducted for the following three land parcels within CAU 551:

- Land Parcel 1 - The area comprising the muckpiles, AST, and stain (e.g., the muckpiles area).
- Land Parcel 2 - The area comprising the Initial and Extended Decision II areas (e.g., the Decision II downslope areas).
- Land Parcel 3 - The area comprising Land Parcel 1 and Land Parcel 2 together.

Land Parcel 1 and Land Parcel 2 use different portions of the CAU 551 area and were included to assess the aspects of those areas. Land Parcel 3 was not used in this assessment. The calculations for RESRAD for Land Parcel 3 uses the highest concentrations found, which are in Land Parcel 1. Workers entering Land Parcel 2 to repair and maintain the electrical and communications cables would not enter Land Parcel 1. Thus, the two land parcels were kept separate for dose assessment purposes. Because the first two land parcels have FALs much larger than that for Land Parcel 3, Land Parcel 3 did not contribute significantly to the overall exposure.

Tier 2 action levels were derived for radiological constituents within Land Parcel 1 and Land Parcel 2. The Tier 2 evaluation for radiological constituents consisted of comparing the analytical results from Land Parcel 1 and Land Parcel 2 to the corresponding Tier 2 action levels. The Tier 2 action levels for Land Parcel 1 and Land Parcel 2 were individually established based on the radionuclide ratios from each area and a dose constraint of 25 mrem/yr using the RESRAD computer code (version 6.22). The radionuclide ratios for Land Parcel 1 were established based on the detected presence and activities of radionuclide constituents detected within Land Parcel 1 or assumed to be present at CAU 551 muckpiles (based on detections in other similar muckpile CAUs). The radionuclide ratios for Land Parcel 2 were established based on the detected presence and activities of radionuclides in environmental samples collected from within Land Parcel 2. The derivations of these Tier II action levels are provided in Appendix E. Land Parcel 1 was modeled using the worst-case scenario results (i.e., highest concentrations), as stipulated in the CAIP for CAU 551.

Land Parcel 2 was modeled using the worst-case scenario sample results for the Decision II downslope area due to the use of the highest concentration of radionuclides in RESRAD calculations.

The FALs for CAU 551 radiological COPCs are shown in Table 2-3.

The PALs listed in the CAIP for CAU 551 (NNSA/NSO, 2004) were used as FALs to evaluate data for the non-principal radionuclides and radiological data from the Verification Sampling and Upslope areas.

Table 2-3
Definition of Final Action Levels for Radiological COPCs

Radionuclide	Land Parcel 1 FAL[a, b] (pCi/g)	Land Parcel 2 FAL[a, b] (pCi/g)	Verification Sampling and Upslope Areas and Non-principal Radionuclides FALs[c] (pCi/g)
Americium-241	79.63	287.42	12.7
Cesium-137	72.07	28.74	12.2
Cobalt-60	0.13	N/A	N/A
Europium-152	1.42	1.03	5.7
Plutonium-238	3.00	3.54	13
Plutonium-239	311.91	194.17	12.7
Strontium-90	N/A	N/A	838
Uranium-234	N/A	N/A	143
Uranium-235	N/A	N/A	17.5
Uranium-238	N/A	N/A	105

[a]Land Parcel 1 is comprised of the four CAU 551 CASs, 12-01-09, 12-06-05, 12-06-07, and 12-06-08. Land Parcel 2 is comprised of the Initial Decision II and Extended Decision II (downslope) areas.
[b]Values computed from RESRAD for CAU 551. The entire report is contained in Appendix E. Computations for the combined muckpiles and Decision II areas (Land Parcel 3) were not used for determination of the FALs.
[c]From PALs stated in CAIP for CAU 551, 25 mrem/yr dose.

FAL = Final action level
mrem/yr = Millirem per year
N/A = Not applicable
PAL = Preliminary action level
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive computer code

3.0 Recommendations

The NNSA/NSO provides the following recommendations:

- No further corrective action is required at CAU 551.
- The corrective action of close in place with administrative controls is recommended at CAU 551.
- A surface area of approximately 94,000 square meters (m^2) (1,011,808 square feet) is use restricted.
- CAU 551 should be moved from Appendix III to Appendix IV of the FFACO.

Activities in the area affected by this closure that were completed include the following:

- Grading of the access road between E- and B-Tunnels to repair damage from erosion and permit recontouring of the road to redirect runoff into the watershed to the north.
- Reduction of water flow in the basin surrounding CAU 551 by improving an existing berm in the road and installing a new berm in the road to direct surface water into the watershed to the north. Two runoff shunts were also created out of the road surface downgradient from the berms to direct surface water to the north.
- Completion of an inventory of historical artifacts in the area, which date back to the earliest days of tunnel testing.
- Posting of use restriction signs at 13 locations identified as being near locations where personnel could conveniently park a vehicle and walk into the area from the roadway.

Annual post-closure inspections are required. These inspections will include the following:

- Inspection of the use restriction signs to ensure all signs are in place and legible.
- Inspection of the condition of the two runoff diversion berms to ensure they are in place and functioning as designed (i.e., to divert runoff out of the basin)
- Inspection of the E-Tunnel turnoff culvert. If visible evidence exists of sediment migrating past the culvert, the conditions at the culvert will be photo-documented.
- Inspection of the general condition of the access road and drainage below the E-Tunnel turnoff culvert. If evidence exists that sediment from within the use restricted area is migrating outside of the use restricted area, NDEP will be notified. In addition, a determination on the need for monitoring (e.g., sample collection and analysis) will be made based on current site conditions.

Upon implementation of the use restriction for CAU 551, closure in place with administrative controls will be enforced. Closure in place with administrative controls was evaluated based on technical merits focusing on performance, reliability, feasibility, and safety.

The NNSA/NSO requests that NDEP issue a Notice of Completion for this CAU and approval to move the CAU from Appendix III to Appendix IV of the FFACO.

4.0 References

CFR, see *Code of Federal Regulations*.

Code of Federal Regulations. 2003a. Title 40 CFR Parts 260 - 282, "Hazardous Waste Management." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2003b. Title 40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce and Prohibitions." Washington, DC: U.S. Government Printing Office.

DOE, see U.S. Department of Energy.

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

EPA, see U.S. Environmental Protection Agency.

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

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Appendix A

Corrective Action Investigation Results

A.1.0 Introduction

This appendix details CAI activities and analytical results for CAU 551. Corrective Action Unit 551 is located in Area 12 of the NTS (Figure 1-1) and is comprised of the four CASs listed below:

- CAS 12-01-09, Aboveground Storage Tank and Stain
- CAS 12-06-05, U-12b Muckpile
- CAS 12-06-07, Muckpile
- CAS 12-06-08, Muckpile

Corrective Action Site 12-01-09 is located in Area 12 of the NTS and consists of an AST and underlying stain located next to a generator building. The tank was likely used during the testing activities conducted in the B-, C-, D-, and F-Tunnels (1957 to 1963).

Corrective Action Sites 12-06-05, 12-06-07, and 12-06-08 also are located in Area 12 of the NTS. Corrective Action Sites 12-06-05 and 12-06-08 muckpiles are adjacent or near B-Tunnel, in which six documented nuclear tests occurred. Corrective Action Site 12-06-07 is adjacent to C-, D-, and F-Tunnels, in which six safety experiments were conducted.

This CAU was investigated because process knowledge indicated the associated CASs may have been used to store or dispose of material considered to be hazardous or radioactive waste by current standards. The CAI was conducted in accordance with the CAU 551 CAIP (NNSA/NSO, 2004) and ROTCs 1, 2, and 3 as developed under the FFACO (1996).

Additional information regarding the history of each site, planning, and the scope of the investigation is presented in the CAU 551 CAIP (NNSA/NSO, 2004) and will not be repeated in this document.

A.1.1 Project Objectives

The primary objective of the investigation was to provide sufficient information and data to develop appropriate corrective action alternatives for each CAS in CAU 551. This objective was achieved by identifying the nature and extent, both horizontal and vertical of COCs (i.e., COPCs at concentrations above action levels).

The selection of soil and/or waste characterization sample locations was based on site conditions, and the strategy developed during the DQO process as outlined in the CAU 551 CAIP (NNSA/NSO, 2004) and subsequent ROTCs. The sampling strategy involved biased (non-probabilistic) sample locations at all CASs.

A.1.2 Content

This appendix describes the investigation and presents the results. The contents of this appendix are as follows:

- Section A.1.0 describes the investigation background, objectives, and content.
- Section A.2.0 provides an investigation overview.
- Sections A.3.0 and A.4.0 provide CAS-specific information regarding field activities, downslope- and upslope-specific information regarding field activities, sampling methods, and laboratory analytical results from investigation sampling.
- Section A.5.0 summarizes WM activities.
- Section A.6.0 discusses the QA and QC procedures followed and results of the QA/QC activities.
- Section A.7.0 summarizes the investigation results.
- Section A.8.0 lists the cited references.

The complete field documentation and laboratory data, including Field Activity Daily Logs (FADLs), sample collection logs (SCLs), analysis request/chain-of-custody forms, soil sample descriptions, laboratory certificates of analyses, analytical results, and surveillance results are retained in project files as hard copy files or electronic media.

A.2.0 Investigation Overview

Field investigation and sampling activities for the CAU 551 CAI were conducted from October to December 2004. Supplemental sampling was conducted between March 10 and May 10, 2005, to provide information on the extent of contamination upslope and downslope from the muckpiles. Table A.2-1 lists the CAI activities that were conducted at each of the CASs.

Table A.2-1
Corrective Action Investigation Activities Conducted at Each Corrective Action Site To Meet Corrective Action Investigation Plan Requirements

Corrective Action Investigation Activities	Corrective Action Site or Decision Level					
	CAS 12-01-09	CAS 12-06-05	CAS 12-06-07	CAS 12-06-08	Decision II, Muckpiles	Upslope Area
Inspected corrective action site system components	X	X	X	X	X	X
Conducted surface land area radiological surveys	X	X	X	X	X	X
Performed site transects/walkovers	X	X	X	X	X	X
Staked/flagged sample locations & recorded coordinates	X	X	S[a]	X	X	X
Collected soil samples from biased locations	X	X	X	X	X	X
Field-screened samples for alpha and beta/gamma radiation	S[b]	X	X	X	X	X
Field-screened soil samples for volatile organic compounds (Decision I sampling only)	X	X	X	X	X	N/A
Collected required quality control samples	X	X	X	X	X	X
Submitted select samples for off-site laboratory analysis	X	X	X	X	X	X
Performed swipe sampling for removable radioactivity and/or metals	X	X	X	X	X	X

[a]Coordinates collected on flat areas of CAS 12-06-07 muckpile only
[b]Decision II samples, first set, at CAS 12-01-09 not screened for radiological parameters

N/A = Not applicable
S = Completed as per plan requirements, with exceptions as noted
X = Completed as per plan requirements

The investigation and sampling program was managed in accordance with the requirements set forth in the CAU 551 CAIP (NNSA/NSO, 2004) and subsequent ROTCs. Field activities were performed in accordance with the approved Industrial Sites Project Health and Safety Plan (SNJV, 2004b) which is consistent with the DOE Integrated Safety Management System. Samples were collected and documented following approved protocols and procedures indicated in the CAU 551 CAIP and Field Work Permit. Quality control samples (e.g., field blanks, equipment rinsate blanks, trip blanks, and duplicate samples) were collected as required by the Industrial Sites QAPP (NNSA/NV, 2002) and the CAU 551 CAIP (NNSA/NSO, 2004). During field activities, waste minimization practices were followed according to approved procedures, including segregation of waste by waste stream.

Weather conditions at the site varied to include sunshine (cool to moderate temperatures), rain, snow, and cloudiness, with gentle to gusty winds. A significant delay was caused by the presence of snow and ice, which prevented safe collection of samples.

The CASs were investigated by conducting radiological surface screening and surveys and by sampling potential contaminant sources, surface, and subsurface soils. Surface soil samples were collected by hand excavation. Subsurface soil samples were collected using hand augering. Investigation intervals and soil samples were field screened for VOCs and alpha and beta/gamma radiation. The results were compared against screening levels to guide in the CAS-specific investigations. Resultant samples were shipped to off-site laboratories to be analyzed for appropriate chemical and radiological parameters. The field-screening readings were also used to guide sampling decisions and H&S controls.

Except as noted in the following CAS-specific sections, CAU 551 sampling locations were accessible and sampling activities at planned locations were not restricted by buildings, storage areas, active operations, or aboveground and underground utilities. Required sampling step-out locations were accessible and remained within anticipated spatial boundaries except where otherwise noted.

Sections A.2.1 through A.2.6 provide the investigation methodology, site geology and hydrology, and laboratory analytical information. Additional activity-specific details for the individual CASs are presented in Sections A.3.0 and A.4.0. Section A.4.3 presents the Decision II, Verification Sampling, and upgradient sampling.

A.2.1 Preliminary Conceptual Models

The preliminary CSMs provided in the CAU 551 CAIP were supported by the CAI results. Revisions of the CSMs were not needed.

A.2.2 Sample Locations

Sampling points for each CAS were selected based on the approach provided in the CAIP and were based on interpretation of existing engineering drawings, aerial and land photographs, interviews with former and current site employees, information obtained during site visits, and site-specific biasing factors. The planned sample locations are discussed in text and shown on figures in the CAIP. Actual sample locations are shown on the figures included in Sections A.3.0 through A.4.3 of this appendix. Some locations were modified slightly from planned positions due to field conditions and observations. In some cases, FSRs and/or laboratory analytical results determined the need for step-out sampling locations. Sample locations were staked, labeled appropriately, and surveyed with a Global Positioning System (GPS) instrument. The actual locations have been plotted based on the coordinates collected by the GPS instrument.

Specific sample location selection guidelines are defined as follows.

- **Pipe welds/joints**: For CAS 12-01-09, metallic piping that was traced/connected to the aboveground storage tank; each joint of the piping is either a threaded fitting or a welded connection, and can be a potential source of weakness or corrosion. These joints are the most likely place for a leak of liquid to develop, although integrity failure of the piping itself is also possible.

- **Stains**: Any spot or area on the soil surface that may indicate the presence of a potentially hazardous liquid was evaluated for sampling. Typically, stains indicate an organic liquid such as an oil has reached the soil, and may have spread out vertically and horizontally.

- **Elevated radiation**: Any location identified during radiological surveys that had alpha/beta/gamma levels significantly higher than the surrounding background soil.

- **Drums, containers, or debris**: Materials of interest that may have been used, or added to, a location and may have contained or come in contact with hazardous or radioactive substances at some point during use.

- **Area of erosion**: A location from which a net removal of soil or muck material has occurred through natural weathering processes (primarily overland water flow). The steep slopes of the muckpiles are especially susceptible to erosive actions.

- **Area of sediment deposition**: Locations from which a net addition of soil or muck material has occurred through natural weathering processes of upslope soils, rock, and muck (primarily overland water flow). Less steep areas at the foot of the muckpiles and in washes are typical areas where eroded material has collected.

- **Lithology**: Locations where variations in lithology (soil, muck, or rock) indicated that different conditions or materials exist. Examples for the CAU 551 area include muck material of different color or texture, muck material that may have been altered through thermal stress during a nuclear test, and shallow contact between muck and native soil along the toes of the muckpiles. This criterion does not include areas of erosion or deposition.

- **Preselected areas based on process knowledge of the site**: These are locations within the Initial Decision II Area primarily downslope from the muckpiles, just off the lowest portions of the muckpiles, within CAIP-specified areas. These areas were chosen during DQO development and based upon process knowledge.

- **Possible pipe effluent deposits**: Within CASs 12-06-05 and 12-06-08, a steel pipe extends horizontally from the upper level of the muckpiles. The purpose of the pipe is unknown; it may have been used at some time to drain water out of B-Tunnel or it may be debris abandoned in the muckpile. If used as a drain pipe, any hazardous or radioactive materials carried by this pipe would have come in contact with muck beneath the end of the pipe.

No debris removal or housekeeping activities were preformed at CAU 551 aside from the removal of the AST and its contents.

A.2.3 Investigation Activities

The investigation activities performed at CAU 551 were those discussed in the CAU 551 CAIP (NNSA/NSO, 2004) and listed in Table A.2-1. The investigation established the nature and extent of contamination associated with each CAS. The following sections describe the specific investigation activities conducted at CAU 551.

A.2.3.1 Surface Radiological Surveys

Surface radiological land walkover surveys were performed within safely accessible area of all four CASs of CAU 551 and in selected portions of the Initial Decision II and Extended Decision II areas.

The results of the surveys were used to guide the investigation and provide for site worker safety, focusing on the identification of areas of elevated radioactivity as described in Section 4.0 of the CAU 551 CAIP (NNSA/NSO, 2004). Radiological land survey results are presented in Figure A.2-1. The results identified some areas of elevated radiation from which samples were collected.

A.2.3.2 Site Walkovers

Site walkovers were performed on the following four CASs within CAU 551: CASs 12-01-09, 12-06-05, 12-06-07, and 12-06-08. This was accomplished by walking over accessible areas in and near all four CASs, as well as the areas identified as Initial Decision II, Extended Decision II, and Upslope Area. Some areas were too steep and/or unstable to traverse, and were not included in the survey. Observations were made to identify biased sampling locations (e.g., stained soil, elevated radioactivity, unidentified or out-of-place objects).

A.2.3.3 Field Screening

Field-screening activities for VOCs were performed at all locations, as specified in the CAU 551 CAIP (NNSA/NSO, 2004). The FSLs for VOC headspace was established at 20 parts per million or 2.5 times background, whichever was greater. All field screening for VOCs was conducted using an FID during Decision I and Decision II activities at all CASs.

Field-screening activities for alpha and beta/gamma radiation were performed at all Decision I locations and at Decision II locations where indicated, as specified in the CAU 551 CAIP (NNSA/NSO, 2004). Site-specific FSLs for alpha and beta/gamma radiation were defined as the mean background activity level plus two times the standard deviation of readings from 10 background locations selected near each CAS. The radiation FSLs are instrument-specific and were established for each instrument and CAS before use. Alpha and beta/gamma radiation screening was performed at each CAS using radiological instruments fitted with a dual-alpha and beta/gamma radiation scintillation probe.

The CAS-specific sections of this document identify the CASs where field screening was conducted and how the FSLs were used to aid in the selection of sample locations. Field-screening results are recorded on SCLs that are retained in project files.

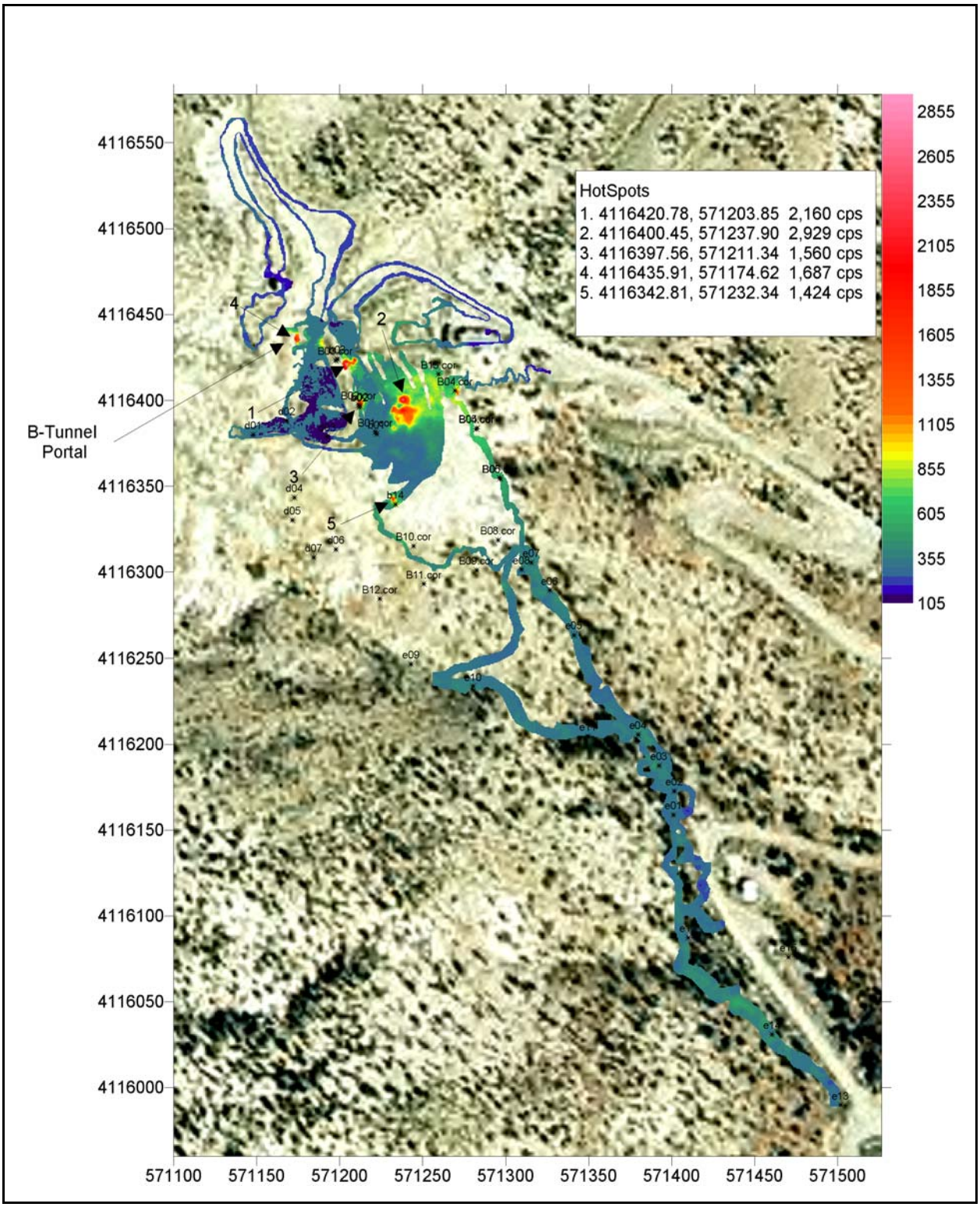


Figure A.2-1
Surface Radiological Land Survey Results for CAU 551 and Surrounding Areas

A.2.3.4 Surface and Subsurface Sampling

Intrusive investigation activities (i.e., surface and shallow subsurface soil sampling), were conducted at all four CASs within CAU 551 to support Decision I and Decision II investigation activities. Soil samples were collected using grab sampling (surface) and hand auger (shallow subsurface samples). Before the start of sampling, all locations for Decision I activities were screened for alpha and beta/gamma radiation. Additional screening was conducted during sample collection to both guide the investigation and serve as an H&S control to protect the sampling team. Labeled sample containers were filled according to the following sequence: total VOCs and TPH-DRO sample containers were filled directly from the sample location, followed by the collection of soil for VOC field screening. Additional soil was transferred into an aluminum pan, homogenized, and field screened for alpha and beta/gamma radiation. All remaining sample containers were then filled. The excess soil was returned to the sampling location and no void spaces remained in the augered holes after backfilling.

Surface soil samples were collected from 0.0 to 0.5 ft bgs at biased locations (e.g., stained soil, settling areas collecting runoff, areas with elevated radiological measurements). Subsurface soil samples were collected from the surface soil sample location where staining was noted, where specified in the CAIP, and/or where field screening or analytical results indicated contamination. A detailed discussion for how the sampling met DQOs is provided in Appendix B.

A.2.3.4.1 Surface Radiological Surveys and Swiping

Screening of personnel and equipment at all four CASs revealed no removable radiological contamination. Swipes taken from the surfaces of PPE and equipment likewise revealed no removable radiological contamination.

A.2.3.4.2 Waste Characterization and Sampling

No debris, soil, equipment, or buildings at the site were identified to be removed from the site; therefore, no samples to characterize this waste were taken. Generation and disposition of IDW is discussed in Section A.5.0.

A.2.3.4.3 Sample Location Documentation

A Trimble GPS instrument, which includes a Trimble TSC-1 datalogger, by use of an Omnistar subscription was used for determining the sample location coordinates as well as CAS points of interest down to a sub 1-meter accuracy. Most sample location coordinates have been incorporated into sample locations maps in Section 3.0. Data for locations B09 through B13 and C07 through C16 were lost. Approximate locations for the lost data are given based upon sample collection logs. Appendix D presents the GPS data in tabular form.

A.2.4 Laboratory Analytical Information

Chemical analyses were performed by EMAX Laboratories, Inc., Torrance, California; radiological analyses were performed by Paragon Analytics, Inc., Fort Collins, Colorado and are DOE Consolidated Audit Program laboratories. This project started before National Environmental Laboratory Accrediation Program requirements were implemented. The analytical parameters and laboratory methods used to analyze investigation samples are listed in Table A.2-2. Organic and inorganic analytical results are reported in this appendix if they were detected at or above the minimum reporting limits (MRLs) established in Table 3-4 of the CAU 551 CAIP (NNSA/NSO, 2004). Radionuclide analytical results are reported in this appendix if they are detected at or above minimum detectable concentrations (MDCs) established in Table 3-3 of the CAU 551 CAIP (NNSA/NSO, 2004).

Validated analytical data for CAU 551 investigation samples have been compiled and evaluated to confirm the nature and define the extent of contamination, if present. The analytical results for each CAS or group of CASs are presented in Sections A.3.0 through A.4.0, and in Section A.4.3 for Decision II samples taken downslope and upslope from the muckpiles at CAU 551. The analytical results have been compared to MRLs or MDCs, as appropriate, and only those above MRLs or MDCs are included in CAS-specific tables.

The analytical parameters are CAS-specific and were selected as specified in the EPA *Guidance for the Data Quality Objectives Process* (EPA, 1994b). Samples collected during step-out sampling were analyzed only for the COPCs that exceeded PALs in the original samples. Bioassessment samples were not collected, because FSRs and observations did not indicate the need.

Table A.2-2
Laboratory Analytical Parameters and Methods, CAU 551 Investigation Samples

Analytical Parameter	Analytical Method
Total volatile organic compounds	SW-846 8260B[a]
Total semivolatile organic compounds	SW-846 8270C[a]
Total petroleum hydrocarbons-gasoline-range organics	SW-846 8015B (modified)[a]
Total petroleum hydrocarbons-diesel-range organics	
Polychlorinated biphenyls	SW-846 8082[a]
Total *Resource Conservation and Recovery Act* (RCRA) metals[b]	Water - SW-846 6010B/7470A[a] Soil - SW-846 6010B/7471A[a]
Total beryllium	
Toxicity Characteristic Leaching Procedure (TCLP) volatile organic compounds	SW-846 1311/8260B[a]
TCLP semivolatile organic compounds	SW-846 1311/8270C[a]
TCLP RCRA metals[b]	SW-846 1311/6010B/7470A[a]
Gamma-emitting radionuclides	Water - EPA 901.1 Soil - HASL-300
Isotopic uranium	Water - ASTM D3972-02 Soil - ASTM C1000-02
Isotopic plutonium	Water - ASTM D3865-02 Soil - ASTM C1001-00
Strontium-90	Water - ASTM D5811-00 Soil - HASL-300
Gross Alpha/Beta	Water - EPA 900.0 Soil - EPA 900.0 (modified)
Tritium	Water - EPA 906.0 Soil - Laboratory SOP

[a]U.S. Environmental Protection Agency (EPA), *Test Methods for Evaluating Solid Waste*, *Physical/Chemical Methods*, 3rd Edition, Parts 1-4, SW-846 CD ROM. Washington, DC. (EPA, 1996)
[b]Arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver

ASTM = American Society for Testing and Materials
HASL = Health and Safety Laboratory

A.2.5 Comparison to Action Levels

Chemicals and radionuclides detected in samples at concentrations greater than the FALs are identified as COCs. If COCs are present, corrective action must be considered for the CAS. The FALs for the CAU 551 investigation are defined in Section 2.1.

Sample data that are equal to or greater than MRLs or MDCs are tabulated in the CAS-specific sections that follow. Results that are equal to or greater than FALs (a subset of those that exceed MRLs or MDCs) are identified by bold text in the corresponding tables and discussed in Sections A.3.0 through A.4.3.

The radiological FALs have been adjusted to a concentration representing a 25 mrem/yr dose (DOE, 1993). These changes do not impact the PALs used for chemical contaminants in the CAIP; those values remain the same. The chemical PALs are considered FALs for this investigation. The radiological PALs identified in the CAIP served to aid in the determination of the extent of the radiological contamination. However, because of the additive nature of the radionuclides and the requirement for the total radioactive dose to potential receptors to be equal to or less than 25 mrem/yr, the RESRAD code (version 6.3) was used to determine the FALs for the radionuclides present in the study areas. This resulted in FALs being different than the PALs. In addition, the FALs for one area may be different than those for another area. The RESRAD model employed for development of the FALs for the radionuclides is presented in Appendix E and the FALs are listed in Table 2-3.

Analytical results below MRLs and MDCs have been excluded to minimize the size of this document. However, the unedited dataset for CAU 551 is retained in an electronic format in the project files.

A.2.6 Watershed Properties

As all CAU 551 CASs are co-located within one watershed, the properties of the watershed affect all four CASs. These properties will impact the corrective actions considered for CAU 551.

A.2.6.1 Watershed Size and Topography

The watershed is bounded by the following features: from the edge of the top of Rainier Mesa to the west, along a line on the southern border that trends nearly due east to the junction of the E-Tunnel turnoff road and the B-Tunnel access road, up to the hill ridges to the east, and then north along the B-Tunnel access road to a point just above CAS 12-01-09, then along a line trending nearly northwest to the mesa top. The watershed size pertaining to CAU 551 is approximately 0.23 square miles.

The watershed consists of very steep slopes, with numerous outcroppings of rock and cliffs. The average east to west slope, from a benchmark at the E-Tunnel muckpile to the mesa edge, is

approximately 42 percent; and from a benchmark near the junction of the access road and the wash draining the CAU 551 area, to a benchmark northwest on the mesa edge, the gradient averages 44 percent.

A.2.6.2 Geology

Regional native surface soil consists of poorly graded, moderately consolidated, alluvial silty sands with gravel, and some cobble-sized volcanic and sedimentary detritus. Native soils present in and around CAU 551 are generally thin, due to the steep slopes of the area, and do contain varying amounts of organic matter, from low amounts of fully decomposed organics to nearly intact leaves, twigs, and branches. Subsurface soil ranged from coarse, very gravelly sands, to very gravely silty sands and was generally lower in organic matter that surface soils.

Muck on all of the muckpiles contained very little organic matter, except near bushes on the flat top portions of the muckpiles. Most muck was generally sandy to silty, but did readily adhere to sampling instruments when moist, giving an apparent sticking behavior of consolidated aggregates of a loam or silty clay loam. Rocks, which were the same yellowish and pinkish color as the muck and may have originated in the same tuff layers as the muck, appeared to be weathering at a more accelerated rate than rocks originating from higher up in the watershed.

A more detailed description of the regional geology for the NTS is provided in the CAU 551 CAIP (NNSA/NSO, 2004). A general field description for each sample was recorded on SCLs that are retained in the project files.

A.2.6.3 Climate

The average annual precipitation measured at a rain gauge installed near the E-Tunnel in 1997 is 11.3 inches (in.) per year. At a weather station atop Rainier Mesa, the average annual precipitation since late 1959 to late 1994 was 12.82 in. per year. The highest average monthly precipitation occurs during July and August (2.7 and 2.1 in. per month, respectively), with January, February, March, September, and November all exceeding 1 in. per month on average. The five highest one-day totals for precipitation were 2.98 in. (February 23, 1998), 2.90 in. (March 17, 1982), 2.80 in. (August 17, 1977), 2.75 in. (August 18, 1983), and 2.69 in. (September 10, 1976).

Average monthly temperatures for the area range from 32 degrees Fahrenheit (°F) during January and December to 69°F during July.

Potential evapotranspiration at the NTS is significantly greater than precipitation, thus limiting vertical migration of contaminants. The annual average precipitation for this region ranges from 6 to 12 in. per year (USGS, 1975).

A.2.6.4 Hydrology

The steep terrain of CAU 551 would drive the overland transport of water at the expense of vertical migration from precipitation events. Two dry washes that join downslope from the CASs provide channels that collect surface runoff from the three muckpiles. All stream flow is ephemeral, occurring only during precipitation events.

Due to the depth to groundwater, arid climatic conditions, and the steep slopes at CAU 551, groundwater is not expected to have been impacted by the potential release of contaminants. Depth to groundwater in nearby Well E-12-1 has been recorded at a depth of 1,527 ft bgs (USGS, 2003).

No saturated zones (e.g., perched water, contaminant saturation) were encountered anywhere in the shallow subsurface adjacent to or below the CASs.

The evaporative demand (Section A.2.6.3) is the dominant factor influencing the movement of water in the unsaturated zone. Recharge to groundwater from precipitation is not significant at the NTS and does not provide a significant mechanism for migration of contaminants to groundwater.

No water is currently draining from B-, C-, D-, or F- Tunnels, nor has drainage from the tunnels been documented.

A.2.6.5 Vegetation

Relatively undisturbed areas of the watershed are vegetated by juniper, pinion pine, low-to-medium-height brush, and sparsely distributed grasses. Depending on the area, the vegetation density ranges from nearly barren on rock outcroppings to nearly full canopy coverage where soil is relatively extensive. Canopy coverage is important in erosion control, as the impact of raindrops hitting the soil surface, and the subsequent dislodging of soil particles, can be greatly reduced with thicker vegetative

cover. Because most areas consist of moderate to steep slopes, the presence of vegetation greatly assists in stabilizing the thin, rocky soils.

The flat tops of the muckpiles are characterized by low-to-medium-height brush, some grasses, and few if any small trees or junipers. Several areas, especially atop CAS 12-06-07 Muckpile, have extensive canopy coverage; other areas have more sparsely vegetated surfaces and are more prone to erosion.

The slopes of the muckpiles are characterized by sparsely to moderately distributed vegetation, mostly low- to medium-height brush. Steep portions of all three muckpiles have very thinly distributed vegetation and are among the most highly susceptible areas to erosion in the watershed.

A.3.0 Corrective Action Site 12-01-09, Aboveground Storage Tank and Stain

Corrective Action Site 12-01-09, Aboveground Storage Tank and Stain, is located in Area 12 of the NTS near the B-, C-, D-, and F-Tunnel portals area. The AST consists of a 550-gallon steel tank situated on a concrete pad (Figure A.3-1). Two small diameter steel pipes connected to the tank enter the soil. One, at the front, connects to a vent pipe; the other, at the rear, connects to the bottom of the tank and runs through a valve before entering the ground. The stain exists directly beneath a weld at the front bottom of the tank. Additional photographs of the tank and stain are presented in Section A.1.1.1 of the CAU 551 CAIP (NNSA/NSO, 2004).

Figure A.3-1
Photograph of 550-Gallon Fuel Tank in CAU 551
Digital photograph of CAS 12-01-09 (SNJV, 2004a)

The CSM for the AST and stain, as seen in Section A.1.2.3 of the CAU 551 CAIP (NNSA/NSO, 2004), illustrated potential lateral and vertical migration of contamination from the stain. The objective for the CAI was to determine (1) whether COCs were present, and (2) the horizontal and vertical extent of the identified COCs. An additional objective to identify and sample any leaks in the underground piping was also incorporated into the CAI.

Analytical results of the tank contents were identified in August 2004 as being consistent with diesel fuel oil. The contents were removed from the tank before soil sampling in October 2004.

A.3.1 Corrective Action Investigation

A total of 22 soil environmental samples (including 2 field duplicates [FDs]) were collected from 9 locations during investigation activities at CAS 12-01-09. An additional waste sample was also collected to characterize the contents of the AST. The sample identification numbers (IDs), sample parameters, and analyses are listed in Table A.3-1, and sample locations and results above FALs presented in Figure A.3-2. The specific CAI activities conducted to satisfy the CAIP requirements at this CAS are described in the following sections.

A.3.1.1 Field Screening

Decision I soil samples (551A002 through 551A008) were field screened for VOCs and alpha and beta/gamma radiation. The first set of Decision II soil samples were field screened for alpha and beta/gamma radiation. The FSRs were compared to FSLs to guide subsequent sampling decisions. The VOC headspace FSLs were not exceeded during sampling activities; alpha radiation FSLs were not exceeded, and beta/gamma radiation FSLs were exceeded on two Decision I samples (551A003 and A004) during sampling activities.

A.3.1.2 Sampling

Decision I sample locations at CAS 12-01-09 were selected based on at least one criterion as follows: (1) presence of stains, and/or (2) position beneath pipe welds/joints (guidelines defined in Section A.2.2). Two locations were selected for Decision I sampling (A01 and A02). Criteria for selection of Decision II locations included choosing sampling sites that formed a roughly triangular pattern around the location identified with contamination greater than the FAL. A nearby steep slope and a generator building impacted the selection of Decision II sample locations. Seven locations were selected for Decision II sampling.

Sampling activities for Decision I included the collection of a surface soil sample at both locations. If the surface sample appeared to contain contamination (field observation or laboratory results), deeper samples were collected from that location at 6 to 12 in. bgs and at 1-ft intervals until either a sample

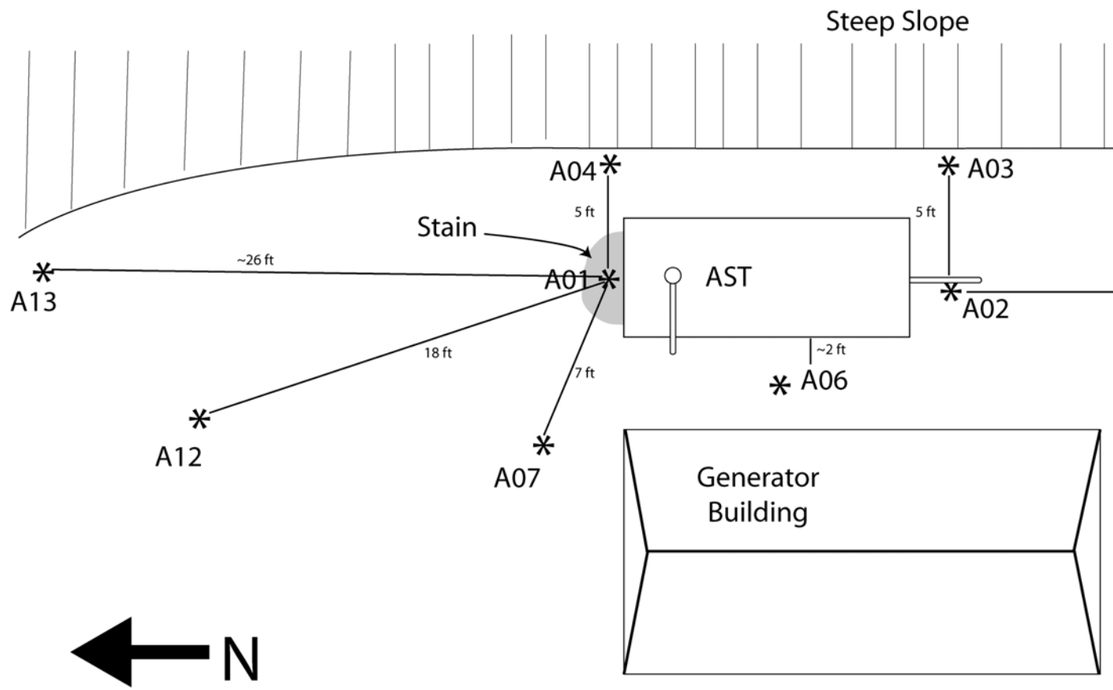
Table A.3-1
Samples Collected at CAS 12-01-09, Aboveground Storage Tank and Stain

Sample Location	Sample Number	Depth (ft bgs)	Sample Matrix	Sample Type	Analyses
A01	551A002	0.0 - 0.5	Soil	Environmental, QC	Set 1
	551A005	0.5 - 1.0	Soil	Environmental	Set 1
	551A006	1.5 - 2.0	Soil	Environmental	Set 1
	551A008	2.5 - 3.0	Soil	Environmental	Set 1
A02	551A003	0.0 - 0.5	Soil	Environmental	Set 1
	551A004	0.0 - 0.5	Soil	Field Duplicate of #551A003	Set 1
	551A007	0.5 - 1.0	Soil	Environmental	Set 1
A03	551A009	0.0 - 0.5	Soil	Environmental	TPH-DRO
	551A010	2.0 - 3.0[a]	Soil	Environmental	TPH-DRO
A04	551A011	0.0 - 0.5	Soil	Environmental	TPH-DRO
	551A012	2.5 - 3.0[a]	Soil	Environmental	TPH-DRO
A05	551A013	0.0 - 0.5	Soil	Environmental	TPH-DRO
	551A014	2.0 - 2.5[a]	Soil	Environmental	TPH-DRO
A06	551A015	0.0 - 0.5	Soil	Environmental	TPH-DRO
	551A016	2.5 - 3.0	Soil	Environmental	TPH-DRO
A07	551A017	0.0 - 0.5	Soil	Environmental	TPH-DRO
	551A018	1.5 - 2.0[a]	Soil	Environmental	TPH-DRO
A11	551A022	0.0 - 0.5	Soil	Environmental	Not Analyzed
A12	551A023	0.0 - 0.5	Soil	Environmental, QC	Set 2
	551A024	3.0 - 3.5[a]	Soil	Environmental	Set 2
A13	551A025	0.0 - 0.5	Soil	Environmental	Set 2
	551A026	0.0 - 0.5	Soil	Field Duplicate of #551A025	Set 2
	551A027	2.5 - 3.0[a]	Soil	Environmental	Set 2
Tank Contents	551A001	N/A	Liquid	WM	Total VOCs, SVOCs, TPH-GRO, TPH-DRO, PCBs, RCRA Metals, Gamma Spectroscopy
N/A	551A301	N/A	Water	Trip Blank	Total VOCs
N/A	551A302	N/A	Water	Field Blank	Set 2
N/A	551A303	N/A	Water	Equipment Rinsate	Set 2

[a]Depth at or near refusal

Set 1 = Total VOCs, Total SVOCs, TPH-DRO, PCBs, Total RCRA Metals, Beryllium, Gamma Spectroscopy, Isotopic Uranium, Isotopic Plutonium, and Strontium-90
Set 2 = Total SVOCs, TPH-DRO, Gamma Spectroscopy, Isotopic Plutonium

DRO = Diesel-range organics
ft bgs = Feet below ground surface
GRO = Gasoline-range organics
N/A = Not applicable
PCB = Polychlorinated biphenyl
QC = Quality control
RCRA = *Resource Conservation and Recovery Act*
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound
WM = Waste management



Location	Depth (ft)	Am-241 (pCi/g)	Cs-137 (pCi/g)	Pu-238 (pCi/g)	Pu-239 (pCi/g)	Diesel (mg/kg)
FAL (pCi/g)		*79.63*	*72.07*	*3.30*	*311.91*	*100*
A01	0.0 – 0.5	------	------	------	------	98,000
	0.5 – 1.0	ND	ND	ND	------	30,000
	1.5 – 2.0	ND	------	------	------	18,000
	2.5 – 3.0	ND	ND	ND	------	17,000
A02	0.0 – 0.5	-----; -----	------; ------	-----; -----	------;------	1,200; 930
	05 – 1.0	------	------	------	------	410
A03	0.0 – 0.5	NA	NA	NA	NA	290
	2.0 – 3.0	NA	NA	NA	NA	860
A04	0.0 – 0.5	NA	NA	NA	NA	200
	2.5 – 3.0	NA	NA	NA	NA	12,000
A05	0.0 – 0.5	NA	NA	NA	NA	ND
	2.0 – 2.5	NA	NA	NA	NA	ND
A06	0.0 – 0.5	NA	NA	NA	NA	ND
	2.5 – 3.0	NA	NA	NA	NA	ND
A07	0.0 – 0.5	NA	NA	NA	NA	5,800
	1.5 – 2.0	NA	NA	NA	NA	920
A12	0.0 – 0.5	------	------	------	------	ND
	3.0 – 3.5	ND	ND	------	------	ND
A13	0.0 – 0.5	ND; ND	------; ------	-----; -----	-----; ------	ND; ND
	2.5 – 3.0	ND	ND	------	------	ND

Notes:

- Cells with two entries separated by a semicolon represent results of field duplicate samples
- FAL values for radionuclides are based on RESRAD Calculations for CAU 551, Land Parcel 1
- NA = Not analyzed
- ND = Not detected
- ------ = Constituent was detected, but at a concentration below FAL

Figure A.3-2
Sample Location Map and Results Above FALs, CAS 12-01-09, Aboveground Storage Tank and Stain

appeared clean or refusal of sampling equipment was met. Location A01 was sampled to a depth of 3 ft; location A02 was sampled to a depth of 1 ft.

Sampling activities for Decision II included the collection of surface samples from seven step-out locations. After preliminary laboratory results indicated all Decision I samples contained diesel above the FAL, Decision II step-out samples were taken below the depths that contamination was previously identified (2.5 to 3.0 ft) or to refusal. Refusal was met at six Decision II locations (A03, A04, A05, A07, A12 and A13) from 2.0 to 3.5 ft bgs.

Samples were then submitted for laboratory analysis. All documentation was prepared and checked according to procedures specified in the CAIP or QAPP before submitting samples for analysis (NNSA/NSO, 2004; NNSA/NV, 2002).

A.3.1.3 Deviations

There were no significant deviations to the CAIP requirements at this CAS. Although not initially identified as COPCs for the Decision II sampling, radionuclides were identified at concentrations above the PAL in samples collected from locations A01 and A02. Therefore, all subsequent samples for this CAS from locations A12 and A13 were analyzed for gamma-emitting radionuclides and isotopic plutonium. This deviation did not impact the closure decision. The investigation and sampling at CAS 12-01-09 is considered sufficient to meet the DQOs.

Based on the review and evaluation of data collected for CAS 12-01-09, adequate delineation of the contamination was accomplished.

A.3.2 Investigation Results

The following sections provide analytical results from the samples collected to complete investigation activities as outlined in the CAIP. Decision I investigation samples were analyzed for the CAIP-specified COPCs which included total VOCs, total SVOCs, TPH-DRO, total RCRA metals and beryllium, PCBs, gamma-emitting radionuclides, isotopic uranium, isotopic plutonium, and strontium (Sr)-90. The first set of Decision II samples (locations A03 through A07) were only analyzed for TPH-DRO. The second set of Decision II samples (locations A12 and A13) were analyzed for SVOCs, TPH-DRO, gamma emitters and isotopic plutonium. The analytical parameters

and laboratory methods used to analyze the investigation samples are listed in Table A.2-2. Table A.3-1 lists the sample-specific analytical suites for CAS 12-01-09.

Analytical results from the soil samples with concentrations exceeding MRLs or MDCs were compared to the FALs and are a subset of the results that exceed MRLs or MDCs. Results greater than the FALs are identified by bold text in the analytical tables. A portion of the analytical results for CAS 12-01-09 were rejected for sensitivity during validation; however, these rejected data did not adversely impact closure decisions and are discussed in Section B.1.4. The Land Parcel 1 FALs (Table 2-3) apply to the radiological data from CAS 12-01-09.

A.3.2.1 Total Volatile Organic Compounds

Total VOC analytical results for soil samples collected at CAS 12-01-09 that were detected above MRLs are presented in Table A.3-2. No VOCs were detected in soil samples above the FALs.

Table A.3-2
Soil Sample Results for Total VOCs Detected Above Minimum Reporting Limits at CAS 12-01-09, Aboveground Storage Tank and Stain

Sample Location	Sample Number	Depths (ft bgs)	Contaminants of Potential Concern (µg/kg)			
			Acetone	Dibromomethane	Methylene Chloride	Trichlorofluoromethane
Final Action Level[a]			**6,000,000**	**NI**	**21,000**	**2,000,000**
A01	551A002	0.0 - 0.5	69 (J)[b]	5.7 (J)[c]	6.9 (J)[b]	16 (J)[b]
	551A005	0.5 - 1.0	8.8 (J)	--	--	4.2 (J)
	551A008	2.5 - 3.0	--	--	--	2.8 (J)
A02	551A003	0.0 - 0.5	8.8 (J)	--	--	--

[a]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2002)
[b]Qualifier added to laboratory data; record accepted. Surrogate recovery exceeded the upper limits. Internal area response show extremely low count.
[c]Qualifier added to laboratory data; record accepted. Internal area response show extremely low count.

ft bgs = Feet below ground surface
VOC = Volatile organic compound
µg/kg = Micrograms per kilogram
J = Estimated value
NI = Not identified
-- = Not detected above minimum reporting limits.

A.3.2.2 Total Semivolatile Organic Compounds

Total SVOC analytical results for soil samples collected at CAS 12-01-09 did not exceed the MRLs or FALs.

A.3.2.3 Total Petroleum Hydrocarbons-Diesel-Range Organics

The TPH-DRO analytical results for soil samples collected at CAS 12-01-09, which were detected above MRLs, are presented in Table A.3-3.

Table A.3-3
Soil Sample Results for TPH-DRO Detected Above Minimum Reporting Limits at CAS 12-01-09, Aboveground Storage Tank and Stain

Sample Location	Sample Number	Depths (ft bgs)	Contaminants of Potential Concern (mg/kg)
			Diesel-Range Organics[a]
Final Action Levels			**100**
A01	551A002	0.0 - 0.5	**98,000** (J)[b]
	551A005	0.5 - 1.0	**30,000** (J)[b]
	551A006	1.5 - 2.0	**18,000** (J)[b]
	551A008	2.5 - 3.0	**17,000** (J)[b]
A02	551A003	0.0 - 0.5	**1,200** (J)[c]
	551A004	0.0 - 0.5	**930** (J)[c]
	551A007	0.5 - 1.0	**410**
A03	551A009	0.0 - 0.5	**290**
	551A010	2.0 - 3.0	**860**
A04	551A011	0.0 - 0.5	**200**
	551A012	2.5 - 3.0	**12,000** (J)[b]
A07	551A017	0.0 - 0.5	**5,800** (J)[b]
	551A018	1.5 - 2.0	**920**

[a]Based on *Nevada Administrative Code*; Contamination of soil: Establishment of action levels (NAC, 2002)
[b]Qualifier added to laboratory data; record accepted. Surrogate diluted out.
[c]Qualifier added to laboratory data; record accepted. Surrogate recovery exceeded the upper limits.

ft bgs = Feet below ground surface
mg/kg = Milligrams per kilogram
J = Estimated value

Diesel concentrations in surface samples at CAS 12-01-09 exceeded the FAL at locations A01, A02, A03, A04, and A07, ranging from 200 to 98,000 mg/kg, and in subsurface samples at locations A01, A02, A03, A04, and A07, ranging from 410 to 30,000 mg/kg (Figure A.3-2).

As expected, the highest concentrations in TPH-DRO occurred immediately beneath the leaky weld (location A01), with the surface sample having the highest concentration at 98,000 mg/kg. Concentrations at most locations (A01, A02, and A07) decreased with depth but did increase with depth at A03 and A04. The area of contiguous contamination at CAS 12-01-09 by TPH-DRO was bounded to the south (location A05), to the west (location A06), and to the north (locations A12 and A13) by surface and subsurface sample results showing no TPH-DRO detectable concentrations (Figure A.3-2). The contamination was bounded to the east by the cliff overhanging the B-Tunnel portal area and in the vertical direction by the underlying rock at 2 to 3.5 ft bgs.

A.3.2.4 Polychlorinated Biphenyls

The PCBs analytical results for soil samples collected at CAS 12-01-09, which were detected above MRLs, are presented in Table A.3-4. No PCBs were detected in soil samples above the FALs.

Table A.3-4
Soil Sample Results for PCBs Detected Above Minimum Reporting Limits at CAS 12-01-09, Aboveground Storage Tank and Stain

Sample Location	Sample Number	Depths (ft bgs)	Contaminants of Potential Concern (µg/kg)	
			Aroclor 1254	Aroclor 1260
Final Action Levels[a]			740	740
A01	551A002	0.0 - 0.5	--	50 (J)
A02	551A003	0.0 - 0.5	110 (J)	100 (J)
	551A004	0.0 - 0.5	93 (J)	110

[a]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2002)

ft bgs = Feet below ground surface
PCB = Polychlorinated biphenyl
µg/kg = Micrograms per kilogram
J = Estimated value. Qualifier added to laboratory data; record accepted. %D between columns >25.
-- = Not detected above minimum reporting limits.

A.3.2.5 Total RCRA Metals and Beryllium

Total RCRA metals and beryllium analytical results for soil samples collected at CAS 12-01-09, which were detected above MRLs, are presented in Table A.3-5. No RCRA metals or beryllium were detected in soil samples above the FALs.

Table A.3-5
Soil Sample Results for Metals Detected Above Minimum Reporting Limits at CAS 12-01-09, Aboveground Storage Tank and Stain

Sample Location	Sample Number	Depths (ft bgs)	Contaminants of Potential Concern (mg/kg)					
			Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead
Final Action Levels			23[a]	67,000[b]	1,900[b]	450[b]	450[b]	750[b]
A01	551A002	0.0 - 0.5	3.04	52.3	2.46	0.131 (J)	93.4	122
	551A005	0.5 - 1.0	2.87	37.2	3.37	0.141 (J)	4.73	26.3
	551A006	1.5 - 2.0	2.9	60.4	3.22	--	2.75	29
	551A008	2.5 - 3.0	3.11	51.2	2.95	--	3.62	27.6
A02	551A003	0.0 - 0.5	3.31	136	1.49	--	65	117
	551A004	0.0 - 0.5	3.08	124	1.79	0.188 (J)	51.7	100
	551A007	0.5 - 1.0	2.94	61.9	2.68	--	11.9	36.1

[a]Based on the background concentrations for metals. Background is considered the mean plus two times the standard deviation for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (NBMG, 1998; Moore, 1999).
[b]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2002)

ft bgs = Feet below ground surface
mg/kg = Milligrams per kilogram
J = Estimated value
-- Not detected above minimum reporting limits.

A.3.2.6 Gamma-Emitting Radionuclides

Gamma-emitting radionuclide analytical results for soil samples collected at CAS 12-01-09, which were detected above MDCs, are presented in Table A.3-6. No gamma-emitting radionuclides were detected in soil samples above FALs.

A.3.2.7 Isotopic Radionuclides

Isotopic radionuclide analytical results for soil samples collected at CAS 12-01-09, which were detected above MDCs, are presented in Table A.3-7. No isotopic radionuclides were detected in soil samples above FALs.

Table A.3-6
Soil Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentration at CAS 12-01-09, Aboveground Storage Tank and Stain

Sample Location	Sample Number	Depths (ft bgs)	Contaminants of Potential Concern (pCi/g)											
			Actinium-228[a]		Americium-241[b]	Bismuth-214[a]		Cesium-137[b]	Lead-212[a]		Lead-214[a]		Thallium-208[a]	
Final Action Levels			5	15	79.63	5	15	72.07	5	15	5	15	5	15
Depth bgs (cm)			<15	>15		<15	>15		<15	>15	<15	>15	<15	>15
A01	551A002	0.0 - 0.5	2.38 (G)	N/A	1.37 (J)[c]	0.75 (G, J)	N/A	0.57 (G)	2.72 (J)[c]	N/A	0.95 (G, J)	N/A	0.89 (G)	N/A
	551A005	0.5 - 1.0	N/A	2.28 (G)	--	N/A	1.07 (G, J)	--	N/A	2.92 (J)[c]	N/A	1.17 (G, J)	N/A	0.89 (G)
	551A006	1.5 - 2.0	N/A	2.51 (G)	--	N/A	0.94 (G, J)	0.36 (G, LT)	N/A	3.39 (J)[c]	N/A	1.24 (G, J)	N/A	0.95 (G)
	551A008	2.5 - 3.0	N/A	2.74 (G)	--	N/A	1.01 (G, J)	--	N/A	3.06 (J)[c]	N/A	0.85 (G, J)	N/A	0.79 (G)
A02	551A003	0.0 - 0.5	1.75 (G)	N/A	15.7 (J)[c]	0.93 (G, J)	N/A	11.7 (G)	2.33 (J)[c]	N/A	1.09 (G, J)	N/A	0.69 (G)	N/A
	551A004	0.0 - 0.5	1.77 (G)	N/A	14.6 (J)[c]	0.98 (G, J)	N/A	11.6 (G)	2.3 (J)[c]	N/A	1.14 (G, J)	N/A	0.58 (G)	N/A
	551A007	0.5 - 1.0	N/A	2.51 (G)	2.23 (J)[c]	N/A	0.77 (G, J)	0.92 (G)	N/A	2.59 (J)[c]	N/A	0.93 (G, J)	N/A	0.93 (G)
A12	551A023	0.0 - 0.5	1.61 (G)	N/A	2.9 (J)[c]	0.98 (G, J)	N/A	0.63 (G)	1.83 (J)[c]	N/A	0.91 (G, J)	N/A	0.74 (G)	N/A
	551A024	3.0 - 3.5	N/A	3.07 (G)	--	N/A	0.99 (G, J)	--	N/A	2.82 (J)[c]	N/A	1.17 (G, J)	N/A	1.22 (G)
A13	551A025	0.0 - 0.5	1.61 (G)	N/A	--	1.13 (G, J)	N/A	0.76 (G)	1.79 (J)[c]	N/A	1.05 (G, J)	N/A	0.6 (G)	N/A
	551A026	0.0 - 0.5	1.65 (G)	N/A	--	0.91 (G, J)	N/A	0.6 (G)	1.63 (J)[c]	N/A	1.2 (G, J)	N/A	0.5 (G)	N/A
	551A027	2.5 - 3.0	N/A	3.17 (G)	--	N/A	0.92 (G, J)	--	N/A	2.94 (J)[c]	N/A	1.35 (G, J)	N/A	1.03 (G)

[a]Taken from the generic guidelines for residual concentrations of actinium-228, bismuth-214, lead-212, lead-214, thallium-208, and thorium-232, as found in Chapter IV of DOE Order 5400.5, Change 2, "Radiation Protection of the Public and Environment." (DOE, 1993). The PALs for these isotopes is specified as 5 pCi/g averaged over the first 15 cm of soil and 15 pCi/g for deeper soils (DOE, 1993). For purposes of this document, 15 cm is assumed to be equivalent to 0.5 ft (6 inches); therefore, 5 pCi/g represents the PALs for these radionuclides in the surface soil (0 to 0.5 ft depth).
[b]Taken from values calculated from RESRAD for CAU 551, Land Parcel 1.
[c]Qualifier added to laboratory data; record accepted. Sample does not meet counting geometry requirements.

cm = Centimeter
ft bgs = Feet below ground surface
mrem/yr = Millirem per year
N/A = Not applicable
PAL = Preliminary action level
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive computer code
< = Less than
> = Greater than
G = Sample density differs more than 15% of laboratory control sample density.
J = Estimated value
LT = Result is less than the requested minimum detectable concentration, greater than the sample-specific minimum detectable concentration.
-- Not detected above minimum reporting limits.

Table A.3-7
Soil Sample Results for Isotopes Detected Above Minimum Reporting Limits at CAS 12-01-09, Aboveground Storage Tank and Stain

Sample Location	Sample Number	Depths (ft bgs)	Contaminants of Potential Concern (pCi/g)					
			Plutonium-238	Plutonium-239	Strontium-90	Uranium-234	Uranium-235	Uranium-238
Final Action Levels			**3.00**[a]	**311.91**[a]	**838**[b]	**143**[b]	**17.5**[b]	**105**[b]
A01	551A002	0.0 - 0.5	0.091	2.73 (J)[c]	--	0.96	--	0.88
	551A005	0.5 - 1.0	--	3.67 (J)[c]	--	1.05	0.059	1.21
	551A006	1.5 - 2.0	0.21	15.4 (J)[c]	--	1.22	--	1.29
	551A008	2.5 - 3.0	--	1.1 (J)[c]	--	1.05	0.06	1.2
A02	551A003	0.0 - 0.5	0.96	46.3 (J)[c]	0.7	0.9	0.058	0.92
	551A004	0.0 - 0.5	0.76	41.3 (J)[c]	0.72	0.89	0.061	1.01
	551A007	0.5 - 1.0	0.081	5.16 (J)[c]	--	1.04	0.04 (LT)	1.05
A12	551A023	0.0 - 0.5	0.065 (J)[c]	1.54 (J)[d]	--	--	--	--
	551A024	3.0 - 3.5	0.008 (J)[c]	0.36 (J)[d]	1	--	--	--
A13	551A025	0.0 - 0.5	0.058 (J)[c]	1.9 (J)[d]	--	--	--	--
	551A026	0.0 - 0.5	0.255 (J)[c]	15.8 (J)[d]	--	--	--	--
	551A027	2.5 - 3.0	-0.002 (J)[c]	0.013 (J)[d]	--	--	--	--

[a]Taken from values calculated from RESRAD for CAU 551, Land Parcel 1.
[b]Taken from the construction, commercial, industrial land use scenario in Table 2.1 of the NCRP Report No. 129 *Recommended Screening Limits for Contaminated Surface Soil and Review Factors Relevant to Site-Specific Studies* (NCRP, 1999). The values provided in this source document were scaled to a 25-mrem/yr dose.
[c]Qualifier added to laboratory data; record accepted. Surrogate recovery exceeded the upper limits.
[d]Qualifier added to laboratory data; record accepted. Duplicate normalized difference exceeds control limits.

ft bgs = Feet below ground surface
mrem/yr = Millirem per year
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive computer code
J = Estimated value
LT = Result is less than the requested minimum detectable concentration, greater than the sample specific minimum detectable concentration.
-- = Not detected above minimum reporting limits.

A.3.3 Nature and Extent of Contamination

The stain beneath the AST at CAS 12-01-09 was confirmed to contain TPH-DRO. The greatest concentration of TPH-DRO was at the surface, directly beneath a leaky weld.

The area of contiguous contamination at CAS 12-01-09 by TPH-DRO was bounded 11 ft to the south (location A05) of the tank, approximately 2 ft to the west (location A06), and approximately 26 ft to the north (locations A12 and A13) by surface and subsurface sample results showing no detectable concentrations (Figure A.3-2). The contamination was bounded approximately 5 ft to the east, by the cliff overhanging the B-Tunnel portal area, and in the vertical direction by continual refusal from underlying rock at 2 to 3.5 ft bgs. Based upon these measurements and the dimensions of the tank (3.5 ft wide [east to west] and 7 ft long [north to south]), and an average of 2.5 ft to native rock, the maximum volume of contaminated soil is approximately 41 cubic yards (yd^3).

A.3.4 Revised Conceptual Site Model

The results of the CAI applicable to the aboveground storage tank and stain did not contradict the CSM for CAS 12-01-09. No revision of the CSM was necessary.

A.4.0 CASs 12-06-05, 12-06-07, and 12-06-08, Muckpiles, Decision I, Decision II Downslope, Verification Sampling, and Upslope Areas

Corrective Action Sites 12-06-05, 12-06-07, and 12-06-08, Muckpiles, are located in Area 12 of the NTS outside the B-, C-, D-, and F-Tunnel portals. These CASs consist of muck resulting from the activities at the tunnel, including drilling, tunnel development, cutback operations, and re-entry mining. Re-entry mining excavated debris impacted during nuclear tests and likely included radioactively contaminated muck. Discrete objects – such as cabling, wood, drums, and other debris – are likely in the muckpiles. During the initial radiological survey, several areas of elevated radioactivity were identified on CASs 12-06-05 and 12-06-08. Because of safety concerns, CAS 12-06-07 was not surveyed during the initial phase.

The CSM for the muckpiles, as seen in Section A.1.2.3 of the CAU 551 CAIP (NNSA/NSA, 2004), was developed to emphasize the dominating influence of the steep slopes, and the thin soils and exposed rock throughout the surrounding area. The CSM explicates the primary migration pathway of lateral movement, into and through washes draining the area, to affect displacement of any contaminants from the muckpiles, rather than any significant vertical migration. The CSM also illustrates the point that all CASs within CAU 551 are contained in one watershed, with the main wash flowing down to the E-Tunnel area. The CSM also assumes the muckpiles contain contaminants identified during previous muckpile investigations.

The objective for the CAI associated with this CSM was to determine: (1) whether additional contaminants are present, (2) whether the concentrations of the expected contaminants are above the expected concentrations, and (3) the lateral extent of the COCs. The spread of COCs from the muckpiles down into the washes draining the area was deemed highly likely, thus an Initial Decision II Area and Extended Decision II Area were designated during the planning for the CAI. Because of the expectation for movement of COCs into the washes, and the mixing of material from all muckpiles as the washes join, Decision II samples and locations were designated separately from muckpile CAS designations.

During the field investigation, results for several samples collected near CAS 12-01-09 indicated gamma-emitting and isotopic radionuclides were present with elevated activities. Also, one sample collected for the purpose of determining background for the area had an elevated Pu-239 activity. The presence of radionuclides around the AST and stain, and upslope from the muckpiles, was not part of the CSM, and it was surmised that the source was elsewhere. After an additional interview and review of supplemental previously classified literature, it was determined that the CAU 551 area was directly beneath the dust cloud that vented out from the Neptune test in C-Tunnel, and the area near CAS 12-01-09 appears to have been converted from a "parking area" (as noted on a 1959 B-Tunnel vicinity plot plan [Holmes & Narver, 1959a]) to generator station #12-65 and the fuel tank, as depicted on a later 1959 plot plan (Holmes & Narver, 1959b). The Neptune test occurred in October 1958. The gamma-emitting radionuclides likely were incorporated in the soil during construction activities resulting in contamination being found with no discernible trend. These findings led to the investigation of the "upslope area" around the Neptune crater to determine the impact this outside source of radionuclide contamination was having on CAU 551, and especially on CAS 12-06-07 (the C-, D, and F-Tunnel muckpile).

The downslope and upslope information is presented separately from the muckpile Decision I results.

A.4.1 Corrective Action Investigation

At CAS 12-06-05, a total of 30 samples (including 2 FDs) were collected from 14 locations during investigation activities. At CAS 12-06-07, a total of 32 samples (including 2 FDs) were collected from 16 locations. At CAS 12-06-08, a total of 15 samples (including 1 FD) were collected from 7 locations. The sample IDs, locations, types, and analyses are listed in Tables A.4-1 through A.4-3. The sample locations for these CASs, as well as other locations within the vicinity, are shown on Figure A.4-1; some locations shown for CASs 12-06-05 and 12-06-07 are approximated. The specific CAI activities conducted to satisfy the CAIP requirements at this CAS are described in the following sections.

Table A.4-1
Samples Collected at CASs 12-06-05, U-12b Muckpile, Decision I
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Sample Matrix	Sample Type	Analyses
B01	551B001	0.0 - 0.5	Soil	Environmental, QC	Set 1
	551B002	0.5 - 1.0	Soil	Environmental	Set 1
	551B003	0.5 - 1.0	Soil	Field Duplicate of #551B002	Set 1
	551B004	2.5 - 3.0	Soil	Environmental	Set 1
B02	551B005	0.0 - 0.5	Soil	Environmental	Set 1
	551B006	1.0 - 1.5	Soil	Environmental	Set 1
B03	551B007	0.0 - 0.5	Soil	Environmental	Set 1
	551B008	1.0 - 1.5[a]	Soil	Environmental	Set 1
B04	551B009	0.0 - 0.5	Soil	Environmental	Set 1
	551B010	3.5 - 4.0	Soil	Environmental	Set 1
B05	551B011	0.0 - 0.5	Soil	Environmental	Set 1
	551B012	1.5 - 2.0[a]	Soil	Environmental	Set 1
B06	551B013	0.0 - 0.5	Soil	Environmental	Set 1
	551B014	2.5 - 3.0[a]	Soil	Environmental	Set 1
B07	551B015	0.0 - 0.5	Soil	Environmental	Set 1
	551B016	1.0 - 1.5	Soil	Environmental	Set 1
B08	551B017	0.0 - 0.5	Soil	Environmental	Set 1
	551B018	2.0 - 3.0	Soil	Environmental	Set 1
B09	551B019	0.0 - 0.5	Soil	Environmental	Set 1
	551B020	1.0 - 1.5	Soil	Environmental	Set 1
B10	551B021	0.0 - 0.5	Soil	Environmental, QC	Set 1
	551B022	2.0 - 3.0	Soil	Environmental	Set 1
B11	551B023	0.0 - 0.5	Soil	Environmental	Set 1
	551B024	1.0 - 1.5[a]	Soil	Environmental	Set 1
B12	551B025	0.0 - 0.5	Soil	Environmental	Set 1
	551B026	0.0 - 0.5	Soil	Field Duplicate of #551B025	Set 1
	551B027	1.0 - 2.0	Soil	Environmental	Set 1
B13	551B028	0.0 - 0.5	Soil	Environmental	Set 1
	551B029	1.5 - 2.0	Soil	Environmental	Set 1
B14	551B030	0.0 - 0.5[a]	Soil	Environmental	Set 3
N/A	551B302	N/A	Water	Field Blank	Set 1

Table A.4-1
Samples Collected at CASs 12-06-05, U-12b Muckpile, Decision I
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Sample Matrix	Sample Type	Analyses
N/A	551B303	N/A	Water	Trip Blank	Total VOCs
N/A	551B304	N/A	Water	Trip Blank	Total VOCs
N/A	551B305	N/A	Water	Trip Blank	Total VOCs
N/A	551B306	N/A	Water	Trip Blank	Total VOCs
N/A	551B307	N/A	Water	Trip Blank	Total VOCs
N/A	551B308	N/A	Water	Field Blank	Set 1
N/A	551B501	N/A	Liquid	WM	Gross Alpha/Beta, Tritium

[a]Depth at or near refusal

Set 1 = Total VOCs, Total SVOCs, TPH-DRO, PCBs, Total RCRA Metals, Beryllium, Gamma Spectroscopy, Isotopic Uranium, Isotopic Plutonium, and Strontium 90
Set 3 = Gamma Spectroscopy, Isotopic Uranium, Isotopic Plutonium, and Strontium-90

DRO = Diesel-range organics
ft bgs = Feet below ground surface
N/A = Not applicable
PCB = Polychlorinated biphenyl
QC = Quality control
RCRA = *Resource Conservation and Recovery Act*
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound
WM = Waste management

Table A.4-2
Samples Collected at CAS 12-06-07, Muckpile, Decision I
(Page 1 of 3)

Sample Location	Sample Number	Depth (ft bgs)	Sample Matrix	Sample Type	Analyses
C01	551C001	0.0 - 0.5	Soil	Environmental, QC	Set 1
	551C002	3.5 - 4.0	Soil	Environmental	Set 1
	551C003	3.5 - 4.0	Soil	Field Duplicate of #551C002	Set 1
C02	551C004	0.0 - 0.5	Soil	Environmental	Set 1
	551C005	1.0 - 1.5	Soil	Environmental	Set 1
C03	551C006	0.0 - 0.5[a]	Soil	Environmental	Set 1
C04	551C007	0.0 - 0.5	Soil	Environmental	Set 1
	551C008	1.0 - 1.5	Soil	Environmental	Set 1
C05	551C009	0.0 - 0.5	Soil	Environmental	Set 1
	551C010	2.5 - 3.0	Soil	Environmental	Set 1

Table A.4-2
Samples Collected at CAS 12-06-07, Muckpile, Decision I
(Page 2 of 3)

Sample Location	Sample Number	Depth (ft bgs)	Sample Matrix	Sample Type	Analyses
C06	551C011	0.0 - 0.5	Soil	Environmental	Set 1
	551C012	0.5 - 1.0	Soil	Environmental	Set 1
C07	551C013	0.0 - 0.5	Soil	Environmental	Set 1
	551C014	1.5 - 2.0	Soil	Environmental	Set 1
C08	551C015	0.0 - 0.5	Soil	Environmental	Set 1
	551C016	1.0 - 1.5	Soil	Environmental	Set 1
C09	551C017	0.0 - 0.5	Soil	Environmental	Set 1
C10	551C018	0.0 - 0.5	Soil	Environmental	Set 1
	551C019	1.0 - 1.5	Soil	Environmental	Set 1
C11	551C020	0.0 - 0.5	Soil	Environmental	Set 1
	551C021	2.5 - 3.0	Soil	Environmental	Set 1
C12	551C022	0.0 - 0.5	Soil	Environmental	Set 1
	551C023	1.0 - 1.5	Soil	Environmental	Set 1
C13	551C024	0.0 - 0.5	Soil	Environmental	Set 1
	551C025	2.0 - 3.0	Soil	Environmental	Set 1
C14	551C026	0.0 - 0.5	Soil	Environmental	Set 1
	551C027	0.0 - 0.5	Soil	Field Duplicate of #551C026	Set 1
	551C028	1.0 - 1.5	Soil	Environmental	Set 1
C15	551C029	0.0 - 0.5	Soil	Environmental	Set 1
	551C030	1.0 - 1.5	Soil	Environmental	Set 1
C16	551C031	0.0 - 0.5	Soil	Environmental	Set 1
	551C032	2.0 - 2.5	Soil	Environmental	Set 1
N/A	551C301	N/A	Water	Trip Blank	Total VOCs
N/A	551C302	N/A	Water	Trip Blank	Total VOCs
N/A	551C303	N/A	Water	Trip Blank	Total VOCs
N/A	551C304	N/A	Water	Field Blank	Set 1
N/A	551C305	N/A	Water	Field Blank	Set 1

Table A.4-2
Samples Collected at CAS 12-06-07, Muckpile, Decision I
(Page 3 of 3)

Sample Location	Sample Number	Depth (ft bgs)	Sample Matrix	Sample Type	Analyses
N/A	551C501	N/A	Liquid	WM	Gross Alpha/Beta, Tritium

[a]Depth at or near refusal

Set 1 = Total VOCs, Total SVOCs, TPH-DRO, PCBs, Total RCRA Metals plus Beryllium, Gamma Spectroscopy, Isotopic Uranium, Isotopic Plutonium, and Strontium-90

DRO = Diesel-range organics
ft bgs = Feet below ground surface
N/A = Not applicable
PCB = Polychlorinated biphenyl
QC = Quality Control
RCRA = *Resource Conservation and Recovery Act*
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound
WM = Waste management

Table A.4-3
Samples Collected at CAS 12-06-08, Muckpile, Decision I
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Sample Matrix	Sample Type	Analyses
D01	551D001	0.0 - 0.5	Soil	Environmental, QC	Set 1
	551D002	0.5 - 1.0	Soil	Environmental	Set 1
	551D003	0.5 - 1.0	Soil	Field Duplicate of #551D002	Set 1
D02	551D004	0.0 - 0.5	Soil	Environmental	Set 1
	551D005	0.5 - 1.0	Soil	Environmental	Set 1
	551D006	1.5 - 2.0	Soil	Environmental	Set 1
D03	551D007	0.0 - 0.5	Soil	Environmental	Set 1
	551D008	0.5 - 1.0	Soil	Environmental	Set 1
D04	551D009	0.0 - 0.5	Soil	Environmental	Set 1
	551D010	2.0 - 3.0[a]	Soil	Environmental	Set 1
D05	551D011	0.0 - 0.5	Soil	Environmental	Set 1
	551D012	1.5 - 2.0[a]	Soil	Environmental	Set 1
D06	551D013	0.0 - 0.5	Soil	Environmental	Set 1
	551D014	1.0 - 1.5[a]	Soil	Environmental	Set 1
D07	551D015	0.0 - 0.5[a]	Soil	Environmental	Set 1
N/A	551D301	N/A	Water	Trip Blank	Total VOCs

Table A.4-3
Samples Collected at CAS 12-06-08, Muckpile, Decision I
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Sample Matrix	Sample Type	Analyses
N/A	551D302	N/A	Water	Trip Blank	Total VOCs
N/A	551D303	N/A	Water	Trip Blank	Total VOCs
N/A	551D501	N/A	Liquid	WM	Gross Alpha/Beta, Tritium

[a]Depth at or near refusal

Set 1 = Total VOCs, Total SVOCs, TPH-DRO, PCBs, Total RCRA Metals, Beryllium, Gamma Spectroscopy, Isotopic Uranium, Isotopic Plutonium, and Strontium-90

DRO = Diesel-range organics
ft bgs = Feet below ground surface
GRO = Gasoline-range organics
N/A = Not applicable
PCB = Polychlorinated biphenyl
QC = Quality Control
RCRA = *Resource Conservation and Recovery Act*
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound
WM = Waste management

A.4.1.1 Field Screening

Decision I soil samples (551B001 through 551B029, 551C001 through 551C030, and 551D001 through 551D015) were field screened for VOCs and alpha and beta/gamma radiation. Screening results for sample 551B030 exceeded the FSRs for alpha and beta/gamma radiation, but the values were not recorded on the SCL. The FSRs were compared to FSLs to guide subsequent sampling decisions. The VOC headspace FSLs were not exceeded during sampling activities. Alpha and/or beta radiation FSLs were exceeded on the following samples during sampling activities:

- CAS 12-06-05: Alpha radiation on 551B005, B009, B011, B012, B014, B022, and B030; beta radiation on 551B001-B003, B005-B009, B011-B014, B019, B022, B023, B028, and B030
- CAS 12-06-07: Alpha radiation on 551C004, C007-C011, C013, C017, C018, C022-C024, C026 and C027; beta radiation on 551C004, C006-C013, C017-C020, and C022-C031
- CAS 12-06-08: Alpha radiation on 551D009-D012, D014, and D015; beta radiation on 551D001-D003, D005, D009, D013, and D015

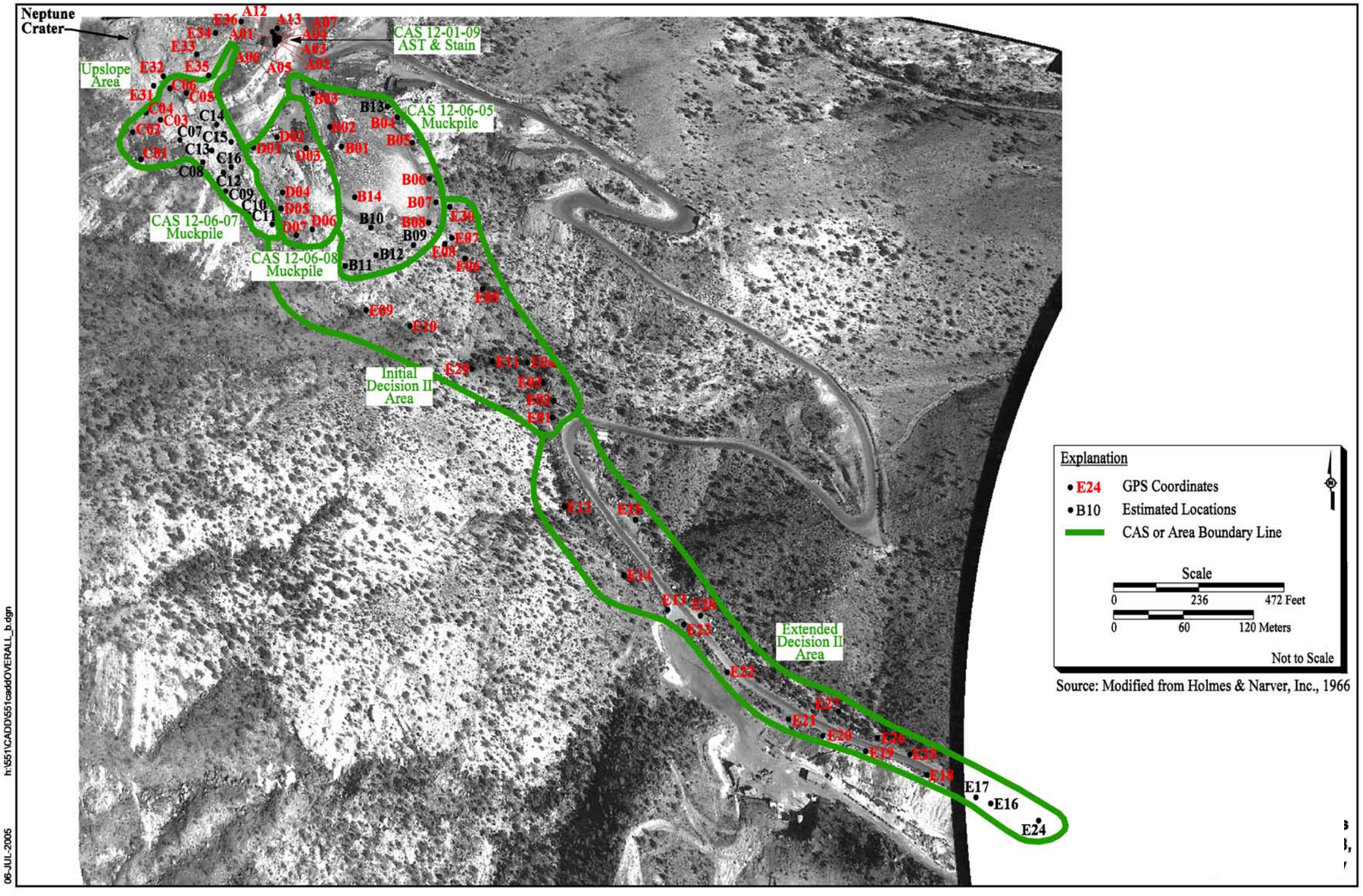


Figure A.4-1
Sample Location Map for CASs 12-06-05, 12-06-07, and 12-06-08, Area 12 Muckpiles and Vicinity

A.4.1.2 Sampling

Decision I sample locations were selected based upon one or more of the following: (1) elevated radiation, (2) drums, containers, or debris, (3) area of erosion, (4) area of sediment deposition, (5) lithology, and/or (6) possible pipe effluent deposits (guidelines defined in Section A.2.2). Fourteen locations were selected on CAS 12-06-05 (B01 through B14); 16 locations were selected on CAS 12-06-07 (C01 through C16); and 7 locations were selected on CAS 12-06-08 (D01 through D07) for Decision I sampling.

Sampling activities for Decision I included the collection of a surface soil sample at the designated locations. Subsurface samples were taken at all locations except B14, C03, C09, and D07, where either refusal to the sampling equipment for collection of deeper samples was encountered, or slope steepness made hand augering difficult. At several locations, a sampling depth of 3 or 4 ft was achieved.

Following sample collection, all samples and corresponding paperwork were reviewed to assure correctness and completeness. Samples were then submitted for laboratory analysis.

A.4.1.3 Deviations

There were no deviations to the CAIP requirements at these CASs. The Decision I investigation and sampling at CASs 12-06-05, 12-06-07, and 12-06-08 met the DQOs. The lateral and vertical extent of contamination in the muckpiles was defined as specified in the CAIP.

For the muckpile CSM parameters, for both COC status and concentrations, as described in Section A.1.3.1.2 in the CAU 551 CAIP (NNSA/NSO, 2004), the rules regarding assignment of highest concentrations from either the historical data or the new data to each muckpile require changes in those parameters. This does not affect the overall CSM for pathways by which the COCs may leave the muckpile CASs, and therefore is not considered a deviation to the CAIP requirements.

A.4.2 Investigation Results

The following sections provide analytical results from the samples collected to complete investigation activities as outlined in the CAIP. Decision I investigation samples were analyzed for

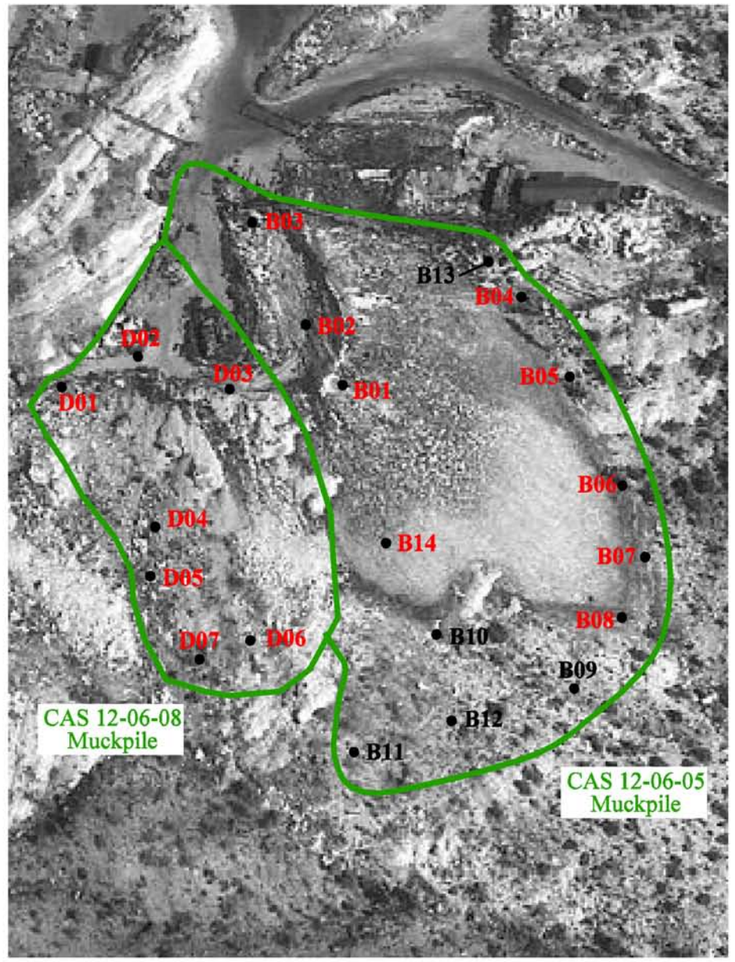
the CAIP-specified COPCs which included VOCs, total SVOCs, TPH-DRO, total RCRA metals and beryllium, PCBs, gamma-emitting radionuclides, isotopic uranium, isotopic plutonium, and Sr-90. The analytical parameters and laboratory methods used to analyze the investigation samples are listed in Table A.2-2. Tables A.4-1 through A.4-3 list the sample-specific analytical suites for CASs 12-06-05, 12-06-07, and 12-06-08, respectively.

Analytical results from the soil samples with concentrations exceeding MRLs or MDCs are summarized in the following sections. These results are compared to the FALs and are a subset of the results that exceed MRLs or MDCs. Results greater than the FALs are identified by bold text in the analytical tables. A portion of the analytical results for CASs 12-06-05, 12-06-07, and 12-06-08 were rejected for sensitivity during validation; however, these rejected data did not adversely impact closure decisions as discussed in Section B.1.4. Ranges for concentration results above the FALs are presented in Figure A.4-2 for CASs 12-06-05 and 12-06-08, and Figure A.4-3 for CAS 12-06-07.

The Land Parcel 1 FALs (Table 2-3) apply to the data from CASs 12-06-05, 12-06-07, and 12-06-08.

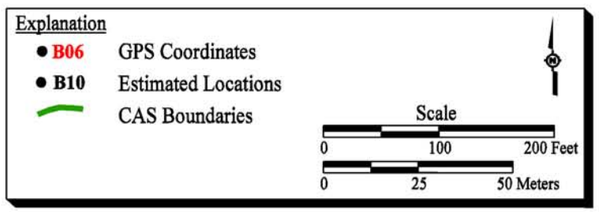
A.4.2.1 Total Volatile Organic Compounds

Total VOC analytical results for soil samples collected at CAS 12-06-05 did not exceed the MRLs. Total VOC analytical results for soil samples collected at CAS 12-06-07 that were detected above MRLs are presented in Table A.4-4. Total VOC analytical results for soil samples collected at CAS 12-06-08 that were detected above the MRLs are presented in Table A.4-5. No VOCs were detected in soil samples above the FALs.



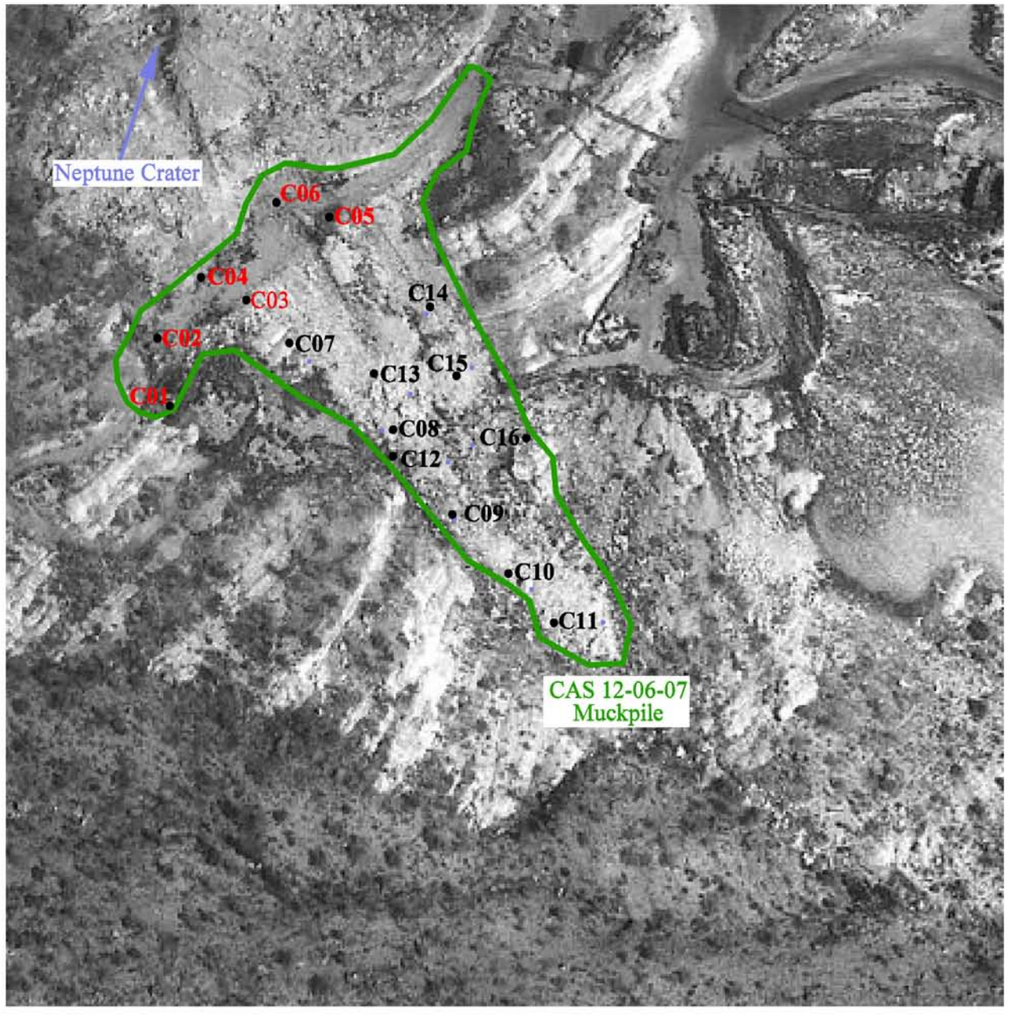
Location	Depth (ft)	Am-241 (pCi/g)	Cs-137 (pCi/g)	Eu-152 (pCi/g)	Pu-238 (pCi/g)	Pu-239 (pCi/g)	Diesel (mg/kg)	Benzo(a)pyrene (ug/kg)	Dibenzo(a,h)anthracene (ug/kg)
Value for FAL		*79.63*	*72.07*	*1.42*	*3.00*	*311.91*	*100*	*210*	*210*
B01	0.0 - 0.5	------	------	------	------	------	ND	ND	ND
	0.5 - 1.0	------; ------	------; ------	------; ------	------; ------	------; ------	------; ------	1,600; 1,200	330; 230
	2.5 - 3.0	ND	------	ND	------	------	------	ND	ND
B02	0.0 - 0.5	107	156	26.6	26.8	1,430	170	ND	ND
	1.0 - 1.5	ND	------	ND	------	------	ND	ND	ND
B03	0.0 - 0.5	99	318	ND	4.07	------	250	ND	ND
	1.0 - 1.5	------	103	ND	------	------	ND	ND	ND
B04	0.0 - 0.5	136	------	5.49	6.5	344	ND	ND	ND
	3.5 - 4.0	------	------	ND	------	------	100	ND	ND
B05	0.0 - 0.5	244	------	ND	13.5	740	170	ND	ND
	1.5 - 2.0	186	------	ND	7.3	367	------	ND	ND
B06	0.0 - 0.5	192	------	ND	10.2	555	ND	ND	ND
	2.0 - 2.5	144	------	ND	7.3	442	ND	ND	ND
B07	0.0 - 0.5	------	------	ND	------	------	------	ND	ND
	1.0 - 1.5	101	------	ND	7	335	ND	ND	ND
B08	0.0 - 0.5	------	------	ND	------	------	ND	ND	ND
	2.0 - 3.0	------	------	ND	------	------	------	310	ND
B09	0.0 - 0.5	------	------	ND	5.1	------	140	ND	ND
	1.0 - 1.5	------	------	ND	------	------	130	ND	ND
B10	0.0 - 0.5	------	------	ND	3.34	------	ND	ND	ND
	2.0 - 3.0	178	------	ND	8.6	452	ND	ND	ND
B11	0.0 - 0.5	------	------	ND	3.29	------	190	ND	ND
	1.0 - 1.5	------	------	ND	------	------	180	ND	ND
B12	0.0 - 0.5	-----; ------	-----; ------	ND; ND	-----; ------	------; ------	----; 120	ND; ND	ND; ND
	1.0 - 2.0	ND	------	ND	------	-----	140	ND	ND
B13	0.0 - 0.5	156	------	------	6.6	321	ND	ND	ND
	1.5 - 2.0	------	------	ND	------	------	ND	ND	ND
B14	0.0 - 0.5	478	164	ND	28.6	1,440	ND	ND	ND
D01	0.0 - 0.5	------	------	ND	------	------	190	ND	ND
	0.5 - 1.0	-----; ------	-----; ------	ND; ND	4.32; 4.24	------; ------	-----; ------	ND; ND	ND; ND
D02	0.0 - 0.5	------	------	ND	------	------	ND	ND	ND
	0.5 - 1.0	------	------	ND	------	------	ND	ND	ND
	1.5 - 2.0	------	------	ND	------	------	ND	ND	ND
D03	0.0 - 0.5	------	------	ND	------	------	ND	ND	ND
	0.5 - 1.0	ND	------	ND	------	------	ND	ND	ND
D04	0.0 - 0.5	370	108	ND	17.4	1,210	5,200	ND	ND
	2.0 - 3.0	93	------	ND	5.8	484	4,300	ND	ND
D05	0.0 - 0.5	------	------	ND	11.6	740	ND	ND	ND
	1.5 - 2.0	191	------	ND	8.8	670	------	ND	ND
D06	0.0 - 0.5	91	------	ND	5.7	360	100	ND	ND
	1.0 - 1.5	------	------	ND	8.5	518	ND	ND	ND
D07	0.0 - 0.5	150	------	ND	9.8	557	------	ND	ND

Notes:
- Cells with two entries separated by a semicolon represent results of field duplicates
- FAL values for radionuclides are based on RESRAD calculations for CAU 551, Land Parcel 1.
- ND = Not detected
- ------ = Concentration was detected, but below FAL



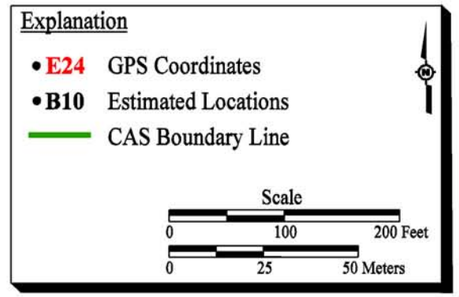
Source: Modified from Holmes & Narver, Inc. 1966

Figure A.4-2
Sample Location Map and Results Above FALs for CASs 12-06-05 and 12-06-08, Area 12 Muckpiles



Location	Depth (ft)	Am-241 (pCi/g)	Cs-137 (pCi/g)	Eu-152 (pCi/g)	Pu-238 (pCi/g)	Pu-239 (pCi/g)	Diesel (mg/kg)
Value for FAL		*79.63*	*72.07*	*1.42*	*3.00*	*311.91*	*100*
C01	0.0 - 0.5	------	ND	ND	------	------	ND
	3.5 - 4.0	ND; ND	ND; ND	ND; ND	ND; ND	ND; ND	ND; ND
C02	0.0 - 0.5	172	------	ND	10.1	760	ND
	1.0 - 1.5	ND	ND	ND	------	------	------
C03	0.0 - 0.5	375	------	1.53	54.5	4,220	ND
C04	0.0 - 0.5	1,020	------	5.03	127	13,200	ND
	1.0 - 1.5	300	------	2.3	11.3	770	ND
C05	0.0 - 0.5	1,210	------	60	53.8	3,880	ND
	2.5 - 3.0	464	------	27.4	20.4	1,560	ND
C06	0.0 - 0.5	204	------	------	12.7	810	ND
	0.5 - 1.0	400	------	2.2	8.4	610	ND
C07	0.0 - 0.5	521	------	1.8	27.1	1,980	ND
	1.5 - 2.0	253	------	------	13	770	ND
C08	0.0 - 0.5	251	------	ND	------	------	ND
	1.0 - 1.5	ND	ND	ND	ND	------	ND
C09	0.0 - 0.5	1,260	------	3.32	42.8	3,030	ND
C10	0.0 - 0.5	3,370	101	9.7	96	7,000	------
	1.0 - 1.5	518	------	1.95	34.2	2,530	------
C11	0.0 - 0.5	606	------	1.73	18.6	1,210	------
	2.5 - 3.0	318	------	ND	16.3	1,230	ND
C12	0.0 - 0.5	500	------	1.78	26.6	1,850	------
	1.0 - 1.5	701	------	1.93	25.6	1,820	ND
C13	0.0 - 0.5	519	------	29.3	30.1	2,280	ND
	2.0 - 3.0	515	------	11.7	18.9	1,390	ND
C14	0.0 - 0.5	489; 415	------; -----	14.8; 14.8	21.7; 26.6	1,570; 1,840	1,300; 2,600
	1.0 - 1.5	202	------	6.9	13.8	1,050	790
C15	0.0 - 0.5	159	------	ND	10	730	ND
	1.0 - 1.5	264	------	1.97	16.1	1,200	ND
C16	0.0 - 0.5	------	------	------	------	------	ND
	2.0 - 2.5	ND	------	ND	------	------	ND

Notes:
- Cells with two entries separated by a semicolon represent results of field duplicates
- FAL values for radionuclides are based on RESRAD Calculations for CAU 551, Land Parcel 1.
- ND = Not detected
- ------ = Concentration was detected, but below FAL



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9/19/2006

Source: Modified from Holmes & Narver, Inc., 1966

Figure A.4-3
Sample Location Map and Results Above FALs for CAS 12-06-07, Area 12 Muckpiles

Table A.4-4
Soil Sample Results for Total VOCs Detected Above Minimum Reporting Limits at CAS 12-06-07
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (µg/kg)		
			Acetone	Methylene Chloride	Vinyl Acetate
Final Action Levels			**6,300,000**	**21,000**	**1,400,000**
C01	551C001	0.0 - 0.5	13 (J)	--	--
	551C002	3.5 - 4.0	--	2.4 (J)	--
C02	551C004RE	0.0 - 0.5	15 (J)	--	--
	551C005RE	1.0 - 1.5	27	--	--
C03	551C006RE	0.0 - 0.5	12 (J)	--	--
C04	551C007RE	0.0 - 0.5	22 (J)[b]	--	--
C05	551C009	0.0 - 0.5	13 (J)	--	--
	551C010	2.5 - 3.0	10 (J)	3 (J)	--
C06	551C011	0.0 - 0.5	9.1 (J)	2.8 (J)	--
	551C012	0.5 - 1.0	9.6 (J)	2.9 (J)	--
C07	551C014	1.5 - 2.0	11 (J)	--	--
C08	551C015	0.0 - 0.5	--	3.6 (J)	--
	551C016	1.0 - 1.5	--	3.7 (J)	--
C09	551C017	0.0 - 0.5	12 (J)	3.6 (J)	27 (J)[c]
C12	551C023	1.0 - 1.5	13 (J)[d]	--	--
C14	551C026	0.0 - 0.5	14 (J)[d]	--	--
	551C027	0.0 - 0.5	15 (J)[d]	--	--
	551C028	1.0 - 1.5	14 (J)	--	--
C15	551C029	0.0 - 0.5	11 (J)	--	--
	551C030	1.0 - 1.5	13 (J)	--	--

Table A.4-4
Soil Sample Results for Total VOCs Detected Above Minimum Reporting Limits at CAS 12-06-07
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (µg/kg)		
			Acetone	Methylene Chloride	Vinyl Acetate
Final Action Levels			**6,300,000**	**21,000**	**1,400,000**
C15	551C031	0.0 - 0.5	15 (J)	--	--
C16	551C032	2.0 - 2.5	19 (J)	--	--

[a]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2002)
[b]Qualifier added to laboratory data; record accepted. Surrogate recovery exceeded the upper limits.
[c]Qualifier added to laboratory data; record accepted. Calibration verification did not meet criteria or was not performed.
[d]Qualifier added to laboratory data; record accepted. An associated trip blank was not analyzed.

ft bgs = Feet below ground surface
VOC = Volatile organic compound
µg/kg = Micrograms per kilogram
J = Estimated value
-- = Not detected above minimum reporting limits.

Table A.4-5
Soil Sample Results for Total VOCs Detected Above Minimum Reporting Limits at CAS 12-06-08, Muckpile
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (µg/kg)	
			Acetone	Methylene Chloride
Final Action Levels[a]			**6,300,000**	**21,000**
D04	551D009	0.0 - 0.5	--	3.9 (J)[b]
	551D010	2.0 - 3.0	13 (J)[c]	3.1 (J)[d]
D05	551D011	0.0 - 0.5	--	3.4 (J)[c]
	551D012	1.5 - 2.0	--	2.9 (J)
D06	551D013RE	0.0 - 0.5	20 (J)	--

Table A.4-5
Soil Sample Results for Total VOCs Detected Above Minimum Reporting Limits at CAS 12-06-08, Muckpile
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (µg/kg)	
			Acetone	Methylene Chloride
Final Action Levels[a]			**6,300,000**	**21,000**
D07	551D015RE	0.0 - 0.5	21 (J)[c]	--

[a]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals* (*PRGs*) (EPA, 2002).
[b]Qualifier added to laboratory data; record accepted. Matrix effects may exist. Surrogate recovery exceeded the upper limits.
[c]Qualifier added to laboratory data; record accepted. An associated trip blank was not analyzed.
[d]Qualifier added to laboratory data; record accepted. An associated trip blank was not analyzed. Surrogate recovery exceeded the upper limits.

ft bgs = Feet below ground surface
µg/kg = Micrograms per kilogram
J = Estimated value
-- = Not detected above minimum reporting limits.

A.4.2.2 Total Semivolatile Organic Compounds

Total SVOC analytical results for soil samples collected at CASs 12-06-07 and 12-06-08 did not exceed the MRLs. Total SVOC analytical results for soil samples collected at CAS 12-06-05 that were detected above MRLs are presented in Table A.4-6.

Concentrations in subsurface samples at CAS 12-06-05 exceeded the FAL for benzo(a)pyrene at locations B01 and B08, ranging from 310 (B08) to 1,600 micrograms per kilogram (µg/kg) (B01). Dibenzo(a,h)anthracene concentrations in a subsurface sample at CAS 12-06-05 exceeded FAL at location B01 (Figure A.4-2).

The SVOC COCs identified at location B01, at a depth of 0.5 to 1.0 ft, were bounded laterally by nearby sample locations and vertically by samples taken at 2.5 to 3.0 ft bgs. Benzo(a)pyrene concentrations that exceed the FAL at location B08 between 2.0 and 3.0 ft bgs were bounded by samples collected at locations along the edge of the muckpile and to the east with samples collected at location E30 at a depth of 2.0 to 2.5 ft bgs. Neither SVOC was found above FALs in samples collected in the Initial Decision II Area (Section A.4.4.2).

Table A.4-6
Soil Sample Results for Total SVOCs Detected Above Minimum Reporting Limits at CAS 12-06-05, U-12b Muckpile

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (μg/kg)											
			Anthracene	Benzo(a)Anthracene	Benzo(a)Pyrene	Benzo(b)Fluoranthene	Benzo(k)Fluoranthene	Benzo(g,h,i)Perylene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Indeno(1,2,3-cd)Pyrene	Phenanthrene	Pyrene
Final Action Levels[a]			**100,000,000**	**2,100**	**210**	**2,100**	**21,000**	**NI**	**210,000**	**210**	**22,000,000**	**2,100**	**NI**	**29,000,000**
B01	551B002	0.5 - 1.0	480	1,900	1,600	1,600	700	1,300 (J)[b]	1,900	330	2,500	1,200	1,600	3,300
	551B003	0.5 - 1.0	--	1,300	1,200	1,200	430	900 (J)[b]	1,400	230	2,200	930	930	2,300
B08	551B018	2.0 - 3.0	--	--	310	540	--	--	390	--	580	--	--	600

[a]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals* (*PRGs*) (EPA, 2002)
[b]Qualifier added to laboratory data; record accepted. Calibration verification did not meet criteria or was not performed.

ft bgs = Feet below ground surface
μg/kg = Micrograms per kilogram
J = Estimated value. Qualifier added to laboratory data; record accepted. Calibration verification did not meet criteria or was not performed.
NI = Not identified
SVOC = Semivolatile organic compound
-- = Not detected above minimum reporting limits.

Corrective Action Sites 12-06-05 and 12-06-08 (combined) are considered to contain benzo(a)pyrene at a concentration of 1,600 µg/kg, and dibenzo(a,h)anthracene at a concentration of 330 µg/kg. The likely source for these SVOCs is not known but may result from runoff from the parking areas and roads.

A.4.2.3 Total Petroleum Hydrocarbons-Diesel-Range Organics

The TPH-DRO results for soil samples collected at CASs 12-06-05, 12-06-07, and 12-06-08 exceeding MRLs are presented in Tables A.4-7 through A.4-9, respectively.

Table A.4-7
Soil Sample Results for TPH-DRO Detected Above Minimum Reporting Limits at CAS 12-06-05, U-12b Muckpile

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)
			Diesel-Range Organics
Final Action Levels[a]			**100**
B01	551B002	0.5 - 1.0	28
	551B003	0.5 - 1.0	74
B02	551B005	0.0 - 0.5	**170**
B03	551B007	0.0 - 0.5	**250**
B04	551B010	3.5 - 4.0	**100**
B05	551B011	0.0 - 0.5	**170**
	551B012	1.5 - 2.0	99
B08	551B018	2.0 - 3.0	82
B09	551B019	0.0 - 0.5	**140**
	551B020	1.0 - 1.5	**130**
B11	551B023	0.0 - 0.5	**190**
	551B024	1.0 - 1.5	**180**
B12	551B025	0.0 - 0.5	98
	551B026	0.0 - 0.5	**120**
	551B027	1.0 - 2.0	**140**

[a]Based on *Nevada Administrative Code*; Contamination of soil: Establishment of action levels (NAC, 2002)

ft bgs = Feet below ground surface
mg/kg = Milligrams per kilogram

Table A.4-8
Soil Sample Results for TPH-DRO Detected Above Minimum Reporting Limits at CAS 12-06-07, Muckpile

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)
			Diesel-Range Organics
Preliminary Action Levels[a]			100
C02	551C005	1.0 - 1.5	42
C10	551C018	0.0 - 0.5	61
	551C019	1.0 - 1.5	88
C11	551C020	0.0 - 0.5	48
C12	551C022	0.0 - 0.5	45
C14	551C026	0.0 - 0.5	**1,300**
	551C027	0.0 - 0.5	**2,600** (J)
	551C028	1.0 - 1.5	**790**

[a]Based on *Nevada Administrative Code*; Contamination of soil: Establishment of action levels (NAC, 2002)

ft bgs = Feet below ground surface
mg/kg = Milligrams per kilogram
J = Estimated value. Qualifier added to laboratory data; record accepted. Surrogate recovery exceeded the upper limits.

Table A.4-9
Soil Sample Results for TPH-DRO Detected Above Minimum Reporting Limits at CAS 12-06-08, Muckpile

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)
			Diesel-Range Organics
Preliminary Action Levels			100
D01	551D001	0.0 - 0.5	**190**
D04	551D009	0.0 - 0.5	**5,200** (J)
	551D010	2.0 - 3.0	**4,300** (J)
D05	551D012	1.5 - 2.0	56
D06	551D013	0.0 - 0.5	**100**
D07	551D015	0.0 - 0.5	98

[a]Based on *Nevada Administrative Code*; Contamination of soil: Establishment of action levels (NAC, 2002)

ft bgs = Feet below ground surface
mg/kg = Milligrams per kilogram
J = Estimated value. Qualifier added to laboratory data; record accepted. Surrogate recovery exceeded the upper limits.

Concentrations of TPH-DRO in surface samples at CAS 12-06-05 exceeded the FAL at locations B02, B03, B05, B09, B11, and B12; ranging from 140 to 250 mg/kg, and in subsurface samples at locations B04, B09, B11 and B12, ranging from 100 to 180 mg/kg. In general, concentrations decreased with depth, though locations B04, B08 (below the FAL), and B12 did have increased concentrations with depth. Concentrations in surface samples at CAS 12-06-07 exceeded the FAL at location C14, with duplicate samples results of 1,300 and 2,600 mg/kg; and in the subsurface sample at location C14, with a result of 790 mg/kg, for a decrease with depth. Concentrations in surface samples at CAS 12-06-08 exceeded the FAL at locations D01, D04, and D06, ranging from 100 to 5,200 mg/kg, and in the subsurface sample at location D04 with a result of 4,300 mg/kg.

The TPH-DRO found at locations B02, B03 and D01 (Figure A.4-2) on the level portions of CASs 12-06-05 and 12-06-08 is not unexpected given the historical practice of draining oil from locomotives onto the muckpiles (see CAU 551 CAIP, Section A.2.4.3) and the use of oil for dust suppression. The TPH-DRO found along the eastern edge of CAS 12-06-05 at locations B04 and B05 may have originated either from erosion of the upper part of the muckpile or from erosion of the access road, which was oiled during the active life of the tunnels (Holmes & Narver, 1959a; 1959b). The TPH-DRO found at the toe of CASs 12-06-05 and 12-06-08 in an east-to-west sequence of locations B09, B12, B11, and D06 may represent movement of contaminated material from higher up on the muckpiles; the same is true for the TPH-DRO found at the more mid-level muckpile locations of C14 (Figure A.4-3) and D04 (identified as a possible stain due to the darkish coloration of the muck). Movement of TPH-DRO-contaminated muck down and off of the muckpiles is highly likely, given TPH-DRO concentrations exceeding the FALs in the washes through the Initial Decision II Area (Section A.4.4.3). The extent of the TPH-DRO was not delineated by samples below the FAL at the lower edges of the CASs 12-06-05 and 12-06-08 muckpiles, but was delineated by samples below the FAL at the lower edges of CAS 12-06-07. Nevertheless, TPH-DRO was found in samples taken from the Initial Decision II Area (Section A.4.4.3).

Because the results for all three muckpile CASs did not exceed the historical highest concentration detected of 10,000 mg/kg for TPH-DRO, as shown on Table A.1-4 of the CAU 551 CAIP (NNSA/NSO, 2004), all three muckpiles are considered to be contaminated by TPH-DRO at a concentration of 10,000 mg/kg.

A.4.2.4 Polychlorinated Biphenyls

Total PCB analytical results for soil samples collected at CASs 12-06-05, 12-06-07, and 12-06-08 did not exceed the MRLs or FALs.

A.4.2.5 Total RCRA Metals and Beryllium

The concentrations of total RCRA metals and beryllium analytical results for soil samples collected at CASs 12-06-05, 12-06-07, and 12-06-08 that exceeded MRLs are presented in Tables A.4-10 through A.4-12, respectively. No RCRA metals or beryllium were detected in soil samples above FALs.

Table A.4-10
Soil Sample Results for Metals Detected Above Minimum Reporting Limits at CAS 12-06-05, U-12b Muckpile
(Page 1 of 2)

Sample Location	Sample Number	Depths (ft bgs)	Contaminants of Potential Concern (mg/kg)								
			Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Final Action Levels			**23[a]**	**67,000[b]**	**1,900[b]**	**450[b]**	**450[b]**	**750[b]**	**310[b]**	**5,100[b]**	**5,100[b]**
B01	551B001	0.0 - 0.5	--	133 (J)	0.539 (J)	--	--	8.7	--	0.649 (J+)	--
	551B002	0.5 - 1.0	--	111 (J)	0.519 (J)	--	--	9.87	--	--	--
	551B003	0.5 - 1.0	--	118 (J)	0.526 (J)	--	--	9.02	--	--	--
	551B004	2.5 - 3.0	--	80.3 (J)	0.535	--	0.742 (J)	6.13	--	--	--
B02	551B005	0.0 - 0.5	2.31	117	0.706	0.443 (J)	1.1 (J)	22.8	--	--	0.69 (J)
	551B006	1.0 - 1.5	1.49	121	0.453 (J)	0.152 (J)	0.657 (J)	4.99	--	--	0.355 (J)
B03	551B007	0.0 - 0.5	2.25	102	0.7	1.78	2.75	86.8	--	--	0.886 (J)
	551B008	1.0 - 1.5	1.96	87.5	0.806	0.669	2.98	52.7	--	--	0.464 (J)
B04	551B009	0.0 - 0.5	1.78	94.1	0.784	0.33 (J)	1.08 (J)	27.9	--	--	0.447 (J)
	551B010	3.5 - 4.0	3.49	33.7	1.47	0.336 (J)	2.45	12.7	--	--	--
B05	551B011	0.0 - 0.5	1.37	79.5	0.543 (J)	0.229 (J)	0.799 (J)	69.2	--	--	--
	551B012	1.5 - 2.0	1.29	112	0.63	0.211 (J)	1.27	34.4	--	--	--
B06	551B013	0.0 - 0.5	--	83	0.471 (J)	0.169 (J)	0.616 (J)	35.8	--	--	--
	551B014	2.0 - 2.5	1.34	78.2	0.482 (J)	0.25 (J)	1.09 (J)	25.6	--	--	0.698 (J)
B07	551B015	0.0 - 0.5	--	83.3	0.638	--	--	14.4	--	--	--
	551B016	1.0 - 1.5	--	84.5	0.571 (J)	--	--	18.2	--	--	--
B08	551B017	0.0 - 0.5	--	89.4	0.595	--	--	10.1	--	--	--
	551B018	2.0 - 3.0	--	75.7	0.715	--	--	10.6	--	--	--

Table A.4-10
Soil Sample Results for Metals Detected Above Minimum Reporting Limits at CAS 12-06-05, U-12b Muckpile
(Page 2 of 2)

Sample Location	Sample Number	Depths (ft bgs)	Contaminants of Potential Concern (mg/kg)								
			Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Final Action Levels			**23[a]**	**67,000[b]**	**1,900[b]**	**450[b]**	**450[b]**	**750[b]**	**310[b]**	**5,100[b]**	**5,100[b]**
B09	551B019	0.0 - 0.5	--	92.3	1.27	--	3.48	19.8	--	--	--
	551B020	1.0 - 1.5	--	112	1.97	--	5.68	21.8	0.133	--	--
B10	551B021	0.0 - 0.5	--	97.4	0.584 (J)	--	--	23.2	--	--	--
	551B022	2.0 - 3.0	--	92.9	0.684	--	--	57.9	--	--	--
B11	551B023	0.0 - 0.5	--	78.7	1.61	--	5.3	15.2	0.0866 (J)	--	--
	551B024	1.0 - 1.5	--	78.8	1.72	--	6.51	10.2	0.0659 (J)	--	--
B12	551B025	0.0 - 0.5	--	95.9	1.8	--	4.43	12.4	0.0608 (J)	--	--
	551B026	0.0 - 0.5	--	95.3	1.57	--	3.9	16.1	0.0453 (J)	--	--
	551B027	1.0 - 2.0	--	44.9	2.26	--	3.83	10	0.297	--	--
B13	551B028	0.0 - 0.5	--	138	0.764	--	--	45.5	--	--	
	551B029	1.5 - 2.0	--	98.6	0.615	--	--	6.79	--	--	

[a]Based on the background concentrations for metals. Background is considered the mean plus two times the standard deviation for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (NBMG, 1998; Moore, 1999).
[b]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals* (*PRGs*) (EPA, 2002)

ft bgs = Feet below ground surface
mg/kg = Milligrams per kilogram
J = Estimated value. Qualifier added to laboratory data; record accepted. Matrix spike recovery outside control limits.
J+ = The result is an estimated quantity, but the result may be biased high. CRI/CRA % recovery(ies) criteria was/were not met.
-- = Not detected above minimum reporting limits.

Because the highest historical concentrations of arsenic and lead of 38.8 and 59,700 mg/kg, respectively (see CAU 551 CAIP, Table A.1-4), were not exceeded by any of the CAI results for the CAU 551 muckpile CASs, all three muckpiles are considered to be contaminated by arsenic and lead at concentrations of 38.8 and 59,700 mg/kg, respectively.

A.4.2.6 Gamma-Emitting Radionuclides

Gamma-emitting radionuclide analytical results for soil samples collected at CASs 12-06-05, 12-06-07, and 12-06-08 that were detected above MDCs are presented in Tables A.4-13 through A.4-15, respectively.

Table A.4-11
Soil Sample Results for Metals Detected Above Minimum Reporting Limits at CAS 12-06-07, Muckpile
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)							
			Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Selenium	Silver
Final Action Levels			**23[a]**	**67,000[b]**	**1,900[b]**	**450[b]**	**450[b]**	**750[b]**	**5,100[b]**	**5,100[b]**
C01	551C001	0.0 - 0.5	2.99	81.9 (J)[c]	1.97	0.656 (J)[d]	0.542 (J-)	14.1 (J)[c]	--	--
	551C002	3.5 - 4.0	0.476 (J)	2.72 (J)[c]	0.411 (J)	0.548 (J)[d]	0.237 (J-)	6.5 (J)[c]	--	--
	551C003	3.5 - 4.0	--	3.37 (J)[c]	0.363 (J)	0.547 (J)[d]	--	13.1 (J)[c]	--	--
C02	551C004	0.0 - 0.5	2.34	160 (J)[c]	1.54	0.656 (J)[d]	1.38 (J-)	10.6 (J)[c]	--	--
	551C005	1.0 - 1.5	2.46	51.4 (J)[c]	3.12	0.638 (J)[d]	0.982 (J-)	18.4 (J)[c]	--	--
C03	551C006	0.0 - 0.5	2.43	91.6 (J)[c]	2.06	0.658 (J)[d]	0.431 (J-)	12.7 (J)[c]	--	--
C04	551C007	0.0 - 0.5	1.57	62.7 (J)[c]	2.24	0.672 (J)[d]	0.839 (J-)	15.5 (J)[c]	--	--
	551C008	1.0 - 1.5	2.25	94.5 (J)[c]	3	0.674 (J)[d]	2.77	17.6 (J)[c]	0.735	--
C05	551C009	0.0 - 0.5	2.96	54.7 (J)[e]	1.87	0.836	--	24.1 (J)[e]	--	0.653 (J)
	551C010	2.5 - 3.0	3.12	35 (J)[e]	1.7	0.755	--	25.3 (J)[e]	--	--
C06	551C011	0.0 - 0.5	1.78	57.8 (J)[e]	0.997	0.323 (J)	0.943 (J)	10.6 (J)[e]	--	0.516 (J)
	551C012	0.5 - 1.0	1.4	46 (J)[e]	0.814	0.296 (J)	0.847 (J)	10 (J)[e]	--	0.524 (J)
C07	551C013	0.0 - 0.5	3.28	50.3 (J)[e]	2.29	0.522 (J)	--	21.3 (J)[e]	--	0.571 (J)
	551C014	1.5 - 2.0	1.48	44.9 (J)[e]	2.49	0.404 (J)	--	15.9 (J)[e]	--	--
C08	551C015	0.0 - 0.5	1.56	90.9 (J)[e]	1.41	0.535 (J)	--	16.3 (J)[e]	--	--
	551C016	1.0 - 1.5	1.07 (J)	110 (J)[e]	1.46	0.642	--	16 (J)[e]	--	--
C09	551C017	0.0 - 0.5	1.19 (J)	50.1 (J)[e]	1.56	0.432 (J)	1.07 (J-)	21.1 (J)[e]	--	--
C10	551C018	0.0 - 0.5	1.17 (J)	63.4 (J)[e]	1.25	0.354 (J)	1.08 (J-)	23.2 (J)[e]	--	--
	551C019	1.0 - 1.5	1.31	69.6 (J)[e]	1.47	0.406 (J)	1.45	17.5 (J)[e]	--	--
C11	551C020	0.0 - 0.5	0.857 (J)	86.3 (J)[e]	1.67	0.445 (J)	--	19.4 (J)[e]	--	--
	551C021	2.5 - 3.0	1.14 (J)	25.8 (J)[e]	2.3	0.596 (J)	--	20.5 (J)[e]	--	--
C12	551C022	0.0 - 0.5	0.535 (J)	51.7 (J)[e]	1.58	0.436 (J)	--	17.6 (J)[e]	--	--
	551C023	1.0 - 1.5	0.734 (J)	41.9 (J)[e]	1.31	0.453 (J)	--	16.8 (J)[e]	--	--

Table A.4-11
Soil Sample Results for Metals Detected Above Minimum Reporting Limits at CAS 12-06-07, Muckpile
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)							
			Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Selenium	Silver
Final Action Levels			**23[a]**	**67,000[b]**	**1,900[b]**	**450[b]**	**450[b]**	**750[b]**	**5,100[b]**	**5,100[b]**
C13	551C024	0.0 - 0.5	0.633 (J)	124 (J)[e]	1.06	0.549 (J)	--	18.2 (J)[e]	--	--
	551C025	2.0 - 3.0	1 (J)	48.9 (J)[e]	1.17	0.427 (J)	0.654 (J)	14.7 (J)[e]	--	0.616 (J)
C14	551C026	0.0 - 0.5	1.16 (J)	127 (J)[e]	1.22	0.431 (J)	--	18.1 (J)[e]	--	--
	551C027	0.0 - 0.5	0.796 (J)	114 (J)[e]	0.943	0.543 (J)	--	19.1 (J)[e]	--	--
	551C028	1.0 - 1.5	0.741 (J)	88.6 (J)[e]	1.18	0.581 (J)	--	11.3 (J)[e]	--	0.335 (J-)
C15	551C029	0.0 - 0.5	0.722 (J)	92 (J)[e]	1.25	0.486 (J)	1.63 (J-)	17 (J)[e]	--	0.446 (J-)
	551C030	1.0 - 1.5	0.761 (J)	47.8 (J)[e]	1.16	0.315 (J)	0.936 (J-)	12.2 (J)[e]	--	0.404 (J-)
C16	551C031	0.0 - 0.5	0.589 (J)	30.7 (J)[e]	1.13	0.291 (J)	0.519 (J-)	9.5 (J)[e]	--	--
	551C032	2.0 - 2.5	0.961 (J)	21.1 (J)[e]	1.06	0.238 (J)	--	6.04 (J)[e]	--	--

[a]Based on the background concentrations for metals. Background is considered the mean plus two times the standard deviation for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (NBMG, 1998; Moore, 1999).
[b]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals* (*PRGs*) (EPA, 2002)
[c]Qualifier added to laboratory data; record accepted. Matrix spike recovery outside control limits. Serial dilution %D outside control limits. Matrix effects may exist.
[d]Qualifier added to laboratory data; record accepted. Matrix spike recovery outside control limits.
[e]Qualifier added to laboratory data; record accepted. Serial dilution %D outside control limits. Matrix effects may exist.

ft bgs = Feet below ground surface
mg/kg = Milligrams per kilogram
J = Estimated value
J- = The result is an estimated quantity, but the result may be biased low. Negative bias found in continuing calibration/method blank.
-- Not detected above minimum reporting limits.

Table A.4-12
Soil Sample Results for Metals Detected Above Minimum Reporting Limits at CAS 12-06-08, Muckpile

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)							
			Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Selenium
Final Action Levels			**23[a]**	**67,000[b]**	**1,900[b]**	**450[b]**	**450[b]**	**750[b]**	**310[b]**	**5,100[b]**
D01	551D001	0.0 - 0.5	2.15	80.7 (J)[c]	1.63	--	1.77	16.4	0.0575 (J)	--
	551D002	0.5 - 1.0	2.41	95.1 (J)[c]	1.84	--	1.84	15.6	0.0728 (J)	--
	551D003	0.5 - 1.0	2.44	68.4 (J)[c]	1.53	--	2.26	13	0.0924 (J)	--
D02	551D004	0.0 - 0.5	2.49	69.4 (J)[c]	2.7	--	2.18	31.3	--	--
	551D005	0.5 - 1.0	2.52	64.4 (J)[c]	2.48	--	3.16	21.2	--	--
	551D006	1.5 - 2.0	2.77	73.2 (J)[c]	2.23	--	2.56	15.9	--	--
D03	551D007	0.0 - 0.5	1.97	134 (J)[c]	1.71	--	0.503 (J)	14.7	--	--
	551D008	0.5 - 1.0	2.05	102 (J)[c]	2.7	0.137 (J)	9.959 (J)	17.1	--	--
D04	551D009	0.0 - 0.5	2.3	79.4 (J)[d]	1.75	0.621 (J)[c]	1.96 (J-)	21 (J)[d]	0.0453 (J)	--
	551D010	2.0 - 3.0	2.07	105 (J)[d]	1.98	0.568 (J)[c]	1.56 (J-)	18.4 (J)[d]	--	--
D05	551D011	0.0 - 0.5	0.91 (J)	47 (J)[d]	1.31	0.7 (J)[c]	0.864 (J-)	14.5 (J)[d]	--	--
	551D012	1.5 - 2.0	1.77	51.4 (J)[d]	1.57	0.679 (J)[c]	1.78 (J-)	12.2 (J)[d]	--	--
D06	551D013	0.0 - 0.5	3.78	93.2 (J)[d]	1.53	0.82 (J)[c]	3.59	16.4 (J)[d]	0.0836 (J)	--
	551D014	1.0 - 1.5	3.77	105 (J)[d]	1.61	0.647 (J)[c]	3.51	33 (J)[d]	0.0731 (J)	0.689
D07	551D015	0.0 - 0.5	3.01	71.5 (J)[d]	1.28	0.643 (J)[c]	2.51	19.6 (J)[d]	0.0503 (J)	--

[a]Based on the background concentrations for metals. Background is considered the mean plus two times the standard deviation for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (NBMG, 1998; Moore, 1999).
[b]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals* (*PRGs*) (EPA, 2002)
[c]Qualifier added to laboratory data; record accepted. Matrix spike recovery outside control limits.
[d]Qualifier added to laboratory data; record accepted. Matrix spike recovery outside control limits. Serial dilution %D outside control limits. Matrix effects may exist.

ft bgs = Feet below ground surface
mg/kg = Milligrams per kilogram
J = Estimated value
J- = The result is an estimated quantity, but the result may be biased low. Negative bias found in continuing calibration/method blank.
-- = Not detected above minimum reporting limits.

Table A.4-13
Soil Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentration at CAS 12-06-05, U-12b Muckpile
(Page 1 of 3)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)											
			Actinium-228[a]		Americium-241[b]	Bismuth-214[a]		Cesium-137[b]	Europium-152[b]	Lead-212[a]		Lead-214[a]		Thallium-208[a]	
Final Action Levels			**5**	**15**	**79.63**	**5**	**15**	**72.07**	**1.42**	**5**	**15**	**5**	**15**	**5**	**15**
Depth bgs (cm)			**<15**	**>15**		**<15**	**>15**			**<15**	**>15**	**<15**	**>15**	**<15**	**>15**
B01	551B001	0.0 - 0.5	2.22 (G)	N/A	6.36 (J)[c]	1.53 (G, J)	N/A	10 (G)	--	2.81 (J)[d]	N/A	1.41 (G, J)	N/A	0.89 (G)	N/A
	551B002	0.5 - 1.0	2.63 (G)	N/A	18.6 (J)[c]	1.18 (G, J)	N/A	8.2 (G)	--	2.86 (J)[d]	N/A	1.39 (G, J)	N/A	0.91 (G)	N/A
	551B003	0.5 - 1.0	2.22 (G)	N/A	31 (J)[c]	1.38 (G, J)	N/A	8.5 (G)	--	3 (J)[d]	N/A	1.28 (G, J)	N/A	1.03 (G)	N/A
	551B004	2.5 - 3.0	N/A	2.04 (G)	N/A	N/A	1.15 (G, J)	1.61 (G)	--	N/A	2.27 (J)[d]	N/A	1.4 (G, J)	N/A	0.85 (G)
B02	551B005	0.0 - 0.5	2.89 (G)	N/A	**107** (J)[d]	--	N/A	**156** (G,M3)	**26.6** (J)[d]	3.05 (J)[d]	N/A	--	N/A	--	N/A
	551B006	1.0 - 1.5	N/A	2.52 (G)	--	N/A	0.91 (G, J)	4.1 (G)	--	N/A	2.81 (J)[d]	N/A	1.37 (G, J)	N/A	0.9 (G)
B03	551B007	0.0 - 0.5	1.99 (G)	N/A	**99** (J)[d]	--	N/A	**318** (G,M3)	--	2.12 (J)[d]	N/A	--	N/A	--	N/A
	551B008	1.0 - 1.5	N/A	1.93 (G)	55.3 (J)[d]	N/A	1.41 (G, J)	**103** (G)	--	N/A	2.84 (J)[d]	N/A	--	N/A	0.86 (G)
B04	551B009	0.0 - 0.5	2.82 (G)	N/A	**136** (J)[d]	1.4 (G, J)	N/A	58 (G)	**5.49** (J)[d]	2.9 (J)[d]	N/A	--	N/A	0.84 (G)	N/A
	551B010	3.5 - 4.0	N/A	1.98 (G)	6.67 (J)[d]	N/A	1.28 (G, J)	14.6 (G)	--	N/A	2.72 (J)[d]	N/A	1.16 (G, J)	N/A	0.98 (G)
B05	551B011	0.0 - 0.5	2.41 (G)	N/A	**244** (J)[d]	1.1 (G, J)	N/A	57.6 (G)	--	2.82 (J)[d]	N/A	1.46 (G, J)	N/A	0.71 (G)	N/A
	551B012	1.5 - 2.0	N/A	1.76 (G)	**186** (J)[d]	N/A	1.14 (G, J)	33 (G)	--	N/A	2.58 (J)[d]	N/A	1.53 (G, J)	N/A	0.9 (G)
B06	551B013	0.0 - 0.5	2.61 (G)	N/A	**192** (J)[d]	1.08 (G, J)	N/A	38.4 (G)	--	3.08 (J)[d]	N/A	1.24 (G, J)	N/A	1 (G)	N/A
	551B014	2.0 - 2.5	N/A	1.98 (G)	**144** (J)[d]	N/A	0.96 (G, J)	27.5 (G)	--	N/A	2.74 (J)[d]	N/A	1.17 (G, J)	N/A	0.7 (G)

Table A.4-13
Soil Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentration at CAS 12-06-05, U-12b Muckpile
(Page 2 of 3)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)													
			Actinium-228[a]		Americium-241[b]	Bismuth-214[a]		Cesium-137[b]	Europium-152[b]	Lead-212[a]		Lead-214[a]		Thallium-208[a]	
Final Action Levels			**5**	**15**	**79.63**	**5**	**15**	**72.07**	**1.42**	**5**	**15**	**5**	**15**	**5**	**15**
Depth bgs (cm)			**<15**	**>15**		**<15**	**>15**			**<15**	**>15**	**<15**	**>15**	**<15**	**>15**
B07	551B015	0.0 - 0.5	2.36 (G)	N/A	52.5 (J)[d]	1.04 (G, J)	N/A	43.9 (G)	--	2.73 (J)[d]	N/A	1.37 (G, J)	N/A	1.11 (G)	N/A
	551B016	1.0 - 1.5	N/A	2.02 (G)	**101** (J)[d]	N/A	1.22 (G, J)	22.2 (G)	--	N/A	2.84 (J)[d]	N/A	1.21 (G, J)	N/A	0.75 (G)
B08	551B017	0.0 - 0.5	1.95 (G)	N/A	19.5 (J)[d]	1 (G, J)	N/A	22.5 (G)	--	2.52 (J)[d]	N/A	--	N/A	0.69 (G)	N/A
	551B018	2.0 - 3.0	N/A	2.78 (G)	33.3 (J)[d]	N/A	1.13 (G, J)	12.1 (G)	--	N/A	2.81 (J)[d]	N/A	1.37 (G, J)	N/A	0.78 (G)
B09	551B019	0.0 - 0.5	2.27 (G)	N/A	52.2 (J)[d]	1.28 (G, J)	N/A	32.4 (G)	--	2.96 (J)[d]	N/A	1.58 (G, J)	N/A	0.79 (G)	N/A
	551B020	1.0 - 1.5	N/A	2.58 (G)	5.7 (J)[d]	N/A	1.47 (G, J)	4.09 (G)	--	N/A	3.01 (J)[d]	N/A	1.56 (G, J)	N/A	1 (G)
B10	551B021	0.0 - 0.5	2.02 (G)	N/A	64.8 (J)[d]	1.06 (G, J)	N/A	26.8 (G)	--	3.08 (J)[d]	N/A	1.24 (G, J)	N/A	0.69 (G)	N/A
	551B022	2.0 - 3.0	N/A	2.48 (G)	**178** (J)[d]	N/A	1.38 (G, J)	55.1 (G)	--	N/A	2.39 (J)[d]	N/A	1.5 (G, J)	N/A	0.77 (G)
B11	551B023	0.0 - 0.5	2.61 (G)	N/A	50.5 (J)[d]	1.3 (G, J)	N/A	22.2 (G)	--	3.23 (J)[d]	N/A	1.04 (G, J)	N/A	0.78 (G)	N/A
	551B024	1.0 - 1.5	N/A	2.32 (G)	14 (J)[d]	N/A	1.16 (G, J)	4.66 (G)	--	N/A	2.44 (J)[d]	N/A	1.18 (G, J)	N/A	0.67 (G)
B12	551B025	0.0 - 0.5	2.78 (G)	N/A	10.4 (J)[d]	1.35 (G, J)	N/A	7.4 (G)	--	2.74 (J)[d]	N/A	1.82 (G, J)	N/A	0.68 (G)	N/A
	551B026	0.0 - 0.5	2.68 (G)	N/A	14 (J)[d]	1.3 (G, J)	N/A	10.1 (G)	--	3.02 (J)[d]	N/A	1.83 (G, J)	N/A	0.96 (G)	N/A
	551B027	1.0 - 2.0	N/A	3.76 (G)	--	N/A	1.44 (G, J)	0.65 (G)	--	N/A	3.85 (J)[d]	N/A	1.74 (G, J)	N/A	1.24 (G)
B13	551B028	0.0 - 0.5	2.54 (G)	N/A	**156** (J)[d]	--	N/A	39.9 (G)	1.14 (J)[d]	3.23 (J)[d]	N/A	1.45 (G, J)	N/A	0.86 (G)	N/A
	551B029	1.5 - 2.0	N/A	2.45 (G)	10.5 (J)[d]	N/A	1.05 (G, J)	5.75 (G)	--	N/A	2.39 (J)[d]	N/A	1.44 (G, J)	N/A	0.67 (G)

Table A.4-13
Soil Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentration at CAS 12-06-05, U-12b Muckpile
(Page 3 of 3)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)													
			Actinium-228[a]		Americium-241[b]	Bismuth-214[a]		Cesium-137[b]	Europium-152[b]	Lead-212[a]		Lead-214[a]		Thallium-208[a]	
Final Action Levels			**5**	**15**	**79.63**	**5**	**15**	**72.07**	**1.42**	**5**	**15**	**5**	**15**	**5**	**15**
Depth bgs (cm)			**<15**	**>15**		**<15**	**>15**			**<15**	**>15**	**<15**	**>15**	**<15**	**>15**
B14	551B030	0.0 - 0.5	1.7 (G)	N/A	**478** (J)[d]	--	N/A	**164** (G)	--	2.15 (J)[d]	N/A	--	N/A	0.68 (G)	N/A

[a]Taken from the generic guidelines for residual concentrations of actinium-228, bismuth-214, lead-212, lead-214, thallium-208, and thorium-232, as found in Chapter IV of DOE Order 5400.5, Change 2, "Radiation Protection of the Public and Environment." (DOE, 1993). The PALs for these isotopes is specified as 5 pCi/g averaged over the first 15 cm of soil and 15 pCi/g for deeper soils (DOE, 1993). For purposes of this document, 15 cm is assumed to be equivalent to 0.5 ft (6 inches); therefore, 5 pCi/g represents the PALs for these radionuclides in the surface soil (0 to 0.5 ft depth).
[b]Taken from values calculated from RESRAD for CAU 551, Land Parcel 1.
[c]Qualifier added to laboratory data; record accepted. Duplicate precision analysis (relative percent difference) outside control limits.
[d]Qualifier added to laboratory data; record accepted. Sample does not meet counting geometry requirements.

cm = Centimeter
ft bgs = Feet below ground surface
mrem/yr = Millirem per year
N/A = Not applicable
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive computer code
< = Less than
> = Greater than
G = Sample density differs by more than 15% of laboratory control sample density.
J = Estimated value
-- = Not detected above minimum reporting limits.

Table A.4-14
Soil Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentration at CAS 12-06-07, Muckpile
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)															
			Actinium-228[a]		Americium-241[b]	Bismuth-212[a]		Bismuth-214[a]		Cesium-137[b]	Europium-152[b]	Lead-212[a]		Lead-214[a]		Thallium-208[a]		Thallium-234[c]
Final Action Levels			5	15	79.63	5	15	5	15	72.07	1.42	5	15	5	15	5	15	105
Depth bgs (cm)			<15	>15		<15	>15	<15	>15			<15	>15	<15	>15	<15	>15	
C01	551C001	0.0 - 0.5	2.15 (G)	N/A	2.66 (J)[d]	--	N/A	1.28 (G, J)	N/A	--	--	2.7 (J)[d]	N/A	1.33 (G, J)	N/A	0.86 (G)	N/A	--
	551C002	3.5 - 4.0	N/A	2.72 (G)	--	N/A	--	N/A	1.61 (G, J)	--	--	N/A	2.88 (J)[d]	N/A	1.65 (G, J)	N/A	0.83 (G)	4.4 (J)[d]
	551C003	3.5 - 4.0	N/A	2.39 (G)	--	N/A	--	N/A	1.56 (G, J)	--	--	N/A	3.56 (J)[d]	N/A	2.03 (G, J)	N/A	0.91 (G)	--
C02	551C004	0.0 - 0.5	2.06 (G)	N/A	**172** (J)[d]	--	N/A	1.04 (G, J)	N/A	20.4 (G)	--	2.08 (J)[d]	N/A	1.26 (G, J)	N/A	0.52 (G)	N/A	--
	551C005	1.0 - 1.5	N/A	3.41 (G)	--	N/A	--	N/A	1.07 (G, J)	--	--	N/A	3.1 (J)[d]	N/A	1.08 (G, J)	N/A	0.88 (G)	--
C03	551C006	0.0 - 0.5	1.91 (G)	N/A	**375** (J)[d]	--	N/A	1.21 (G, J)	N/A	32.4 (G)	**1.53** (J)[d]	2.55 (J)[d]	N/A	1.39 (G, J)	N/A	0.7 (G)	N/A	--
C04	551C007	0.0 - 0.5	2.94 (G)	N/A	**1,020** (J)[d]	--	N/A	--	N/A	58.2 (G)	**5.03** (J)[d]	2.55 (J)[d]	N/A	--	N/A	0.96 (G)	N/A	--
	551C008	1.0 - 1.5	N/A	2.69 (G)	**300** (J)[d]	N/A	--	N/A	--	26.5 (G)	**2.3** (J)[d]	N/A	2.45 (J)[d]	N/A	--	N/A	0.87 (G)	--
C05	551C009	0.0 - 0.5	--	N/A	**1,210** (J)[d]	--	N/A	--	N/A	62.7 (G, M3)	**60** (J)[d]	2.12 (J)[d]	N/A	--	N/A	--	N/A	--
	551C010	2.5 - 3.0	N/A	1.84 (G)	**464** (J)[d]	N/A	--	N/A	--	13.9 (G)	**27.4** (J)[d]	N/A	1.76 (J)[d]	N/A	0.94 (G, J)	N/A	0.51 (G)	--
C06	551C011	0.0 - 0.5	2.36 (G)	N/A	**204** (J)[d]	--	N/A	1.09 (G, J)	N/A	29 (G)	1.38 (J)[d]	2.77 (J)[d]	N/A	1.33 (G, J)	N/A	0.95 (G)	N/A	--
	551C012	0.5 - 1.0	N/A	2.97 (G)	**400** (J)[d]	N/A	--	N/A	1.6 (G, J)	25.6 (G)	**2.2** (J)[d]	N/A	2.69 (J)[d]	N/A	1.69 (G, J)	N/A	0.78 (G)	--
C07	551C013	0.0 - 0.5	1.85 (G)	N/A	**521** (J)[d]	--	N/A	1.2 (G, J)	N/A	20.6 (G)	**1.8** (J)[d]	3.22 (J)[d]	N/A	--	N/A	0.94 (G)	N/A	--
	551C014	1.5 - 2.0	N/A	3 (G)	**253** (J)[d]	N/A	3.3 (G)	N/A	1.14 (G, J)	8.2 (G)	0.75 (J)[d]	N/A	3.03 (J)[d]	N/A	1.24 (G, J)	N/A	1.03 (G)	--
C08	551C015	0.0 - 0.5	1.95 (G)	N/A	**251** (J)[d]	--	N/A	1.1 (G, J)	N/A	5.02 (G)	--	2.14 (J)[d]	N/A	1.1 (G, J)	N/A	0.68 (G)	N/A	--
	551C016	1.0 - 1.5	N/A	1.79 (G)	--	N/A	--	N/A	1.05 (G, J)	--	--	N/A	2.45 (J)[d]	N/A	1.13 (G, J)	N/A	0.81 (G)	--
C09	551C017	0.0 - 0.5	2.99 (G)	N/A	**1,260** (J)[d]	--	N/A	1.51 (G, J)	N/A	40.6 (G)	**3.32** (J)[d]	3.25 (J)[d]	N/A	1.46 (G, J)	N/A	0.92 (G)	N/A	--
C10	551C018	0.0 - 0.5	2.77 (G)	N/A	**3,370** (J)[d]	--	N/A	--	N/A	**101** (G)	**9.7** (J)[d]	2.42 (J)[d]	N/A	--	N/A	--	N/A	--
	551C019	1.0 - 1.5	N/A	2.74 (G)	**518** (J)[d]	N/A	--	N/A	1.46 (G, J)	17.7 (G)	**1.95** (J)[d]	N/A	2.68 (J)[d]	N/A	1.47 (G, J)	N/A	0.93 (G)	--
C11	551C020	0.0 - 0.5	2.39 (G)	N/A	**606** (J)[d]	--	N/A	1.11 (G, J)	N/A	27.6 (G)	**1.73** (J)[d]	3.09 (J)[d]	N/A	1.44 (G, J)	N/A	0.86 (G)	N/A	--
	551C021	2.5 - 3.0	N/A	2.65 (G)	**318** (J)[d]	N/A	--	N/A	1.07 (G, J)	13.5 (G)	--	N/A	3.13 (J)[d]	N/A	0.99 (G, J)	N/A	0.76 (G)	--

Table A.4-14
Soil Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentration at CAS 12-06-07, Muckpile
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)															
			Actinium-228[a]		Americium-241[b]	Bismuth-212[a]		Bismuth-214[a]		Cesium-137[b]	Europium-152[b]	Lead-212[a]		Lead-214[a]		Thallium-208[a]		Thallium-234[c]
Final Action Levels			5	15	79.63	5	15	5	15	72.07	1.42	5	15	5	15	5	15	105
Depth bgs (cm)			<15	>15		<15	>15	<15	>15			<15	>15	<15	>15	<15	>15	
C12	551C022	0.0 - 0.5	2.77 (G)	N/A	**500** (J)[d]	--	N/A	1.31 (G, J)	N/A	22.5 (G)	**1.78** (J)[d]	2.8 (J)[d]	N/A	1.18 (G, J)	N/A	0.97 (G)	N/A	--
	551C023	1.0 - 1.5	N/A	2.89 (G)	**701** (J)[d]	N/A	--	N/A	1.1 (G, J)	32.1 (G)	**1.93** (J)[d]	N/A	2.75 (J)[d]	N/A	1.7 (G, J)	N/A	0.89 (G)	--
C13	551C024	0.0 - 0.5	--	N/A	**519** (J)[d]	--	N/A	--	N/A	16.2 (G)	**29.3** (J)[d]	1.85 (J)[d]	N/A	1.17 (G, J)	N/A	--	N/A	--
	551C025	2.0 - 3.0	N/A	2.46 (G)	**515** (J)[d]	N/A	--	N/A	1.29 (G, J)	35.4 (G)	**11.7** (J)[d]	N/A	2.47 (J)[d]	N/A	1.22 (G, J)	N/A	--	--
C14	551C026	0.0 - 0.5	--	N/A	**489** (J)[d]	--	N/A	--	N/A	19.9 (G)	**14.8** (J)[d]	1.66 (J)[d]	N/A	--	N/A	--	N/A	--
	551C027	0.0 - 0.5	1.9 (G)	N/A	**415** (J)[d]	--	N/A	--	N/A	19.1 (G)	**14.8** (J)[d]	1.58 (J)[d]	N/A	--	N/A	--	N/A	--
	551C028	1.0 - 1.5	N/A	--	**202** (J)[d]	N/A	--	N/A	1.11 (G, J)	12.8 (G)	**6.9** (J)[d]	N/A	2.25 (J)[d]	N/A	1.24 (G, J)	N/A	0.84 (G)	--
C15	551C029	0.0 - 0.5	2.27 (G)	N/A	**159** (J)[d]	--	N/A	1.23 (G, J)	N/A	19.8 (G)	--	3.18 (J)[d]	N/A	1.02 (G, J)	N/A	0.78 (G)	N/A	--
	551C030	1.0 - 1.5	N/A	2.45 (G)	**264** (J)[d]	N/A	--	N/A	1.19 (G, J)	25.9 (G)	**1.97** (J)[d]	N/A	2.57 (J)[d]	N/A	1.37 (G, J)	N/A	0.93 (G)	--
C16	551C031	0.0 - 0.5	2.71 (G)	N/A	34.2 (J)[d]	--	N/A	1.24 (G, J)	N/A	8.5 (G)	1.23 (J)[d]	2.83 (J)[d]	N/A	1.31 (G, J)	N/A	0.82 (G)	N/A	--
	551C032	2.0 - 2.5	N/A	2.57 (G)	--	N/A	--	N/A	1 (G, J)	11.1 (G)	--	N/A	3.3 (J)[d]	N/A	1.3 (G, J)	N/A	0.98 (G)	--

[a]Taken from the generic guidelines for residual concentrations of actinium-228, bismuth-214, lead-212, lead-214, thallium-208, and thorium-232, as found in Chapter IV of DOE Order 5400.5, Change 2, "Radiation Protection of the Public and Environment." (DOE, 1993). The PALs for these isotopes is specified as 5 pCi/g averaged over the first 15 cm of soil and 15 pCi/g for deeper soils (DOE, 1993). For purposes of this document, 15 cm is assumed to be equivalent to 0.5 ft (6 inches); therefore, 5 pCi/g represents the PALs for these radionuclides in the surface soil (0 to 0.5 ft depth).
[b]Taken from values calculated from RESRAD for CAU 551, Land Parcel 1.
[c]Taken from the construction, commercial, industrial land use scenario in Table 2.1 of the NCRP Report No. 129, *Recommended Screening Limits for Contaminated Surface Soil and Review Factors Relevant to Site-Specific Studies* (NCRP, 1999). The values provided in this source document were scaled to a 25-mrem/yr dose.
[d]Qualifier added to laboratory data; record accepted. Sample does not meet counting geometry requirements.

cm = Centimeter
ft bgs = Feet below ground surface
mrem/yr = Millirem per year
N/A = Not applicable
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive computer code
< = Less than
> = Greater than
G = Sample density differs by more than 15% of laboratory control sample density.
J = Estimated value
-- = Not detected above minimum reporting limits.

Table A.4-15
Soil Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentration at CAS 12-06-08, Muckpile
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)											
			Actinium-228[a]		Americium-241[b]	Bismuth-214[a]		Cesium-137[b]	Lead-212[a]		Lead-214[a]		Thallium-208[a]	
Final Action Levels			**5**	**15**	**79.63**	**5**	**15**	**72.07**	**5**	**15**	**5**	**15**	**5**	**15**
Depth bgs (cm)			**<15**	**>15**		**<15**	**>15**		**<15**	**>15**	**<15**	**>15**	**<15**	**>15**
D01	551D001	0.0 - 0.5	2.3 (G)	N/A	29.8 (J)[c]	1.39 (G, J)	N/A	11.6 (G)	2.9 (J)[d]	N/A	1.11 (G, J)	N/A	0.97 (G)	N/A
	551D002	0.5 - 1.0	N/A	2.24 (G)	49 (J)[c]	N/A	1.03 (G, J)	8.7 (G)	N/A	2.51 (J)[d]	N/A	1.01 (G, J)	N/A	0.87 (G)
	551D003	0.5 - 1.0	N/A	2.34 (G)	58.7 (J)[c]	N/A	0.98 (G, J)	8.3 (G)	N/A	3.02 (J)[d]	N/A	1.12 (G, J)	N/A	0.83 (G)
D02	551D004	0.0 - 0.5	2.23 (G)	N/A	3.35 (J)[c]	1.25 (G, J)	N/A	7.37 (G)	2.44 (J)[d]	N/A	1.37 (G, J)	N/A	1.02 (G)	N/A
	551D005	0.5 - 1.0	N/A	1.91 (G)	6.9 (J)[c]	N/A	0.94 (G, J)	7.3 (G)	N/A	3.34 (J)[d]	N/A	1.36 (G, J)	N/A	0.9 (G)
	551D006	1.5 - 2.0	N/A	2.18 (G)	4.6 (J)[c]	N/A	0.82 (G, J)	4.02 (G)	N/A	3.08 (J)[d]	N/A	1.15 (G, J)	N/A	0.82 (G)
D03	551D007	0.0 - 0.5	1.86 (G)	N/A	5.5 (J)[c]	1.08 (G, J)	N/A	3.81 (G)	1.74 (J)[d]	N/A	1.11 (G, J)	N/A	0.7 (G)	N/A
	551D008	0.5 - 1.0	N/A	2.95 (G)	--	N/A	0.86 (G, J)	1.71 (G)	N/A	3.13 (J)[d]	N/A	1.13 (G, J)	N/A	0.91 (G)
D04	551D009	0.0 - 0.5	2.66 (G)	N/A	**370** (J)[d]	1.24 (G, J)	N/A	**108** (G)	2.63 (J)[d]	N/A	--	N/A	0.96 (G)	N/A
	551D010	2.0 - 3.0	N/A	1.9 (G)	**93** (J)[d]	N/A	1.18 (G, J)	23.1 (G)	N/A	2.72 (J)[d]	N/A	1.14 (G, J)	N/A	0.87 (G)
D05	551D011	0.0 - 0.5	2.79 (G)	N/A	69 (J)[d]	1.51 (G, J)	N/A	27 (G)	2.88 (J)[d]	N/A	1.34 (G, J)	N/A	1.11 (G)	N/A
	551D012	1.5 - 2.0	N/A	2.33 (G)	**191** (J)[d]	N/A	1.24 (G, J)	22.8 (G)	N/A	2.87 (J)[d]	N/A	1.52 (G, J)	N/A	1.01 (G)
D06	551D013	0.0 - 0.5	2.16 (G)	N/A	**91** (J)[d]	1.12 (G, J)	N/A	31.2 (G)	2.81 (J)[d]	N/A	1.07 (G, J)	N/A	0.69 (G)	N/A
	551D014	1.0 - 1.5	N/A	2.9 (G)	79 (J)[d]	N/A	1.21 (G, J)	27 (G)	N/A	2.94 (J)[d]	N/A	1.29 (G, J)	N/A	0.66 (G)
D07	551D015	0.0 - 0.5	2.3 (G)	N/A	**150** (J)[d]	1.27 (G, J)	N/A	52.3 (G)	2.73 (J)[d]	N/A	--	N/A	0.92 (G)	N/A

Table A.4-15
Soil Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentration at CAS 12-06-08, Muckpile
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)											
			Actinium-228[a]		Americium-241[b]	Bismuth-214[a]		Cesium-137[b]	Lead-212[a]		Lead-214[a]		Thallium-208[a]	
Final Action Levels			5	15	79.63	5	15	72.07	5	15	5	15	5	15
Depth bgs (cm)			<15	>15		<15	>15		<15	>15	<15	>15	<15	>15

[a]Taken from the generic guidelines for residual concentrations of actinium-228, bismuth-214, lead-212, lead-214, thallium-208, and thorium-232, as found in Chapter IV of DOE Order 5400.5, Change 2, "Radiation Protection of the Public and Environment." (DOE, 1993). The PALs for these isotopes is specified as 5 pCi/g averaged over the first 15 cm of soil and 15 pCi/g for deeper soils (DOE, 1993). For purposes of this document, 15 cm is assumed to be equivalent to 0.5 ft (6 inches); therefore, 5 pCi/g represents the PALs for these radionuclides in the surface soil (0 to 0.5 ft depth).
[b]Taken from values calculated from RESRAD for CAU 551, Land Parcel 1.
[c]Qualifier added to laboratory data; record accepted. Duplicate precision analysis (relative percent difference) outside control limits.
[d]Qualifier added to laboratory data; record accepted. Sample does not meet counting geometry requirements.

cm = Centimeter
ft bgs = Feet below ground surface
mrem/yr = Millirem per year
N/A = Not applicable
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive computer code
< = Less than
> = Greater than
G = Sample density differs by more than 15% of laboratory control sample density.
J = Estimated value
-- = Not detected above minimum reporting limits

Am-241: The concentrations of several surface and subsurface samples collected from CASs 12-06-05 and 12-06-08 exceeded the FAL for Am-241 (Tables A.4-13 and A.4-15; Figure A.4-2). Surface sample concentrations for Am-241 above the FAL ranged from 91 to 478 pCi/g, and subsurface sample concentrations ranged from 93 to 191 pCi/g. In general, surface samples showed higher levels of contamination than subsurface samples at CAS 12-06-05 with exceptions at locations B07 and B10. No trend was discernible for CAS 12-06-08. The highest concentration of Am-241 on these muckpiles was found in a surface sample taken at location B14, just below the flat portion of the second tier, near a pile of cabling and debris. Because Am-241 was a newly identified COC for CASs 12-06-05 and 12-06-08, both muckpiles are considered to be contaminated at the highest concentration found in samples from both muckpiles, 478 pCi/g. Americium-241 was not bounded by samples below the FAL at the lower edges of the muckpiles and did exceed the FAL in samples taken at one location from the Initial Decision II Area (Section A.4.4.6).

The concentrations for nearly all surface and subsurface samples collected from CAS 12-06-07 exceeded the FAL for Am-241 (Table A.4-14 and Figure A.4-3). Surface sample concentrations for Am-241 above the FAL ranged from 159 to 3,370 pCi/g, and subsurface sample concentrations ranged from 202 to 701 pCi/g. In general, surface samples showed higher levels of contamination than subsurface samples with exceptions at locations C06, C12, and C15. The highest concentration of Am-241 on this muckpile was found in a surface sample taken at location C10, near the lower southwest side of the toeslope. Because Am-241 was a newly identified COC for CAS 12-06-07, this muckpile is considered to be contaminated at the highest concentration found, 3,370 pCi/g. Americium-241 was not bounded by samples below the FAL at the lower edges of the muckpile and did exceed the FAL in samples taken at one location from the Initial Decision II Area (Section A.4.4.6).

Cs-137: The concentrations for five surface and subsurface samples collected from CASs 12-06-05 and 12-06-08 exceeded the FAL for Cs-137 (Tables A.4-13 and A.4-15; Figure A.4-2). Surface concentrations for Cs-137 above the FAL ranged from 108 to 318 pCi/g, and one subsurface sample concentration was 103 pCi/g. In general, surface samples showed higher levels of contamination than subsurface samples, with the exception at location B10. The highest concentration of Cs-137 was found in a surface sample taken at location B03, on the slope between the upper and lower flat

portions of CAS 12-06-05, near what appears to be Trinity glass. Because the results for these two muckpiles did not exceed the historical highest concentration detected of 3,050 pCi/g for Cs-137 (see CAU 551 CAIP, Table A.1-4), both muckpiles are considered to be contaminated by Cs-137 at a concentration of 3,050 pCi/g. Cesium-137 was found at concentrations exceeding the FAL at three locations in the Initial Decision II Area and one location in the Extended Decision II Area.

The concentrations for one surface sample collected from CAS 12-06-07 exceeded the FAL for Cs-137 (Table A.4-14 and Figure A.4-3) with a concentration of 101 pCi/g at location C10. Subsurface samples did not exceed the FAL. In general, surface samples showed higher levels of contamination than subsurface samples with the exception of locations C12 and C15. The highest concentration of Cs-137 was found in the same sample that had the highest concentration of Am-241. Because the results for this muckpile did not exceed the highest historical concentration detected of 3,050 pCi/g for Cs-137 (see CAU 551 CAIP, Table A.1-4), the muckpile is considered to be contaminated by Cs-137 at a concentration of 3,050 pCi/g. Cesium-137 contamination extended beyond the lower edge of the muckpile to three locations in the Initial Decision II Area and one location in the Extended Decision II Area.

Eu-152: The concentration for two surface samples collected from CASs 12-06-05 and 12-06-08 exceeded the FAL for Eu-152 (Table A.4-13 and Figure A.4-2). The samples containing Eu-152 above FAL, at a concentration of 5.49 and 26.6 pCi/g, were taken from the surface at locations B02 and B04. Location B02 was near what appeared to be Trinity glass on the lower flat portion of CAS 12-06-05. Because Eu-152 was a newly identified COC for CASs 12-06-05 and 12-06-08, these muckpiles are considered to be contaminated at the highest concentration found, 26.6 pCi/g. Europium-152 was bounded by samples below the FAL at the lower edges of the muckpiles but was found in samples above the FAL taken at one location from the Initial Decision II Area and one location from the Extended Decision II Area (Section A.4.4.6).

The Eu-152 concentrations in 10 surface samples and 8 subsurface samples collected from CAS 12-06-07 exceeded the FAL (Table A.4-14 and Figure A.4-3). Surface sample concentrations for Eu-152 above the FAL ranged from 1.53 to 60 pCi/g, and subsurface sample concentrations ranged from 1.93 to 29.3 pCi/g. All samples except those collected at Locations C06 and C12 with concentrations above FALs showed a decrease in concentration with depth. The highest

concentration of Eu-152 on this muckpile was found in a surface sample taken at location C05, near the edge of the flat upper portion of the muckpile. Because Eu-152 was a newly identified COC for CAS 12-06-07, this muckpile is considered to be contaminated at the highest concentration found, 60 pCi/g. Europium-152 contamination extended laterally beyond the lower edges of the muckpile (location C10) and exceeded the FAL in samples taken at two locations from the Initial Decision II Area (Section A.4.4.6) and one location from the Extended Decision II Area.

Co-60: The expected COC cobalt (Co)-60 was not detected above the FAL in any of the three CAU 551 muckpiles. Because the highest historical concentration (see CAU 551 CAIP, Table A.1-4) was not exceeded by any of the CAI results for the three muckpile CASs, all three muckpiles are considered to be contaminated by Co-60 at a concentration of 5.3 pCi/g.

A.4.2.7 Isotopic Radionuclides

Isotopic radionuclide analytical results for soil samples collected at CASs 12-06-05, 12-06-07, and 12-06-08 that exceeded the MDCs are presented in Tables A.4-16 through A.4-18, respectively.

Uranium (U)-234, U-235, U-238, and Sr-90 were not detected above FALs on the muckpiles.

Pu-238: The concentrations for 10 surface samples at CAS 12-06-05 and 4 surface samples collected at CAS 12-06-08 exceeded the FAL for Pu-238 (Tables A.4-16 and A.4-18; Figure A.4-2). These concentrations ranged from 3.29 pCi/g at location B03 to 28.6 pCi/g at location B14. The concentrations for four subsurface samples at CAS 12-06-05 and four subsurface samples at CAS 12-06-08 exceeded the FAL for Pu-238 (Tables A.4-16 and A.4-18; Figure A.4-2). These concentrations ranged from 4.24 to 8.8 pCi/g. In general, surface samples showed higher concentrations than subsurface samples except at locations B07, B10, D01, and D06. Because the highest concentration of Pu-238 (28.6 pCi/g) exceeded the highest historical concentration of 20.2 pCi/g (see CAU 551 CAIP, Table A.1-4), CASs 12-06-05 and 12-06-08 are considered to be contaminated at a concentration of 28.6 pCi/g. Plutonium-238 concentrations exceeding the FAL extended beyond the lower edges of the muckpile into the Initial Decision II Area (Section A.4.4.7) and Extended Decision II Area.

Table A.4-16
Soil Sample Results for Isotopes Detected Above Minimum Reporting Limits at CAS 12-06-05, U-12b Muckpile
(Page 1 of 2)

Sample Location	Sample Number	Depths (ft bgs)	Contaminants of Potential Concern (pCi/g)					
			Plutonium-238	Plutonium-239	Strontium-90	Uranium-234	Uranium-235	Uranium-238
Final Action Levels			**3.00**[a]	**311.91**[a]	**838**[b]	**143**[b]	**17.5**[b]	**105**[b]
B01	551B001	0.0 - 0.5	0.43	24.6	--	1.14	0.055	1.15
	551B002	0.5 - 1.0	0.83	43.7	0.7	1.11	0.08	1.25
	551B003	0.5 - 1.0	0.79	46.5	0.84	1.28	0.085	1.33
	551B004	2.5 - 3.0	0.108	5.53	--	1.24	--	1.04
B02	551B005	0.0 - 0.5	**26.8** (M3)	**1,430** (M3)	6.3 (J)	12.9 (M3)	0.192	1.16 (M3)
	551B006	1.0 - 1.5	0.289	14.4	--	1.09	--	1.09
B03	551B007	0.0 - 0.5	**4.07**	222	11.5 (J)	1.17 (M3)	--	1.19 (M3)
	551B008	1.0 - 1.5	2.31 (M3)	104 (M3)	4.8	1.08	--	1.15
B04	551B009	0.0 - 0.5	**6.5**	**344**	3.03	2.67 (M3)	--	1.26 (M3)
	551B010	3.5 - 4.0	1	48	--	1.61	0.092	1.37
B05	551B011	0.0 - 0.5	**13.5** (M3)	**740** (M3)	6.3 (J)	1.89 (M3)	--	1.23 (M3)
	551B012	1.5 - 2.0	**7.3**	**367** (M3)	2.55 (J)	1.77 (M3)	--	1.09 (M3)
B06	551B013	0.0 - 0.5	**10.2** (M3)	**555** (M3)	3.8	1.8	--	0.91
	551B014	2.0 - 2.5	**7.3** (M3)	**442** (M3)	2.59	1.71 (M3)	0.067	1.03
B07	551B015	0.0 - 0.5	2.45 (M3)	126 (M3)	4.2 (J)	1.19	0.079	0.97
	551B016	1.0 - 1.5	**7** (M3)	**335** (M3)	1.86 (J)	1.44	0.064	1.16
B08	551B017	0.0 - 0.5	0.94	43.6	1.92	0.99	--	0.96
	551B018	2.0 - 3.0	1.28	67	1.22	1.07	0.063	1.02
B09	551B019	0.0 - 0.5	**5.1** (M3)	191 (M3)	1.49 (J)	1.44 (M3)	--	1.33 (M3)
	551B020	1.0 - 1.5	0.306	13.1	--	1.07	--	1.37
B10	551B021	0.0 - 0.5	**3.34**	171	2.84	1.24	--	0.99
	551B022	2.0 - 3.0	**8.6** (M3)	**452** (M3)	4.8 (J)	1.5 (M3)	--	0.89 (M3)
B11	551B023	0.0 - 0.5	**3.29**	172 (M3)	3.2 (J)	1.75 (M3)	--	1.24 (M3)
	551B024	1.0 - 1.5	0.56	34.7	0.83	1.12	--	1.03
B12	551B025	0.0 - 0.5	0.79	33	0.68 (J)	1.19	0.044 (LT)	1.54
	551B026	0.0 - 0.5	0.82	33.6	--	1.15	0.067	1.49
	551B027	1.0 - 2.0	0.4	7.8	--	1.3	0.081	1.67

Table A.4-16
Soil Sample Results for Isotopes Detected Above Minimum Reporting Limits at CAS 12-06-05, U-12b Muckpile
(Page 2 of 2)

Sample Location	Sample Number	Depths (ft bgs)	Contaminants of Potential Concern (pCi/g)					
			Plutonium-238	Plutonium-239	Strontium-90	Uranium-234	Uranium-235	Uranium-238
Final Action Levels			**3.00**[a]	**311.91**[a]	**838**[b]	**143**[b]	**17.5**[b]	**105**[b]
B13	551B028	0.0 - 0.5	**6.6** (M3)	**321** (M3)	3.15 (J)	1.94 (M3)	--	1.4 (M3)
	551B029	1.5 - 2.0	1.07	50.5	0.39 (LT)	1.24	0.069	1.11
B14	551B030	0.0 - 0.5	**28.6** (M3)	**1,440** (M3)	21.7	2.49	0.087	1.14

[a]Taken from values computed from RESRAD for CAU 551, Land Parcel 1.
[b]Taken from the construction, commercial, industrial land use scenario in Table 2.1 of the NCRP Report No. 129 *Recommended Screening Limits for Contaminated Surface Soil and Review Factors Relevant to Site-Specific Studies* (NCRP, 1999). The values provided in this source document were scaled to a 25-mrem/yr dose.

ft bgs = Feet below ground surface
mrem/yr = Millirem per year
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive computer code
J = Estimated value
LT = Result is less than the requested minimum detected concentration, greater than the sample specific minimum detectable concentration.
M3 = The requested minimum detectable concentration was not met, but the reported activity is greater than the reported minimum detectable concentration.
-- = Not detected above minimum reporting limits.

The concentrations for most surface and subsurface samples collected at CAS 12-06-07 exceeded the FAL for Pu-238 (Table A.4-17 and Figure A.4-3). Surface concentrations for Pu-238 above the FAL ranged from 10 to 127 pCi/g, and subsurface sample concentrations ranged from 8.4 to 34.2 pCi/g. In general, all surface samples showed higher levels of contamination than subsurface samples, with the exception at location C15. The highest concentration of Pu-238 was found in the surface sample from location C04, near the F-Tunnel portal. Because the highest concentration of 127 pCi/g exceeded the highest historical concentration of 20.2 (see CAU 551 CAIP, Table A.1-4), CAS 12-06-07 is considered to be contaminated with Pu-238 at a concentration of 127 pCi/g. The Pu-238 concentrations exceeding the FAL extended beyond the lower edges of the muckpile into the Initial and Extended Decision II areas (Section A.4.4.7).

Table A.4-17
Soil Sample Results for Isotopes Detected Above Minimum Reporting Limits at CAS 12-06-07, Muckpile
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)					
			Plutonium-238	Plutonium-239	Strontium-90	Uranium-234	Uranium-235	Uranium-238
Final Action Levels			**3.00**[a]	**311.91**[a]	**838**[b]	**143**[b]	**17.5**[b]	**105**[b]
C01	551C001	0.0 - 0.5	0.089	9.7	--	1.06	0.073	1.14
	551C002	3.5 - 4.0	--	--	--	1.68	0.059	1.63
	551C003	3.5 - 4.0	--	--	--	1.73	0.09	1.83
C02	551C004	0.0 - 0.5	**10.1** (M3)	**760** (M3)	2.49 (J)	2.7 (M3)	--	0.8 (M3)
	551C005	1.0 - 1.5	0.063	2.64	--	1.35	--	1.19
C03	551C006	0.0 - 0.5	**54.5** (M3)	**4,220** (M3)	6.4 (J)	10.7 (M3)	0.33 (M3)	1.33 (M3)
C04	551C007	0.0 - 0.5	**127** (M3)	**13,200** (M3)	21.7 (J)	22.8 (M3)	0.86 (M3)	1.47 (M3)
	551C008	1.0 - 1.5	**11.3** (M3)	**770** (M3)	6 (J)	3.25	0.125	0.86
C05	551C009	0.0 - 0.5	**53.8** (M3)	**3,880** (M3)	12.7 (J)	16.8 (M3)	0.8 (M3)	1.46 (M3)
	551C010	2.5 - 3.0	**20.4** (M3)	**1,560** (M3)	2.83 (J)	5.22	0.2	1.51 (M3)
C06	551C011	0.0 - 0.5	**12.7** (M3)	**810** (M3)	4.3	2.8	--	1.21 (M3)
	551C012	0.5 - 1.0	**8.4** (M3)	**610** (M3)	3.19	2.48 (M3)	--	1.3
C07	551C013	0.0 - 0.5	**27.1** (M3)	**1,980** (M3)	1.91	6.9 (M3)	0.32 (M3)	1.14 (M3)
	551C014	1.5 - 2.0	**13** (M3)	**770** (M3)	0.84	3.06	0.143	1.06
C08	551C015	0.0 - 0.5	2.5 (M3)	224 (M3)	--	1.62	0.076	1.14
	551C016	1.0 - 1.5	--	2.43 (J)[c]	--	1.2	0.053	1.23
C09	551C017	0.0 - 0.5	**42.8** (M3)	**3,030** (M3)	2.99	9.5 (M3)	0.31 (M3)	1.35
C10	551C018	0.0 - 0.5	**96** (J)[d]	**7,000** (J)[d]	7.9 (J)	23.2 (M3)	0.88 (M3)	1.65 (M3)
	551C019	1.0 - 1.5	**34.2** (M3)	**2,530** (M3)	1.62	7.1 (M3)	0.28 (M3)	1.24 (M3)
C11	551C020	0.0 - 0.5	**18.6** (M3)	**1,210** (M3)	1.59	4.36	0.159	1.29
	551C021	2.5 - 3.0	**16.3** (M3)	**1,230** (M3)	1.19	4.21	0.153	1.06
C12	551C022	0.0 - 0.5	**26.6** (M3)	**1,850** (M3)	2.05 (J)	6.5 (M3)	--	1.13 (M3)
	551C023	1.0 - 1.5	**25.6** (M3)	**1,820** (M3)	2.39 (J)	6.6 (M3)	0.38 (M3)	1.48 (M3)
C13	551C024	0.0 - 0.5	**30.1** (M3)	**2,280** (M3)	3.51 (J)	6.2	0.29 (M3)	1.15 (M3)
	551C025	2.0 - 3.0	**18.9** (M3)	**1,390** (M3)	3.9 (J, Y1)	6.1	0.3 (M3)	1.28

Table A.4-17
Soil Sample Results for Isotopes Detected Above Minimum Reporting Limits at CAS 12-06-07, Muckpile
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)					
			Plutonium-238	Plutonium-239	Strontium-90	Uranium-234	Uranium-235	Uranium-238
Final Action Levels			**3.00**[a]	**311.91**[a]	**838**[b]	**143**[b]	**17.5**[b]	**105**[b]
C14	551C026	0.0 - 0.5	**21.7** (M3)	**1,570** (M3)	3.8 (J)	6	0.22	0.93
	551C027	0.0 - 0.5	**26.6** (M3)	**1,840** (M3)	4.3 (J, Y1)	6.4 (M3)	0.18	1.25 (M3)
	551C028	1.0 - 1.5	**13.8** (M3)	**1,050** (M3)	3.71 (J, Y1)	3.18 (M3)	0.178 (M3)	1.14
C15	551C029	0.0 - 0.5	**10** (M3)	**730** (M3)	3.48 (Y1)	2.38	0.11	1.01
	551C030	1.0 - 1.5	**16.1** (M3)	**1,200** (M3)	4.4 (Y1)	3.9 (M3)	--	1.28 (M3)
C16	551C031	0.0 - 0.5	1.9	133	2.47 (Y1)	1.37	0.082	1.18
	551C032	2.0 - 2.5	0.11	5.8	3.51 (Y1)	1.09	0.06	0.97

[a]Taken from values computed from RESRAD for CAU 551, Land Parcel 1.
[b]Taken from the construction, commercial, industrial land use scenario in Table 2.1 of the NCRP Report No. 129 *Recommended Screening Limits for Contaminated Surface Soil and Review Factors Relevant to Site-Specific Studies* (NCRP, 1999). The values provided in this source document were scaled to a 25-mrem/yr dose.
[c]Qualifier added to laboratory data; record accepted. Duplicate precision analysis (relative percent difference) outside control limits.
[d]Qualifier added to laboratory data; record accepted. Chemical yield above control limits.

ft bgs = Feet below ground surface
mrem/yr = Millirem per year
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive computer code
J = Estimated value
M3 = The requested minimum detectable concentration was not met, but the reported activity is greater than the reported minimum detectable concentration.
Y1 = Chemical yield is in control at 100-110%. Quantitative yield is assumed.
-- = Not detected above minimum reporting limits.

Table A.4-18
Soil Sample Results for Isotopes Detected Above Minimum Reporting Limits at CAS 12-06-08, Muckpile

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)					
			Plutonium-238	Plutonium-239	Strontium-90	Uranium-234	Uranium-235	Uranium-238
Final Action Levels			**3.00**[a]	**311.91**[a]	**838**[b]	**143**[b]	**17.5**[b]	**105**[b]
D01	551D001	0.0 - 0.5	1.64	98	--	1.17	0.07	1.04
	551D002	0.5 - 1.0	**4.32**	299	--	2.21	0.158	1.23
	551D003	0.5 - 1.0	**4.24** (M3)	279	--	1.6	--	0.94
D02	551D004	0.0 - 0.5	0.8	54.5	0.62	1.09	0.05 (LT)	1.15
	551D005	0.5 - 1.0	0.408	23.1	0.5 (Y1)	1.14	--	1.16
	551D006	1.5 - 2.0	0.51	25.7	--	1.28	0.056	1.26
D03	551D007	0.0 - 0.5	0.4	21.7	0.61	1.01	0.043 (LT)	1.05
	551D008	0.5 - 1.0	0.264	14.6	--	0.86	0.061	0.95
D04	551D009	0.0 - 0.5	**17.4** (M3)	**1,210** (M3)	15.1 (J)	4.93	0.167	1.58
	551D010	2.0 - 3.0	**5.8** (M3)	**484** (M3)	3.42 (J)	2.13	--	1.11 (M3)
D05	551D011	0.0 - 0.5	**11.6** (M3)	**790** (M3)	2.39 (J)	2.31 (M3)	--	1.26
	551D012	1.5 - 2.0	**8.8** (M3)	**670** (M3)	2.8 (J)	3.33 (M3)	0.155	1.31 (M3)
D06	551D013	0.0 - 0.5	**5.7** (M3)	**360** (M3)	4.8 (J)	2.45 (M3)	0.15	1.23 (M3)
	551D014	1.0 - 1.5	**8.5** (M3)	**518** (M3)	4.1 (J)	2.39 (M3)	--	1.16 (M3)
D07	551D015	0.0 - 0.5	**9.8** (M3)	**557** (M3)	5 (J)	3.2 (M3)	--	1.67 (M3)

[a]Taken from values computed from RESRAD for CAU 551, Land Parcel 1.
[b]Taken from the construction, commercial, industrial land use scenario in Table 2.1 of the NCRP Report No. 129 *Recommended Screening Limits for Contaminated Surface Soil and Review Factors Relevant to Site-Specific Studies* (NCRP, 1999). The values provided in this source document were scaled to a 25-mrem/yr dose.

ft bgs = Feet below ground surface
mrem/yr = Millirem per year
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive computer code
J = Estimated value
LT = Result is less than the requested minimum detectable concentration, greater than the sample specific minimum detectable concentration.
M3 = The requested minimum detectable concentration was not met, but the reported activity is greater than the reported minimum detectable concentration.
Y1 = Chemical yield is in control at 100-110%. Quantitative yield is assumed.
-- = Not detected above minimum reporting limits.

Pu-239: The concentrations for four surface samples at CAS 12-06-05 and four surface samples at CAS 12-06-08 exceeded the FAL for Pu-239 (Tables A.4-16 and A.4-18; Figure A.4-2). The concentrations for three subsurface samples at CAS 12-06-05 and three subsurface samples at CAS 12-06-08 exceeded the FAL for Pu-239 (Tables A.4-16 and A.4-18; Figure A.4-2). Surface sample concentrations for Pu-239 above the FAL ranged from 360 to 1,440 pCi/g, and subsurface sample concentrations ranged from 367 to 670 pCi/g. In general, surface samples showed higher levels of contamination than subsurface samples, with the exception of locations B10 and D06. The highest concentration of Pu-239 was found in a surface sample taken at location B14, and is the same sample that had the highest concentration of Am-241 and Pu-238 on CASs 12-06-05 and 12-06-08. Because the results for these muckpiles exceeded the historical highest concentration detected of 122 pCi/g for Pu-239 (CAU 551 CAIP, Table A.1-4), the muckpile is considered to be contaminated by Pu-239 at a concentration of 1,440 pCi/g. The Pu-239 contamination extended beyond the lower edges of the muckpile and was identified above the FALs in samples taken from the Initial and Extended Decision II areas (Section A.4.4.7).

The concentrations for most samples collected at CAS 12-06-07 exceeded the FAL for Pu-239 (Table A.4-17 and Figure A.4-3). Surface sample concentrations for Pu-239 above the FAL ranged from 730 to 13,200 pCi/g, and subsurface sample concentrations ranged from 610 to 2,530 pCi/g. In general, surface samples showed higher levels of contamination than subsurface samples with the exception of locations C11 and C15. The highest concentration of Pu-239 was found in a surface sample taken at location C04, and is the same sample that had the highest concentration of Pu-238 on CAS 12-06-07. Because the results for this muckpile exceeded the historical highest concentration detected of 122 pCi/g for Pu-239 (see CAU 551 CAIP, Table A.1-4), the muckpile is considered to be contaminated by Pu-239 at a concentration of 13,200 pCi/g. The Pu-239 contamination extends beyond the lower edges of the muckpile and was identified above the FALs in samples taken from the Initial and Extended Decision II areas (Section A.4.4.7).

A.4.3 CASs 12-06-05, 12-06-07, and 12-06-08, Muckpiles, Decision II, Downslope Area, Verification Sampling Area, and Upslope Area

The Decision II area for the muckpiles was originally limited to the downslope areas from each of the three muckpiles and the extent of any lateral migration of COCs identified with CAU 551 muckpiles. This contamination was originally thought to be limited to downslope washes draining the area that

may carry contamination to or beyond the E-Tunnel muckpile. During the course of the investigation, it was discovered that radiological contamination also existed in upslope areas away from the muckpiles (i.e., AST and stain samples, and one background sample from an area above and to the northwest of CAS 12-01-09). A subsequent review of likely sources for this contamination focused on the Neptune crater and events surrounding the Neptune test in C-Tunnel. Confirmation of the Neptune test being the most probable source for the contamination was made during an interview and a subsequent review of additional literature provided. To establish a border between CAS 12-06-07 and a potential, new source of contamination not previously identified, and to gain an idea of the extent of the effects on CAU 551, the Decision II area was expanded to include selected locations along bordering roadways.

For determining the extent of lateral contamination downslope from the CAU 551 muckpiles, the steep slopes and short distances to washes preclude associating COCs in many samples with any one particular muckpile, as well as with contamination that may come from non-muckpile areas in the watershed. Therefore, this section, therefore, presents the results for the off-muckpile areas without identifying any one muckpile as the possible source, unless noted otherwise. During DQO development, the concept of an "Initial Decision II" area and "Extended Decision II" area was established. The muckpiles downslope area consists of these two areas.

An additional area was identified for sampling in May 2005 to verify that radiological contamination had not moved down the wash from CAUs 551 and 383. This area and a smaller plot near the Defense Threat Reduction Agency generator equipment were both designated as the "Verification Sampling Area." Aerial photographs depicting the estimated Initial Decision II and Extended Decision II sampling locations are presented in Section A.1.8, Figures A.1-11 and A.1-12, in the CAU 551 CAIP (NNSA/NSO, 2004).

The muckpiles Decision II downslope area at CAU 551 was included in the muckpiles' CSM as presented in Section A.1.2.3 of the CAU 551 CAIP (NNSA/NSO, 2004).

A.4.3.1 Corrective Action Investigation

For the muckpiles Decision II downslope area, a total of 49 environmental samples (including 3 FDs) were collected from 30 locations. For the muckpiles Decision II upslope area, a total of 22

environmental samples (including 1 duplicate) were collected from 15 locations. Three samples, each collected at the surface from three separate locations for the original purpose of determining background concentrations, are included in these totals, because they were collected in the probable area of impact from the Neptune test. For the Verification Sampling Area, a total of 16 samples (including 1 FD) were collected from 15 locations. The sample IDs, locations, types, and analyses are listed in Tables A.4-19 and A.4-20, respectively. Sample locations are shown on Figure A.4-4 (downslope, Initial Decision II Area), Figure A.4-5 (downslope, Extended Decision II Area), Figure A.4-6 (downslope, Verification Sampling Area), and Figure A.4-7 (Decision II upslope area). Because three locations in the Extended Decision II Area were outside the area covered by the higher resolution aerial photograph from 1966 used, locations E16, E17, and E24 are shown on Figure A.4-6 as well. Location E18 was included to give an idea of location proximities. The specific CAI activities conducted to satisfy the CAIP requirements at this CAS are described in the following sections.

Table A.4-19
Samples Collected at CAU 551, Muckpiles Decision II, Downslope
(Page 1 of 4)

Sample Location	Sample Number	Depth (ft bgs)	Sample Matrix	Sample Type	Analyses
E01	551E001	0.0 - 0.5	Soil	Environmental	Set 1
	551E002	1.0 - 1.5	Soil	Environmental	Set 1
E02	551E003	0.0 - 0.5	Soil	Environmental	Set 1
	551E004	0.0 - 0.5	Soil	Field Duplicate of #551E003	Set 1
	551E005	1.0 - 1.5	Soil	Environmental	Set 1
E03	551E006	0.0 - 0.5	Soil	Environmental	Set 1
E04	551E007	0.0 - 0.5	Soil	Environmental	Set 1
	551E008	1.0 - 1.5	Soil	Environmental	Set 1
E05	551E009	0.0 - 0.5[a]	Soil	Environmental	Set 1
E06	551E010	0.0 - 0.5	Soil	Environmental	Set 1
	551E011	1.0 - 1.5	Soil	Environmental	Set 1
E07	551E012	0.0 - 0.5[a]	Soil	Environmental	Set 1
E08	551E013	0.0 - 0.5	Soil	Environmental	Set 1
	551E014	1.0 - 1.5	Soil	Environmental	Set 1
E09	551E015	0.0 - 0.5	Soil	Environmental	Set 1
	551E016	1.5 - 2.0	Soil	Environmental	Set 1

Table A.4-19
Samples Collected at CAU 551, Muckpiles Decision II, Downslope
(Page 2 of 4)

Sample Location	Sample Number	Depth (ft bgs)	Sample Matrix	Sample Type	Analyses
E10	551E017	0.0 - 0.5	Soil	Environmental	Set 1
	551E018	1.0 - 1.5	Soil	Environmental	Set 1
E11	551E019	0.0 - 0.5	Soil	Environmental	Set 1
	551E020	1.0 - 1.5	Soil	Environmental	Set 1
E12	551E021	0.0 - 0.5	Soil	Environmental	Set 1
E13	551E022	0.0 - 0.5	Soil	Environmental	Set 1
E14	551E023	0.0 - 0.5	Soil	Environmental	Set 1
	551E024	0.0 - 0.5	Soil	Field Duplicate of #551E023	Set 1
E15	551E025	0.0 - 0.5	Soil	Environmental	Set 1
E16	551E026	0.0 - 0.5	Soil	Environmental, QC	Set 4
E17	551E027	0.0 - 0.5	Soil	Environmental	Set 4
E18	551E028	0.0 - 0.5	Soil	Environmental	Set 4
E19	551E029	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium, Strontium-90
E20	551E030	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium, Strontium-90
	551E031	0.5 - 1.0	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium, Strontium-90
E21	551E032	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium, Strontium-90
E22	551E033	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium, Strontium-90
	551E034	0.5 - 1.0	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium, Strontium-90
E23	551E035	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium, Strontium-90
	551E036	0.5 - 1.0	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium, Strontium-90
E24	551E037	0.0 - 0.5	Soil	Environmental	Set 4
	551E038	0.5 - 1.0	Soil	Environmental	Set 4
E25	551E039	0.0 - 0.5	Soil	Environmental	Set 4

Table A.4-19
Samples Collected at CAU 551, Muckpiles Decision II, Downslope
(Page 3 of 4)

Sample Location	Sample Number	Depth (ft bgs)	Sample Matrix	Sample Type	Analyses
E26	551E040	0.0 - 0.5	Soil	Environmental	Set 4
	551E041	0.0 - 0.5	Soil	Field Duplicate of #551E040	Set 4
	551E042	0.5 - 1.0	Soil	Environmental	Set 4
E27	551E043	0.0 - 0.5	Soil	Environmental	Set 4, SVOCs
E28	551E044	0.0 - 0.5	Soil	Environmental	Set 4, SVOCs
	551E045	0.5 - 1.0	Soil	Environmental	Set 4, SVOCs
E29	551E046	0.0 - 0.5	Soil	Environmental	Set 4, SVOCs
	551E047	1.0 - 1.5	Soil	Environmental	Set 4, SVOCs
E30	551E048	0.0 - 0.5	Soil	Environmental	Set 4, SVOCs
	551E049	2.0 - 2.5	Soil	Environmental	Set 4, SVOCs
X01	PA-551X001	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium
X02	PA-551X002	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium
	PA-551X003	0.0 - 0.5	Soil	Field Duplicate of PA-551X002	Gamma Spectroscopy, Isotopic Plutonium
X03	PA-551X004	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium
X04	PA-551X005	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium
X05	PA-551X006	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium
X06	PA-551X007	0.0 - 0.5	Soil	Environmental, QC	Gamma Spectroscopy, Isotopic Plutonium
X07	PA-551X008	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium
X08	PA-551X009	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium
X09	PA-551X010	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium
X10	PA-551X011	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium
X11	PA-551X012	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium
X12	PA-551X013	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium

Table A.4-19
Samples Collected at CAU 551, Muckpiles Decision II, Downslope
(Page 4 of 4)

Sample Location	Sample Number	Depth (ft bgs)	Sample Matrix	Sample Type	Analyses
X13	PA-551X014	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium
X14	PA-551X015	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy, Isotopic Plutonium
N/A	551E301	N/A	Water	Trip Blank	Total VOCs
N/A	551E302	N/A	Water	Field Blank	Set 1
N/A	551E303	N/A	Water	Trip Blank	Total VOCs
N/A	551E304	N/A	Water	Trip Blank	Total VOCs
N/A	551E305	N/A	Water	Trip Blank	Total VOCs
N/A	551E306	N/A	Water	Equipment Rinsate Blank	Set 1
N/A	551E307	N/A	Water	Trip Blank	Total VOCs
N/A	551E308	N/A	Water	Field Blank	Set 4
N/A	PA-551X300	N/A	Water	Field Blank	Gamma Spectroscopy, Isotopic Plutonium
N/A	551E501	N/A	Liquid	WM	Gross Alpha/Beta, Tritium

[a]Depth at or near refusal

Set 1 = Total VOCs, Total SVOCs, TPH-DRO, PCBs, Total RCRA Metals, Beryllium, Gamma Spectroscopy, Isotopic Uranium, Isotopic Plutonium, and Strontium-90
Set 4 = TPH-DRO, Gamma Spectroscopy, Isotopic Plutonium, Strontium-90

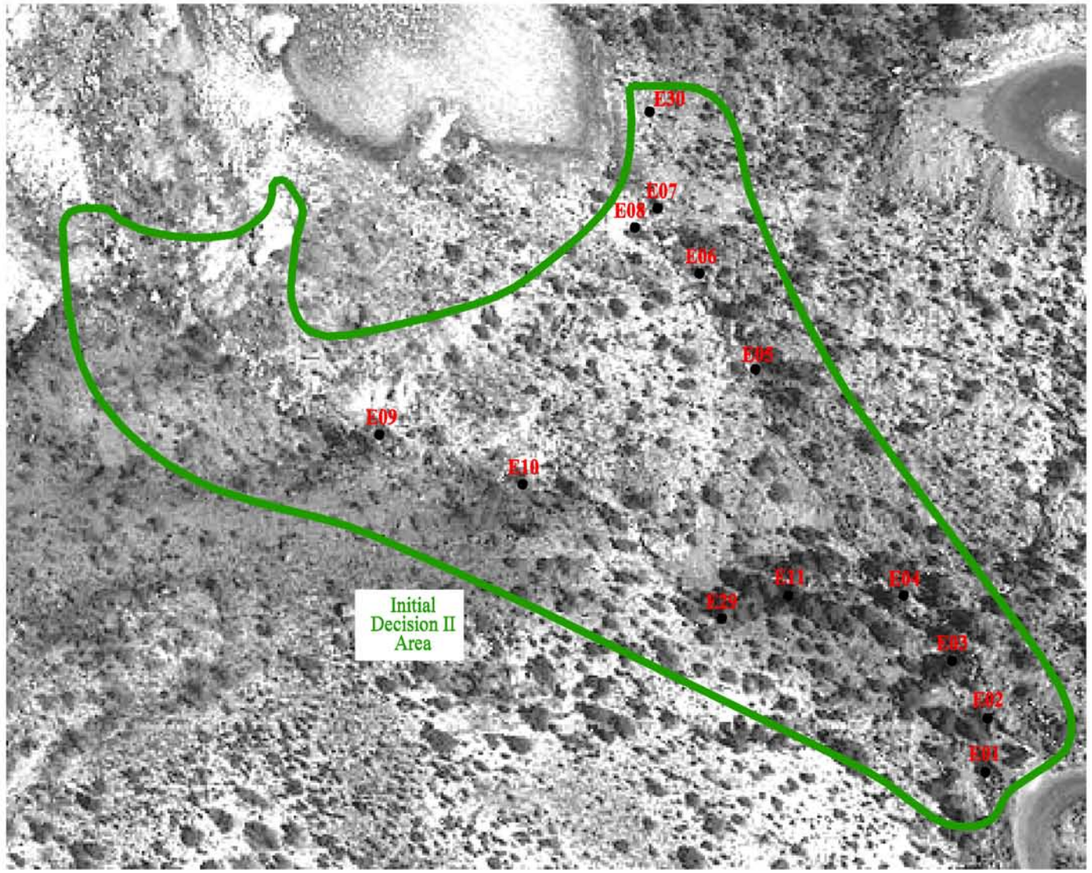
DRO = Diesel-range organics
ft bgs = Feet below ground surface
N/A = Not applicable
PCB = Polychlorinated biphenyl
QC = Quality Control
RCRA = *Resource Conservation Recovery Act*
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound
WM = Waste management

Table A.4-20
Samples Collected at CAU 551, Muckpiles Decision II, Upslope

Sample Location	Sample Number	Depth (ft bgs)	Sample Matrix	Sample Type	Analyses
A08	551A019	0.0 - 0.5	Soil	Environmental	Set 3
A09	551A020	0.0 - 0.5	Soil	Environmental	Set 3
A10	551A021	0.0 - 0.5	Soil	Environmental	Set 3
E31	551E050	0.0 - 0.5	Soil	Environmental	Set 3
	551E051	0.5 - 1.0	Soil	Environmental	Set 3
E32	551E052	0.0 - 0.5	Soil	Environmental	Set 3
E33	551E053	0.0 - 0.5	Soil	Environmental	Set 3
E34	551E054	0.0 - 0.5	Soil	Environmental	Set 3
	551E055	0.5 - 1.0	Soil	Environmental	Set 3
E35	551E056	0.0 - 0.5	Soil	Environmental	Set 3
E36	551E057	0.0 - 0.5	Soil	Environmental	Set 3
	551E058	0.5 - 1.0	Soil	Environmental	Set 3
E37	551E059	0.0 - 0.5	Soil	Environmental	Set 3
	551E060	0.5 - 1.0	Soil	Environmental	Set 3
E38	551E061	0.0 - 0.5	Soil	Environmental	Set 3
E39	551E062	0.0 - 0.5	Soil	Environmental	Set 3
E40	551E063	0.0 - 0.5	Soil	Environmental, QC	Set 3
	551E064	0.5 - 1.0	Soil	Environmental	Set 3
E41	551E065	0.0 - 0.5	Soil	Environmental	Set 3
E42	551E066	0.0 - 0.5	Soil	Environmental	Set 3
	551E067	0.0 - 0.5	Soil	Field Duplicate of #551E066	Set 3
	551E068	0.5 - 1.0	Soil	Environmental	Set 3
N/A	551E309	N/A	Water	Field Blank	Set 3

Set 3 = Gamma Spectroscopy, Isotopic Uranium, Isotopic Plutonium, and Strontium 90

ft bgs = Feet below ground surface
N/A = Not applicable
QC = Quality control



Location	Depth (ft)	Am-241 (pCi/g)	Cs-137 (pCi/g)	Eu-152 (pCi/g)	Pu-238 (pCi/g)	Pu-239 (pCi/g)	Diesel (mg/kg)
Value for FAL		*287.42*	*28.74*	*1.03*	*3.54*	*194.17*	*100*
E01	0.0 - 0.5	------	------	ND	------	------	220
	1.0 - 1.5	------	------	ND	------	------	170
E02	0.0 - 0.5	------; ------	------; ------	ND	------; ------	------; ------	280; 340
	1.0 - 1.5	------	------	ND	------	------	130
E03	0.0 - 0.5	------	31.7	1.51	3.78	195	190
E04	0.0 - 0.5	------	------	ND	4.15	221	230
	1.0 - 1.5	------	------	ND	------	------	------
E05	0.0 - 0.5	------	------	ND	------	------	------
E06	0.0 - 0.5	------	------	ND	4.65	240	------
	1.0 - 1.5	------	35	ND	6	309	------
E07	0.0 - 0.5	------	------	ND	4.93	247	230
E08	0.0 - 0.5	ND	------	ND	ND	------	220
	1.0 - 1.5	ND	ND	ND	ND	------	------
E09	0.0 - 0.5	------	------	ND	------	------	ND
	0.5 - 1.0	------	------	ND	------	------	ND
E10	0.0 - 0.5	487	------	1.74	4.2	329	110
	1.0 - 1.5	------	------	ND	------	------	ND
E11	0.0 - 0.5	------	------	ND	------	------	------
	0.5 - 1.0	------	------	ND	------	------	ND
E29	0.0 - 0.5	------	------	ND	------	------	------
	1.0 - 1.5	ND	ND	ND	------	------	------
E30	0.0 - 0.5	------	36.6	ND	5.8	318	130
	2.0 - 2.5	ND	------	ND	------	------	240

Notes:
- Cells with two entries separated by a semicolon represent results of field duplicates
- FAL values for radionuclides are based on RESRAD calculations for CAU 551, Land Parcel 2.
- NA = Not analyzed
- ND = Not detected
- ------ = Concentration was detected, but below FAL

Explanation
- E06 GPS Coordinates
- Area Boundary

Scale
0 100 200 Feet
0 25 50 Meters

Source: Modified from Holmes & Narver, Inc. 1966

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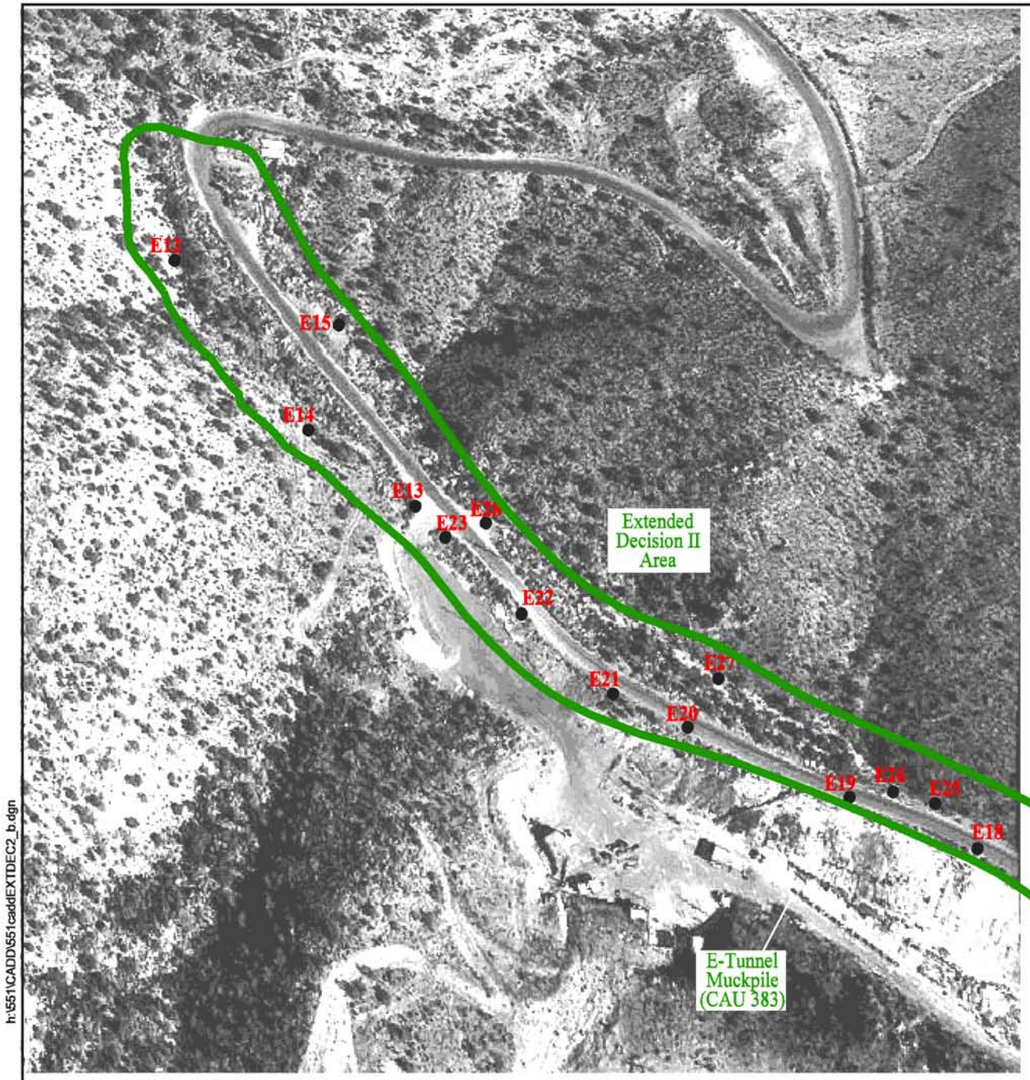
30-JUN-2005

Figure A.4-4
Sample Location Map and Results Above FALs for CAU 551, Initial Decision II Area



Location	Depth (ft)	Am-241 (pCi/g)	Cs-137 (pCi/g)	Eu-152 (pCi/g)	Pu-238 (pCi/g)	Pu-239 (pCi/g)	Diesel (mg/kg)
Value for FAL		*287.42*	*28.74*	*1.03*	*3.54*	*194.17*	*100*
E12	0.0 - 0.5	------	------	ND	------	------	ND
E13	0.0 - 0.5	------	---------	ND	------	------	------
E14	0.0 - 0.5	------; ------	48.7; 48.6	1.48; 1.59	------; 4.57	-------; 229	ND; ND
E15	0.0 - 0.5	ND	------	ND	------	------	700
E16	0.0 - 0.5	ND	ND	ND	------	------	340
E17	0.0 - 0.5	ND	ND	ND	------	------	440
E18	0.0 - 0.5	ND	------	ND	------	------	850
E19	0.0 - 0.5	ND	------	ND	------	------	NA
E20	0.0 - 0.5	ND	ND	ND	------	------	NA
	0.5 - 1.0	ND	ND	ND	------	------	NA
E21	0.0 - 0.5	ND	ND	ND	------	------	NA
E22	0.0 - 0.5	ND	------	ND	------	------	NA
	0.5 - 1.0	ND	------	ND	------	------	NA
E23	0.0 - 0.5	ND	------	ND	------	------	NA
	0.5 - 1.0	ND	ND	ND	------	------	NA
E24	0.0 - 0.5	ND	------	ND	------	------	450
	0.5 - 1.0	ND	ND	ND	------	------	620
E25	0.0 - 0.5	ND	------	ND	------	------	980
E26	0.0 - 0.5	ND; ND	------; ------	ND	------; ------	------; ------	410; 380
	0.5 - 1.0	ND	------	ND	------	------	670
E27	0.0 - 0.5	ND	------	ND	------	------	530
E28	0.0 - 0.5	ND	------	ND	------	------	530
	0.5 - 1.0	ND	------	ND	------	------	240

Notes:
- Cells with two entries separated by a semicolon represent results of field duplicates
- FAL values for radionuclides are based on results from RESRAD calculations for CAU551, Land Parcel 2.
- NA = Not analyzed
- ND = Not detected
- ------ = Concentration was detected, but below FAL

Explanation
- E06 GPS Coordinates
- E17 Estimated Locations
- Area Boundary

Scale
0 150 300 Feet
0 40 80 Meters

Source: Modified from Holmes & Narver, Inc. 1966

Figure A.4-5
Sample Location Map and Results Above FALs for CAU 551, Extended Decision II Area

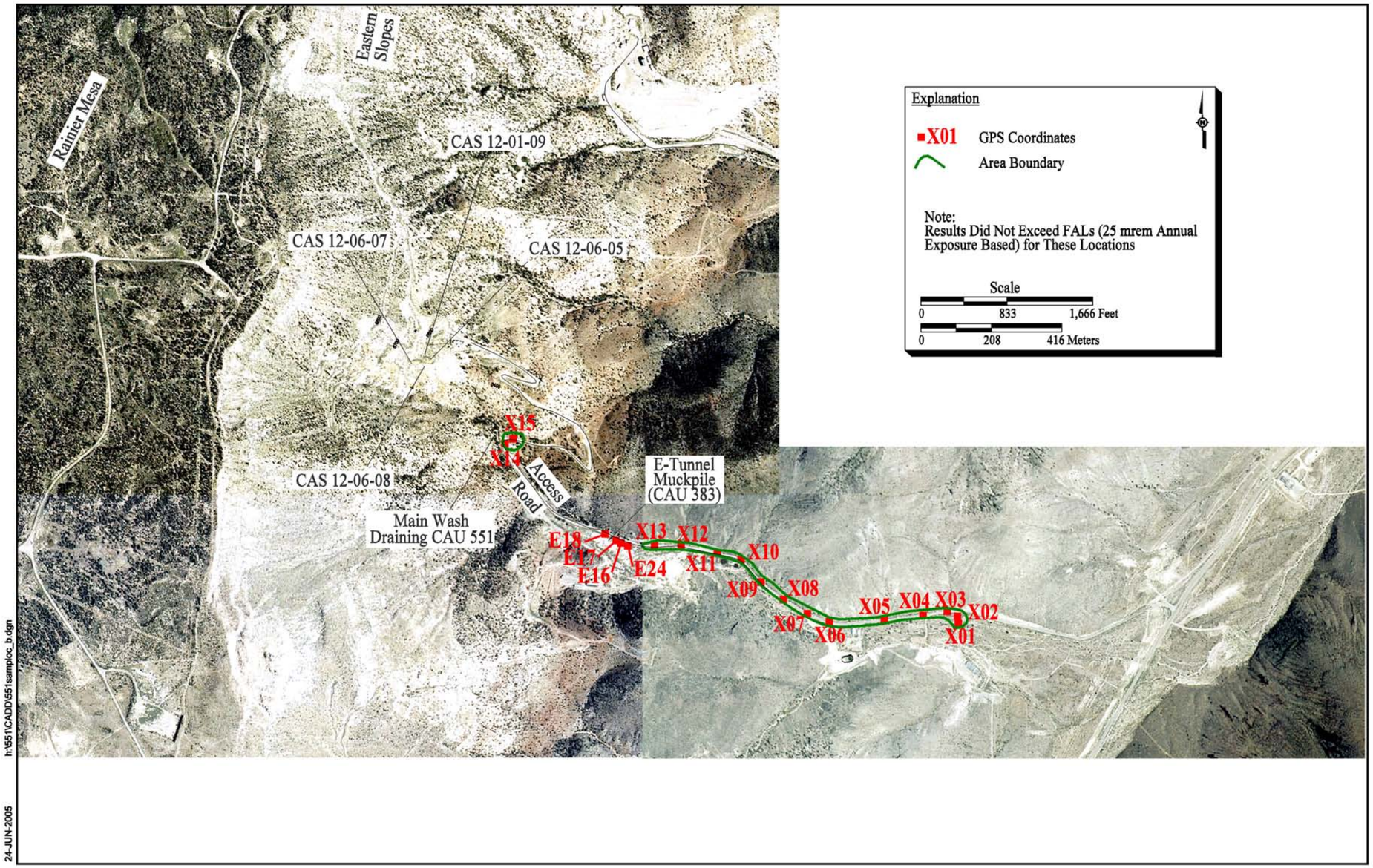
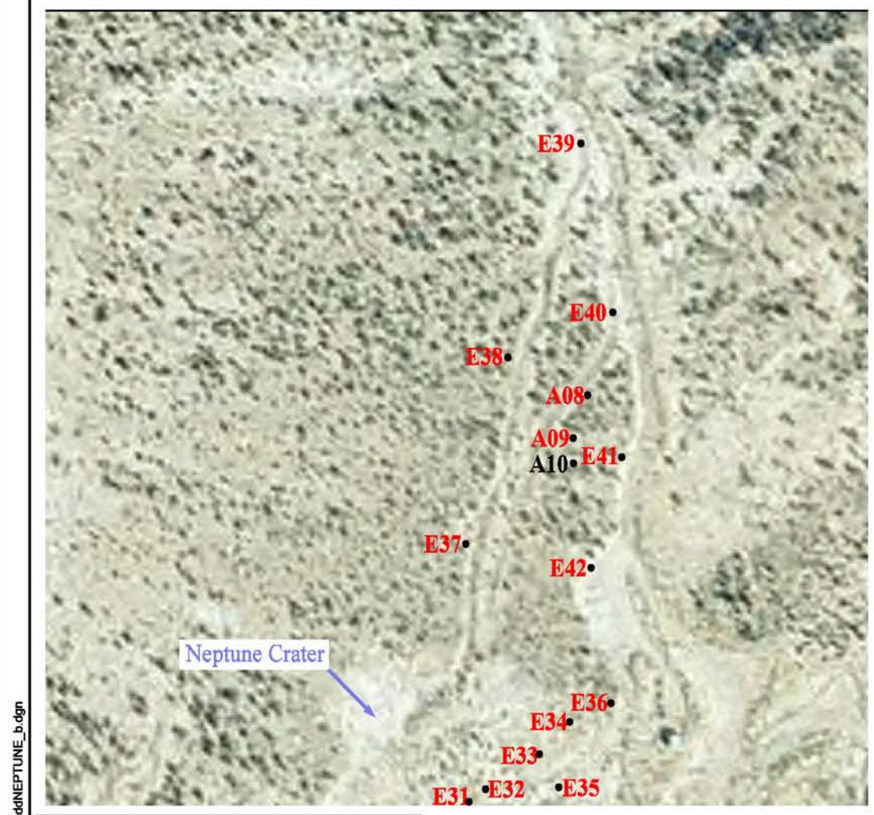


Figure A.4-6
Sample Location Map for CAU 551, Verification Sampling Area



Location	Depth (ft)	Am-241 (pCi/g)	Cs-137 (pCi/g)	Pu-238 (pCi/g)	Pu-239 (pCi/g)
Value for FAL		*12.7*	*12.2*	*13*	*12.7*
A08	0.0 - 0.5	------	------	------	21.8
A09	0.0 - 0.5	ND	------	------	------
A10	0.0 - 0.5	------	------	------	------
E31	0.0 - 0.5	319	43.4	26.1	2,080
	0.5 - 1.0	347	55.2	18.9	1,140
E32	0.0 - 0.5	395	29.7	18.9	1,060
E33	0.0 - 0.5	90	------	------	183
E34	0.0 - 0.5	389	24.5	29.3	2,230
	0.5 - 1.0	263	17.5	------	820
E35	0.0 - 0.5	135	------	------	213
E36	0.0 - 0.5	------	------	------	72
	0.5 - 1.0	------	------	------	------
E37	0.0 - 0.5	ND	ND	ND	------
	0.5 - 1.0	ND	ND	ND	------
E38	0.0 - 0.5	------	------	------	------
E39	0.0 - 0.5	ND	------	------	------
E40	0.0 - 0.5	ND	ND	ND	------
	0.5 - 1.0	ND	ND	ND	ND
E41	0.0 - 0.5	ND	------	------	------
E42	0.0 - 0.5	------; ------	------; ------	------; ------	------; ------
	0.5 - 1.0	ND	------	ND	------

Notes:
- Cells with two entries separated by a semicolon represent results of field duplicates
- FAL values are based on annual exposure of 25 mrem
- ND = Not detected
- ------ = Concentration was detected, but below FAL

Figure A.4-7
Sample Location Map and Results Above FALs for Upslope Area

A.4.3.2 Field Screening

Muckpiles Decision II downslope and upslope soil samples (551E001 through 551E068) and Verification Sampling Area samples (PA-551X001 through PA-551X016) were field screened for alpha and beta/gamma radiation. Soil samples 551E001 through 551E025 were field screened for VOCs; after preliminary results determined that VOCs were not exceeding FALs on any samples taken at CAU 551, later samples were not screened for VOCs. The FSRs were compared to FSLs to guide subsequent sampling decisions. The VOC headspace FSLs were not exceeded during sampling activities. Alpha and/or beta radiation FSLs were exceeded on the following samples during sampling activities:

- Downslope: Alpha radiation on 551E007-E009, E011, E015, E023, E024, and E048; beta radiation on 551E002, E005-E012, E015, E017, E019, E022, E023, E048, and PA-551X006. Sample 551E042 was too wet to screen in the field; instead, a sample was taken to Mercury for analysis by gamma spectroscopy, before shipping a separate portion to the analytical laboratory. This analyses did not identify alpha or beta radioactivity.

- Upslope: Alpha radiation on 551E050, 551E051, 551E052, 551E053, 551E055, 551E056, 551E057, and 551E058; beta radiation on 551E050, 551E051, 551E052, 551E053, and 551E061.

A.4.3.3 Sampling

Initial Decision II downslope sample locations were selected based upon the guidelines of: (1) elevated radiation, (2) drums, containers, or debris, (3) area of erosion, (4) area of sediment deposition, (5) lithology, and/or (6) preselected areas based on process knowledge of the site (guidelines defined in Section A.2.2). For Initial Decision II sampling, the areas from which locations were selected were those specified in the CAU 551 CAIP (NNSA/NSO, 2004). Extended Decision II locations (E12 through E28) were chosen further downslope in the wash and were selected primarily as areas of sediment accumulation. Location E29 was selected up the western slope of the watershed, several meters from Initial Decision II location E11, to confirm TPH-DRO was confined to the washes draining CAU 551 and was not part of a more widespread watershed contamination. Location E30 was selected up an eastern slope leading to the B-Tunnel access road, several meters from location B08, to confirm benzo(a)pyrene was not part of a more widespread contamination on the east side of the investigation area.

For the Verification Sampling Area, sample locations were selected as areas of sediment accumulation.

Upslope sample locations were selected based upon the guidelines of (1) elevated radiation, (2) area of deposition, (3) lithology, and/or (4) preselected areas based on process knowledge of the site. The areas from which locations were selected were not specified in the CAIP but instead were selected to assist in establishing a boundary between CAS 12-06-07 and the Neptune test affected area and to assist in determining the extent of contamination between CAU 551 and the Neptune crater. These locations were designated E31 through E42. Locations A08, A09, and A10, originally chosen for sampling as background locations, were added to the set of upslope sample locations after determination the area had been affected by the Neptune test.

Sampling activities for Decision II included the collection of a surface soil sample at all designated locations. Subsurface samples were taken at all locations except E03, E05, E07, E12 through E19, E21, E25, E27, E32, E33, E35, E38, E39, E41, and X01-X15. The maximum sampling depth achieved (2.0 to 2.5 ft) was at location E30, where refusal to sampling equipment was encountered.

Following sample collection, all samples and corresponding paperwork were reviewed to assure correctness and completeness. Samples were then submitted for laboratory analysis.

A.4.3.4 Deviations

There were no deviations to the CAIP requirements for the Decision II portion of the CAI. The investigation and sampling in the downslope area is considered sufficient to meet the DQOs. The boundary between CAS 12-06-07 and the Neptune test affected area is drawn based upon process knowledge. The finding of contamination further downslope and upslope than expected were incorporated into the CAIP through ROTC 1 and ROTC 2.

A.4.4 Investigation Results

The following sections provide analytical results from the samples collected to complete investigation activities as outlined in the CAIP (NNSA/NSA, 2004). Decision II investigation samples from downslope locations E01 through E15 were analyzed for the CAIP-specified COPCs, which included VOCs, total SVOCs, TPH-DRO, total RCRA metals and beryllium, PCBs,

gamma-emitting radionuclides, isotopic uranium, isotopic plutonium, and Sr-90. Decision II investigation samples from downslope locations E16 through E28 were analyzed for the COPCs found to exceed PALs during previous sampling events; the COPCs included gamma-emitting radionuclides; isotopic plutonium; Sr-90; and, at selected locations, SVOCs and TPH-DRO. Decision II investigation samples to determine the extent of a contaminant within the Initial Decision II Area include location A29, where samples were analyzed for TPH-DRO contamination as well as gamma-emitting radionuclides, isotopic plutonium, Sr-90, and SVOCs; and location A30, where samples were analyzed for SVOC contamination as well as TPH-DRO, gamma-emitting radionuclides, isotopic plutonium, and Sr-90. Verification Sampling Area samples were analyzed for gamma-emitting radionuclides and isotopic plutonium.

Decision II investigation samples from upslope locations E31 through E42 were analyzed for the gamma-emitting radionuclides, isotopic uranium, isotopic plutonium, and Sr-90, because these were the only COCs identified in the northernmost samples taken in CAS 12-06-07. Locations A08, A09, and A10, originally sampled to determine background radiological concentrations, were redesignated as Decision II upslope locations after they were determined to be within the Neptune test affected area. The analytical parameters and laboratory methods used to analyze the investigation samples are listed in Table A.2-2. Table A.4-20 lists the sample-specific analytical suites for Decision II sampling.

Analytical results from the soil samples with concentrations exceeding MRLs or MDCs are summarized in the following sections. These results are compared to FALs and are a subset of the results that exceed MRLs or MDCs. Results greater than the FALs are identified by bold text in the analytical tables.

The Land Parcel 2 FALs (Table 2-3) apply to the data from the Initial and Extended Decision II areas. The PALs stated in the CAIP for CAU 551 (NNSA/NSO, 2004) apply to the data from the Verification Sampling Area and the upslope area.

A.4.4.1 Total Volatile Organic Compounds

Total VOC analytical results for soil samples collected in the Decision II downslope area that were detected above MRLs are presented in Table A.4-21. No VOCs were detected above FALs.

Table A.4-21
Soil Sample Results for Total VOCs Detected Above Minimum Reporting Limits at Muckpiles, Decision II, Downslope

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (µg/kg)	
			Acetone	Toluene
Final Action Levels[a]			**6,300,000**	**520,000**
E01	551E001	0.0 - 0.5	--	4.4 (J)[b]
E02	551E003	0.0 - 0.5	--	2.3 (J)[b]
	551E004	0.0 - 0.5	--	4.3 (J)[b]
E03	551E006	0.0 - 0.5	--	3.2 (J)[b]
E06	551E011	1.0 - 1.5	8.2 (J)	--
E08	551E013	0.0 - 0.5	--	3.1 (J)
	551E014	1.0 - 1.5	7.4 (J)	--
E14	551E023	0.0 - 0.5	--	3.4 (J)
	551E024	0.0 - 0.5	--	2.7 (J)
E15	551E025	0.0 - 0.5	--	4.8 (J)

[a]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals* (*PRGs*) (EPA, 2002)
[b]Qualifier added to laboratory data; record accepted. An associated trip blank was not analyzed

ft bgs = Feet below ground surface
µg/kg = Micrograms per kilogram
J = Estimated value
-- = Not detected above minimum reporting limits.

Verification Sampling Area and upslope area samples were not analyzed for VOCs, because VOCs were not identified as COCs at any CAU 551 CAS.

A.4.4.2 Total Semivolatile Organic Compounds

Total SVOC analytical results for soil samples collected in the Decision II downslope area that were detected above MRLs are presented in Table A.4-22. No SVOCs were detected in soil samples above FALs. Verification Sampling Area and upslope area samples were not analyzed for SVOCs.

A.4.4.3 Total Petroleum Hydrocarbons-Diesel-Range Organics

The TPH-DRO results for soil samples collected in the Decision II downslope area exceeding MRLs are presented in Table A.4-23.

Table A.4-22
Soil Sample Results for Total SVOCs Detected Above Minimum Reporting Limits at Muckpiles, Decision II, Downslope

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (µg/kg)
			Bis(2-Ethylhexyl)Phthalate
Final Action Levels[a]			120,000
E13	551E022	0.0 - 0.5	940

[a]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals* (*PRGs*) (EPA, 2002)

ft bgs = Feet below ground surface
SVOC = Semivolatile organic compound
µg/kg = Micrograms per kilogram

Concentrations in surface samples from the Decision II downslope area exceeded the FAL for TPH-DRO at locations E01 through E05, E07, E08, E10, E15, E16 through E18, E24 through E28, and E30, ranging from 110 to 980 mg/kg; and in subsurface samples at locations E01, E02, E24, E26, and E30, ranging from 130 to 670 mg/kg (Figures A.4-4 and A.4-5).

Two areas found with contiguous concentrations of TPH-DRO in samples above the FAL are (1) the lower part of the Initial Decision II Area, from samples at locations E04 and E05 through locations E03 and E02 down to location E01, and (2) the north side of the access road in the Extended Decision II Area from location E15 through locations E28, E27, and E26; down to location E25; then across the access road, from location E18 through locations E16 and E17 to location E24. With results from locations E12, E13, and E14, on the south side of the access road across from location E15, not yielding results for TPH-DRO above the FAL, locations E19 through E23 were not designated for TPH-DRO analysis.

Table A.4-23
Soil Sample Results for TPH-DRO Detected Above Minimum Reporting Limits at Muckpiles, Decision II, Downslope
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)
			Diesel-Range Organics
Final Action Levels[a]			**100**
E01	551E001	0.0 - 0.5	**220**
	551E002	1.0 - 1.5	**170**
E02	551E003	0.0 - 0.5	**280**
	551E004	0.0 - 0.5	**340**
	551E005	1.0 - 1.5	**130**
E03	551E006	0.0 - 0.5	**190**
E04	551E007	0.0 -0.5	**230**
	551E008	1.0 - 1.5	43
E05	551E009	0.0 - 0.5	**200**
E06	551E010	0.0 - 0.5	95
	551E011	1.0 - 1.5	70
E07	551E012	0.0 - 0.5	**230**
E08	551E013	0.0 - 0.5	**220**
	551E014	1.0 - 1.5	69
E10	551E017	0.0 - 0.5	**110**
E11	551E019	0.0 - 0.5	47
E13	551E022	0.0 - 0.5	39
E15	551E025	0.0 - 0.5	**700**
E16	551E026	0.0 - 0.5	**340**
E17	551E027	0.0 - 0.5	**440**
E18	551E028	0.0 - 0.5	**850** (J)
E24	551E037	0.0 - 0.5	**450**
	551E038	0.5 - 1.0	**620** (J)
E25	551E039	0.0 - 0.5	**980** (J)
E26	551E040	0.0 - 0.5	**410**
	551E041	0.0 - 0.5	**380**
	551E042	0.5 - 1.0	**670** (J)
E27	551E043	0.0 - 0.5	**530**
E28	551E044	0.0 - 0.5	**530**
	551E045	0.5 - 1.0	**240**

Table A.4-23
Soil Sample Results for TPH-DRO Detected Above Minimum Reporting Limits at Muckpiles, Decision II, Downslope
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)
			Diesel-Range Organics
Final Action Levels[a]			**100**
E30	551E048	0.0 - 0.5	**130**
	551E049	2.0 - 2.5	**240**

[a]Based on *Nevada Administrative Code*; Contamination of soil: Establishment of action levels (NAC, 2002)

ft bgs = Feet below ground surface
mg/kg = Milligrams per kilogram
J = Estimated value. Qualifier added to laboratory data; record accepted. Surrogate recovery exceeded the upper limits.

The source of the TPH-DRO contamination throughout the Initial Decision II Area is not known, but as discussed in Section A.4.2.3, it may have come from either erosion of the upper parts of the muckpiles impacted by the historical practice of draining oil from locomotives onto the muckpiles (see CAU 551 CAIP, Section A.2.4.3) or from erosion of the access road, which was oiled for dust control when the tunnels were actively used (Holmes & Narver, 1959a; 1959b). The results for the Extended Decision II Area may have been due to erosion of the muckpiles impacted by the historical practice of draining oil from locomotives onto the muckpiles (see CAU 551 CAIP, Section A.2.4.3). With the higher concentrations of TPH-DRO in the Extended Decision II Area (locations E15-E18, and E24-E28) than in the Initial Decision II Area, in general, the more probable explanations for the source would be either erosion of the access road, which was oiled when the tunnels were actively used (Holmes & Narver, 1959a; 1959b), or the former presence of compressors that leaked oil onto a pad at the upper end of the wash (north side of the access road), currently designated CAU 540, CAS 12-99-01. This CAS is currently in Appendix III and the investigation began in January 2006.

The extent of TPH-DRO contamination exceeding the FALs from CAU 551 muckpiles is the lower boundary of the Initial Decision II Area. Samples in the wash immediately below the boundary did not contain TPH-DRO above the FAL.

Total petroleum hydrocarbons-DRO was not a COC for samples taken from the Verification Sampling Area and upslope area.

A.4.4.4 Polychlorinated Biphenyls

Total PCB analytical results for soil samples collected in the Initial Decision II downslope area that were detected above MRLs are presented in Table A.4-24. No PCBs were detected in soil samples above FALs. The PCBs were not COCs for the Verification Sampling Area and upslope area.

Table A.4-24
Soil Sample Results for PCBs Detected Above Minimum Reporting Limits at Muckpiles, Decision II, Downslope

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (µg/kg)	
			Aroclor 1254	Aroclor 1262
Final Action Levels[a]			740	740
E01	551E001	0.0 - 0.5	--	26 (J)
E10	551E017	0.0 - 0.5	130	--
E13	551E022	0.0 - 0.5	--	25 (J)
E15	551E025	0.0 - 0.5	--	35 (J)

[a]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals* (*PRGs*) (EPA, 2002)

ft bgs = Feet below ground surface
PCB = Polychlorinated biphenyl
µg/kg = Micrograms per kilogram
J = Estimated value
-- = Not detected above minimum reporting limits.

A.4.4.5 Total RCRA Metals and Beryllium

Total RCRA metals and beryllium analytical results for soil samples collected in the Initial Decision II downslope area that were detected above MRLs are presented in Table A.4-25. No total RCRA metals or beryllium were detected in soil samples above FALs. Verification Sampling Area and upslope area samples were not analyzed for total RCRA metals and beryllium, because RCRA metals and beryllium were not identified as COCs at any CAU 551 CAS.

A.4.4.6 Gamma-Emitting Radionuclides

Gamma-emitting radionuclide analytical results for soil samples collected in the Decision II downslope area that were detected above MDCs are presented in Table A.4-26. Gamma-emitting radionuclide results for soil samples collected in the Verification Sampling Area that were detected above MDCs are presented in Table A.4-27. No gamma-emitting radionuclides were detected in soil

Table A.4-25
Soil Sample Results for Metals Detected Above Minimum Reporting Limits at Muckpiles, Decision II, Downslope
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)							
			Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Silver
Final Action Levels			**23[a]**	**67,000[b]**	**1,900[b]**	**450[b]**	**450[b]**	**750[b]**	**310[b]**	**5,100[b]**
E01	551E001	0.0 - 0.5	2.9	115	1.18	--	3.62	15.4 (J)[c]	0.122 (J)[d]	--
	551E002	1.0 - 1.5	1.53 (J-)	62.3	0.822	--	2.28	7.77 (J)[c]	0.0934 (J)[d]	--
E02	551E003	0.0 - 0.5	3.42	127	1.13	--	1.38	12 (J)[c]	0.125 (J)[d]	--
	551E004	0.0 - 0.5	2.74	142	1.23	--	1.99	12.2 (J)[c]	0.178 (J)[d]	--
	551E005	1.0 - 1.5	2.17 (J-)	87.4	1.21	--	2.55	21 (J)[c]	0.0568 (J)[d]	--
E03	551E006	0.0 - 0.5	1.74 (J-)	95.5	0.986	--	3.73	19.2 (J)[c]	0.356 (J)[d]	--
E04	551E007	0.0 -0.5	2.05 (J-)	113	1.17	--	4.53	26 (J)[c]	0.11 (J)[d]	--
	551E008	1.0 - 1.5	2.95	117	1.43	--	2.94	15.1 (J)[c]	0.0919 (J)[d]	--
E05	551E009	0.0 - 0.5	1.81	83.7	0.872	--	2.23	22.4 (J)[c]	0.0756 (J)[d]	--
E06	551E010	0.0 - 0.5	0.96 (J-)	99.6	0.849	--	--	22.7 (J)[c]	--	--
	551E011	1.0 - 1.5	1.94 (J-)	86.5	1.13	--	--	22 (J)[c]	--	--
E07	551E012	0.0 - 0.5	1.77 (J-)	95.8	0.783	--	--	22.9 (J)[c]	--	--
E08	551E013	0.0 - 0.5	3.33	92.8	1.12	--	4.84	10.7 (J)[c]	0.0664 (J)[d]	--
	551E014	1.0 - 1.5	3.32	509	1.78	0.218 (J)	3.02	20.1 (J)[c]	0.338	--
E09	551E015	0.0 - 0.5	1.31	150	0.808	0.189 (J)	0.816 (J)	9.63	0.0543 (J)	--
	551E016	1.5 - 2.0	--	77.1	1.28	0.233 (J)	1.2 (J)	8.81	0.166	--
E10	551E017	0.0 - 0.5	1.26 (J)	73.6	1.81	0.542 (J)	2.67	18.4	--	0.383 (J)
	551E018	1.0 - 1.5	--	62.9	0.931	0.318 (J)	1.66	9.81	--	--
E11	551E019	0.0 - 0.5	--	48.5	0.67	0.332 (J)	2.15	8.88	--	0.422 (J)
	551E020	1.0 - 1.5	--	61.1	0.947	0.316 (J)	2.01	6.53	--	--
E12	551E021	0.0 - 0.5	0.93 (J)	82.1	0.758	0.263 (J)	1.73	9.49	0.0588 (J)	--
E13	551E022	0.0 - 0.5	--	99.5	0.749	0.317 (J)	2.88	18.7	0.0416 (J)	--
E14	551E023	0.0 - 0.5	1.17 (J)	107	1.11	0.364 (J)	4.5	33.8	0.0458 (J)	0.371 (J)
	551E024	0.0 - 0.5	1.28	109	1.13	0.363 (J)	4.51	26.9	0.0468 (J)	0.471 (J)
E15	551E025	0.0 - 0.5	0.932 (J)	106	0.776	0.233 (J)	1.52	9.06	0.0394 (J)	--

Table A.4-25
Soil Sample Results for Metals Detected Above Minimum Reporting Limits at Muckpiles, Decision II, Downslope
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)							
			Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Silver
Final Action Levels			**23[a]**	**67,000[b]**	**1,900[b]**	**450[b]**	**450[b]**	**750[b]**	**310[b]**	**5,100[b]**

[a]Based on the background concentrations for metals. Background is considered the mean plus two times the standard deviation for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (NBMG, 1998; Moore, 1999).
[b]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals* (*PRGs*) (EPA, 2002)
[c]Qualifier added to laboratory data; record accepted. Serial dilution %D outside control limits. Matrix effects may exist.
[d]Qualifier added to laboratory data; record accepted. Matrix spike recovery outside control limits.

ft bgs = Feet below ground surface
mg/kg = Milligrams per kilogram
J = Estimated value
J- = The result is an estimated quantity, but the result may be biased low. Negative bias found in continuing calibration/method blank.
-- = Not detected above minimum reporting limits.

samples above the FALs in the Verification Sampling Area. Gamma-emitting radionuclide analytical results for soil samples collected in the Decision II upslope area that were detected above MDCs are presented in Table A.4-28.

Table A.4-26
Soil Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentration at Muckpiles, Decision II, Downslope
(Page 1 of 3)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)															
			Actinium-228[a]		Americium-241[b]	Bismuth-212[a]		Bismuth-214[a]		Cesium-137[b]	Europium-152[b]	Lead-212[a]		Lead-214[a]		Thallium-208[a]	
Final Action Levels			**5**	**15**	**287.42**	**5**	**15**	**5**	**15**	**28.74**	**1.03**	**5**	**15**	**5**	**15**	**5**	**15**
Depth bgs (cm)			**<15**	**>15**		**<15**	**>15**	**<15**	**>15**			**<15**	**>15**	**<15**	**>15**	**<15**	**>15**
E01	551E001	0.0 - 0.5	2.03 (G)	N/A	33 (J)[c]	--	N/A	1.15 (G, J)	N/A	9.3 (J)[d]	--	2.1 (J)[e]	N/A	1.67 (G, J)	N/A	0.83 (G)	N/A
	551E002	1.0 - 1.5	N/A	2.48 (G)	1.8 (J)[c]	N/A	--	N/A	1.28 (G, J)	1.23 (J)[d]	--	N/A	2.8 (J)[e]	N/A	1.57 (G, J)	N/A	0.78 (G)
E02	551E003	0.0 - 0.5	2.11 (G)	N/A	1.02 (J)[c]	--	N/A	1.27 (G, J)	N/A	2.06 (J)[d]	--	2.7 (J)[e]	N/A	1.58 (G, J)	N/A	0.72 (G)	N/A
	551E004	0.0 - 0.5	1.86 (G)	N/A	1.2 (J)[c]	2.8 (G)	N/A	1.16 (G, J)	N/A	1.92 (J)[d]	--	2.46 (J)[e]	N/A	1.24 (G, J)	N/A	0.71 (G)	N/A
	551E005	1.0 - 1.5	N/A	2.68 (G)	0.65 (J)[c]	N/A	--	N/A	1.6 (G, J)	2.39 (J)[d]	--	N/A	2.96 (J)[e]	N/A	1.43 (G, J)	N/A	0.98 (G)
E03	551E006	0.0 - 0.5	2.41 (G)	N/A	71.5 (J)[c]	--	N/A	--	N/A	**31.7** (J)[d]	**1.51** (J)[e]	2.17 (J)[e]	N/A	1.14 (G, J)	N/A	0.85 (G)	N/A
E04	551E007	0.0 -0.5	2.52 (G)	N/A	87 (J)[c]	--	N/A	1.48 (G, J)	N/A	26.9 (J)[d]	--	2.6 (J)[e]	N/A	1.53 (G, J)	N/A	0.95 (G)	N/A
	551E008	1.0 - 1.5	N/A	2.2 (G)	16.6 (J)[c]	N/A	--	N/A	1.54 (G, J)	27.8 (J)[d]	--	N/A	3.53 (J)[e]	N/A	1.24 (G, J)	N/A	0.78 (G)
E05	551E009	0.0 - 0.5	2.44 (G)	N/A	94 (J)[e]	--	N/A	1.42 (G, J)	N/A	19.9 (G)	--	2.64 (J)[e]	N/A	1.21 (G, J)	N/A	0.68 (G)	N/A
E06	551E010	0.0 - 0.5	2.27 (G)	N/A	137 (J)[e]	--	N/A	1.71 (G, J)	N/A	23.1 (G)	--	2.62 (J)[e]	N/A	1.25 (G, J)	N/A	0.88 (G)	N/A
	551E011	1.0 - 1.5	N/A	2.3 (G)	131 (J)[e]	N/A	--	N/A	1.15 (G, J)	**35** (G)	--	N/A	2.41 (J)[e]	N/A	1.06 (G, J)	N/A	0.83 (G)
E07	551E012	0.0 - 0.5	2.64 (G)	N/A	198 (J)[e]	--	N/A	1.88 (G, J)	N/A	27.4 (G)	--	2.61 (J)[e]	N/A	1.25 (G, J)	N/A	0.61 (G)	N/A
E08	551E013	0.0 - 0.5	2.23 (G)	N/A	--	--	N/A	1.52 (G, J)	N/A	0.77 (G)	--	2.94 (J)[e]	N/A	1.54 (G, J)	N/A	0.81 (G)	N/A
	551E014	1.0 - 1.5	N/A	2 (G)	--	N/A	--	N/A	1.16 (G, J)	--	--	N/A	2.76 (J)[e]	N/A	1.38 (G, J)	N/A	0.74 (G)
E09	551E015	0.0 - 0.5	1.98 (G)	N/A	18.2 (J)[c]	--	N/A	1.28 (G, J)	N/A	9.7 (J)[d]	--	2.56 (J)[e]	N/A	1.53 (G, J)	N/A	0.89 (G)	N/A
	551E016	1.5 - 2.0	N/A	2.31 (G)	3.9 (J)[c]	N/A	--	N/A	1.33 (G, J)	2.18 (J)[d]	--	N/A	2.84 (J)[e]	N/A	1.45 (G, J)	N/A	0.95 (G)
E10	551E017	0.0 - 0.5	2.86 (G)	N/A	**487** (J)[c]	--	N/A	1.31 (G, J)	N/A	24.6 (J)[d]	**1.74** (J)[e]	2.94 (J)[e]	N/A	1.84 (G, J)	N/A	0.93 (G)	N/A
	551E018	1.0 - 1.5	N/A	2.7 (G)	3.9 (J)[c]	N/A	--	N/A	1.44 (G, J)	2.57 (J)[d]	--	N/A	3.01 (J)[e]	N/A	1.58 (G, J)	N/A	0.84 (G)
E11	551E019	0.0 - 0.5	2.52 (G)	N/A	5.9 (J)[c]	--	N/A	1.15 (G, J)	N/A	7.23 (J)[d]	--	2.5 (J)[e]	N/A	1.35 (G, J)	N/A	0.79 (G)	N/A
	551E020	1.0 - 1.5	N/A	2.93 (G)	0.09 (J)[c]	N/A	--	N/A	1.55 (G, J)	0.17 (J)[d]	--	N/A	3.17 (J)[e]	N/A	1.19 (G, J)	N/A	0.97 (G)
E12	551E021	0.0 - 0.5	2.42 (G)	N/A	-1.3 (J)[c]	--	N/A	1.2 (G, J)	N/A	1.99 (J)[d]	--	2.94 (J)[e]	N/A	1.53 (G, J)	N/A	0.72 (G)	N/A

Table A.4-26
Soil Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentration at Muckpiles, Decision II, Downslope
(Page 2 of 3)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)															
			Actinium-228[a]		Americium-241[b]	Bismuth-212[a]		Bismuth-214[a]		Cesium-137[b]	Europium-152[b]	Lead-212[a]		Lead-214[a]		Thallium-208[a]	
Final Action Levels			5	15	287.42	5	15	5	15	28.74	1.03	5	15	5	15	5	15
Depth bgs (cm)			<15	>15		<15	>15	<15	>15			<15	>15	<15	>15	<15	>15
E13	551E022	0.0 - 0.5	1.9 (G)	N/A	59.1 (J)[c]	--	N/A	1.15 (G, J)	N/A	23.2 (J)[d]	--	2.04 (J)[e]	N/A	1.3 (G, J)	N/A	0.78 (G)	N/A
E14	551E023	0.0 - 0.5	2.3 (G)	N/A	92 (J)[c]	--	N/A	1.35 (G, J)	N/A	**48.7** (J)[d]	**1.48** (J)[e]	2.63 (J)[e]	N/A	1.39 (G, J)	N/A	0.86 (G)	N/A
	551E024	0.0 - 0.5	2.62 (G)	N/A	77.6 (J)[c]	--	N/A	1.29 (G, J)	N/A	**48.6** (J)[d]	**1.59** (J)[e]	2.94 (J)[e]	N/A	1.63 (G, J)	N/A	0.94 (G)	N/A
E15	551E025	0.0 - 0.5	1.89 (G)	N/A	0.2 (J)[c]	--	N/A	1.04 (G, J)	N/A	0.34 (J)[d]	--	2.24 (J)[e]	N/A	1.02 (G, J)	N/A	0.63 (G)	N/A
E18	551E028	0.0 - 0.5	2.2 (G)	N/A	--	1.92 (G)	N/A	1.06 (G, J)	N/A	0.51 (G)	--	2.29 (J)[e]	N/A	1.01 (G, J)	N/A	0.64 (G)	N/A
E19	551E029	0.0 - 0.5	2.11 (G)	N/A	--	2.35 (G)	N/A	0.96 (G, J)	N/A	1.05 (G)	--	2.56 (J)[e]	N/A	1.14 (G, J)	N/A	0.75 (G)	N/A
E20	551E030	0.0 - 0.5	2.57 (G)	N/A	--	--	N/A	1.11 (G, J)	N/A	--	--	3.23 (J)[e]	N/A	1.19 (G, J)	N/A	0.94 (G)	N/A
	551E031	0.5 - 1.0	N/A	2.31 (G)	--		--	N/A	1.11 (G, J)	--	--	N/A	2 (J)[e]	N/A	0.93 (G, J)	N/A	0.5 (G)
E21	551E032	0.0 - 0.5	1.86 (G)	N/A	--	--	N/A	1 (G, J)	N/A	--	--	2.7 (J)[e]	N/A	1.34 (G, J)	N/A	0.84 (G)	N/A
E22	551E033	0.0 - 0.5	2.03 (G)	N/A	--	--	N/A	1 (G, J)	N/A	0.32 (G)	--	2.65 (J)[e]	N/A	1.18 (G, J)	N/A	0.83 (G)	N/A
	551E034	0.5 - 1.0	1.9 (G)	N/A	--		2.4 (G)	N/A	0.92 (G, J)	N/A	--	N/A	2.63 (J)[e]	N/A	1.31 (G, J)	N/A	0.71 (G)
E23	551E035	0.0 - 0.5	--	N/A	--	--	N/A	--	N/A	1.7 (G)	--	1.1 (J)[e]	N/A	0.8 (G, J)	N/A	0.45 (G)	N/A
	551E036	0.5 - 1.0	N/A	--	--		--	N/A	--	0.85 (G)	--	N/A	0.83 (J)[e]	N/A	--	N/A	--
E24	551E037	0.0 - 0.5	--	N/A	--	--	N/A	0.99 (G, J)	N/A	N/A	--	1.27 (J)[e]	N/A	0.76 (G, J)	N/A	--	N/A
	551E038	0.5 - 1.0	N/A	--	--		--	N/A	--	--	--	N/A	1.54 (J)[e]	N/A	0.96 (G, J)	N/A	--
E25	551E039	0.0 - 0.5	1.7 (G)	N/A	--	--	N/A	1.11 (G, J)	N/A	0.77 (G)	--	2.2 (J)[e]	N/A	1.23 (G, J)	N/A	0.71 (G)	N/A
E26	551E040	0.0 - 0.5	1.91 (G)	N/A	--	--	N/A	0.89 (G, J)	N/A	0.81 (G)	--	2.16 (J)[e]	N/A	0.96 (G, J)	N/A	0.62 (G)	N/A
	551E041	0.0 - 0.5	1.74 (G)	N/A	--	--	N/A	0.79 (G, J)	N/A	0.97 (G)	--	2.31 (J)[e]	N/A	1.05 (G, J)	N/A	0.6 (G)	N/A
	551E042	0.5 - 1.0	N/A	2.08 (G)	--		--	N/A	1.08 (G, J)	1.38 (G)	--	N/A	2.44 (J)[e]	N/A	1.04 (G, J)	N/A	0.78 (G)
E27	551E043	0.0 - 0.5	1.6 (G)	N/A	--	--	N/A	1.06 (G, J)	N/A	1.38 (G)	--	2.51 (J)[e]	N/A	1.13 (G, J)	N/A	0.68 (G)	N/A

Table A.4-26
Soil Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentration at Muckpiles, Decision II, Downslope
(Page 3 of 3)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)															
			Actinium-228[a]		Americium-241[b]	Bismuth-212[a]		Bismuth-214[a]		Cesium-137[b]	Europium-152[b]	Lead-212[a]		Lead-214[a]		Thallium-208[a]	
Final Action Levels			**5**	**15**	**287.42**	**5**	**15**	**5**	**15**	**28.74**	**1.03**	**5**	**15**	**5**	**15**	**5**	**15**
Depth bgs (cm)			**<15**	**>15**		**<15**	**>15**	**<15**	**>15**			**<15**	**>15**	**<15**	**>15**	**<15**	**>15**
E28	551E044	0.0 - 0.5	1.8 (G)	N/A	--	--	N/A	0.95 (G, J)	N/A	1.18 (G)	--	2.05 (J)[e]	N/A	0.99 (G, J)	N/A	0.65 (G)	N/A
	551E045	0.5 - 1.0	1.47 (G)	N/A	--	N/A	--	N/A	1.04 (G, J)	1.12 (G)	--	N/A	1.6 (J)[e]	N/A	0.83 (G, J)	N/A	0.63 (G)
E29	551E046	0.0 - 0.5	2.21 (G)	N/A	0.96 (J)[e]	--	N/A	1.3 (G, J)	N/A	0.74 (G)	--	2.25 (J)[e]	N/A	1.3 (G, J)	N/A	0.87 (G)	N/A
	551E047	1.0 - 1.5	N/A	2.28 (G)	--	N/A	--	N/A	1.13 (G, J)	--	--	N/A	3 (J)[e]	N/A	1.11 (G, J)	N/A	0.79 (G)
E30	551E048	0.0 - 0.5	1.7 (G)	N/A	101 (J)[e]	--	N/A	--	N/A	**36.6** (G)	--	2.98 (J)[e]	N/A	1.5 (G, J)	N/A	0.8 (G)	N/A
	551E049	2.0 - 2.5	N/A	2.68 (G)	--	N/A	--	N/A	1.26 (G, J)	0.99 (G)	--	N/A	2.59 (J)[e]	N/A	1.32 (G, J)	N/A	0.87 (G)

[a]Taken from the generic guidelines for residual concentrations of actinium-228, bismuth-214, lead-212, lead-214, thallium-208, and thorium-232, as found in Chapter IV of DOE Order 5400.5, Change 2, "Radiation Protection of the Public and Environment." (DOE, 1993). The PALs for these isotopes is specified as 5 pCi/g averaged over the first 15 cm of soil and 15 pCi/g for deeper soils (DOE, 1993). For purposes of this document, 15 cm is assumed to be equivalent to 0.5 ft (6 inches); therefore, 5 pCi/g represents the PALs for these radionuclides in the surface soil (0 to 0.5 ft depth).
[b]Taken from values calculated from RESRAD for CAU 551, Land Parcel 2.
[c]Qualifier added to laboratory data; record accepted. Duplicate normalized difference outside control limits.
[d]Qualifier added to laboratory data; record accepted. Duplicate precision analysis (relative percent difference) outside control limits.
[e]Qualifier added to laboratory data; record accepted. Sample does not meet counting geometry requirements.

cm = Centimeter
ft bgs = Feet below ground surface
mrem/yr = Millirem per year
N/A = Not applicable
PAL = Preliminary action level
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive computer code
< = Less than
> = Greater than
G = Sample density differs by more than 15% of laboratory control sample density.
J = Estimated value
-- = Not detected above minimum reporting limits.

Table A.4-27
Soil Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentration at Verification Sampling Area

Sample Location	Sample Number	Depths (ft bgs)	Contaminants of Potential Concern (pCi/g)					
			Actinium-228[a]	Bismuth-214[a]	Cesium-137[b]	Lead-212[a]	Lead-214[a]	Thallium-208[a]
Final Action Levels			5	5	12.2	5	5	5
Depth bgs (cm)			<15	<15		<15	<15	<15
X01	PA-551X001	0.0 - 0.5	1.2 (G)	0.71 (G, J)	0.28 (G, LT)	1.67 (J)[c]	0.95 (G, J)	0.38 (G)
X02	PA-551X002	0.0 - 0.5	1.63 (G)	0.83 (G,J)	0.31 (G, LT)	1.32 (J)[c]	0.98 (G, J)	0.49 (G)
	PA-551X003	0.0 - 0.5	1.63 (G)	0.73 (G, J)	0.28 (G, LT)	1.36 (J)[c]	0.78 (G, J)	0.45 (G)
X03	PA-551X004	0.0 - 0.5	1.8 (G)	0.73 (G, J)	--	1.84 (J)[c]	0.99 (G, J)	0.57 (G)
X04	PA-551X005	0.0 - 0.5	1.84 (G)	0.97 (G, J)	0.35 (G, LT)	2.66 (J)[c]	1.03 (G, J)	0.59 (G)
X05	PA-551X006	0.0 - 0.5	2.32 (G)	0.75 (G, J)	--	1.67 (J)[c]	1.05 (G, J)	0.64 (G)
X06	PA-551X007	0.0 - 0.5	1.58 (G)	0.84 (G, J)	0.46 (G, LT)	1.73 (J)[c]	1.06 (G,J)	0.47 (G)
X07	PA-551X008	0.0 - 0.5	1.49 (G)	0.74 (G, J)	0.39 (G, LT)	1.41 (J)[c]	0.94 (G, J)	0.42 (G)
X08	PA-551X009	0.0 - 0.5	1.74 (G)	0.93 (G, J)	0.48 (G, LT)	1.93 (J)[c]	1.01 (G, J)	0.57 (G)
X09	PA-551X010	0.0 - 0.5	1.25 (G)	0.87 (G, J)	0.54 (G)	1.17 (J)[c]	0.75 (G, J)	0.49 (G)
X10	PA-551X011	0.0 - 0.5	1.34 (G)	1.04 (G, J)	1 (G)	1.43 (J)[c]	0.92 (G, J)	0.5 (G)
X11	PA-551X012	0.0 - 0.5	1.43 (G)	1.04 (G, J)	1.03 (G)	1.7 (J)[c]	1.04 (G, J)	0.42 (G)
X12	PA-551X013	0.0 - 0.5	1.59 (G)	0.76 (G, J)	0.81 (G)	1.64 (J)[c]	0.97 (G, J)	0.6 (G)
X13	PA-551X014	0.0 - 0.5	1.48 (G)	0.94 (G, J)	0.64 (G)	1.54 (J)[c]	0.91 (G, J)	0.58 (G)
X14	PA-551X015	0.0 - 0.5	1.74 (G)	1.04 (G, J)	0.54 (G)	2 (J)[c]	0.89 (G, J)	0.6 (G)
X15	PA-551X016	0.0 - 0.5	1.97 (G)	0.95 (G, J)	--	2.5 (J)[c]	1.12 (G, J)	0.73 (G)

[a]Taken from the generic guidelines for residual concentrations of actinium-228, bismuth-214, lead-212, lead-214, thallium-208, and thorium-232, as found in Chapter IV of DOE Order 5400.5, Change 2, "Radiation Protection of the Public and Environment." (DOE, 1993). The PALs for these isotopes is specified as 5 pCi/g averaged over the first 15 cm of soil and 15 pCi/g for deeper soils (DOE, 1993). For purposes of this document, 15 cm is assumed to be equivalent to 0.5 ft (6 inches); therefore, 5 pCi/g represents the PALs for these radionuclides in the surface soil (0 to 0.5 ft depth).

[b]Taken from the construction, commercial, industrial land use scenario in Table 2.1 of the NCRP Report No. 129 *Recommended Screening Limits for Contaminated Surface Soil and Review Factors Relevant to Site-Specific Studies* (NCRP, 1999). The values provided in this source document were scaled to a 25-mrem/yr dose.

[c]Qualifier added to laboratory data; record accepted. Sample does not meet counting geometry requirements.

cm = Centimeter
ft bgs = Feet below ground surface
mrem/yr = Millirem per year
pCi/g = Picocuries per gram
G = Sample density differs by more than 15% of laboratory control sample density.
J = Estimated value
LT = Result is less than the requested minimum detectable concentration, greater than the sample specific minimum detectable concentration.
< = Less than
-- = Not detected above minimum reporting limits.

Table A.4-28
Soil Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentration at Muckpiles, Decision II Upslope
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)															
			Actinium-228[a]		Americium-241[b]	Bismuth-212[a]		Bismuth-214[a]		Cesium-137[b]	Europium-152[b]	Lead-212[a]		Lead-214[a]		Thallium-208[a]	
Final Action Levels			5	15	12.7	5	15	5	15	12.2	5.7	5	15	5	15	5	15
Depth bgs (cm)			<15	>15		<15	>15	<15	>15			<15	>15	<15	>15	<15	>15
A08	551A019	0.0 - 0.5	2.82 (G)	N/A	6.5 (J)[c]	--	N/A	1.54 (G, J)	N/A	5.9 (G)	--	2.87 (J)[c]	N/A	1.64 (G, J)	N/A	0.91 (G)	N/A
A09	551A020	0.0 - 0.5	2.23 (G)	N/A	--	--	N/A	1.41 (G,J)	N/A	2.32 (G)	--	3.43 (J)[c]	N/A	1.57 (G, J)	N/A	0.87 (G)	N/A
A10	551A021	0.0 - 0.5	2.05 (G)	N/A	3.38 (J)[c]	--	N/A	0.95 (G, J)	N/A	3.28 (G)	--	2.56 (J)[c]	N/A	0.92 (G, J)	N/A	0.57 (G)	N/A
E31	551E050	0.0 - 0.5	--	N/A	**319** (J)[c]	--	N/A	--	N/A	**43.4** (G, M3)	--	2.58 (J)[c]	N/A	--	N/A	0.8 (G)	N/A
	551E051	0.5 - 1.0	N/A	2.39 (G)	**347** (J)[c]	N/A	--	N/A	--	**55.2** (G)	--	N/A	2.36 (J)[c]	N/A	--	N/A	0.62 (G)
E32	551E052	0.0 - 0.5	2.26 (G)	N/A	**395** (J)[c]	--	N/A	--	N/A	**29.7** (G)	4.93 (J)[c]	2.4 (J)[c]	N/A	1.1 (G, J)	N/A	0.63 (G)	N/A
E33	551E053	0.0 - 0.5	1.8 (G)	N/A	**90** (J)[c]	--	N/A	1.05 (G, J)	N/A	5.44 (G)	--	3.06 (J)[c]	N/A	1.35 (G, J)	N/A	0.7 (G)	N/A
E34	551E054	0.0 - 0.5	2.61 (G)	N/A	**389** (J)[c]	--	N/A	--	N/A	**24.5** (G)	2.06 (J)[c]	2.31 (J)[c]	N/A	1.47 (G, J)	N/A	0.82 (G)	N/A
	551E055	0.5 - 1.0	N/A	2.29 (G)	**263** (J)[c]	N/A	--	N/A	1.06 (G, J)	**17.5** (G)	1.58 (J)[c]	N/A	2.27 (J)[c]	N/A	1.4 (G, J)	N/A	0.77 (G)
E35	551E056	0.0 - 0.5	2.74 (G)	N/A	**135** (J)[c]	--	N/A	1.47 (G, J)	N/A	9 (G)	1.23 (J)[c]	2.39 (J)[c]	N/A	1.13 (G, J)	N/A	0.82 (G)	N/A
E36	551E057	0.0 - 0.5	2.39 (G)	N/A	7.05 (J)[c]	--	N/A	1.21 (G, J)	N/A	1.18 (G)	--	2.59 (J)[c]	N/A	1.2 (G, J)	N/A	0.69 (G)	N/A
	551E058	0.5 - 1.0	N/A	2.28 (G)	2.16 (J)[c]	N/A	--	N/A	1.2 (G, J)	0.57 (G)	--	N/A	2.69 (J)[c]	N/A	1.33 (G, J)	N/A	0.9 (G)
E37	551E059	0.0 - 0.5	2.49 (G)	N/A	--	--	N/A	1.32 (G, J)	N/A	--	--	2.73 (J)[c]	N/A	1.36 (G, J)	N/A	0.95 (G)	N/A
	551E060	0.5 - 1.0	N/A	2.6 (G)	--	N/A	--	N/A	1.37 (G, J)	--	--	N/A	3.2 (J)[c]	N/A	1.63 (G, J)	N/A	0.93 (G)
E38	551E061	0.0 - 0.5	2.37 (G)	N/A	0.78 (J)[c]	--	N/A	1.36 (G, J)	N/A	1.07 (G)	--	2.91 (J)[c]	N/A	1.51 (G, J)	N/A	0.8 (G)	N/A
E39	551E062	0.0 - 0.5	2.52 (G)	N/A	--	--	N/A	1.22 (G, J)	N/A	0.47 (G, LT)	--	2.73 (J)[c]	N/A	1.34 (G, J)	N/A	0.82 (G)	N/A
E40	551E063	0.0 - 0.5	2.57 (G)	N/A	--	--	N/A	1.29 (G, J)	N/A	--	--	2.59 (J)[c]	N/A	1.28 (G, J)	N/A	0.76 (G)	N/A
	551E064	0.5 - 1.0	N/A	2.52 (G)	--	N/A	--	N/A	1.2 (G, J)	--	--	N/A	2.84 (J)[c]	N/A	1.47 (G, J)	N/A	0.77 (G)
E41	551E065	0.0 - 0.5	--	N/A	--	--	N/A	0.92 (G, J)	N/A	0.51 (G)	--	1.55 (J)[c]	N/A	0.95 (G, J)	N/A	0.56 (G)	N/A

Table A.4-28
Soil Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentration at Muckpiles, Decision II Upslope
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)													
			Actinium-228[a]		Americium-241[b]	Bismuth-212[a]		Bismuth-214[a]		Cesium-137[b]	Europium-152[b]	Lead-212[a]		Lead-214[a]		Thallium-208[a]	
Final Action Levels			5	15	12.7	5	15	5	15	12.2	5.7	5	15	5	15	5	15
Depth bgs (cm)			<15	>15		<15	>15	<15	>15			<15	>15	<15	>15	<15	>15
E42	551E066	0.0 - 0.5	1.8 (G)	N/A	0.92 (J)[c]	--	N/A	1.19 (G, J)	N/A	0.66 (G)	--	2.42 (J)[c]	N/A	1.17 (G, J)	N/A	0.72 (G)	N/A
	551E067	0.0 - 0.5	2.3 (G)	N/A	0.66 (J)[c]	--	N/A	1.2 (G, J)	N/A	0.75 (G)	--	2.74 (J)[c]	N/A	1.22 (G, J)	N/A	0.84 (G)	N/A
	551E068	0.5 - 1.0	N/A	2.39 (G)	--	N/A	--	N/A	1.02 (G, J)	--	--	N/A	2.61 (J)[c]	N/A	1.1 (G, J)	N/A	0.83 (G)

[a]Taken from the generic guidelines for residual concentrations of actinium-228, bismuth-214, lead-212, lead-214, thallium-208, and thorium-232, as found in Chapter IV of DOE Order 5400.5, Change 2, "Radiation Protection of the Public and Environment." (DOE, 1993). The PALs for these isotopes is specified as 5 pCi/g averaged over the first 15 cm of soil and 15 pCi/g for deeper soils (DOE, 1993). For purposes of this document, 15 cm is assumed to be equivalent to 0.5 ft (6 inches); therefore, 5 pCi/g represents the PALs for these radionuclides in the surface soil (0 to 0.5 ft depth).
[b]Taken from the construction, commercial, industrial land use scenario in Table 2.1 of the NCRP Report No. 129, *Recommended Screening Limits for Contaminated Surface Soil and Review Factors Relevant to Site-Specific Studies* (NCRP, 1999). The values provided in this source document were scaled to a 25-mrem/yr dose.
[c]Qualifier added to laboratory data; record accepted. Sample does not meet counting geometry requirements.

cm = Centimeter
ft bgs = Feet below ground surface
mrem/yr = Millirem per year
N/A = Not applicable
PAL = Preliminary action level
pCi/g = Picocuries per gram
< = Less than
> = Greater than
G = Sample density differs by more than 15% of laboratory control sample density
J = Estimated value
LT = Result is less than requested minimum detectable concentration, greater than sample specific minimum detectable concentration.
M3 = The requested minimum detectable concentration was not met, but the reported activity is greater than the minimum detectable concentration.
-- = Not detected above minimum reporting limit.

Am-241 Downslope: The concentration of one surface sample collected from the Initial Decision II Area (location E10) exceeded the FAL for Am-241 (Table A.4-26 and Figure A.4-4). The sample, taken almost midway down a wash that drains CASs 12-06-07 and 12-06-08, had a concentration of Am-241 at 487 pCi/g. Samples from the Extended Decision II and Verification Sampling areas did not exceed their respective FALs.

Am-241 Upslope: The concentrations of nearly all surface and subsurface samples collected from the Decision II upslope area inside the contamination area (locations E31-E36) exceeded the FAL for Am-241 (Table A.4-28 and Figure A.4-7). Surface sample concentrations for Am-241 above the FAL ranged from 90 to 395 pCi/g. The concentrations of subsurface samples ranged from 263 to 347 pCi/g. Samples taken from locations outside the contamination area, to the east and north along both the mesa access and Neptune crater access roads, yielded concentrations below FALs.

Americium-241 contamination above the FAL is continuous from CAS 12-06-07 into the areas affected by the Neptune test.

Cs-137 Downslope: The concentrations of two surface samples collected from the Initial Decision II Area exceeded the FAL for Cs-137, ranging from 31.7 to 36.6 pCi/g, and the concentration for one subsurface sample exceeded the FAL for Cs-137 at 35 pCi/g (Table A.4-26 and Figure A.4-4). The concentrations of duplicate surface samples collected from the Extended Decision II Area (location E14) exceeded the FAL for Cs-137 (Table A.4-26 and Figure A.4-5). The samples, taken midway down the wash on the south side of the access road (between the E-Tunnel turnoff and the large bend in the access road) had concentrations of 48.7 and 48.6 pCi/g. Samples taken from the Verification Sampling Area did not exceed the FAL.

Cs-137 Upslope: The concentrations of five out of nine surface and subsurface samples collected from the Decision II upslope area inside the contamination area (locations E31-E36) exceeded the FAL for Cs-137 (Table A.4-28 and Figure A.4-7). Surface sample concentrations for Cs-137 above the FAL ranged from 24.5 to 43.4 pCi/g. The concentrations of subsurface samples ranged from 17.5 to 55.2 pCi/g. Samples taken from locations outside the contamination area, to the east and north along both the mesa access and Neptune crater access roads, yielded concentrations below FALs. Cesium-137 contamination above the FAL is continuous from CAS 12-06-07 into the Neptune test affected area.

Eu-152 Downslope: The concentration of two surface samples collected from the Initial Decision II Area exceeded the FAL for Eu-152, ranging from 1.51 to 1.74 pCi/g (Table A.4-26 and Figure A.4-4). The concentrations of duplicate surface samples collected from the Extended Decision II Area (location E14) exceeded the FAL for Eu-152, at 1.48 and 1.59 pCi/g (Table A.4-26 and Figure A.4-5). Samples taken from the Verification Sampling Area and upslope area did not exceed the FAL.

A.4.4.7 Isotopic Radionuclides

Isotopic radionuclide analytical results for soil samples collected from the Decision II downslope area, the Verification Sampling Area, and upslope area that were detected above MDCs are presented in Tables A.4-29 through A.4-31.

Uranium-234, U-235, U-238, and Sr-90 were not detected above the FALs in samples taken from the Initial Decision II Area.

Pu-238 Downslope: The concentrations of six surface samples collected from the Initial Decision II Area exceeded the FAL for Pu-239, ranging from 3.78 to 5.8 pCi/g, and the concentration of one subsurface sample exceeded the FAL at 6 pCi/g (Table A.4-29 and Figure A.4-4). The concentration of one surface sample collected from the Extended Decision II Area (location E14) exceeded the FAL for Pu-238 at 4.57 pCi/g (Table A.4-31 and Figure A.4-5). Samples taken from the Verification Sampling Area did not exceed the FAL.

Pu-238 Upslope: Four samples collected in the Decision II upslope area, all within the contamination area, had concentrations that exceed the FAL (Table A.4-31 and Figure A.4-7), ranging from 18.9 to 29.3 pCi/g. The sample with the highest concentration of Pu-238, from the surface at location E34, was the same sample that yielded the highest concentration of Pu-239 for the Decision II upslope area, as discussed below.

Pu-239 Downslope: The concentrations of six surface samples from the Initial Decision II Area exceeded the FAL for Pu-239 (Table A.4-29 and Figure A.4-4), ranging from 195 to 329 pCi/g. The concentration of only one subsurface sample, at 309 pCi/g, exceeded the FAL for Pu-239. The concentration of one surface sample collected from the Extended Decision II Area (location E14)

Table A.4-29
Soil Sample Results for Isotopes Detected Above Minimum Reporting Limits at Muckpiles, Decision II, Downslope
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)					
			Plutonium-238	Plutonium-239	Strontium-90	Uranium-234	Uranium-235	Uranium-238
Final Action Levels			**3.54**[a]	**194.17**[a]	**838**[b]	**143**[b]	**17.5**[b]	**105**[b]
E01	551E001	0.0 - 0.5	1.04 (J)[c]	44	--	1.14	--	1.37
	551E002	1.0 - 1.5	0.39 (J)[c]	19.5	--	1.22	0.087	1.2
E02	551E003	0.0 - 0.5	0.57 (J)[c]	7.6	--	0.9	--	1.09 (M3)
	551E004	0.0 - 0.5	0.52 (J)[c]	7.9 (M3)	--	1.03 (M3)	--	1.16 (M3)
	551E005	1.0 - 1.5	0.153 (J)[c]	4.76	--	1.15	--	1.14 (M3)
E03	551E006	0.0 - 0.5	**3.78** (J)[c]	**195** (Y1)	1.51 (Y1)	1.75	0.101	1.03
E04	551E007	0.0 -0.5	**4.15** (J)[c]	**221** (J)[d]	1.66	1.67 (M3)	--	1.17
	551E008	1.0 - 1.5	1.95 (J)[c]	63	1.17 (Y1)	1.63 (M3)	--	1.43
E05	551E009	0.0 - 0.5	2.69 (Y2)	132 (Y2)	0.93	1.31	--	0.85
E06	551E010	0.0 - 0.5	**4.65**	**240**	1.79	1.39 (M3)	0.163	1.06
	551E011	1.0 - 1.5	**6** (M3)	**309** (M3)	2.05 (Y2)	3.13 (M3)	--	1.3 (M3)
E07	551E012	0.0 - 0.5	**4.93**	**247**	1.22 (Y1)	1.57	0.083	1.16
E08	551E013	0.0 - 0.5	--	2.47	--	1.12 (M3)	--	1.41 (M3)
	551E014	1.0 - 1.5	--	0.7	--	1.53	--	1.37
E09	551E015	0.0 - 0.5	2.03 (J)[c]	82	2.98	1.31 (M3)	--	1.09 (M3)
	551E016	1.5 - 2.0	0.192 (J)[c]	13.8	--	1.29 (M3)	--	1.33 (M3)
E10	551E017	0.0 - 0.5	**4.2** (J)[c]	**329** (M3)	3.54	2.49	--	1.22
	551E018	1.0 - 1.5	0.95 (J)[c]	18.4	--	1.25 (M3)	--	1.2
E11	551E019	0.0 - 0.5	2.24 (J)[c]	35.6	0.71 (Y1)	1.66 (M3)	--	1.56 (M3)
	551E020	1.0 - 1.5	0.106 (J)[c]	0.65	--	1.35	0.094	1.41
E12	551E021	0.0 - 0.5	0.36 (J)[c]	2.2	--	1.01	--	1.05
E13	551E022	0.0 - 0.5	2.6 (J)[c]	132	1.24 (Y1)	1.44	--	0.99 (M3)
E14	551E023	0.0 - 0.5	3.22 (J)[c]	166 (M3)	3.07 (Y1)	1.79 (M3)	--	1.02 (M3)
	551E024	0.0 - 0.5	**4.57** (J)[c]	**229** (M3)	2.5	1.8 (M3)	--	1.53
E15	551E025	0.0 - 0.5	0.082 (J)[c]	0.43	--	1.04	--	1.18
E16	551E026	0.0 - 0.5	0.074	0.31	--	--	--	--
E17	551E027	0.0 - 0.5	0.53	1.41	--	--	--	--
E18	551E028	0.0 - 0.5	0.099	0.27	--	--	--	--
E19	551E029	0.0 - 0.5	0.149	0.395	--	--	--	--
E20	551E030	0.0 - 0.5	0.124	0.231	--	--	--	--
	551E031	0.5 - 1.0	--	0.67	--	--	--	--

Table A.4-29
Soil Sample Results for Isotopes Detected Above Minimum Reporting Limits at Muckpiles, Decision II, Downslope
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)					
			Plutonium-238	Plutonium-239	Strontium-90	Uranium-234	Uranium-235	Uranium-238
Final Action Levels			**3.54**[a]	**194.17**[a]	**838**[b]	**143**[b]	**17.5**[b]	**105**[b]
E21	551E032	0.0 - 0.5	--	0.035 (LT)	--	--	--	--
E22	551E033	0.0 - 0.5	0.83	2.16	--	--	--	--
E23	551E035	0.0 - 0.5	--	0.39	--	--	--	--
	551E036	0.5 - 1.0	--	0.136	--	--	--	--
E24	551E037	0.0 - 0.5	0.076	0.396	--	--	--	--
E25	551E039	0.0 - 0.5	0.277	1.15	--	--	--	--
E26	551E040	0.0 - 0.5	0.139	0.56	--	--	--	--
	551E041	0.0 - 0.5	0.52	14.9	--	--	--	--
	551E042	0.5 - 1.0	--	0.86	--	--	--	--
E27	551E043	0.0 - 0.5	0.41 (J)[c]	3.15 (J)[c]	--	--	--	--
E28	551E044	0.0 - 0.5	0.074 (J)[c]	1.86 (J)[c]	--	--	--	--
	551E045	0.5 - 1.0	0.112 (J)[c]	0.98 (J)[c]	--	--	--	--
E29	551E046	0.0 - 0.5	0.34 (J)[c]	2.89 (J)[c]	--	--	--	--
	551E047	1.0 - 1.5	0.005 (J)[c]	-0.001 (J)[c]	--	--	--	--
E30	551E048	0.0 - 0.5	**5.8** (M3)	**318** (M3)	1.95 (Y1)	--	--	--
	551E049	2.0 - 2.5	0.158 (J)[c]	6.4 (J)[c]	--	--	--	--

[a]Taken from values calculated from RESRAD for CAU 551, Land Parcel 2.
[b]Taken from the construction, commercial, industrial land use scenario in Table 2.1 of the NCRP Report No. 129 *Recommended Screening Limits for Contaminated Surface Soil and Review Factors Relevant to Site-Specific Studies* (NCRP, 1999). The values provided in this source document were scaled to a 25-mrem/yr dose.
[c]Qualifier added to laboratory data; record accepted. Duplicate precision analysis (relative percent difference) outside control limits.
[d]Qualifier added to laboratory data; record accepted. Chemical yield above control limits.

ft bgs = Feet below ground surface
mrem/yr = Millirem per year
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive computer code
J = Estimated value
LT = Result is less than requested, greater than sample specific minimum detectable concentration.
M3 = The requested minimum detectable concentration was not met, but the reported activity is greater than the reported minimum detectable concentration.
Y1 = Chemical yield is in control at 100-110%. Quantitative yield is assumed.
Y2 = Chemical yield outside default limits.
-- = Not detected above minimum reporting limits.

Table A.4-30
Soil Sample Results for Isotopes Detected Above Minimum Reporting Limits at Verification Sampling Area

Sample Location	Sample Number	Depths (ft bgs)	Contaminants of Potential Concern (pCi/g)	
			Plutonium-238	Plutonium-239
Final Action Levels[a]			13	12.7
X01	PA-551X001	0.0 - 0.5	0.106	1.25 (J)
X02	PA-551X002	0.0 - 0.5	0.219	0.67 (J)
	PA-551X003	0.0 - 0.5	0.29	0.97 (J)
X03	PA-551X004	0.0 - 0.5	0.057	0.331 (J)
X04	PA-551X005	0.0 - 0.5	--	0.084 (J)
X05	PA-551X006	0.0 - 0.5	--	0.163 (J)
X06	PA-551X007	0.0 - 0.5	--	0.194 (J)
X07	PA-551X008	0.0 - 0.5	0.246	0.69 (J)
X08	PA-551X009	0.0 - 0.5	0.152	0.65 (J)
X09	PA-551X010	0.0 - 0.5	--	0.224 (J)
X10	PA-551X011	0.0 - 0.5	--	0.34 (J)
X11	PA-551X012	0.0 - 0.5	--	0.307 (J)
X12	PA-551X013	0.0 - 0.5	0.064	0.242 (J)
X13	PA-551X014	0.0 - 0.5	--	0.085 (J)
X14	PA-551X015	0.0 - 0.5	0.079	0.311 (J)
X15	PA-551X016	0.0 - 0.5	0.082	0.284 (J)

[a]Taken from the construction, commercial, industrial land use scenario in Table 2.1 of the NCRP Report No. 129 *Recommended Screening Limits for Contaminated Surface Soil and Review Factors Relevant to Site-Specific Studies* (NCRP, 1999). The values provided in this source document were scaled to a 25-mrem/yr dose.

ft bgs = Feet below ground surface
pCi/g = Picocuries per gram
J = Estimated value. Qualifier added to laboratory data; record accepted. Duplicate normalized difference exceeds control limits.
-- = Not detected above minimum reporting limits.

exceeded the FAL for Pu-239 at 229 pCi/g (Table A.4-30 and Figure A.4-5) and none of the subsurface samples exceeded the FAL. Samples taken from the Verification Sampling Area did not exceed the FAL.

Pu-239 Upslope: The concentrations of all but one surface and subsurface samples collected from the Decision II upslope area inside the contamination area (locations E31-E36) exceeded the FAL for Pu-239 (Table A.4-31 and Figure A.4-7). Surface sample Pu-239 concentrations exceeding the FAL

Table A.4-31
Soil Sample Results for Isotopes Detected Above Minimum Reporting Limits at Muckpiles, Decision II Upslope
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)					
			Plutonium-238	Plutonium-239	Strontium-90	Uranium-234	Uranium-235	Uranium-238
Final Action Levels[a]			**13**	**12.7**	**838**	**143**	**17.5**	**105**
A08	551A019	0.0 - 0.5	1.21	**21.8**	0.79	1.12	0.06	1.11
A09	551A020	0.0 - 0.5	0.77	10.1	--	1.2	0.066	1.13
A10	551A021	0.0 - 0.5	0.91	11.9	--	0.78	--	0.74
E31	551E050	0.0 - 0.5	**26.1** (J)	**2,080** (M3)	6.9	5.64	0.25	1.03
	551E051	0.5 - 1.0	**18.9** (J)	**1,140** (M3)	9.7	3.41	0.157 (M3)	0.94
E32	551E052	0.0 - 0.5	**18.9** (J)	**1,060** (M3)	5.5	3.24 (M3)	--	0.9 (M3)
E33	551E053	0.0 - 0.5	2.68	**183**	1.21	1.58	--	1.1
E34	551E054	0.0 - 0.5	**29.3** (M3)	**2,230** (M3)	2.48	4.43 (M3)	0.24 (M3)	1.57 (M3)
	551E055	0.5 - 1.0	12.7 (M3)	**820** (M3)	1.87	3.02 (M3)	--	1.29 (M3)
E35	551E056	0.0 - 0.5	3.1 (J)	**213** (M3)	2.08	1.61	0.078	1
E36	551E057	0.0 - 0.5	1.15 (J)	**72** (M3)	--	1.08	0.066	1.01
	551E058	0.5 - 1.0	0.119 (J)	7.3	--	0.93	--	0.99
E37	551E059	0.0 - 0.5	--	0.89	--	1.19	--	1.08
	551E060	0.5 - 1.0	--	0.157	--	1.16	--	1.1
E38	551E061	0.0 - 0.5	0.36	4.53	--	1.19	0.071	1.09
E39	551E062	0.0 - 0.5	0.133	1.62	--	1.04	0.087	1.14
E40	551E063	0.0 - 0.5	--	0.41	--	1.22	0.092	1.17
	551E064	0.5 - 1.0	--	--	--	1.08	0.114	1.14
E41	551E065	0.0 - 0.5	0.099	1.62	--	0.78	0.072	0.74

Table A.4-31
Soil Sample Results for Isotopes Detected Above Minimum Reporting Limits at Muckpiles, Decision II Upslope
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)					
			Plutonium-238	Plutonium-239	Strontium-90	Uranium-234	Uranium-235	Uranium-238
Final Action Levels[a]			**13**	**12.7**	**838**	**143**	**17.5**	**105**
E42	551E066	0.0 - 0.5	0.58	6.5	--	1.13	0.138	1.13
	551E067	0.0 - 0.5	0.357	3.23	--	1.13	0.092	1.19
	551E068	0.5 - 1.0	--	2.12	--	0.96	0.075	0.9

[a]Taken from the construction, commercial, industrial land use scenario in Table 2.1 of the NCRP Report No. 129 *Recommended Screening Limits for Contaminated Surface Soil and Review Factors Relevant to Site-Specific Studies* (NCRP, 1999). The values provided in this source document were scaled to a 25-mrem/yr dose.

ft bgs = Feet below ground surface
mrem/yr = Millirem per year
pCi/g = Picocuries per gram
J = Estimated value. Qualifier added to laboratory data; record accepted. Duplicate precision analysis (relative percent difference) outside control limits.
M3 = The requested minimum detectable concentration was not met, but the reported activity is greater than the reported minimum detectable concentration.
-- = Not detected above minimum reporting limits.

ranged from 72 to 2,230 pCi/g. The concentrations of subsurface samples ranged from 840 to 1,140 pCi/g. Only one of 12 samples taken from locations outside the contamination area, to the east and north along both the mesa access and Neptune crater access roads, showed a Pu-239 concentration above the FAL. This location was one of the original "background" sample locations (A08). Plutonium-239 contamination above the FAL is continuous from CAS 12-06-07 into the Neptune test affected area.

A.4.5 Nature and Extent of Contamination

Samples collected from numerous locations were found to contain one or more contaminants above FALs. As per the CAU 551 CAIP, each muckpile is considered to be contaminated at the highest concentrations of (1) contaminants identified above FALs during previous (historical) investigations

of muckpiles at NTS but not identified in samples taken at each muckpile, (2) contaminants identified above FALs during previous investigations of muckpiles at NTS but having higher concentrations found in samples taken at each muckpile, or (3) newly identified contaminants for each muckpile with concentrations above FALs. For purposes of this investigation, CASs 12-06-05 and 12-06-08 are considered to be contaminated at the highest levels assigned to either.

The contaminants assigned to each muckpile, the highest concentration assigned to each muckpile, and whether or not the contaminant extended downslope into the Initial Decision II Area (discussed in the following section) are presented in Table A.4-32.

Table A.4-32
CASs 12-06-05, 12-06-07, and 12-06-08 Contaminants of Concern, Highest Concentrations Assigned, and Extent

Contaminants of Concern	Highest Contaminant Concentration			Final Action Level[a]	Contaminant Extends into Initial Decision II Area?
	CAS 12-06-05	CAS 12-06-07	CAS 12-06-08		
Arsenic	38.8 mg/kg[b, c]	38.8 mg/kg[b, c]	38.8 mg/kg[b, c]	23 mg/kg	No
Lead	59,700 mg/kg[b, c]	59,700 mg/kg[b, c]	59,700 mg/kg[b, c]	750 mg/kg	No
Benzo(a)pyrene	1,600 µg/kg	N/A	1,600 µg/kg	210 µg/kg	No
Dibenzo(a,h)anthracene	330 µg/kg	N/A	330 µg/kg	210 µg/kg	No
TPH-DRO	10,000 mg/kg[b]	10,000 mg/kg[b]	10,000 m/kg[b]	100 mg/kg	Yes
Americium-241	478 pCi/g	3,370 pCi/g	478 pCi/g	79.63 pCi/g	Yes
Cesium-137	3,050 pCi/g[b]	3,050 pCi/g[b]	3,050 pCi/g[b]	72.07 pCi/g	Yes
Cobalt-60	5.3 pCi/g[b, c]	5.3 pCi/g[b, c]	5.3 pCi/g[b, c]	0.13 pCi/g	No
Europium-152	26.6 pCi/g	60 pCi/g	26.6 pCi/g	1.42 pCi/g	Yes
Plutonium-238	28.6 pCi/g	127 pCi/g	28.6 pCi/g	3.00 pCi/g	Yes
Plutonium-239	1,440 pCi/g	13,200 pCi/g	1,440 pCi/g	311.91 pCi/g	Yes

[a]Chemical FALs from CAU 551 CAIP PALs; radiological FALs from RESRAD Land Parcel 1
[b]Historical high value from previous Nevada Test Site muckpile investigations
[c]Expected contaminants of concern, not detected above FAL in CAU 551 muckpile samples

DRO = Diesel-range organics
FAL = Final action level
mg/kg = Milligrams per kilogram
N/A = Not applicable
PAL = Preliminary action level
pCi/g = Picocuries per gram
TPH = Total petroleum hydrocarbons
µg/kg = Micrograms per kilogram

Radiological contamination was bounded in the downslope direction, and all contaminants were bounded by samples taken at the westernmost location (C01; Figure A.4-3), indicating no adjoining contamination to the west of CAU 551.

The Initial Decision II Area, immediately downslope and downstream from the CAU 551 muckpiles, was found to be contaminated at one or more locations by TPH-DRO, Am-241, Cs-137, Eu-152, Pu-238, and Pu-239 above the FALs.

Further down the washes, in the Extended Decision II Area, all locations on the northeast side of the access road and at the lower end of the sampling area on the southwest side of the access road had TPH-DRO contamination at concentrations above the FAL, and were generally higher than those for samples taken from the Initial Decision II Area suggesting a source other than the muckpiles, such as road oil. The extent of the TPH-DRO contamination for CAU 551, however, is at the lower boundary of the Initial Decision II Area based on concentrations below FALs found at locations E12, E13, and E14.

The TPH-DRO was not found above the FAL on the upper, flat part of the CAS 12-06-07 muckpile, and thus had been bounded below the upslope Decision II Area.

For radionuclide COCs, one location in the Extended Decision II Area (location E14, between the E-Tunnel turnoff and the large bend in the access road) were found to be contaminated by Cs-137, Eu-152, Pu-238, and Pu-239 above the FALs. All radionuclides were bounded by samples at all locations on both sides of the access road further down the wash through the remainder of the Extended Decision II Area and through the entire Verification Sampling Area. The radioactive contamination is limited to the areas upslope from the access road leading to the E-Tunnel.

For the upslope areas, the radionuclides Am-241, Cs-137, Pu-238, and Pu-239 contaminants were identified at concentrations exceeding the FALs. Contamination from these COCs is continuous from the Neptune crater area into CAS 12-06-07. The Neptune crater area is suspected of contributing contamination to the other two muckpiles and the downslope areas.

The delineation of the Neptune crater area from CAU 551 (along CAS 12-06-07) is defined by a line drawn from the vicinity of sample location E31 to E32 to E35, and extending to the west along the

most reasonable edge between the level muckpile top (CAS 12-06-07) and adjoining upslope areas impacted by the Neptune crater.

A.4.6 Revised Conceptual Site Model

The results of the CAI applicable to the muckpiles did not contradict the CSM for CASs 12-06-05, 12-06-07, and 12-06-08. No revision of the CSM was necessary.

The results of the CAI applicable to the area downslope from the muckpiles did not contradict the CSM for CASs 12-06-05, 12-06-07, and 12-06-08. No revision of the CSM was necessary. The upslope area is not considered to be impacted by material placed in the muckpiles and therefore is not a facet of the CSM.

A.5.0 Waste Management

Corrective Action Unit 551 waste minimization practices were incorporated into the field activities. Controls were in place to minimize the use of hazardous materials and the unnecessary generation of hazardous and/or mixed waste. Decontamination activities were planned and executed to minimize the volume of rinsate generated.

Potentially hazardous/radioactive waste generated during the investigation was placed in 55-gallon steel drums and labeled “Hazardous Waste - Pending Analysis” and/or “Radioactive Waste - Pending Analysis.” One hazardous waste accumulation area (HWAA), one satellite accumulation area (SAA), and one radioactive controlled area (RCA) were established to manage the waste at the investigation areas. The amount, type, and source of the waste placed into each drum was recorded in the WM logbooks at each location.

A.5.1 Characterization Objective

The waste streams include decontamination rinse water, disposable PPE, field screening, and disposable sampling equipment. The types, amounts and disposal of the waste are detailed in the following subsections. Newly generated wastes such as rinsate, PPE, and sampling debris (plastic) have been characterized based on associated soil samples and knowledge of the waste generation process. For waste drums not sampled directly and characterized, the characterization was based on process knowledge and analytical results of the corresponding soil samples. No listed constituents are identified at CAU 551. Therefore, the waste characterization is based on its characteristic properties. Analytical results for each drum of waste or associated samples were reviewed to ensure compliance with federal regulations, state regulations, DOE directives/policies, guidance, waste disposal criteria and Stoller-Navarro Joint Venture procedures. Analytical data were reviewed through Tier 1, 2, and 3 validation.

A.5.2 Investigation Waste Streams

Newly generated IDW was segregated into the following waste streams:

- Personal protective equipment and disposable sampling equipment
- Decontamination rinsate

A.5.3 Investigation-Derived Waste Generated

A total of nine drums of IDW were generated during the investigation:

- One drum was characterized as hydrocarbon impacted waste (e.g., PPE/plastic). Pickup and disposal for this waste stream is intended for the hydrocarbon waste landfill
- Six drums were characterized as sanitary waste (e.g., rinsate). Pickup and disposal for this waste stream is intended for the sanitary lagoon
- Two drums were characterized as low-level waste (e.g., PPE/plastic). Pickup and disposal for this waste stream is intended for the radiological waste management facility.

A.5.4 Waste Characterization Samples

Waste management samples were collected from drummed waste, as necessary, to facilitate full characterization of the waste for disposal. Selected drums of rinsate were sampled, based on analytical results from associated media samples, to determine the concentrations of the chemical constituents and/or radiological isotopes present in the associated IDW (Table A.5-1).

A.5.4.1 Corrective Action Site 12-01-09, Aboveground Storage Tank and Stain

The aboveground storage tank was sampled by Composite Liquid Waste Sampler (COLIWASA) in advance of field work to determine the contents of the tank. The liquid sample was analyzed for total VOCs, total SVOCs, total RCRA metals, TPH-DRO and TPH-gasoline-range organics (GRO), PCBs and gamma-emitting radionuclides (sample #551A001, Table A.5-1). Other than corroded metal flakes from the inside of the tank no sludge/solid material was found in the sample removed. Analytical results suggest the material was compatible with diesel fuel. Concentrations of components that exceeded the FAL were found for naphthalene (350,000 µg/L and 410,000 µg/kg), TPH-DRO (910,000 mg/kg), and TPH-GRO (2,600 mg/kg), as presented in Table A.5-2. Total

RCRA metals were found to be below PALs. Gamma-emitting radionuclides were not detected. The contents of the tank were pumped out in October, 2004, and removed from site.

A drum (551A01) was used to separately contain PPE and the COLIWASA used during the tank sampling. Additionally, one drum (551A02) was used to contain rinsate generated during CAI decontamination activities at CAS 12-01-09.

Table A.5-1
Waste Characterization Samples Collected at CAU 551

Sample Location	Sample Number	Depth (ft bgs)	Sample Matrix	Purpose	Analyses
12-01-09, tank content	551A001	N/A	Liquid	WC	VOCs, SVOCs, TPH-GRO, TPH-DRO, PCBs, RCRA Metals, Gamma Spectrometry
Drum 551B01 (contents)	551B501	N/A	Aqueous	WC	Gross Alpha/Beta, Tritium
Drum 551C01 (contents)	551C501	N/A	Aqueous	WC	Gross Alpha/Beta, Tritium
Drum 551D01 (contents)	551D501	N/A	Aqueous	WC	Gross Alpha/Beta, Tritium
Drum 551E01 (contents)	551E501	N/A	Aqueous	WC	Gross Alpha/Beta, Tritium

DRO = Diesel-range organics
ft bgs = Feet below ground surface
GRO = Gasoline-range organics
N/A = Not applicable
PCB = Polychlorinated biphenyl
RCRA = *Resource Conservation and Recovery Act*
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound
WC = Waste characterization

A.5.4.2 Corrective Action Sites 12-06-05, 12-06-07, and 12-06-08, Muckpiles

One drum (551C01) was used to contain IDW (PPE and disposable sampling equipment) from the CAU 551 muckpiles CAI. Three drums (551B01, 551C02, and 551D01) were used to contain rinsate generated during CAI decontamination activities at CASs 12-06-05, 12-06-07, and 12-06-08.

Each rinsate drum for these CASs was sampled for waste management characterization of gross alpha/beta and tritium. Results of those analyses above minimum reporting limits are presented in Table A.5-2 (samples 551B501, 551C501, and 551D501).

Table A.5-2
Liquid Samples Detected Above Minimum Reporting Limits

Sample Number	Sample Matrix	Parameter	Result	Units
CAS 12-01-09				
551A001	Liquid	Naphthalene	**350,000** (J)[a]	µg/L
551A001	Liquid	2-Methylnaphthalene	3,400,000 (J)[b]	µg/kg
551A001	Liquid	Selenium	0.57 (J-)	mg/kg
551A001	Liquid	Diesel-Range Organics	**910,000** (J)[c]	mg/kg
551A001	Liquid	Gasoline-Range Organics	**2,600** (J)[d]	mg/kg
551A001	Liquid	Lead	3	mg/kg
551A001	Liquid	Naphthalene	**410,000** (J)[b]	µg/kg
551A001	Liquid	Phenanthrene	940,000 (J)[b]	µg/kg
CAS 12-06-05				
551B501	Liquid	Gross Beta	6.8	pCi/L
CAS 12-06-07				
551C501	Liquid	Gross Beta	30.5	pCi/L
551C501	Liquid	Gross Alpha	56.3 (J)[e]	pCi/L
CAS 12-06-08				
551D501	Liquid	Gross Beta	29.9 (M3)	pCi/L
551D501	Liquid	Gross Alpha	46 (J)[e]	pCi/L
Muckpiles, Decision II				
551E501	Liquid	Gross Alpha	62 (J)[e]	pCi/L
551E501	Liquid	Gross Beta	58 (M3)	pCi/L

[a]Qualifier added to laboratory data; record accepted. An associated trip blank was not analyzed. Volatile/Reactive sample vial contained headspace.
[b]Qualifier added to laboratory data; record accepted. Matrix effects may exist. Surrogate recovery exceeded upper limits.
[c]Qualifier added to laboratory data; record accepted. Surrogates diluted out.
[d]Qualifier added to laboratory data; record accepted. Volatile/Reactive sample vial contained headspace.
[e]Qualifier added to laboratory data; record accepted. Duplicate precision analysis (relative percent difference) outside control limits.

mg/kg = Milligrams per kilogram
pCi/L = Picocuries per liter
µg/kg = Micrograms per kilogram
µg/L = Micrograms per liter
J = Estimated value
J- = The result is an estimated quantity, but the result may be biased low. Negative bias found in continuing calibration/method blank.
M3 = The requested minimum detectable concentration was not met, but the reported activity is greater than reported minimum detectable concentration.

A.5.4.3 CAU 551 Decision II, Downslope and Upslope Areas

One drum (551E01) was used to contain IDW (PPE and disposable sampling equipment) from the downslope investigation area of CAU 551. Two drums (551E02 and 551E03) were used to contain rinsate generated during CAI decontamination activities in the Initial Decision II and Extended Decision II areas.

One rinsate drum (551E02) was sampled for WM characterization of gross alpha/beta and tritium. Results of this analysis above MRLs are presented in Table A.5-2 (sample 551E501).

A.6.0 Quality Assurance

This section contains a summary of QA/QC measures implemented during the sampling and analysis activities conducted in support of the CAU 551 CAI. The following sections discuss the data validation process, QC samples, and nonconformances. A detailed evaluation of the DQIs is presented in Appendix B.

Laboratory analyses were conducted for samples used in the decision-making process to provide a quantitative measurement of any COPCs present. Rigorous QA/QC was implemented for all laboratory samples including documentation, verification and validation of analytical results, and affirmation of DQI requirements related to laboratory analysis. Detailed information regarding the QA program is contained in the Industrial Sites QAPP (NNSA/NV, 2002).

A.6.1 Data Validation

Data validation was performed in accordance with the Industrial Sites QAPP (NNSA/NV, 2002) and approved protocols and procedures. All laboratory data from samples collected and analyzed for CAU 551 were evaluated for data quality according to the EPA Functional Guidelines (EPA, 1994a and 1999). These guidelines are implemented in a tiered process and are presented in Sections A.6.1.1 through A.6.1.3. Data were reviewed to ensure that samples were appropriately processed and analyzed, and the results were evaluated using validation criteria. Documentation of the data qualifications resulting from these reviews is retained in project files as a hard copy and electronic media.

One hundred percent of the data analyzed as part of this investigation were subjected to Tier 1 and Tier 2 evaluations. A Tier 3 evaluation was performed on approximately 5 percent of the data analyzed.

A.6.1.1 Tier 1 Evaluation

Tier 1 evaluation for chemical and radiochemical analysis examines, but is not limited to:

- Sample count/type consistent with chain of custody.
- Analysis count/type consistent with chain of custody.

- Correct sample matrix.
- Significant problems stated in cover letter or case narrative.
- Completeness of certificates of analysis.
- Completeness of Contract Laboratory Program (CLP) or CLP-like packages.
- Completeness of signatures, dates, and times on chain of custody.
- Condition-upon-receipt variance form included.
- Requested analyses performed on all samples.
- Date received/analyzed given for each sample.
- Correct concentration units indicated.
- Electronic data transfer supplied.
- Results reported for field and laboratory QC samples.
- Whether or not the deliverable met the overall objectives of the project.

A.6.1.2 Tier 2 Evaluation

Tier 2 evaluation for chemical and radiochemical analysis examines, but is not limited to:

Chemical:

- Correct detection limits achieved.
- Sample date, preparation date, and analysis date for each sample.
- Holding time criteria met.
- Quality control batch association for each sample.
- Cooler temperature upon receipt.
- Sample pH for aqueous samples, as required.
- Detection limits properly adjusted for dilution, as required.
- Blank contamination evaluated and applied to sample results/qualifiers.
- Matrix spike (MS)/matrix spike duplicate (MSD) percent recoveries (%R) and relative percent differences (RPDs) evaluated and qualifiers applied to laboratory results, as necessary.
- Field duplicate RPDs evaluated using professional judgment and qualifiers applied to laboratory results, as necessary.
- Laboratory duplicate (LabDup) RPDs evaluated and qualifiers applied to laboratory results, as necessary.
- Surrogate %R evaluated and qualifiers applied to laboratory results, as necessary.

- Laboratory control sample (LCS) %R evaluated and qualifiers applied to laboratory results, as necessary.
- Initial and continuing calibration evaluated and qualifiers applied to laboratory results, as necessary.
- Internal standard evaluation.
- Mass spectrometer tuning criteria.
- Organic compound quantitation.
- Inductively coupled plasma interference check sample evaluation.
- Graphite furnace atomic absorption quality control.
- Inductively coupled plasma serial dilution effects.
- Re-calculation of 10 percent of laboratory results from raw data.

Radioanalytical:

- Correct detection limits achieved.
- Blank contamination evaluated and, if significant, qualifiers are applied to sample results.
- Certificate of Analysis consistent with data package documentation.
- Quality control sample results (duplicates, LCSs, laboratory blanks) evaluated and used to determine laboratory result qualifiers.
- Sample results, uncertainty, and minimum detectable concentration evaluated.
- Detector system calibrated with National Institute for Standards and Technology (NIST)-traceable sources.
- Calibration sources preparation was documented, demonstrating proper preparation and appropriateness for sample matrix, emission energies, and concentrations.
- Detector system response to daily or weekly background and calibration checks for peak energy, peak centroid, peak full-width half-maximum, and peak efficiency, depending on the detection system.
- Tracers NIST-traceable, appropriate for the analysis performed, and recoveries that met QC requirements.

- Documentation of all QC sample preparation complete and properly performed.
- Spectra lines, photon emissions, particle energies, peak areas, and background peak areas support the identified radionuclide and its concentration.

A.6.1.3 Tier 3

The Tier 3 review is an independent examination of the Tier 2 evaluation. The Tier 3 review duplicates the Tier 2 review for a limited number of samples (typically 5 percent) by an independent agency and includes the following additional evaluations:

Chemical:

- Recalculation of all laboratory results from raw data

Radioanalytical:

- QC sample results (e.g., calibration source concentration, %R, and RPD) verified.
- Radionuclides and their concentration validated as appropriate considering their decay schemes, half-lives, and process knowledge, and history of the facility and site.
- Each identified line in spectra verified against emission libraries and calibration results.
- Independent identification of spectra lines, area under the peaks, and quantification of radionuclide concentration in a random number of sample results.

A Tier 3 review of 5 percent of the sample analytical data was performed by TechLaw, Inc., of Lakewood, Colorado. Tier 2 and Tier 3 results were compared and, where differences were noted, data were reviewed and changes made accordingly.

A.6.2 Field Quality Control Samples

Field QC samples consisted of 16 trip blanks, 2 equipment rinsate blanks, 8 field blanks, 10 MS/MSDs, and 10 FDs collected and submitted for analysis by the laboratory analytical methods shown in Table A.2-2. The QC samples were assigned individual sample numbers and sent to the laboratory "blind." Additional samples were selected by the laboratory to be analyzed as LabDups.

A.6.2.1 Field Quality Control Samples

Review of the field blank analytical data for soil sampling indicates that there was no cross-contamination due to transportation practices or the ambient conditions, and that decontamination was adequate. Field, equipment rinsate, and source blanks were analyzed for the applicable parameters listed in Table A.2-2, and trip blanks were analyzed for VOCs only.

During the sampling events, 10 FDs were sent as blind samples to the laboratory to be analyzed for the investigation parameters listed in Table A.2-2. For these samples, the duplicate results precision (i.e., RPDs between the environmental sample results and their corresponding FD sample results) were evaluated to the guidance set forth in the EPA Functional Guidelines (EPA, 1994a).

A.6.2.2 Laboratory Quality Control Samples

Analysis of method QC blanks were performed on each sample delivery group (SDG) for inorganics. Analysis for surrogate spikes and preparation blanks (PBs) were performed on each SDG for organics only. Initial and continuing calibration and LCSs were performed for each chemical SDG by EMAX Laboratories, Inc. and for each radiological SDG by Paragon Analytical, Inc. The results of these analyses were used to qualify associated environmental sample results according to the EPA Functional Guidelines (EPA, 1994a and 1999). Documentation of data qualifications resulting from the application of these guidelines is retained in project files as hard copy and electronic media.

The laboratory included a PB, LCS, and a LabDup sample with each batch of field samples analyzed for radionuclides.

A.6.3 Field Nonconformances

There were no field nonconformances identified for the CAI.

A.6.4 Laboratory Nonconformances

Laboratory nonconformances are generally due to inconsistencies in the analytical instrumentation operation, sample preparations, extractions, missed holding times, and fluctuations in internal standard and calibration results. Twenty-nine nonconformances were issued by the laboratory that

may or may not have resulted in qualifying data. These laboratory nonconformances have been accounted for during the data qualification process.

A.7.0 Summary

Analytes detected in soil samples during the CAI were evaluated against the FALs to determine the nature and extent of COCs for CAU 551. Assessment of the data generated from investigation activities indicates the FALs were exceeded in many soil samples at all CAU 551 CASs. The following summarizes the results for CAS 12-01-09, and separately, CASs 12-06-05, 12-06-07, and 12-06-08, and downslope areas.

CAS 12-01-09, Aboveground Storage Tank and Stain. Analytical results from a sample of the tank contents indicated that the liquid was diesel fuel, and was not radiologically contaminated. Analytical results from the stain and surrounding areas revealed that TPH-DRO did indeed contaminate the soil, vertically to the depth of underlying rock (average of 2.5 ft), and horizontally no further than 11 ft to the south of the tank, approximately 2 ft to the west, approximately 26 ft to the north, and approximately 5 ft to the east. Approximately 41 yd^3 of soil are estimated to be contaminated with TPH-DRO above the FAL.

CASs 12-06-05, 12-06-07, and 12-06-08, Area 12 Muckpiles, and Downslope Areas. The three muckpiles were found to be extensively contaminated by radionuclides and TPH-DRO. The TPH-DRO and radionuclides have moved into the washes. The TPH-DRO was traced to the lower end of the Initial Decision II Area, but not into the Extended Decision II Area. Radionuclide contamination was detected above the FALs in the downslope areas to location E14 between the E-Tunnel turnoff and the large bend in the access road. Additionally, two locations on CAS 12-06-05 were found to be contaminated by SVOCs, which were bounded laterally. Contamination was bounded to the west of CAU 551 by clean samples taken at the westernmost sampling location, at CAS 12-06-07, and by samples taken midway between the muckpiles and to the lower boundary of the Initial Decision II Area. All three muckpiles are considered to be contaminated by chemical and radiological contaminants, at their highest levels, as presented in Table A.4-32. As material in the washes from one CAS muckpile becomes readily mixed with material from other CAS muckpiles, boundaries were not redrawn down the washes to indicate the lower extent of CAS boundaries.

The estimated volume of contaminated muck in the muckpiles is:

- CAS 12-06-05, approximately 49,240 yd^3
- CAS 12-06-07, approximately 4,930 yd^3
- CAS 12-06-08, approximately 1,590 yd^3

The volume of contaminated soil in the Initial Decision II and Extended Decision II areas was not calculated. However, TPH-DRO and radiological contamination from CAU 551 is limited to the wash channels and a short lateral distance from the drainages leading from the muckpiles. Although not quantified, TPH-DRO and radiological contamination is concluded to be continuous to the lower levels on the muckpiles and in the downslope drainings. This area is also considered to have been affected by radiological fallout from the dust cloud generated by the Neptune venting from C-Tunnel.

A.8.0 References

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EPA, see U.S. Environmental Protection Agency.

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Appendix B

Data Assessment

B.1.0 Data Assessment

The DQA process is the scientific evaluation of the actual investigation results to determine whether the DQO criteria established in Section 6.2 of the CAU 551 CAIP were met and whether DQO decisions can be resolved at the desired level of confidence (NNSA/NSO, 2004). The DQO process ensures that the right type, quality, and quantity of data will be available to support the resolution of those decisions at an appropriate level of confidence. Using both the DQO and DQA processes helps to ensure that DQO decisions are sound and defensible.

The DQA involves five steps that begin with a review of the DQOs and end with an answer to the DQO decisions. The five steps are briefly summarized as follows:

Step 1: Review DQOs and Sampling Design - Review the DQO process to provide context for analyzing the data. State the primary statistical hypotheses; confirm the limits on decision errors for committing false rejection (Type I) or false acceptance (Type II) decision errors; and review any special features, potential problems, or any deviations to the sampling design.

Step 2: Conduct a Preliminary Data Review - A preliminary data review should be performed by reviewing QA reports and inspecting the data both numerically and graphically validating and verifying the data to ensure that the measurement systems performed in accordance with the criteria specified and using the validated dataset to determine whether the quality of the data is satisfactory.

Step 3: Select the Test - Select the test based on the population of interest, population parameter, and the hypotheses. Identify the key underlying assumptions that could cause a change in one of the DQO decisions.

Step 4: Verify the Assumptions - Perform tests of assumptions. If data are missing or censored, determine the impact on DQO decision error.

Step 5: Draw Conclusions from the Data - Perform the calculations required for the test.

B.1.1 Review DQOs and Sampling Design

This section contains a review of the DQO process presented in Appendix A of the CAU 551 CAIP. The DQO decisions are presented with the DQO provisions to limit false rejection (false negative) or false acceptance (false positive) decision errors. Special features, potential problems, or any deviations to the sampling design are also presented.

Two DQO decisions are presented in the CAU 551 CAIP:

- Decision I - "Is a COC present in environmental media within the CAS at a concentration that could pose an unacceptable risk to human health and the environment?"
- Decision II - "If a COC is present, is sufficient information available to evaluate appropriate corrective action alternatives?"

These decision rules apply as stated above to CAS 12-01-09, Aboveground Storage Tank and Stain.

Because the investigation of the CAU 551 muckpiles could not follow the model developed for previous muckpile CAIs, the Decision I statement was further developed for CASs 12-06-05, 12-06-07, and 12-06-08. In Section A.1.3.1.2 of the CAIP for CAU 551 (NNSA/NSO, 2004) the Decision I statement was broken out into four supporting decision statements. This allowed for the use of historical NTS muckpile investigation data in making assumptions about the COCs and their levels to be expected in the CAU 551 muckpiles. The participants at the CAU 551 DQO meeting agreed upon this approach to supplant the information that could not be gathered from areas on the muckpiles due to safety hazards created by the steep slopes in and around these CASs.

The first two of the four supporting decision statements for Decision I address the historical muckpile data used for the purpose of establishing expected COCs and their levels for the CAU 551 muckpile CSM. The second two supporting decision statements for Decision I address the newly acquired muckpile data obtained from those areas of the muckpiles deemed safely accessible to sampling personnel.

The two supporting Decision I statements addressing historical muckpile data are:

- Decision Ia statement: Are COPCs present in muck samples collected during previous muckpile investigations at levels above current (June 2004) PALs?

- Decision Ib statement: Are the COPCs identified in muck at concentrations above PALs in previous NTS muckpile investigations expected to be present at concentrations above PALs in the CAU 551 muckpiles?

The two supporting Decision I statements addressing newly acquired muckpile data are:

- Decision Ic statement: Are COCs present in the samples that can be collected at CAU 551 muckpiles?

- Decision Id statement: Do the data acquired at CAU 551 muckpiles support the CSM, including the outputs of Decisions Ia and Ib?

Further discussion of these four supporting Decision I statements, and a Decision Flow Diagram illustrating the sequence of processing information with these statements, are presented in Section A.1.3.1.2 of the CAU 551 CAIP (NNSA/NSO, 2004). The use of historical muckpile data resulted in assuming seven COCs exist in the CAU 551 muckpiles at the highest concentrations previously detected during investigations of other NTS muckpiles, as shown in Table A.1-4 of the CAU 551 CAIP (NNSA/NSO, 2004). The three muckpiles CASs, therefore, have been administratively established as being contaminated, at a minimum, with these seven expected COCs and their expected levels. The information gathered from field sampling during the CAI impacts the underlying assumption for the CSM of seven expected COCs by either (1) adjusting the contaminant concentration to a higher level based on the analytical results from CAU 551 or (2) adding a COC that was not assumed to exist in the muckpiles. Because of this approach, the traditional Decision rule of "No Further Action" if COPC concentrations are less than corresponding FALs, for Decision I, is not valid for the CAU 551 muckpiles CAI, but it remains valid for CAS 12-01-09.

The traditional Decision II statement remains unchanged from previous muckpile investigations.

B.1.1.1 Decision I

Decision Rules:

- If the concentration of any COPC in a target population exceeds the FAL for a COPC in a Decision I sample, either from previous NTS muckpile investigations (applicable only to the CAU 551 muckpiles) or from samples collected at CAU 551, then that COPC is identified as a COC and the extent of the contamination will be determined.

- For CASs 12-06-05, 12-06-07, and 12-06-08, if all COPC concentrations in samples collected from the CAU 551 muckpiles are less than the corresponding FALs, the decision will be that only those COPCs considered as expected COCs will be assumed to be present at the CAU 551 muckpiles.

- For CAS 12-01-09, if COPC concentrations are less than the corresponding FAL, then the decision will be no further action.

Null Hypothesis: A COC is present in the stain or muckpiles.

Alternative condition: A COC is not present in the stain or muckpiles.

Population Parameter: For the AST and stain, the maximum observed sample result; for the muckpiles, the maximum value from previous muckpile investigations or the new COPC data values generated from sampling in accessible areas of the CAU 551 muckpiles, whichever is greater.

B.1.1.1.1 DQO Provisions To Limit False Negative Decision Error

A false rejection decision error (where consequences are more severe) was controlled by meeting the following DQO provision criteria established in Section A.1.7.1 of the CAU 551 CAIP (NNSA/NSO, 2004):

1a. For CAS 12-01-09, having a high degree of confidence that locations selected will identify COCs if present anywhere within the CAS, or

1b. For CASs 12-06-05, 12-06-07, and 12-06-08, having a high degree of confidence that historical data evaluations (Decision Ia & Ib for muckpile investigations) combined with data generated from accessible portions of the CAU 551 muckpiles will identify COCs, if present, anywhere within the CASs.

2. Having a high degree of confidence that analyses of the newly obtained CAU 551 data will be sufficient to detect any COCs present in the sampled media and that the detection limits are adequate to ensure an accurate quantification of the COCs.

3. Concurrent, with Decision I sampling, collection, and analysis (full suite), Decision II samples will be collected for the muckpile CASs (locations in Initial Decision II sampling areas within downslope areas).

Criteria 1a/1b:

One or more of the following CAIP sample location selection guidelines were used in choosing each of the sample locations depicted in Tables A.3-1, A.4-1 through A.4-3, A.5-1, and A.5-2. Guidelines followed to satisfy the first DQO provision criteria are:

1. Selection of sampling locations for CAS 12-01-09 were to be in areas most likely contaminated by COCs (e.g., in the stain, beneath pipe welds and joints). This was accomplished by sampling the center of a stain (stains guideline) beneath a corroded weld, and near a pipe joint (pipe welds/joints guideline).

2. For CASs 12-06-05, 12-06-07, and 12-06-08, both (a) the highest concentrations of COCs detected in previous muckpile investigations were expected to occur in the muckpiles, and (b) sampling locations on safely accessible areas of the muckpiles were to be chosen to bias the investigation towards the most-likely contaminated accessible areas. Selection of sampling locations on the muckpiles was accomplished by one or more of the following: sampling surveyed areas that contained elevated radiation (elevated radiation guideline), tunnel operation debris (drums, containers, or debris guideline), evidence of erosion (area of erosion guideline), evidence of deposition (area of deposition guideline), changes in muck/soil textures, colors or other features (geological conditions or materials guideline), and/or possible deposits from the outflow of a pipe protruding horizontally in the B-Tunnel muckpiles (possible pipe effluent deposits guideline).

Specific guidelines are listed and defined in Section A.2.2.

Criterion 2:

To satisfy the second DQO provision criterion, all samples were analyzed using the analytical methods listed in Tables 3-3 and 3-4 of the CAIP and for the chemical and radiological analytes listed in Table A.1-7 of the CAIP. Table B.1-1 provides a reconciliation of samples analyzed to the planned analytical program found in Table 3-2 of the CAU 551 CAIP (NNSA/NSO, 2004) for Decision I and Initial Decision II (muckpiles) sampling.

Samples were submitted for all of the analytical methods specified in the analytical program presented in Section A.1.4.3.3 of the CAIP with the following exception: Sample 551B030, taken during the last day of Decision I sampling, was submitted for radiological analysis only. However, this does not affect the DQO decisions because locations on all sides did not detect chemical contaminants above the FALs other than TPH-DRO.

Table B.1-1
CAU 551 Environmental Samples Submitted per Analyte for CAU 551

		REQUIRED ANALYTES									
		Total VOCs	Total SVOCs	PCBs	Metals	Beryllium	TPH-DRO	Gamma Spectroscopy	Isotopic Uranium	Isotopic Plutonium	Strontium-90
CAS	12-01-09 (AST)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	12-06-05	S[a]	S[a]	S[a]	S[a]	S[a]	S[a]	Y	Y	Y	Y
	12-06-07	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	12-06-08	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Area	Initial Decision II, Muckpiles	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

[a]All samples except 551B030 (radiological analysis only)

AST = Aboveground storage tank
DRO = Diesel-range organics
PCB = Polychlorinated biphenyl
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound
S = Required for all samples; not all samples analyzed (as noted)
Y = Required for all samples; all samples analyzed

Sample results were assessed against the DQI of sensitivity as defined in the Industrial Sites QAPP (NNSA/NV, 2002). The sensitivity goal defined in the CAIP states that analytical detection limits will be less than the corresponding action level, thus ensuring that the analyses were sensitive enough to identify and quantify any COCs present in the samples, as described in Section 6.2.8 and Table 6-1 of the CAU 551 CAIP (NNSA/NSO, 2004). This goal was not achieved for the chemical analytical results listed in Table B.1-2. All radiological analytes met the sensitivity goal. Results not meeting the sensitivity goal were not used in making DQO decisions and will therefore be considered as rejected data. The impact on DQO decisions is addressed in the assessment of completeness.

To ensure that the dataset is of sufficient quality and completeness, the entire dataset, as well as individual sample results, were assessed against the DQIs of precision, accuracy, comparability, completeness, and representativeness, as defined in the Industrial Sites QAPP (NNSA/NV, 2002).

Table B.1-2
Chemical Analytes Failing Sensitivity Criteria for CAU 551
(Page 1 of 7)

Sample Number	Parameter	Result (µg/kg)	Detection Limit (µg/kg)	2002 Industrial PRG (µg/kg)
551A002	4-Bromophenyl-Phenyl Ether	7,500	7,500	1,764.5
551A002	Bis(2-Chloroethyl)Ether	7,500	7,500	550
551A002	Hexachlorobenzene	7,500	7,500	1,100
551A002	1,2-Diphenylhydrazine	7,500	7,500	2,200
551A002	Indeno(1,2,3-cd)Pyrene	7,500	7,500	2,100
551A002	Benzo(b)Fluoranthene	7,500	7,500	2,100
551A002	Benzo(a)Pyrene	4,600	4,600	210
551A002	Dibenzo(a,h)Anthracene	4,600	4,600	210
551A002	Benzo(a)Anthracene	7,500	7,500	2,100
551A002	N-Nitroso-Di-N-Propylamine	5,300	5,300	250
551A002	3,3'-Dichlorobenzidine	38,000	38,000	3,800
551A002DL	1,2,3-Trichloropropane	55	55	11
551A003	Benzo(a)Pyrene	450	450	210
551A003	Dibenzo(a,h)Anthracene	450	450	210
551A003	N-Nitroso-Di-N-Propylamine	530	530	250
551A004	Benzo(a)Pyrene	460	460	210
551A004	Dibenzo(a,h)Anthracene	460	460	210
551A005	Hexachlorobenzene	4,200	4,200	1,100
551A004	N-Nitroso-Di-N-Propylamine	530	530	250
551A005	Benzo(a)Pyrene	510	510	210
551A005	Dibenzo(a,h)Anthracene	510	510	210
551A005	N-Nitroso-Di-N-Propylamine	590	590	250
551A006	Benzo(a)Pyrene	500	500	210
551A006	Dibenzo(a,h)Anthracene	500	500	210
551A006	Hexachlorobenzene	4,100	4,100	1,100
551A006	N-Nitroso-Di-N-Propylamine	580	580	250
551A007	Benzo(a)Pyrene	450	450	210
551A007	Dibenzo(a,h)Anthracene	450	450	210
551A007	N-Nitroso-Di-N-Propylamine	520	520	250
551A008	Benzo(a)Pyrene	500	500	210
551A008	Dibenzo(a,h)Anthracene	500	500	210
551A008	N-Nitroso-Di-N-Propylamine	580	580	250
551A024	Benzo(a)Pyrene	260	260	210

Table B.1-2
Chemical Analytes Failing Sensitivity Criteria for CAU 551
(Page 2 of 7)

Sample Number	Parameter	Result (µg/kg)	Detection Limit (µg/kg)	2002 Industrial PRG (µg/kg)
551A024	Dibenzo(a,h)Anthracene	260	260	210
551A027	Benzo(a)Pyrene	260	260	210
551A027	Dibenzo(a,h)Anthracene	260	260	210
551B019DL	1,2,3-Trichloropropane	61	61	11
551B027	Benzo(a)Pyrene	250	250	210
551B027	Dibenzo(a,h)Anthracene	250	250	210
551C001	Benzo(a)Pyrene	260	260	210
551C001	Dibenzo(a,h)Anthracene	260	260	210
551C004	Benzo(a)Pyrene	260	260	210
551C004	Dibenzo(a,h)Anthracene	260	260	210
551C005	Benzo(a)Pyrene	260	260	210
551C005	Dibenzo(a,h)Anthracene	260	260	210
551C006	Benzo(a)Pyrene	260	260	210
551C006	Dibenzo(a,h)Anthracene	260	260	210
551C007	Benzo(a)Pyrene	270	270	210
551C007	Dibenzo(a,h)Anthracene	270	270	210
551C008	Benzo(a)Pyrene	270	270	210
551C008	Dibenzo(a,h)Anthracene	270	270	210
551C009	Benzo(a)Pyrene	260	260	210
551C009	Dibenzo(a,h)Anthracene	260	260	210
551C011	Benzo(a)Pyrene	250	250	210
551C011	Dibenzo(a,h)Anthracene	250	250	210
551C012	Benzo(a)Pyrene	260	260	210
551C012	Dibenzo(a,h)Anthracene	260	260	210
551C013	Benzo(a)Pyrene	270	270	210
551C013	Dibenzo(a,h)Anthracene	270	270	210
551C014	Benzo(a)Pyrene	270	270	210
551C014	Dibenzo(a,h)Anthracene	270	270	210
551C015	Benzo(a)Pyrene	260	260	210
551C015	Dibenzo(a,h)Anthracene	260	260	210
551C016	Benzo(a)Pyrene	260	260	210
551C016	Dibenzo(a,h)Anthracene	260	260	210
551C017	Benzo(a)Pyrene	270	270	210

Table B.1-2
Chemical Analytes Failing Sensitivity Criteria for CAU 551
(Page 3 of 7)

Sample Number	Parameter	Result (µg/kg)	Detection Limit (µg/kg)	2002 Industrial PRG (µg/kg)
551C017	Dibenzo(a,h)Anthracene	270	270	210
551C018	Benzo(a)Pyrene	270	270	210
551C018	Dibenzo(a,h)Anthracene	270	270	210
551C019	Benzo(a)Pyrene	250	250	210
551C019	Dibenzo(a,h)Anthracene	250	250	210
551C020	Benzo(a)Pyrene	270	270	210
551C020	Dibenzo(a,h)Anthracene	270	270	210
551C021	Benzo(a)Pyrene	270	270	210
551C021	Dibenzo(a,h)Anthracene	270	270	210
551C022	Benzo(a)Pyrene	260	260	210
551C022	Dibenzo(a,h)Anthracene	260	260	210
551C023	Benzo(a)Pyrene	270	270	210
551C023	Dibenzo(a,h)Anthracene	270	270	210
551C024	Benzo(a)Pyrene	270	270	210
551C024	Dibenzo(a,h)Anthracene	270	270	210
551C025	Benzo(a)Pyrene	260	260	210
551C025	Dibenzo(a,h)Anthracene	260	260	210
551C026	4-Bromophenyl-Phenyl Ether	4,100	4,100	1,764.5
551C026	Bis(2-Chloroethyl)Ether	4,100	4,100	550
551C026	Hexachlorobenzene	4,100	4,100	1,100
551C026	Indeno(1,2,3-cd)Pyrene	4,100	4,100	2,100
551C026	Benzo(b)Fluoranthene	4,100	4,100	2,100
551C026	Benzo(a)Pyrene	2,500	2,500	210
551C026	Dibenzo(a,h)Anthracene	2,500	2,500	210
551C026	Benzo(a)Anthracene	4,100	4,100	2,100
551C026	N-Nitroso-Di-N-Propylamine	2,900	2,900	250
551C027	4-Bromophenyl-Phenyl Ether	4,100	4,100	1,764.5
551C027	Bis(2-Chloroethyl)Ether	4,100	4,100	550
551C027	Hexachlorobenzene	4,100	4,100	1,100
551C027	Indeno(1,2,3-cd)Pyrene	4,100	4,100	2,100
551C027	Benzo(b)Fluoranthene	4,100	4,100	2,100
551C027	Benzo(a)Pyrene	2,500	2,500	210
551C027	Dibenzo(a,h)Anthracene	2,500	2,500	210

Table B.1-2
Chemical Analytes Failing Sensitivity Criteria for CAU 551
(Page 4 of 7)

Sample Number	Parameter	Result (µg/kg)	Detection Limit (µg/kg)	2002 Industrial PRG (µg/kg)
551C027	Benzo(a)Anthracene	4,100	4,100	2,100
551C027	N-Nitroso-Di-N-Propylamine	2,900	2,900	250
551C028	4-Bromophenyl-Phenyl Ether	4,200	4,200	1,764.5
551C028	Bis(2-Chloroethyl)Ether	4,200	4,200	550
551C028	Hexachlorobenzene	4,200	4,200	1,100
551C028	Indeno(1,2,3-cd)Pyrene	4,200	4,200	2,100
551C028	Benzo(b)Fluoranthene	4,200	4,200	2,100
551C028	Benzo(a)Pyrene	2,600	2,600	210
551C028	Dibenzo(a,h)Anthracene	2,600	2,600	210
551C028	Benzo(a)Anthracene	4,200	4,200	2,100
551C028	N-Nitroso-Di-N-Propylamine	3,000	3,000	250
551C029	Benzo(a)Pyrene	250	250	210
551C029	Dibenzo(a,h)Anthracene	250	250	210
551C030	Benzo(a)Pyrene	510	510	210
551C030	Dibenzo(a,h)Anthracene	510	510	210
551C030	N-Nitroso-Di-N-Propylamine	590	590	250
551C031	Benzo(a)Pyrene	260	260	210
551C031	Dibenzo(a,h)Anthracene	260	260	210
551C032	Benzo(a)Pyrene	270	270	210
551C032	Dibenzo(a,h)Anthracene	270	270	210
551D001	Benzo(a)Pyrene	250	250	210
551D001	Dibenzo(a,h)Anthracene	250	250	210
551D008	Benzo(a)Pyrene	250	250	210
551D008	Dibenzo(a,h)Anthracene	250	250	210
551D009	Benzo(a)Pyrene	500	500	210
551D009	Dibenzo(a,h)Anthracene	500	500	210
551D009	N-Nitroso-Di-N-Propylamine	580	580	250
551D009DL	1,2,3-Trichloropropane	62	62	11
551D010	Benzo(a)Pyrene	450	450	210
551D010	Dibenzo(a,h)Anthracene	450	450	210
551D010	N-Nitroso-Di-N-Propylamine	530	530	250
551D011	Benzo(a)Pyrene	280	280	210
551D011	Dibenzo(a,h)Anthracene	280	280	210

Table B.1-2
Chemical Analytes Failing Sensitivity Criteria for CAU 551
(Page 5 of 7)

Sample Number	Parameter	Result (µg/kg)	Detection Limit (µg/kg)	2002 Industrial PRG (µg/kg)
551D012	Benzo(a)Pyrene	270	270	210
551D012	Dibenzo(a,h)Anthracene	270	270	210
551D013	Benzo(a)Pyrene	330	330	210
551D013	Dibenzo(a,h)Anthracene	330	330	210
551D013	N-Nitroso-Di-N-Propylamine	380	380	250
551D014	Benzo(a)Pyrene	260	260	210
551D014	Dibenzo(a,h)Anthracene	260	260	210
551D015	Benzo(a)Pyrene	260	260	210
551D015	Dibenzo(a,h)Anthracene	260	260	210
551E001	Benzo(a)Pyrene	480	480	210
551E001	Dibenzo(a,h)Anthracene	480	480	210
551E001	N-Nitroso-Di-N-Propylamine	560	560	250
551E003	Benzo(a)Pyrene	460	460	210
551E003	Dibenzo(a,h)Anthracene	460	460	210
551E003	N-Nitroso-Di-N-Propylamine	530	530	250
551E004	Benzo(a)Pyrene	460	460	210
551E004	Dibenzo(a,h)Anthracene	460	460	210
551E004	N-Nitroso-Di-N-Propylamine	540	540	250
551E007	Benzo(a)Pyrene	250	250	210
551E007	Dibenzo(a,h)Anthracene	250	250	210
551E009	Benzo(a)Pyrene	250	250	210
551E009	Dibenzo(a,h)Anthracene	250	250	210
551E010	Benzo(a)Pyrene	250	250	210
551E010	Dibenzo(a,h)Anthracene	250	250	210
551E011	Benzo(a)Pyrene	250	250	210
551E011	Dibenzo(a,h)Anthracene	250	250	210
551E012	Benzo(a)Pyrene	270	270	210
551E012	Dibenzo(a,h)Anthracene	270	270	210
551E017	Benzo(a)Pyrene	270	270	210
551E017	Dibenzo(a,h)Anthracene	270	270	210
551E022	Benzo(a)Pyrene	470	470	210
551E022	Dibenzo(a,h)Anthracene	470	470	210
551E022	N-Nitroso-Di-N-Propylamine	540	540	250

Table B.1-2
Chemical Analytes Failing Sensitivity Criteria for CAU 551
(Page 6 of 7)

Sample Number	Parameter	Result (µg/kg)	Detection Limit (µg/kg)	2002 Industrial PRG (µg/kg)
551E023	Benzo(a)Pyrene	500	500	210
551E023	Dibenzo(a,h)Anthracene	500	500	210
551E023	N-Nitroso-Di-N-Propylamine	580	580	250
551E024	Benzo(a)Pyrene	500	500	210
551E024	Dibenzo(a,h)Anthracene	500	500	210
551E024	N-Nitroso-Di-N-Propylamine	580	580	250
551E025	Benzo(a)Pyrene	440	440	210
551E025	Dibenzo(a,h)Anthracene	440	440	210
551E025	N-Nitroso-Di-N-Propylamine	510	510	250
551E026	Benzo(A)Pyrene	1,100	1,100	210
551E026	Bis(2-Chloroethyl)Ether	1,900	1,900	550
551E026	Dibenzo(A,H)Anthracene	1,100	1,100	210
551E026	N-Nitroso-Di-N-Propylamine	1,300	1,300	250
551E027	Benzo(A)Pyrene	1,100	1,100	210
551E027	Bis(2-Chloroethyl)Ether	1,800	1,800	550
551E027	Dibenzo(A,H)Anthracene	1,100	1,100	210
551E027	N-Nitroso-Di-N-Propylamine	1,300	1,300	250
551E028	Benzo(A)Pyrene	2,200	2,200	210
551E028	Bis(2-Chloroethyl)Ether	3,600	3,600	550
551E028	Dibenzo(A,H)Anthracene	2,200	2,200	210
551E028	Hexachlorobenzene	3,600	3,600	1,100
551E028	N-Nitroso-Di-N-Propylamine	2,500	2,500	250
551E037	Benzo(A)Pyrene	2,200	2,200	210
551E037	Bis(2-Chloroethyl)Ether	3,600	3,600	550
551E037	Dibenzo(A,H)Anthracene	2,200	2,200	210
551E037	Hexachlorobenzene	3,600	3,600	1,100
551E037	N-Nitroso-Di-N-Propylamine	2,600	2,600	250
551E038	Benzo(A)Pyrene	2,300	2,300	210
551E038	Bis(2-Chloroethyl)Ether	3,800	3,800	550
551E038	Dibenzo(A,H)Anthracene	2,300	2,300	210
551E038	Hexachlorobenzene	3,800	3,800	1,100
551E038	N-Nitroso-Di-N-Propylamine	2,700	2,700	250
551E039	Benzo(A)Pyrene	2,100	2,100	210

Table B.1-2
Chemical Analytes Failing Sensitivity Criteria for CAU 551
(Page 7 of 7)

Sample Number	Parameter	Result (µg/kg)	Detection Limit (µg/kg)	2002 Industrial PRG (µg/kg)
551E039	Bis(2-Chloroethyl)Ether	3,500	3,500	550
551E039	Dibenzo(A,H)Anthracene	2,100	2,100	210
551E039	Hexachlorobenzene	3,500	3,500	1,100
551E039	N-Nitroso-Di-N-Propylamine	2,500	2,500	250
551E040	Benzo(A)Pyrene	2,200	2,200	210
551E040	Bis(2-Chloroethyl)Ether	3,600	3,600	550
551E040	Dibenzo(A,H)Anthracene	2,200	2,200	210
551E040	Hexachlorobenzene	3,600	3,600	1,100
551E040	N-Nitroso-Di-N-Propylamine	2,500	2,500	250
551E042	Benzo(A)Pyrene	2,500	2,500	210
551E042	Bis(2-Chloroethyl)Ether	4,100	4,100	550
551E042	Dibenzo(A,H)Anthracene	2,500	2,500	210
551E042	Hexachlorobenzene	4,100	4,100	1,100
551E042	N-Nitroso-Di-N-Propylamine	2,900	2,900	250
551E043	Benzo(A)Pyrene	450	450	210
551E043	Dibenzo(A,H)Anthracene	450	450	210
551E043	N-Nitroso-Di-N-Propylamine	530	530	250
551E044	Benzo(A)Pyrene	450	450	210
551E044	Dibenzo(A,H)Anthracene	450	450	210
551E044	N-Nitroso-Di-N-Propylamine	520	520	250
551E045	Benzo(A)Pyrene	440	440	210
551E045	Dibenzo(A,H)Anthracene	440	440	210
551E045	N-Nitroso-Di-N-Propylamine	510	510	250

PRG = Preliminary Remediation Goal
µg/kg = Micrograms per kilogram

The DQI goals were presented in Table 6-1 of the CAIP. As presented in Tables B.1-2 through B.1-8, these goals were met for each the DQIs.

Precision

Precision is used to assess the variability of a population of measurements with the variability of the analysis process, as described in Section 6.2.3 and Table 6-1 of the CAU 551 CAIP

(NNSA/NSO, 2004) through the use of MS/MSDs, LabDups, LCS/laboratory control sample duplicates (LCSDs), and FD samples.

Precision for chemical analyses is expressed as the RPD between duplicate measurements. Precision for radiological analysis is conducted by evaluating the duplicate precision through using the RPD or normalized difference (ND). The RPD is applicable when both the sample and its duplicate have concentrations of the target radionuclide exceeding five times their MDC. This excludes many measurements because the samples contain non-detectable or low levels of the target radionuclide. In situations where the RPD does not apply, duplicate results are evaluated using the ND. For the purpose of determining data precision of sample analyses, all water and soil samples, including field QC samples (e.g., trip blanks, equipment rinsate samples, field blanks) were evaluated and incorporated into the precision calculation.

The chemical precision analysis results presented in Table B.1-3 and the radiological precision analysis results presented in Table B.1-4 demonstrate that the performance metric for precision of 80 percent was exceeded for all analytes except TPH-DRO, which had an FD precision rate of 60.0 percent. However, there is no action criteria for organic analyses FDs. Isotopic plutonium had an FD precision rate of 73.7 percent and an ND of 66.7 percent. With the source of plutonium likely being from one or more safety experiments, the plutonium would have been dispersed more in particle form than in molecular form, thus the appearance of a particle in one of two duplicates is a reasonable result. Therefore, the dataset is determined to be acceptable for the DQI of precision.

Table B.1-3
Chemical Precision Measurements

	ORGANICS				INORGANICS	
	VOCs	**SVOCs**	**TPH-DRO**	**PCBs**	**Metals***	**Mercury**
Matrix Spike Duplicate (MSD) Precision						
Total MSD Measurements	44	120	13	20	72	9
Total RPDs Within Criteria	44	118	12	20	72	8
MSD Percent Precision	**100**	**98.3**	**92.3**	**100**	**100**	**88.9**
Laboratory Control Sample Duplicate (LCSD) Precision						
Total LCSD Measurements	125	50	7	8	88	10
Total RPDs Within Criteria	125	42	7	8	88	10
LCSD Percent Precision	**100**	**84.0**	**100**	**100**	**100**	**100**
Field Sample Duplicate (FD) Precision						
Total FD Measurements	488	620	10	56	64	8
Total RPDs Within Criteria	488	618	6	56	61	8
FD Percent Precision	**100**	**99.7**	**60.0**	**100**	**95.3**	**100**
Laboratory Sample Duplicate (LabDup) Precision						
Total LabDup Measurements	N/A	N/A	N/A	N/A	72	9
Total RPDs Within Criteria	N/A	N/A	N/A	N/A	72	9
LabDup Percent Precision	**N/A**	**N/A**	**N/A**	**N/A**	**100**	**100**

*Measurements include arsenic, barium, beryllium, cadmium, chromium, lead, selenium, silver

DRO = Diesel-range organics
N/A = Not applicable
PCB = Polychlorinated biphenyl
RPD = Relative percent difference
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

Table B.1-4
Radiological Precision Measurements

	Gamma Spectroscopy	Isotopic Uranium	Isotopic Plutonium	Strontium-90
Laboratory Sample Duplicate Precision				
Relative Percent Difference (RPD)				
Total Measurements	64	42	49	12
Total RPDs Within Criteria	62	42	43	12
Percent Precision	**96.9**	**100**	**87.8**	**100**
Normalized Difference (ND)				
Total Measurements	584	23	12	14
Total NDs Within Criteria	583	23	11	14
Percent Precision	**99.8**	**100**	**91.7**	**100**
Field Sample Duplicate Precision				
Relative Percent Difference				
Total Measurements	35	18	19	2
Total RPDs Within Criteria	34	17	14	2
Percent Precision	**97.1**	**94.4**	**73.7**	**100**
Normalized Difference				
Total Measurements	210	9	3	8
Total NDs Within Criteria	210	9	2	8
Percent Precision	**100**	**100**	**66.7**	**100**

Accuracy

Accuracy is a measure of the closeness of an individual measurement or the average or a number of measurements to the true value, as described in Section 6.2.4 and Table 6-1 of the CAU 551 CAIP (NNSA/NSO, 2004). It is used to assess the performance of laboratory measurement processes as well as to evaluate individual groups of analyses (i.e., sample delivery groups).

For the purpose of determining the accuracy of sample analyses, all water and soil samples, including field QC samples (e.g., trip blanks, equipment rinsate samples, field blanks) were evaluated and incorporated into the accuracy calculation. The chemical accuracy measurements presented in Table B.1-5 and the radiological accuracy measurements presented in Table B.1-6 exceed 85 percent,

Table B.1-5
Chemical Accuracy Measurements

	ORGANICS				INORGANICS	
	VOCs	**SVOCs**	**TPH-DRO**	**PCBs**	**Metals***	**Mercury**
Matrix Spike (MS) Accuracy						
Total MS Measurements	90	240	26	40	144	18
Total MS Measurements Within Criteria	89	220	24	40	138	17
MS Percent Accuracy	**98.9**	**91.7**	**92.3**	**100**	**85.8**	**94.4**
Laboratory Control Sample (LCS) Accuracy						
Total LCS Measurements	250	210	25	34	176	20
Total LCS Measurements Within Criteria	250	210	25	34	176	20
LCS Percent Accuracy	100	100	100	100	100	100
Surrogate Accuracy						
Total Measurements Analyzed	9,280	8,813	149	810	N/A	N/A
Total Measurements Not Affected by Out-of-Control Surrogates	9,273	8,810	137	810	N/A	N/A
Surrogate Percent Accuracy	99.9	99.97	91.9	100	N/A	N/A

*Measurements include arsenic, barium, beryllium, cadmium, chromium, lead, selenium, silver

DRO = Diesel-range organics
N/A = Not applicable
PCB = Polychlorinated biphenyl
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

thereby meeting the performance metric of an accuracy of at least 80 percent. The dataset is determined to be acceptable for the DQI of accuracy.

Table B.1-6
Radiological Accuracy Measurements

	Gamma Spectroscopy	Isotopic Uranium	Isotopic Plutonium	Strontium-90
Laboratory Control Sample Accuracy				
Total Measurements	66	36	33	22
Total Percent Recoveries Within Criteria	66	36	33	22
Percent Accuracy	**100**	**100**	**100**	**100**

Representativeness

Representativeness is the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition (EPA, 1987). Representativeness is assured by a carefully developed sampling strategy, collecting the specified number of samples from proper sampling locations, and analyzing them by the approved analytical methods, as described in Section 6.2.5 and Table 6-1 of the CAU 551 CAIP (NNSA/NSO, 2004).

The DQO process as identified in Appendix A of the CAIP was used to address sampling and analytical requirements for CAU 551. During this process, it was identified that representative samples could not be collected from all areas of the muckpiles due to safety considerations. However, the use of historical muckpile data was evaluated and determined to be sufficient to fill this potential data gap. The newly acquired data were collected from areas most likely to contain contamination. Therefore, the analytical data acquired during the CAU 551 CAI combined with the historical muckpile data are considered representative of the population parameters.

Comparability

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another, as described in Section 6.2.7 and Table 6-1 of the CAU 551 CAIP (NNSA/NSO, 2004) and in EPA DQOs (EPA, 1987).

Field sampling, as described in the CAU 551 CAIP (NNSA/NSO, 2004), was performed and documented in accordance with approved procedures that are comparable to standard industry

practices. U.S. Department of Energy-approved analytical methods and procedures were used to analyze, report, and validate the data. These are comparable to other methods used not only in industry and government practices but, most importantly, are comparable to other investigations conducted for the NTS. Therefore, datasets within this project are considered comparable to other datasets generated using these same standardized DOE procedures, thereby meeting DQO requirements.

Also, standard, approved field and analytical methods ensured that data were appropriate for comparison to the investigation action levels specified in the CAIP.

Completeness

Completeness is a quantitative and qualitative evaluation of measurement system performance. The criterion for meeting completeness is defined as generating sufficient data of the appropriate quality to satisfy the data needs identified in the CAU 551 CAIP DQOs (NNSA/NSO, 2004).

Table 6-1 in the CAU 551 CAIP defines acceptable criteria for completeness to be 80 percent of CAS-specific non-critical analytes identified in the CAIP as having valid results and 90 percent of critical analytes (including Decision II samples) having valid results. Also, the data must be of sufficient quality to be able to support the DQO decisions.

Rejected data were not used in the resolution of DQO decisions and are not counted towards meeting the completeness goals. Table B.1-2 provides the rejected data failing the criteria for sensitivity. The data for one COC (Pu-239) from a sample taken from the Initial Decision II Area was rejected due to overlap between the analyte curve and the tracer curve. Upon re-analysis, the problem was resolved and the new data were accepted. No additional rejected data were generated during the CAI.

As presented in Tables B.1-7 and B.1-8, the criteria for completeness were met.

Table B.1-7
Chemical Completeness Measurements

Completeness Parameters	ORGANICS				INORGANICS	
	VOCs	SVOCs	TPH-DRO	PCBs	Metals*	Mercury
Sample Analysis Completeness						
Total Samples Sent to Laboratory	131	138	149	115	115	115
Total Samples Analyzed	131	138	149	115	115	115
Percent Completeness	**100**	**100**	**100**	**100**	**100**	**100**
Measurement Usability Completeness						
Total Measurements**	9,280	8,813	149	810	919	115
Total Measurements Rejected - Field	0	0	0	0	0	0
Total Measurements Rejected - Lab/Matrix	69	11	0	0	0	0
Percent Completeness	**99.3**	**99.9**	**100**	**100**	**100**	**100**

*Measurements include arsenic, barium, beryllium, cadmium, chromium, lead, selenium, silver
**Measurements include re-analyses

DRO = Diesel-range organics
PCB = Polychlorinated biphenyl
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

Criterion 3:

To satisfy the third DQO provision criterion, areas identified for sampling during Initial Decision II sampling activities were downslope from the muckpiles, as stated in Section A.1.8.2 of the CAU 551 CAIP (NNSA/NSO, 2004). Guidelines for selection of locations during this phase of the CAI included the provision that each location be in an area likely impacted by muck material eroded from a muckpile (preselected areas based on process knowledge of the site). Additional guidelines included areas of elevated radiation, drums, containers or debris, and geological material difference. Initial Decision II sampling locations are depicted in Figure A.4-4.

Table B.1-8
Radiological Completeness Measurements

Completeness Parameters	Gamma Spectroscopy	Isotopic Uranium	Isotopic Plutonium	Strontium-90
Sample Analysis Completeness				
Total Samples Sent to Laboratory	171	138	170	163
Total Samples Analyzed	171	138	170	163
Percent Completeness	**100**	**100**	**100**	**100**
Measurement Usability Completeness				
Total Measurements*	3,814	414	342	163
Total Measurements Rejected - Field	0	0	0	0
Total Measurements Rejected - Lab/Matrix	0	0	0	0
Percent Completeness	**100**	**100**	**100**	**100**

*Measurements include re-analyses

B.1.1.1.2 DQO Provisions To Limit False Positive Decision Error

The false acceptance decision error was controlled by assessing the potential for false positive analytical results. Quality assurance/QC samples such as field blanks, trip blanks, LCSs, and method blanks were used to determine whether a false positive analytical result may have occurred. Of 36 QA/QC samples submitted, no false positive analytical results were detected.

Proper decontamination of sampling equipment and the use of certified clean sampling equipment and containers also minimized the potential for cross contamination that could lead to a false positive analytical result.

B.1.1.2 Decision II

With the identification of COCs throughout the Initial Decision II Area downslope of the muckpiles, those results were addressed in conjunction with Initial Decision I results. Decision II findings discussed in this section consist of the Decision II activities at CAS 12-01-09 and the Extended Decision II activities downslope from the Initial Decision II Area.

Decision Rules:

- If the observed concentration of any COC in a Decision II sample exceeds the FALs, then additional samples will be collected to complete the determination of the extent.

- If observed COC concentrations in a sample from all bounding directions are less than the FALs, then the decision will be that the extent of contamination has been defined in the lateral and/or vertical direction.

Null Hypotheses - The extent of a COC has not been defined.

Alternative Condition - The extent of a COC has been defined.

Population Parameter - The population parameter for Decision II data will be the observed concentration of each unbounded COC in any sample.

B.1.1.2.1 DQO Provisions To Limit False Negative Decision Error

A false rejection decision error (where consequences are more severe) is controlled by meeting the following criteria:

1. Having a high degree of confidence that the sample locations selected will identify the extent of the COCs.

2. Having a high degree of confidence that analyses conducted will be sufficient to detect any COCs present in the samples.

3. Having a high degree of confidence that the dataset is of sufficient quality and completeness.

Criterion 1:

The following guidelines were used in selecting Decision II sample locations.

- Selection of sampling locations associated with the vertical extent was accomplished by collection Decision II samples at depths equal to or greater than the Decision I samples for CAS 12-01-09.

- At CAS 12-01-09, selection of sampling locations associated with lateral extent was accomplished by measuring a maximum of 15 ft from the Decision I sample location in a triangular pattern surrounding the Decision I location. Adjustments to the sampling protocol

were made by the Site Supervisor based on site-specific information and biasing factors. The distances and directions were recorded on the sample collection log and in the FADL.

- In the Extended Decision II Area downslope from the muckpiles, sampling locations were targeted in portions of washes that appeared to have accumulated sediment during precipitation events. An average of at least one location was sampled every 100 ft of the main drainage, down to the uppermost extent of CAU 383 sampling locations.

Soil sample results demonstrated that the vertical and lateral extent of COCs were adequately defined. The locations and concentrations of the extent samples are shown in Figures A.3-1, A.4-4, A.4-5 and A.4-7.

Criterion 2:

All samples were analyzed for the COCs identified as present in the respective CAS or in the Initial Decision II Area.

- CAS 12-01-09 - TPH-DRO.
- CAS 12-06-05 - Benzo(1)pyrene, Dibenzo(a,h)anthracene, TPH-DRO, Am-241, Cs-137, Eu-152, Pu-238, Pu-239.
- CAS 12-06-07 - TPH-DRO, Am-241, Cs-137, Eu-152, Pu-238, Pu-239.
- CAS 12-06-08 - TPH-DRO, Am-241, Cs-137, Pu-239.
- Initial Decision II - TPH-DRO, Am-241, Cs-137, Eu-152, Pu-238, and Pu-239.

The sensitivity DQO was accomplished for all analyses as demonstrated in Table B.1-2.

Criterion 3:

To satisfy the third criterion for extent, the entire dataset, as well as individual sample results, were assessed against the DQIs of precision, accuracy, comparability, completeness, and representativeness, as defined in the Industrial Sites QAPP (NNSA/NV, 2002). The DQI discussion is presented under Criterion 3 for Decision I.

B.1.1.2.2 DQO Provisions To Limit False Positive Decision Error

The false acceptance decision error was controlled by assessing the potential for false positive analytical results. Quality assurance/QC samples such as field blanks, trip blanks, LCSs, and method blanks were used to determine whether a false positive analytical result may have occurred. Of 16 trip blanks, 8 field blanks, and 10 MS/MSD QA/QC samples submitted, no false positive analytical results were detected.

Proper decontamination of sampling equipment and the use of certified clean sampling equipment and containers also minimized the potential for cross-contamination that could lead to a false positive analytical result.

B.1.2 Conduct a Preliminary Data Review

A preliminary data review was conducted by reviewing QA reports and inspecting the data. The contract analytical laboratories generate a QA report when data quality does not meet contractual requirements. Rejected data and sensitivity requirements not being met do not indicate that contractual requirements were not met; rejected data are a result of chemical analysis performance specifications not being met. Re-analysis of rejected data reproduced the original result, with the exception of the one re-analysis for Pu-239, indicating that matrix effects are interfering with the internal standard response, resulting in rejection of the data. Sensitivity requirements cannot always be met. Due to matrix interferences, viscosity of sample extract, or high level of contaminants, some samples must be analyzed at a dilution. Detection limits are sample specific and will vary from sample to sample. Because detection limits are sample specific, unusually difficult samples will not meet sensitivity requirements.

All data received from the analytical laboratories met contractual requirements and a QA report was not generated. Data were validated and verified to ensure that the measurement systems performed in accordance with the criteria specified and that the validated dataset quality is satisfactory.

B.1.3 Select the Test and Identify Key Assumptions

The test for supporting DQO Decision I was the comparison of the maximum reported concentrations of the analytes from each CAS to the corresponding FAL. The test for supporting DQO Decision II

was the comparison of the COC concentrations from each bounding sample to the corresponding FALs.

The key assumptions that could impact a DQO decision are listed in Table B.1-9.

B.1.4 Verify the Assumptions

The results of the investigation support the key assumptions identified in the CAU 551 DQOs and Table B.1-9 except as listed below:

- Exception: For the seven expected COCs for the muckpile CASs, three (arsenic, lead, and Co-60) were found to have highest concentrations below both FALs and expected concentrations; two (TPH-DRO and Cs-137) were found to have highest concentrations between FALs and expected concentrations; and two (Pu-238 and Pu-239) were found to have highest concentrations in excess of both FALs and expected concentrations. Additionally, four COCs (benzo(a)pyrene, dibenzo(a,h)anthracene, Am-241, and Eu-152) not expected for the muckpile CASs were found, with highest concentrations above FALs.

- Impact: The impact to the CSM is as follows. The five COCs (arsenic, lead, Co-60 TPH-DRO and Cs-137) found to have highest concentrations below expected concentrations remain as COCs for the muckpiles, at their highest concentrations previously detected during investigations of other NTS muckpiles (no change). The highest concentrations found in the muckpiles or downslope in the Initial Decision II Area for Pu-238 and/or Pu-239 that exceeds the expected concentrations will be set as the concentration for the applicable muckpile (with 12-06-05 and 12-06-08 affected as one). If the highest concentration is found downslope in the Initial Decision II Area, the muckpiles that could have contributed contamination to that location will be established at the higher of either the downslope concentration or the highest found in that muckpile. Newly identified COCs (benzo(a)pyrene, dibenzo(a,h)anthracene, Am-241, and Eu-152) will be set at their highest concentrations for those applicable muckpiles (with 12-06-05 and 12-06-08 affected as one).

- Exception: TPH-DRO was found further downslope in the wash than expected.

- Impact: The volume of contamination will increase and the potential exposure may impact more individuals working in the area.

- Exception: A source of radiological contamination was identified upslope from the CAU 551 area.

- Impact: The source of the upslope contamination is assumed to be the Neptune crater. This source could add additional contamination to the muckpiles and result in higher level of potential exposure. The Neptune crater area may be further investigated at a later date. For

Table B.1-9
Key Assumptions

Exposure Scenario	Site workers are only exposed to contaminants of concern (COCs) through oral ingestion, inhalation, external exposure to radiation, or dermal contact (by absorption) of COCs in the soils. Exposure to contamination is limited to industrial site workers, construction/remediation workers, and military personnel conducting training. The investigation results did not reveal any potential exposures routes other than those identified in the conceptual site models (CSMs).
Affected Media	Surface soil, shallow subsurface soil, and potentially perched (shallow) groundwater, possibly by total petroleum hydrocarbons-diesel-range organics. Deep groundwater contamination is not a concern; therefore, contaminants migrating to regional aquifers are not considered in the decision process. The investigation results did not reveal any affected media other than those identified in the CSMs.
Location of Contamination/Release Points	The area of contamination within the original corrective action site (CAS) boundaries is contiguous. The extent of COC concentration generally decreases away from the area of contamination. The investigation results identified an area of contamination other than those identified in the CSMs, which is actively contributing radiological contamination to CAU 551. This area is upslope from CAS 12-06-07 and is the area affected by the Neptune test, ensuing road construction/reconstruction (1958-59), and scientific study of the crater (1959).
Transport Mechanisms	Surface transport may occur as a result of a spill or storm water runoff. The investigation results did not reveal any transport mechanisms other than those identified in the CSMs.
Preferential Pathways	The preferential pathway is considered overland flow due to run-on and runoff from the muckpiles. The investigation results did not reveal any preferential pathways other than those identified in the CSMs.
Lateral and Vertical Extent of Contamination	Subsurface contamination of the muckpiles, where present, may not be contiguous and does not necessarily decrease with distance and depth from the source. Original contamination of the muckpiles was not uniform; erosion of the muckpiles is not uniform; and deposition of eroded material in the washes draining CAU 551 is not uniform. Contributing to the lack of a trend in the lateral extent results is the influx into the washes of uncontaminated sediment eroded from other areas of the watershed, which both dilutes out sediment from CAU 551 and could likely contribute to even more non-uniformity of the results. Subsurface contamination of 12-01-09 is contiguous, and does decrease with distance. Surface contamination may occur laterally as a result of a spill or stormwater runoff. The investigation results did not reveal any lateral and vertical extent of contamination other than those identified in the CSMs.
Groundwater Impacts	None. Not investigated; eliminated in the Corrective Action Investigation Plan by process knowledge.
Future Land Use	Nonresidential. The future land-use scenario is Nuclear Test Zone.
Other Data Quality Objective Assumptions	Buried material may exist at CASs 12-06-05, 12-06-07, and 12-06-08.

the purposes of this investigation, the boundary between CAU 551 and Neptune crater area is assumed to be the uppermost part of the CAS 12-06-07 muckpile, as defined in Section A.4.6.

All data collected during the CAI supported CSMs with the exceptions noted in this section. These exceptions did not invalidate the CSMs presented in the CAIP, nor did they necessitate revisions to the CSMs.

B.1.5 Results

This section resolves the two DQO decisions for each of the CAU 551 CASs.

B.1.5.1 Decision I

Decision Rule: If the concentration of any COPC in a target population exceeds the FAL for a COPC in a Decision I sample, either from previous NTS muckpile investigations (applicable only to the CAU 551 muckpiles) or from samples collected at CAU 551, then that COPC is identified as a COC and the extent of contamination sampling (Decision II) will be conducted.

Results: In the following CASs and areas, COPCs exceeded FALs.

- CAS 12-01-09 - TPH-DRO
- CAS 12-06-05 - Benzo(a)pyrene, Dibenzo(a,h)anthracene, TPH-DRO, Am-241, Cs-137, Eu-152, Pu-238, Pu-239
- CAS 12-06-07 - TPH-DRO, Am-241, Cs-137, Eu-152, Pu-238, Pu-239
- CAS 12-06-08 - TPH-DRO, Am-241, Cs-137, Pu-238, Pu-239
- Initial Decision II - TPH-DRO, Am-241, Cs-137, Eu-152, Pu-238 and Pu-239
- Extended Decision II - TPH-DRO, Cs-137, Eu-152, Pu-238, and Pu-239

For all three muckpile CASs, the following COPCs are considered to exceed the FALs based on previous NTS muckpile investigations (i.e., not detected in CAU 551 samples at concentration exceeding FALs)

- CASs 12-06-05, 12-06-07, 12-06-08 - Arsenic, Lead, Co-60

Decision Rule: For CASs 12-06-05, 12-06-07, and 12-06-08, if all COPC concentrations are less than the corresponding FALs, the decision will be that only those COPCs considered as expected COCs will be assumed to be present at the CAU 551 muckpiles.

Result: As per the previous Decision Rule, COPC concentrations did exceed the FALs for the expected COCs TPH-DRO and Cs-137; the concentrations, however, did not exceed the expected concentrations for TPH-DRO and Cs-137. Also, COPC concentrations did exceed the FALs for the expected COCs Pu-238 and Pu-239, and the concentrations did exceed expected concentration levels for Pu-238 and Pu-239.

Thus, for the expected COCs TPH-DRO and Cs-137, the concentration levels found during previous muckpile investigations are established at all three CAU 551 muckpiles as:

- TPH-DRO at 10,000 mg/kg for all three CASs.
- Cs-137 at 3,050 pCi/g for all three CASs.

For the expected COCs Pu-238 and Pu-239, the highest concentrations of COCs that were found during the CAI are established as follows:

- Pu-238 at 28.6 pCi/g in CASs 12-06-05 and 12-06-08, and at 127 pCi/g in CAS 12-06-07.
- Pu-239 at 1,440 pCi/g in CASs 12-06-05 and 12-06-08, and 13,200 pCi/g in CAS 12-06-07.

Contaminants of concern identified at other muckpiles but not detected at CAU 551 above FALs are considered to be present in the muckpiles at CAU 551 at the highest detected level (arsenic at 38.8 mg/kg, lead at 59,700 mg/kg, and Co-60 at 5.3 pCi/g) for all three muckpiles. Newly identified COCs (Am-241, Eu-152, benzo(a)pyrene and dibenzo(a,h)anthracene) are considered to be present at the highest detected concentrations when found above FALs in their respective muckpiles (12-06-05 and 12-06-08 are combined).

The impact from assigning the highest concentration to the muckpiles of contaminants either not detected above FALs in samples taken from the CAU 551 muckpiles (arsenic, lead, and Co-60) or detected above FALs in samples taken from the muckpiles but not as high as historically identified (TPH-DRO and Cs-137) is considered minimal due to the widespread contamination of Pu-239 at concentrations well above the historical highest concentration of 122 pCi/g. The Pu-239

contamination will drive the corrective action process because its presence gives the highest health risk of all COCs at CAU 551 and its long-term persistence with a half-life of 24,110 years.

Decision Rule: For CAS 12-01-09, if all COPC concentrations are less than the corresponding FALs, then the decision will be no further action.

Result: COCs were identified at this CAS; therefore, further action was necessary.

B.1.5.2 Decision II

Decision Rule: If the observed concentration of any COC in a Decision II sample exceeds the FALs, then additional samples will be collected to complete the determination of the extent.

Result: Additional samples were collected, and the extent of each COC was determined.

Decision Rule: If all observed COC population parameters are less than the FALs, then the decision will be that the extent of contamination has been defined in the lateral and/or vertical direction.

Result: The vertical and lateral extent of contamination at CASs 12-01-09, 12-06-05, 12-06-07, and 12-06-08 were defined (Figures A.3-1 and A.4-1 through A.4-3) with the following exception. The presence of the Neptune crater and Neptune affected area upslope from CAS 12-06-07 does not permit the extent of radiological contamination upslope to be defined. The Neptune affected area appears to be releasing radiologically contaminated soil and alluvium, which is being transported into CAU 551. The boundary drawn between CAS 12-06-07 and the CAS for the Neptune crater will have to be based upon process knowledge, not radiological surveys and sample results. Therefore, the boundary is set at the upper limit of the muckpile, because the muckpile is known to be contaminated and based upon the CSM recognizing that contamination would not travel upslope (i.e., erosion would carry contamination downslope).

B.2.0 References

EPA, see U.S. Environmental Protection Agency.

NNSA/NSO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office.

NNSA/NV, see U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office.

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

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2004. *Corrective Action Investigation Plan for Corrective Action Unit 551: Area 12 Muckpiles*, Nevada Test Site, Nevada, DOE/NV—976. Las Vegas, NV.

U.S. Environmental Protection Agency. 1987. *Data Quality Objectives for Remedial Response Activities*, EPA/540/G-87/003. Washington, DC.

Appendix C

Closure Activity Summary

C.1.0 Closure Activity Summary

The following sections document closure activities completed for CAU 551 at CASs 12-01-09, 12-06-05, 12-06-07, and 12-06-08. Activities that were completed to support the closure process for CAU 551 included: (1) the grading of the access road leading up to the B-Tunnel area, (2) the reduction of water flow in the B-Tunnel area basin by installation of two diversion berms on the access road and the modification of the north side of the access road, (3) completion of an inventory of historical artifacts in the area, (4) the posting of use restriction signs, and (5) the completion of the use restriction documentation. The area being closed for CAU 551 is shown in Figure C.1-1. Each activity is discussed below.

C.1.1 Grading of the Access Road Between the E-Tunnel and B-Tunnel Area

Due to the erosion of the access road along sections between E- and B-Tunnels, hindering vehicle travel to the area, ruts in the road (Figure C.1-2) were filled and the surface of the road was graded from the area upgradient from E-Tunnel to the last usable portion of the road above the B-Tunnel portal (Figures C.1-1 and C.1-3). At several locations the surface of the graded road was recontoured to direct water flow on the roadway back into the watershed to the north. Clean fill was brought to the site on an as needed basis to complete this effort.

C.1.2 Reduction of Water Flow in B-Tunnel Basin

For the collection and flow of runoff in the B-Tunnel basin (denoted as subbasin S5 in Bechtel Nevada [BN], 2005) an estimation of the runoff volumes for the watershed around and upgradient from E-Tunnel was made (BN, 2005). The access road itself acts as a conduit for the collection and flow of runoff from the area above the B-Tunnel area, changing the natural flow of water in this area from its historical route, which enters the watershed to the north, and instead carries this water into the B-Tunnel basin. Restoration of the flow of this runoff back into its native watershed, coupled with the road modifications downgradient (e.g., redirecting precipitation that collects on the road directly from precipitation and runs further down the road, into the north watershed), results in an estimated 33 percent reduction in runoff for the B-Tunnel basin.

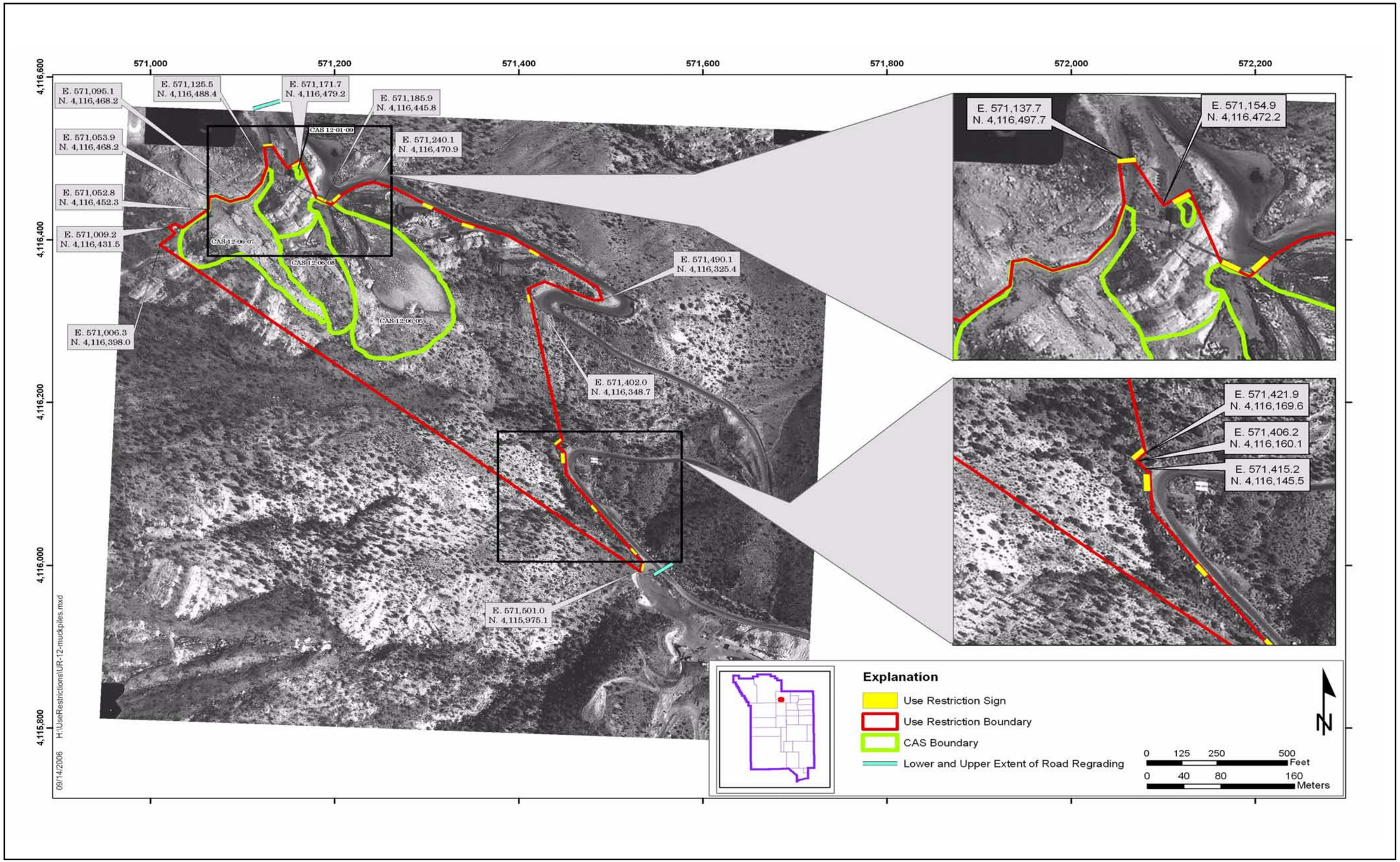

Figure C.1-1
CAU 551, Use Restricted Area

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Figure C.1-2
CAU 551 Eroded Access Road Below B-Tunnel Area

Figure C.1-3
Graded Access Road Below B-Tunnel Area with Water Diversion Improvements

The modifications made to reduce the movement of precipitation runoff from uncontaminated areas into the B-Tunnel basin (Figure C.1-1) consisted of the improvement of an existing berm upgradient from the last usable portion of the road (Figures C.1-4 and C.1-5), the installation of a new berm adjacent to the last usable portion of the road (Figures C.1-4 and C.1-6), movement of soil from the north side of the road behind the berms to direct surface water into the watershed to the north, and removal of soil from several portions of the access road downgradient from the B-Tunnel portal and the creation of two runoff shunts, also to direct runoff into the adjacent watershed (Figures C.1-4, C.1-7, and C.1-8).

C.1.3 Completion of an Inventory of Historical Artifacts in CAU 551 Area

Before the implementation of the use restriction for CAU 551, an evaluation of historical artifacts was completed in the area. The equipment and objects which will remain within the area being closed date back to the earliest days of tunnel testing (Figure C.1-9). The Rainier test conducted in B-Tunnel on September 19, 1957 (Figure C.1-10) was the first detonation contained underground, and the Neptune test conducted in C-Tunnel on October 14, 1958, was the first underground test to form a subsidence crater (DOE/NV, 2000). Artifacts identified in the area to have significant historical value are discussed in the evaluation report (DRI, 2006).

C.1.4 Posting of Use Restriction Signs

Because construction of a fence surrounding the land area encompassed by CAU 551 is not feasible, 13 Use Restriction signs were posted along the access road at the CAU 551 boundaries (Figure C.1-11). The access road itself is not included in the Use Restriction for CAU 551, as contamination was limited to inside the watershed. Persons travelling to the area include workers maintaining the power lines and facilities, workers investigating the Neptune crater area, NTS security personnel, and personnel inspecting the condition of CAU 551. Signs were placed at each location where a person travelling on the access road might conveniently park a vehicle and walk into the area from the roadway. The locations of the sign postings are depicted in Figure C.1-1, and the coordinates are listed in Table C.1-1.

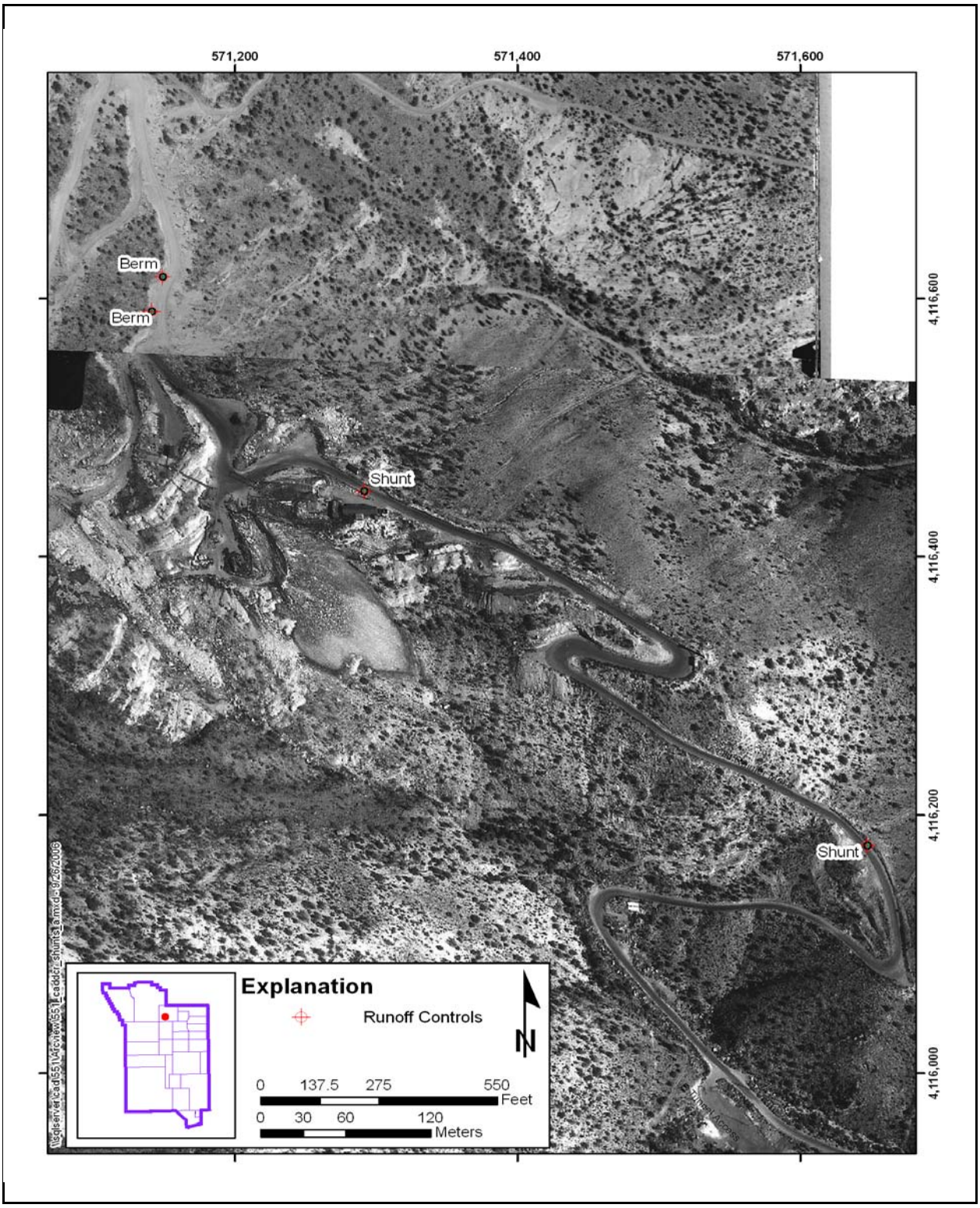


Figure C.1-4
CAU 551 Positions of Water Diversion Berms and Road Recontouring

Figure C.1-5
CAU 551 Before and After Reconditioning of Upper Diversion Berm

Figure C.1-6
CAU 551 Before and After Installation of Lower Diversion Berm

Figure C.1-7
CAU 551 Before and After Road Recontouring for Water Diversion

Figure C.1-8
Runoff Shunt on Access Road

Figure C.1-9
Muck Rail Car Southeast of B-Tunnel Portal (upper left), Mucking Car Dumper/Camel Back Narrow Gauge (upper right), Rail Lines and C-Tunnel Portal (lower left), and Equipment/Supply Sheds (lower right)

Figure C.1-10
B-Tunnel Portal Area with Rainier Test History Sign

Figure C.1-11
CAU 551, Use Restriction Postings

Table C.1-1
Use Restriction Sign Location Coordinates for CAU 551

Location	Easting	Northing
551-01	571137.7	4116497.8
551-02	571161.7	4116477.5
551-03	571185.9	4116445.9
551-04	571203.6	4116443.3
551-05	571298.2	4116441.1
551-06	571341.4	4116417.5
551-07	571412.2	4116385.1
551-08	571405.5	4116330.8
551-09	571411.6	4116164.4
551-10	571411.5	4116136.8
551-11	571447.1	4116067.4
551-12	571493.3	4116010.7
551-13	571502.8	4115985.5

C.1.5 Completion of Use Restriction Documentation

The Use Restriction implemented for CAU 551 is presented on the following page.

CAU Use Restriction Information

CAU Use Restriction Information

CAU Number/Description: CAU 551, Area 12 Muckpiles

Applicable CAS Number(s)/Description(s):

- CAS 12-01-09, Aboveground Storage Tank and Stain
- CAS 12-06-05, U-12b Muckpile
- CAS 12-06-07, Muckpile
- CAS 12-06-08, Muckpile

Contact (organization/project): NNSA/NSO Industrial Sites Sub-Project Director
Surveyed Area (UTM, Zone 11, NAD 27, meters):

Northwest Corner:	N = 4116398.0	E = 571006.3
South, D-Tunnel Portal:	N = 4116423.4	E = 571016.5
West, D-Tunnel Portal:	N = 4116431.5	E = 571009.2
East, D-Tunnel Portal:	N = 4116435.1	E = 571016.6
SE, D-Tunnel Portal:	N = 4116430.1	E = 571024.4
East, F-Tunnel Portal:	N = 4116452.3	E = 571052.8
Near C-Tunnel Portal:	N = 4116468.2	E = 571053.9
East, C-Tunnel Portal:	N = 4116469.4	E = 571060.7
Along C-Tunnel Road:	N = 4116462.4	E = 571075.9
Along C-Tunnel Road:	N = 4116468.2	E = 571095.1
Along C-Tunnel Road:	N = 4116488.4	E = 571125.5
Northern Point:	N = 4116525.6	E = 571121.2
Northeast Corner:	N = 4116530.7	E = 571133.4
NW of B-Tunnel Portal:	N = 4116472.2	E = 571154.9
North, B-Tunnel Portal:	N = 4116479.2	E = 571171.7
East, B-Tunnel Portal:	N = 4116451.0	E = 571180.1
Along Access Road:	N = 4116442.8	E = 571196.4
Along Access Road:	N = 4116456.3	E = 571213.7
Along Access Road:	N = 4116466.8	E = 571226.1
Along Access Road:	N = 4116470.9	E = 571240.1
Along Access Road:	N = 4116462.8	E = 571263.5
Along Access Road:	N = 4116424.7	E = 571334.8
Along Access Road:	N = 4116404.4	E = 571388.0
Along Access Road:	N = 4116342.6	E = 571484.6
Along Access Road:	N = 4116325.4	E = 571490.8
Along Access Road:	N = 4116325.0	E = 571481.7
Along Access Road:	N = 4116350.2	E = 571423.8
Along Access Road:	N = 4116348.7	E = 571402.0
North of Road:	N = 4116169.6	E = 571421.9
Northwest of Road:	N = 4116160.1	E = 571406.2
Along Access Road:	N = 4116145.5	E = 571415.2
Along Access Road:	N = 4116113.2	E = 571422.2
Along Access Road:	N = 4115997.6	E = 571505.3
Southernmost Point:	N = 4115975.1	E = 571501.0

Survey Date: September 2006 **Survey Method (GPS, etc.):** Map coordinates
Site Monitoring Requirements: Inspection of Use Restriction signs, and indications of sediment movement past the E-Tunnel turnoff culvert.
Required Frequency (quarterly, annually?): Annually
If Monitoring Has Started, Indicate last Completion Date: N/A

Use Restrictions

The future use of any land related to this Corrective Action Unit (CAU), as described by the above surveyed location, is restricted from any DOE or Air Force activity that may alter or modify the containment control as approved by the state and identified in the CAU Closure Report or other CAU 551 documentation, unless appropriate concurrence is obtained in advance.

Comments: This Use Restriction is for the surface and subsurface disturbances. CASs 12-01-09, 12-06-05, 12-06-07, and 12-06-08 are restricted from the surface to an approximate depth of 100 ft bgs. The restricted area is not fenced but is posted with signs at convenient access points along the only road accessing the area. Coordinates for the area will be entered into the NTS database. Annual post-closure inspections are required. Monitoring will be conducted if, during the annual inspections, visible evidence exists of sediment migrating past the E-Tunnel turnoff culvert. The conditions at the E-Tunnel turnoff culvert will be photo-documented to demonstrate the potential migration. In the event of sediment having migrated out of the use restricted area, NDEP will be notified and NNSA/NSO and NDEP will determine the number of locations to be sampled. See the CADD/CR for additional information on the condition of the site.

The following table lists the contaminants and the highest level for each CAS.

CASs 12-01-09, 12-06-05, 12-06-07, and 12-06-08 COCs and Highest Concentrations Assigned

Contaminants of Concern	Highest Contaminant Concentration			
	CAS 12-01-09	CAS 12-06-05	CAS 12-06-07	CAS 12-06-08
Arsenic	NA	38.8 mg/kg	38.8 mg/kg	38.8 mg/kg
Lead	NA	59,700 mg/kg	59,700 mg/kg	59,700 mg/kg
Benzo(a)pyrene	NA	1,600 µg/kg	NA	1,600 µg/kg
Dibenzo(a,h)anthracene	NA	330 µg/kg	NA	330 µg/kg
TPH-DRO	98,000 mg/kg	10,000 mg/kg	10,000 mg/kg	10,000 mg/kg
Americium-241	NA	478 pCi/g	3,370 pCi/g	478 pCi/g
Cesium-137	NA	3,050 pCi/g	3,050 pCi/g	3,050 pCi/g
Cobalt-60	NA	5.3 pCi/g	5.3 pCi/g	5.3 pCi/g
Europium-152	NA	26.6 pCi/g	60 pCi/g	26.6 pCi/g
Plutonium-238	NA	28.6 pCi/g	127 pCi/g	28.6 pCi/g
Plutonium-239	NA	1,440 pCi/g	13,200 pCi/g	1,440 pCi/g

mg/kg = Milligrams per kilogram
NA = Not applicable
pCi/g = Picocuries per gram
TPH-DRO = Total petroleum hydrocarbons, diesel-range organics
µg/kg = Micrograms per kilogram

Submitted By: Kevin Cabble **Date:** 11-15-06

cc with copy of survey map (paper and digital [.dgn] formats):
CAU Files (2 copies)

C.2.0 References

BN, see Bechtel Nevada.

Bechtel Nevada. 2005. *Flood Assessment for Corrective Action Unit 383 and 551: Nevada Test Site, Nye County, Nevada.* November. Las Vegas, NV.

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

DRI, see Desert Research Institute.

Desert Research Institute. 2006. Written communication. Subject: "A Historical Evaluation of Tunnel U12b Area 12, Nevada Test Site, Nye County, Nevada," Desert Research Institute Historical Evaluation Short Report HE050106-1 Project #061412. August. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 2000. *United States Nuclear Tests July 1945 through September 1992.* DOE/NV--209-REV 15. December. Las Vegas, NV.

Appendix D

Sample Location Coordinates

D.1.0 Sample Location Coordinates

Sample location coordinates were collected during the CAI using a Trimble GPS, Model TSCI. These coordinates identify the field sampling locations (e.g., latitude, longitude) at CAU 551, CASs 12-01-09, 12-06-05, 12-06-07, and 12-06-08.

Sample locations and pertinent locations of interest at are shown on Figures A.3-1 and A.4-1 through A.4-6. The corresponding coordinates for CAU 551 sample locations are listed in Table D.1-1.

Table D.1-1
Sample Location Coordinates for CAU 551
(Page 1 of 4)

Location	Northing	Easting	Latitude	Longitude
A01	4116469	571167.2	37.1938	116.1981
A02	4116467	571167.0	37.19378	116.1981
A03	4116467	571169.1	37.19378	116.1981
A04	4116469	571169.9	37.1938	116.1981
A05	4116464	571166.6	37.19376	116.1981
A06	4116468	571166.2	37.19379	116.1982
A07	4116471	571166.1	37.19382	116.1982
A08	4116644	571125.6	37.19538	116.1986
A09	4116621	571117.9	37.19518	116.1987
A12	4116474	571164.1	37.19385	116.1982
A13	4116477	571168.2	37.19387	116.1981
B01*	4116380	571222.2	37.193	116.1975
B02	4116397	571212.4	37.19314	116.1976
B03	4116424	571198.6	37.19339	116.1978
B04	4116404	571269.4	37.19321	116.197
B05	4116384	571282.2	37.19302	116.1969
B06	4116354	571296.6	37.19276	116.1967
B07	4116335	571302.0	37.19258	116.1966
B08	4116318	571295.9	37.19243	116.1967
B09*	4116300	571283.1	37.19227	116.1969

Table D.1-1
Sample Location Coordinates for CAU 551
(Page 2 of 4)

Location	Northing	Easting	Latitude	Longitude
B10*	4116314	571247.0	37.1924	116.1973
B11*	4116283	571225.3	37.19212	116.1975
B12*	4116292	571251.3	37.1922	116.1972
B13	4116413	571261.0	37.19329	116.1971
B14	4116339	571233.6	37.19262	116.1974
C01	4116369	571053.5	37.19291	116.1994
C02	4116392	571046.2	37.19312	116.1995
C03	4116402	571069.7	37.19321	116.1992
C04	4116408	571057.7	37.19326	116.1994
C05	4116419	571098.1	37.19336	116.1989
C06	4116428	571077.6	37.19344	116.1992
D01	4116380	571148.0	37.193	116.1984
D02	4116388	571168.1	37.19307	116.1981
D03	4116379	571192.5	37.19299	116.1979
D04	4116343	571172.7	37.19266	116.1981
D05	4116330	571171.4	37.19255	116.1981
D06	4116313	571197.8	37.19239	116.1978
D07	4116308	571184.4	37.19235	116.198
E01	4116159	571401.0	37.19099	116.1955
E02	4116173	571401.6	37.19111	116.1955
E03	4116188	571392.4	37.19125	116.1956
E04	4116205	571379.7	37.1914	116.1958
E05	4116264	571341.1	37.19194	116.1962
E06	4116289	571326.5	37.19217	116.1964
E07	4116306	571315.5	37.19232	116.1965
E08	4116301	571309.6	37.19228	116.1966
E09	4116247	571242.9	37.19179	116.1973
E10	4116234	571280.3	37.19167	116.1969
E11	4116205	571349.7	37.19141	116.1961

Table D.1-1
Sample Location Coordinates for CAU 551
(Page 3 of 4)

Location	Northing	Easting	Latitude	Longitude
E12	4116087	571409.9	37.19034	116.1954
E13	4115990	571501.6	37.18946	116.1944
E14	4116031	571460.4	37.18983	116.1949
E15	4116076	571470.3	37.19023	116.1948
E16	4115847	571777.0	37.18815	116.1913
E17	4115862	571745.0	37.18828	116.1917
E18	4115870	571723.5	37.18836	116.1919
E19	4115889	571669.7	37.18853	116.1925
E20	4115900	571628.3	37.18864	116.193
E21	4115913	571599.7	37.18876	116.1933
E22	4115952	571547.7	37.18911	116.1939
E23	4115967	571520.4	37.18925	116.1942
E24	4115833	571817.5	37.18802	116.1909
E25	4115885	571702.1	37.1885	116.1922
E26	4115898	571674.1	37.18861	116.1925
E27	4115920	571641.4	37.18882	116.1929
E28	4115982	571537.3	37.18938	116.194
E29	4116199	571332.3	37.19135	116.1963
E30	4116331	571313.5	37.19255	116.1965
E31	4116426	571070.0	37.19342	116.1992
E32	4116433	571078.6	37.19348	116.1991
E33	4116451	571106.7	37.19364	116.1988
E34	4116468	571122.6	37.1938	116.1986
E35	4116434	571116.9	37.19349	116.1987
E36	4116483	571137.8	37.19393	116.1985
E37	4116566	571061.7	37.19468	116.1993
E38	4116663	571083.8	37.19556	116.1991
E39	4116776	571122.1	37.19657	116.1986
E40	4116687	571138.8	37.19577	116.1984

Table D.1-1
Sample Location Coordinates for CAU 551
(Page 4 of 4)

Location	Northing	Easting	Latitude	Longitude
E41	4116611	571143.4	37.19508	116.1984
E42	4116554	571127.3	37.19457	116.1986
X01	4115604	572764.0	37.18588	116.1802
X02	4115626	572761.0	37.18608	116.1803
X03	4115641	572731.0	37.18621	116.1806
X04	4115629	572660.0	37.18611	116.1814
X05	4115616	572545.0	37.18600	116.1827
X06	4115610	572382.0	37.18597	116.1845
X07	4115634	572318.0	37.18619	116.1853
X08	4115676	572246.0	37.18657	116.1861
X09	4115727	572180.0	37.18703	116.1868
X10	4115793	572122.0	37.18763	116.1875
X11	4115814	572051.0	37.18783	116.1882
X12	4115837	571944.0	37.18804	116.1895
X13	4115836	571865.0	37.18804	116.1903
X14	4116136	571423.0	37.19078	116.1953
X15	4116151	571448.0	37.19091	116.1950

*Approximate location

Appendix E

Derivation of Residual Radioactive Material Guidelines for Radionuclides in Soil at Corrective Action Unit 551, Area 12 Muckpiles, Nevada Test Site, Nevada

E.1.0 Introduction

The NNSA/NSO Environmental Restoration Division, Industrial Sites Project has numerous soil sites impacted from the development, testing, and production of nuclear weapons that are scheduled to undergo characterization and remediation. These impacts can take the form of chemical and/or radiological contaminants. Similar to its approach for chemical contamination, the NNSA/NSO is committed to properly evaluating, radiologically characterizing, and where appropriate, remediating these sites to ensure the radiation doses to workers and members of the public are maintained as low as reasonably achievable below the primary dose limits as stated in DOE Order 5400.5 (DOE, 1993).

To accomplish this, the DOE must evaluate the potential for residual radioactive contamination in surface soils, and determine compliance with the requirements of DOE Order 5400.5 (DOE, 1993). The DOE Order 5400.5 requires that: "The Authorized Limits shall be established to 1) provide that, at a minimum, the basic dose limits … will not be exceeded, or 2) be consistent with applicable generic guidelines." Because generic guidelines have not been established for volumetric residual radioactivity for the radionuclides of concern at CAU 551 land areas, Authorized Limits, or FALs, were derived using the RESRAD (Yu et al., 2001) computer program. The goal of this effort was to produce Authorized Limits, in units of pCi/g in soil above background, for CAU 551 that would result in radiation doses less than 25 mrem/yr to an industrial worker at the site.

To develop the FALs, a "realistic" yet conservative radiation dose analysis was conducted using approved exposure scenarios and site-specific data to determine the translation between surface soil concentrations and individual radiation doses. For this analysis, site-specific data included soil sampling results obtained during site investigation activities at CAU 551, site investigation results from similar sites in the vicinity of CAU 551, and meteorological data obtained from the Air Resources Laboratory/Special Operations and Research Division. This report provides the radiation dose modeling analysis supporting the technical derivation of the Authorized Limits for CAU 551, Area 12 Muckpiles, NTS, Nevada. This report also defines the radionuclides considered and approved exposure scenarios for the NTS, identifies the applicable exposure pathways and key input data or assumptions, presents the radiation doses for unit concentrations of radionuclides in soil, and establishes the FALs for selected land parcels at CAU 551.

E.2.0 Facility Description

Corrective Action Unit 551, Area 12 Muckpiles, consists of four inactive CASs located in the southwestern portion of Area 12, which is approximately 40 miles beyond the main gate to the NTS. Figures E.2-1 and E.2-2, which were included in the CAU 551 CAIP, provide a visual representation of CAU 551. The four CASs consist of three muckpiles and an AST and stain. The muckpiles and AST were used during underground nuclear testing at the B-, C-, D-, and F-Tunnels in the late 1950s and early 1960s, and have mostly remained inactive since that period. In addition to the four CASs, the area downslope from the three muckpile CASs has been included in this site investigation. The CASs and impacted areas investigated during the CAU 551 CAI are:

- CAS 12-01-09, Aboveground Storage Tank and Stain
- CAS 12-06-05, U-12b Muckpile
- CAS 12-06-07, Muckpile
- CAS 12-06-08, Muckpile
- Area downslope of the muckpiles (identified in the CADD as Decision I and II areas)

Each CAS is fully described in the CAIP for CAU 551.

Downslope Area

As described in the CAU 551 CAIP, the CSM for CASs 12-06-05, 12-06-07, and 12-06-08 (muckpiles) addressed the contamination of the muckpiles, and any potential lateral movement of radiological contamination from the muckpiles during precipitation events, into the washes draining the area. The area downslope from the muckpiles that defines the extent of any lateral migration of COCs originating from the three CAU 551 muckpiles was also included in the site investigation activities. Contaminated sediment moving off of a single muckpile during a precipitation event will join sediment and material from the other muckpiles within a short distance. Identifying contaminants within this area as originating from a specific muckpile is not possible. Past investigations of muckpiles at the NTS have indicated that contamination has not migrated vertically into the native material underlying the muckpile but has migrated laterally due to erosion.

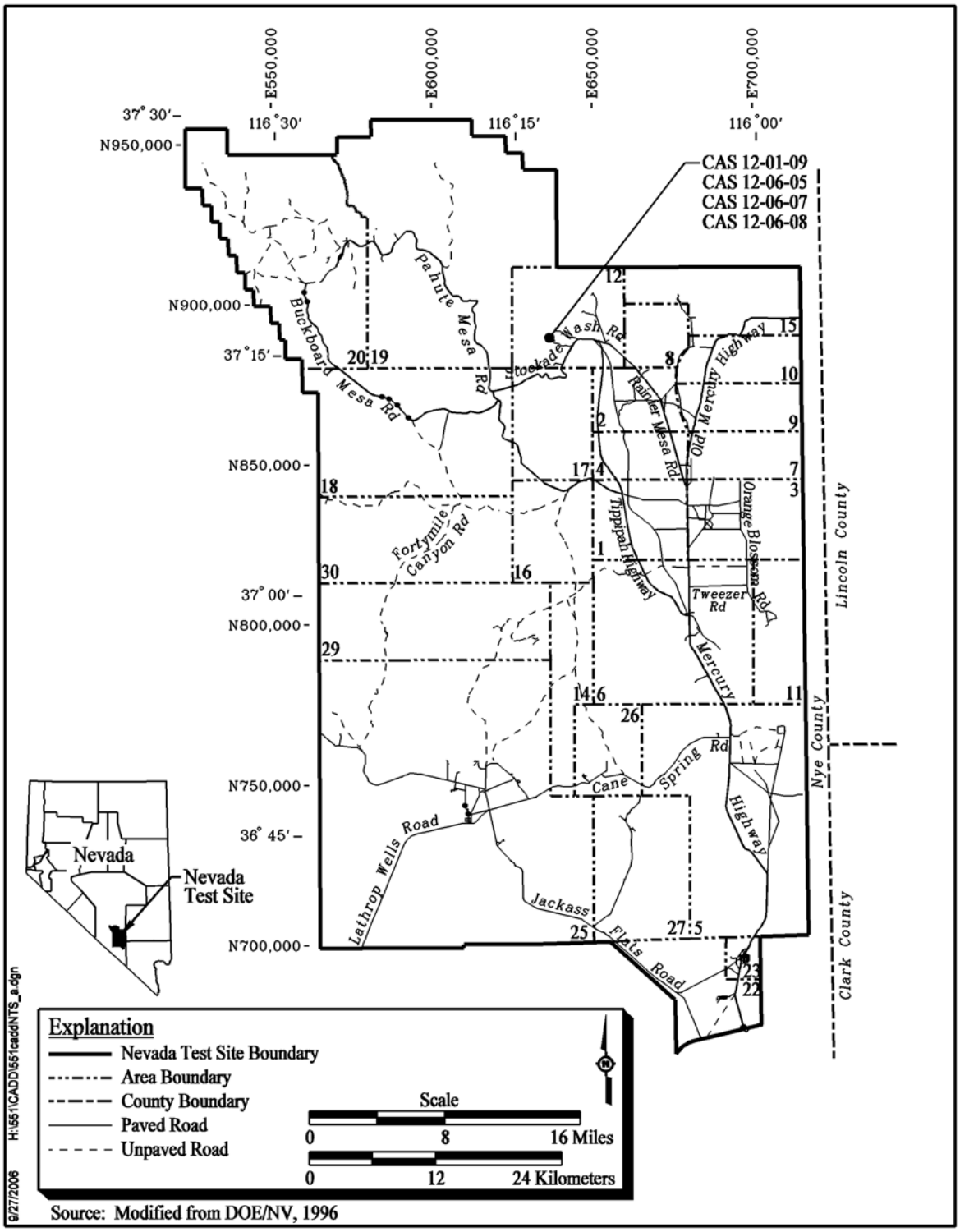
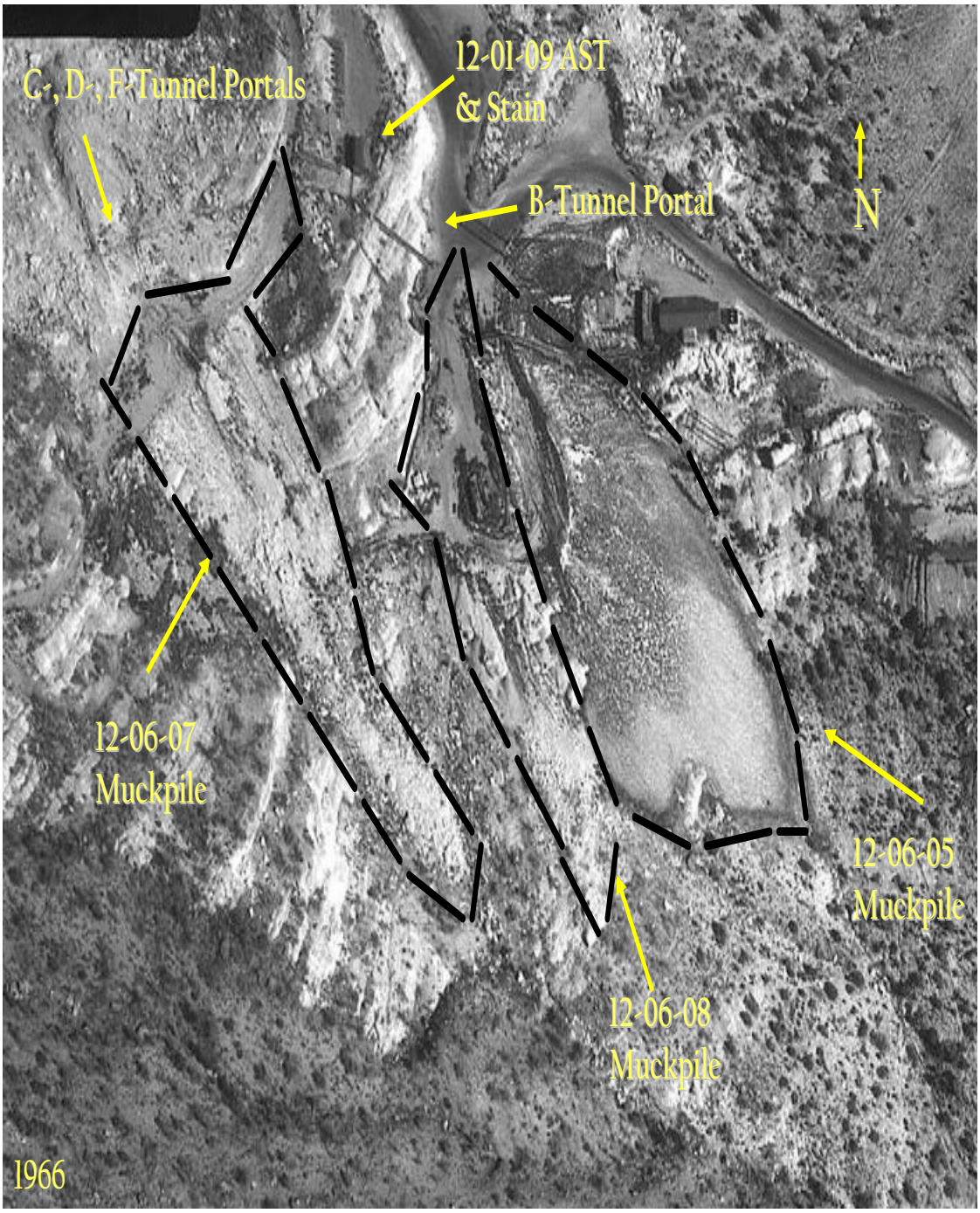


Figure E.2-1
Nevada Test Site Map with CAU 551, Area 12 Muckpiles, CAS Locations



Source: Modified from Holmes & Narver, Inc., 1966

Figure E.2-2
Overhead Aerial Photograph Depicting
CASs 12-01-09, 12-06-05, 12-06-07, and 12-06-08

To facilitate the development of FALs, land areas included within the CAU 551 CAI were grouped into the following land parcels:

- Land Parcel 1: CASs 12-06-05, 12-06-07, 12-06-08 and 12-01-09 (the three muckpiles and the AST and Stain.
- Land Parcel 2: Downslope area only.
- Land Parcel 3: CASs 12-06-05, 12-06-07, 12-06-08 and 12-01-09 (the three muckpiles and the AST and Stain) and the downslope area.

The following sections provide a brief summary of the operational history for CAU 551.

E.2.1 Corrective Action Site 12-01-09, Aboveground Storage Tank and Stain

Corrective Action Site 12-01-09, AST and Stain, consists of an aboveground fuel storage tank and underlying soil stain located next to a generator building. The tank appears on a 1959 engineering drawing (Holmes & Narver, 1959b) and was likely used during the operational period for the B-, C-, D-, and F-Tunnels from 1957 to 1963. The stain lies beneath the north end of the tank and likely resulted from fuel released either by spillage during refueling activities or from a leak in the tank.

E.2.2 Corrective Action Sites 12-06-05 and 12-06-08, Muckpiles

Corrective Action Sites 12-06-05 and 12-06-08 consist of the muckpile located outside of B-Tunnel. The muckpile was created from operations in and around B-Tunnel from 1957 to 1963. It is unclear why the muckpile was given two CAS designations; however, it is assumed the split was done based on a physical separation of two lobes of the muckpile. This split appears to have been caused by a drainage that presently flows between them and/or from muck dumping practices. Aside from the different radiological postings on the two muckpiles, there is no reason to suspect that the two CASs contain material from different sources. During the site investigation both CASs that make up the B-Tunnel Muckpile were treated as one site. The B-Tunnel was the site of six confirmed nuclear tests, one high-explosives test (AEC, 1958; name of test not provided in document) and one confirmed accidental explosion (Holmes & Narver, 1959a). The muck and debris in both CASs resulted from the activities conducted at the tunnel, including drilling, tunnel development, cutback operations, and re-entry mining. Re-entry mining and excavation activities produced muck — which

consists of rock debris, cabling, scrap metal, and cementations mixtures — and may contain radioactive contaminants.

E.2.3 Corrective Action Site 12-06-07, Muckpile

Corrective Action Site 12-06-07, Muckpile, consists of one muckpile created from operations in and around C-, D-, and F-Tunnels during 1957 and 1958. The C-Tunnel was the site of three safety tests, D-Tunnel was the site of one safety test, and F-Tunnel was the site of two safety tests. The muck and debris in this CAS resulted from the activities conducted at the tunnels, including drilling, tunnel development, cutback operations, and re-entry mining. Re-entry mining and excavation activities produced muck, which may contain radioactive contaminants.

E.2.4 Downslope Area

As described in the CAU 551 CAIP, the CSM for CASs 12-06-05, 12-06-07, and 12-06-08 (muckpiles) addressed the contamination of the muckpiles, and any potential lateral movement of radiological contamination from the muckpiles during precipitation events, into the washes draining the area. The area downslope from the muckpiles that defines the extent of any lateral migration of COCs originating from the three CAU 551 muckpiles was also included in the site investigation activities. Past investigations of muckpiles at the NTS have indicated that contamination has not migrated vertically into the native material underlying the muckpile, but has migrated laterally due to erosion, thereby making land downslope from the muckpiles an additional area of concern.

E.2.5 Release Information

The CAS-specific release information, migration routes, exposure pathways, and affected media are discussed in this section. Based on historical information and process knowledge, the primary sources of potential environmental contaminants released to the soil within CAU 551 consist of potentially contaminated muck from the muckpiles and TPH-DRO from the AST and underlying stain. Lateral migration of contaminants is considered the primary transport mechanism due to the steep slopes of the area. Potentially affected media for all CASs include surface and shallow subsurface soil. Exposure routes to site workers include ingestion, inhalation, and/or dermal contact (absorption) from disturbance of contaminated soils, debris, and/or structures. At CAU 551, surface soils may have also been impacted by contamination associated with atmospheric testing and/or

venting or breaching of radioactive contaminants from nearby tunnels such as the Neptune test. Contamination associated with these events is outside the scope of CAU 551 site investigation. However, releases from sources outside the CAS boundaries would migrate through the same drainages and it is not possible to separate the two sources. Therefore, the contamination identified to be downslope from the muckpiles may have originated from sources outside the boundary of the subject CASs but have been included in this evaluation.

E.3.0 Site Investigation Activities

E.3.1 Site Investigation Plans

Corrective action investigation activities were performed as set forth in the CAU 551 CAIP (NNSA/NSO, 2004) from October 4, 2004, through April 7, 2005. The purpose of the CAU 551 CAIP was to address the decision statements in the project-specific DQOs by:

- Determining whether COPCs are present in the soils associated with CAU 551.
- Determining whether any of the COPCs found in the muckpile CASs were expected COCs, and if so, determining whether their concentration(s) fell within or outside of the expected range (NNSA/NSO, 2004).
- Determining whether the COPCs not expected, if present, at any CAU 551 CAS exceed action levels, thereby becoming COCs.
- Determining the lateral and vertical extent of all identified COCs.
- Ensuring adequate data have been collected to close the sites under the NDEP, RCRA (CFR, 2003a), TSCA (CFR, 2003b), and DOE requirements.

The DQO process is a seven-step strategic planning approach based upon the scientific method used to plan data collection activities for CAU 551, Area 12 Muckpiles. The DQOs are designed to ensure that data collected will provide sufficient and reliable information to identify, evaluate and technically defend the recommended corrective actions (e.g., no further action, closure in place, or clean closure).

The primary objective of the investigation was to provide sufficient information and data to develop appropriate corrective action alternatives for each CAS in CAU 551. This objective was achieved by identifying the nature and extent, both horizontal and vertical of COCs (i.e., COPCs at concentrations above action levels), and the vertical and lateral extent of the COCs.

The investigation strategy was developed by representatives of NDEP and NNSA/NSO, in accordance with EPA *Guidance for Quality Assurance Project Plans*, EPA QA/G-5 (EPA, 2002a) and *Guidance for the Data Quality Objectives Process*, EPA QA/G-4 (EPA, 2000b). The investigation strategy also identifies and references the associated EPA Quality System Documents entitled *Data Quality Objectives for Hazardous Waste Site Investigation*, EPA QA/G-4HW (EPA, 2000a), and

Guidance on Choosing a Sampling Design for Environmental Data Collection, EPA QA/G-5S (EPA, 2002b), upon which the DQO process is based. The CAU 551 CAIP contains a detailed description of the investigation strategy and the DQO process.

E.3.2 Summary of Specific Site Investigation Activities

This section provides a brief description of work activities conducted to support the investigation of radioactive contamination at CAU 551.

Surface Radiological Surveys

Surface radiological land surveys were performed within safely accessible areas of all four CASs of CAU 551, and in selected portions of the downslope. The results of the surveys were used to guide the investigation and provide for site worker safety, focusing on the identification of locations with elevated radioactivity areas as described in Section 4.0 of the CAU 551 CAIP (NNSA/NSO, 2004). Radiological land survey results are presented in Figure E.3-1, which was taken from the CAU 551 CADD. The results identified some areas of elevated radiation from which samples were collected.

Site Walkovers

Site walkovers were performed on the safely accessible area of all four CASs of CAU 551 and in selected portions of the downslope. Some areas were too steep and/or unstable to traverse and not included in the survey. Observations were made to identify biased sampling locations (e.g., stained soil, electrical radioactivity, unidentified or out-of-place objects).

Field Screening

Field-screening activities for alpha and beta/gamma radiation were performed at locations, as specified in the CAU 551 CAIP (NNSA/NSO, 2004). Site-specific FSLs for alpha and beta/gamma radiation were defined as the mean background activity level plus two times the standard deviation of readings from 10 background locations selected near each CAS. The radiation FSLs are instrument-specific and were established for each instrument and CAS before use. Alpha and beta/gamma radiation screening was performed at each CAS using a NE Technologies Electra or a ThermoEberline E-600 with a dual-alpha and beta/gamma radiation scintillation probe. The

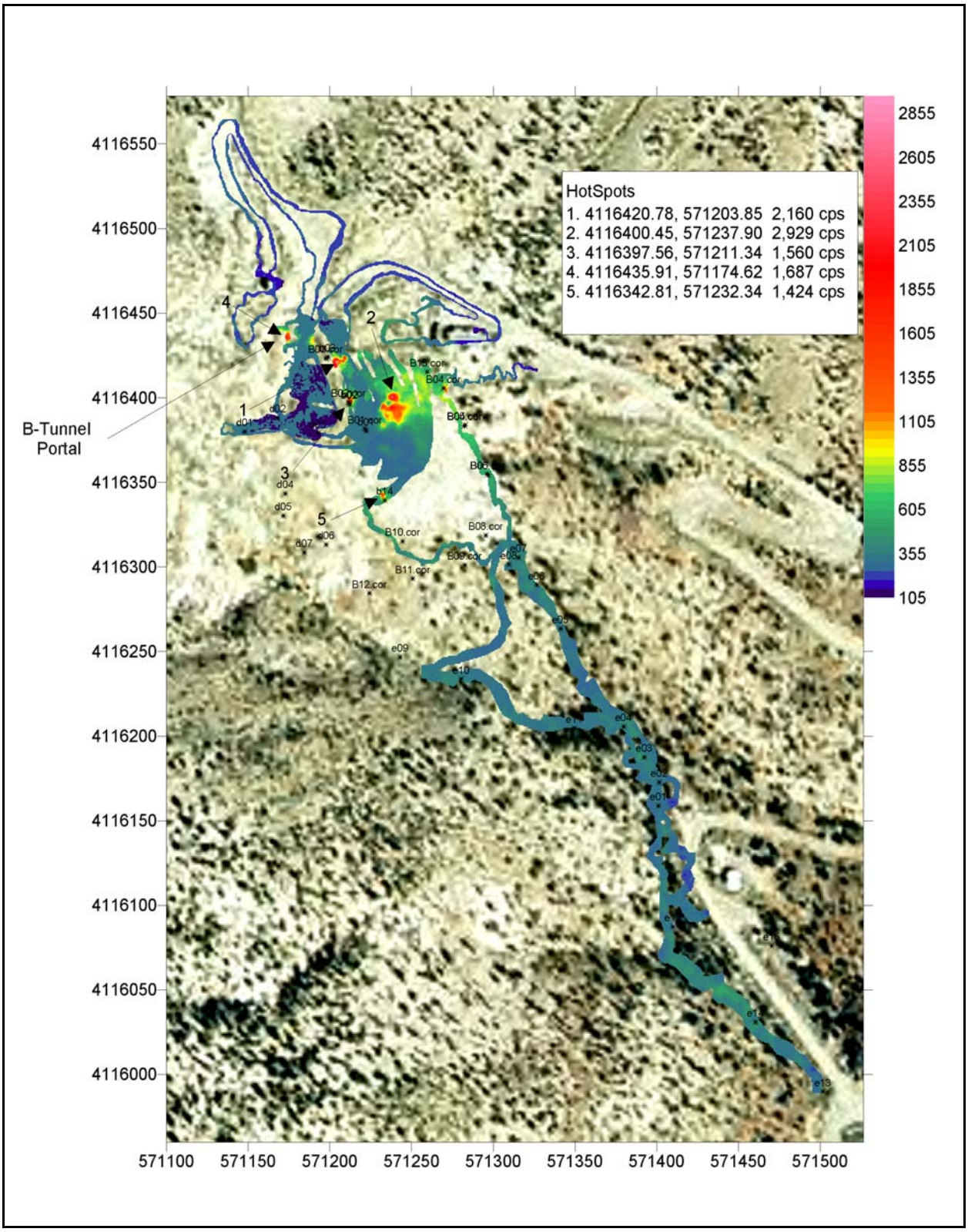


Figure E.3-1
Surface Radiological Land Survey Results for CAU 551 and Surrounding Areas

CAS-specific sections of the CAU 551 CADD identify the CASs where field screening was conducted and how the FSLs were used to aid in the selection of sample locations.

Surface and Subsurface Sampling

Intrusive investigation activities (i.e., surface and shallow subsurface soil sampling) were conducted at all four CASs within CAU 551 and the downslope area. Soil samples were collected using grab sampling (surface) and hand auger (shallow subsurface samples). Before the start of sampling, the location was screened for alpha and beta/gamma radiation. Additional screening was conducted during sample collection to both guide the investigation and to ensure that radiological controls were adequate to protect workers during sampling activities. Labeled sample containers were filled according to the following sequence: total VOCs and TPH-DRO sample containers were filled directly from the sample location, followed by the collection of soil for VOC field screening. Additional soil was transferred into an aluminum pan, homogenized, and field screened for alpha and beta/gamma radiation. All remaining sample containers were then filled. The excess soil was returned to the sampling location and no void spaces remained in the augured holes after backfilling. Surface soil samples were collected from 0.0 to 0.5 ft bgs at biased locations (e.g., stained soil, settling areas collecting runoff, areas with elevated radiological measurements). Subsurface soil samples were collected from the surface soil sample location where staining was noted, where specified in the CAIP, and/or where field screening or analytical results indicated contamination. A detailed discussion for how the sampling met DQOs is provided in the CAU 551 CADD/CR.

Figure E.3-1 is in Universal Transverse Mercator (UTM) North American Datum (NAD) of 1927 with contours expressed in units of counts per second. The mean background count rate is 229 counts per second.

Sampling Locations

To achieve the objective of identifying the nature and extent of both horizontal and vertical COCs, a judgmental (non-probabilistic) sampling scheme was used for selecting sample locations and evaluating analytical results. Judgmental sampling allows the methodical selection of sample locations that target the populations of interest (defined in the DQOs). The selection of soil sample locations was based on site conditions using the strategy developed during the DQO process, as outlined in the CAU 551 CAIP (NNSA/NSO, 2004) and subsequent ROTCs.

The sampling strategy used biased sample locations for all CASs. Sampling points for each CAS were selected based on the approach provided in the CAIP, which included interpretation of existing engineering drawings, aerial and land photographs, interviews with former and current site employees, information obtained during site visits, and site-specific biasing factors. The planned sample locations are discussed the CAIP. Some planned locations were modified slightly from planned positions due to field conditions and observations. In some cases, FSRs and/or laboratory analytical results determined the need for step-out sampling locations. Sample locations were staked, labeled appropriately, and surveyed with a GPS instrument. The actual locations have been plotted based on the coordinates collected by the GPS instrument see Figure E.3-2, which was taken from the CAU 551 CADD/CR. The CAU 551 CADD/CR contains a detailed description of the actual sample locations.

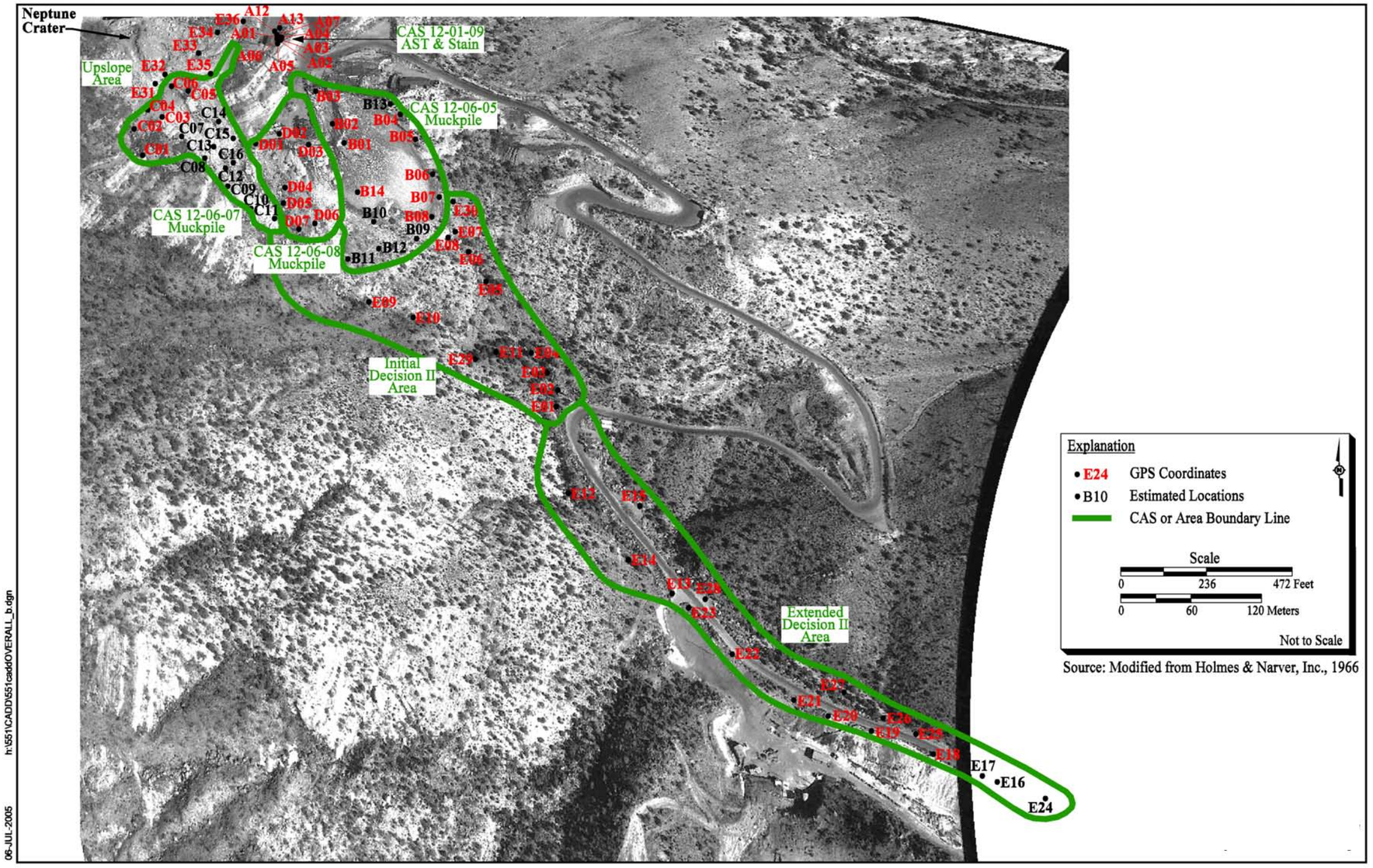


Figure E.3-2
Sample Location Map for CASs 12-06-05, 12-06-07, and 12-06-08, Area 12 Muckpiles and Vicinity

E.4.0 Site Investigation Sample Results

The RESRAD calculations are based on validated analytical soil sample results obtained during site investigation activities and other applicable information specified in the CAIP. The RESRAD calculations involving the muckpile areas are based upon the value of the maximum radionuclide concentration, as specified in the CAU 551 CAIP. The RESRAD calculations of the downslope area (i.e., Land Parcel 2) were performed for the COCs present at the CAU 551 muckpiles using the maximum radionuclide concentrations obtained from the downslope area soil sample results. The CAU 551 CADD contains a detailed description of the sample results, analytical parameters, and laboratory methods used to analyze the soil samples. The following section provides a summary of the samples taken at CAU 551.

Aboveground Storage Tank and Stain, CAS 12-01-09

A total of 22 soil environmental samples (including 2 FDs) were collected from 9 locations during investigation activities at CAS 12-01-09. The highest principal radionuclide concentrations detected at this CAS included:

- Am-241 at 15.7 pCi/g
- Cs-137 at 11.7 pCi/g
- Pu-239 at 46.3 pCi/g

Muckpiles, CASs 12-06-05, 12-06-07, and 12-06-08

At CAS 12-06-05, a total of 30 samples (including 2 FDs) were collected from 14 locations.
At CAS 12-06-07, a total of 32 samples (including 2 FDs) were collected from 16 locations.
At CAS 12-06-08, a total of 15 samples (including 1 FD) were collected from 7 locations.
The highest principal radionuclide concentrations detected at the muckpile CASs included:

- Am-241 at 3,370 pCi/g was detected in CAS 12-06-07.
- Cs-137 at 318 pCi/g was detected in CAS 12-06-05.
- Europium (Eu)-152 at 60 pCi/g was detected in CAS 12-06-07.
- Pu-238 at 127 pCi/g was detected in CAS 12-06-07.
- Pu-239 at 13,200 pCi/g was found in CAS 12-06-07.

The CAU 551 CAIP specifies that each muckpile will be considered to be contaminated at the highest concentration of (1) contaminants identified above PALs during previous (historical) investigations of

muckpiles at the NTS but not identified in samples taken at each muckpile, (2) contaminants identified above PALs during previous investigations of muckpiles at the NTS but having higher concentrations found in samples taken at each muckpile, and (3) newly identified contaminants for each muckpile with concentrations above FALs. The maximum radionuclide concentration values used to perform the RESRAD calculations that involve the muckpile land areas (Land Parcels 1 and 3) are listed in Table E.4-1.

Table E.4-1
Radionuclide Concentrations Assigned to Land Parcels 1 and 3

Radionuclides	Muckpiles (Maximum Activity Concentration) (pCi/g)	Results Taken From
Americium-241	3,370	CAS 12-06-07 sample results
Cesium-137	3,050	Highest historical concentration
Cobalt-60	5.3	Highest historical concentration
Europium-152	60	CAS 12-06-07 sample results
Plutonium-238	127	CAS 12-06-07 sample results
Plutonium-239	13,200	CAS 12-06-07 sample results

pCi/g = Picocuries per gram

Downslope Area

A total of 49 soil environmental samples were collected within the downslope area. The highest radionuclide concentrations (for COC present at the CAU 551 muckpiles) detected within the downslope area included:

- Am-241 at 487 pCi/g
- Eu-152 at 1.74 pCi/g
- Cs-137 at 48.7 pCi/g
- Pu-238 at 6 pCi/g
- Pu-239 at 329 pCi/g

E.5.0 Initial Concentrations for Principal Radionuclides

Principal radionuclides are defined as radionuclides with a half-life greater than six months. The decay products of any principal radionuclide down to, but not including, the next principal radionuclide in its decay chain are defined as associated radionuclides. The RESRAD assumes that a principal radionuclide is in secular equilibrium with its associated radionuclides at the point of exposure. Therefore, associated radionuclides and radionuclides with half-lives less than six months are not input into the RESRAD calculations.

E.5.1 Authorized Values for Initial Concentrations of Principal Radionuclides

The authorized exposure scenarios specify that the value of the arithmetic mean plus the 95 percent upper confidence level (UCL) obtained from site-specific sampling results be entered as the principal radionuclide concentrations for RESRAD calculates for sites that have randomized datasets. For sites that do not have randomized datasets (e.g., biased), the maximum radionuclide concentration will be used as the initial concentration. The sample results for all samples with radionuclide concentrations above the minimum detectable concentration within the land parcels are entered into the EPA software application ProUCL version 3.0. The ProUCL software is used to calculate the 95 percent UCL for principal radionuclide concentrations based on the distribution of the unknown mean.

For instances where the ProUCL software determined that there was not enough data to calculate the 95 percent UCL, for a specific radionuclide or the dataset did not meet the requirements, for a statistical manipulation, the maximum concentration from the sample dataset was used as the initial concentration for that radionuclide.

E.5.2 Authorized Values for Initial Concentrations of Principal Radionuclides for Area Averaging/Locations with Elevated Radioactivity Scenarios

The DOE Order 5400.5 (DOE, 1993) states: "Residual concentrations of radioactive material in soil are defined as those in excess of background concentrations averaged over an area of 100 m^2" (5400.5, IV, 4.a.). DOE Order 5400.5 also states: "If the average concentration of any surface or below-surface area less than or equal to 25 m^2, exceeds the limit or guideline by a factor of (100/A)0.5, [where A is the area (in square meters) of the region in which concentrations are

elevated], limits for (locations with elevated radioactivity) shall also be developed and applied" (5400.5, IV, 4.a.(1)). The rationale for the locations with elevated radioactivity criterion is discussed in DOE G 441.1-XX (DOE, 2002).

The purpose of the locations with elevated radioactivity criterion is to ensure that applying the homogeneous criteria, in which the concentrations of residual radioactive material are averaged over a 100-m^2 area, does not result in the release of small areas that, because of averaging, contain unacceptably high concentrations of RESRAD. The locations with elevated radioactivity criterion is used to supplement Authorized Limits for larger areas and is intended to prevent excessive exposures from a small, contaminated area that is within a larger area that meets the basic Authorized Limits. Thus, it is intended for use in areas where the residual radioactive material concentrations are not uniform. Also, the above locations with elevated radioactivity criterion was derived conservatively, assuming the Authorized Limits were based on a dose constraint of 25 mrem/yr and selected to ensure unlikely exposure conditions would not cause the primary dose limit (100 mrem/yr) to be exceeded. The authorized exposure scenarios specify that the value of the maximum concentration of principal radionuclides obtained from site-specific sampling results be entered as the principal radionuclide concentrations for RESRAD locations with elevated radioactivity calculations. The authorized area parameters for RESRAD locations with elevated radioactivity calculations are 1 m^2, 10 m^2, and 100 m^2 contamination areas.

E.5.3 Initial Concentrations of Principal Radionuclide for CAU 551

As described in the CAU 551 CAIP, each muckpile is considered to be contaminated at the highest concentration of (1) contaminants identified above PALs during previous (historical) investigations of muckpiles at the NTS but not identified in samples taken at each muckpile, (2) contaminants identified above PALs during previous investigations of muckpiles at the NTS but having higher concentrations found in samples taken at each muckpile, or (3) newly identified contaminants for each muckpile with concentrations above FALs. These maximum radionuclide concentration values were used to perform the RESRAD calculations for Land Parcel 1 and Land Parcel 2. Because these initial radionuclide concentrations were bound by the CAIP, and consist of the maximum radionuclide concentrations identified during the CAI at CAU 551, or from historical muckpile characterization activities, locations with elevated radioactivity calculations and analysis of the radionuclide spatial

distribution for Land Parcels 1 and 2 are not required. The RESRAD calculations for these two land parcels already assume uniform distribution of contamination at the maximum concentrations from the dataset.

The RESRAD calculations for Land Parcel 2 were performed using the same principal radionuclides as Land Parcels 1 and 3. The maximum radionuclide concentration values from the sample results of the downslope area were used as the initial concentration of principal radionuclides for Land Parcel 2. Because RESRAD calculations for this land parcel assumes uniform distribution of contamination at the maximum radionuclide concentrations from the sample results dataset, locations with elevated radioactivity calculations and analysis of the radionuclide spatial distribution are not required.

The initial radionuclide concentrations used for the three RESRAD calculations are listed in Table E.5-1.

Table E.5-1
CAU 551 Initial Radionuclide Concentrations

Radionuclides	Land Parcel 1 (Maximum Activity Concentration) (pCi/g)	Land Parcel 2 (Maximum Activity Concentration) (pCi/g)	Land Parcel 3 (Maximum Activity Concentration) (pCi/g)
Americium-241	3,370	487	3,370
Cesium-137	3,050	48.7	3,050
Cobalt-60	5.3	N/A*	5.3
Europium-152	60	1.74	60
Plutonium-238	127	6.0	127
Plutonium-239	13,200	329	13,200

*Cobalt-60 was not detected in samples taken within Land Parcel 2.

N/A = Not applicable
pCi/g = Picocuries per gram

E.5.4 Inhomogeneous Contamination and Initial Radionuclide Concentrations

A contaminated zone is inhomogeneous if it contains a contaminated region within which the concentration of a radionuclide exceeds three times the average for the contaminated zone. The RESRAD uses a mathematical construct that assumes uniform distribution of radionuclides within a volume. However, RESRAD recognizes that radiological contamination is inhomogeneous in nature and provides detailed guidance for applying inhomogeneous criteria (e.g., locations with elevated radioactivity criteria, sum of fractions rule). The RESRAD User's Manual states that the inhomogeneous release criteria are generally more realistic, hence less restrictive, than the homogeneous release criteria. This shows that the approved initial radionuclide concentration values (i.e., the maximum radionuclide concentration from the sample dataset) will result in more restrictive release criteria. The arithmetic mean plus the 95 percent UCL are used for the initial concentrations of principal radionuclides when the sample results are obtained using a random sampling method. The maximum radionuclide concentrations values are used for the initial concentrations of principal radionuclides when the sample results are obtained using a non-probabilistic (e.g., bias or judgmental sampling) sampling method.

A statistical approach should always be considered as a first priority regarding the estimation of soil concentrations, as cited in the *Data Collection Handbook To Support Modeling the Impacts of Radioactive Material in Soil* (Yu et al., 1993). The 95 percent UCL represents a value that has a 5 percent chance that the actual mean of the dataset would exceed it. The 95 percent UCL is computed using the EPA code ProUCL. The code calculates the 95 percent UCL based on the distribution of the dataset (e.g., normal, log-normal, gamma, non-parametric).

The ProUCL software has been developed to compute an appropriate 95 percent UCL of the unknown population mean to support exposure assessment and cleanup decisions for EPA projects. A 95 percent UCL of the unknown population arithmetic mean is often used to:

- Estimate the exposure point concentration term
- Determine the attainment of cleanup standards
- Estimate background level mean contaminant concentrations
- Compare the soil concentrations with site-specific soil screening levels

It is important to compute a reliable, conservative, and stable 95 percent UCL of the population mean using the available data. The 95 percent UCL should approximately provide the 95 percent coverage for the unknown population mean.

The EPA has recommended that the maximum value of the dataset be used for the initial exposure point concentration term when the 95 percent UCL exceeds the maximum (EPA, 1992). However, if the maximum value of the dataset is used, then most of the statistical data associated with the distribution of the dataset is ignored (except for the maximum). Therefore, by using the mean plus the 95 percent UCL, the statistical data associated with the dataset are retained and the value approaches or exceeds the maximum value of the dataset as recommended by EPA.

However, the CAU 551 RESRAD evaluation uses the maximum concentration of the principal radionuclide to develop the FALs, because random sampling was not possible given the safety concerns for the area (i.e., steep slopes).

E.6.0 Authorized RESRAD Exposure Pathways and Scenarios

This section describes the input parameters, exposures scenarios, and guidance for calculating site-specific radiological remediation levels for Industrial Sites projects using the RESRAD computer code, as agreed to by NNSA/NSO, Stoller-Navarro Joint Venture (SNJV), National Security Technologies, LLC (NSTec), and NDEP.

E.6.1 Guidance for RESRAD Calculations

The guidance in this section was developed by NNSA/NSO, SNJV, BN, and NDEP and is only applicable to soils containing residual radioactive material. This guidance does not apply to structures, facilities, equipment, and building materials containing contaminated surfaces or volume contamination. The primary dose limit for any member of the public is 100-mrem total effective dose equivalent (TEDE) in a year. This limit applies to the sum of internal and external doses resulting from all modes of exposure to all radiation sources other than background radiation and doses received as a patient from medical sources as required by DOE 5400.5, II.1.a.(3)(a) (DOE, 1993). The dose constraint is defined as one quarter of the dose limit (i.e., 25-mrem) and will be applied to ensure that in a 1,000-year period the maximally exposed individual does not exceed the dose constraint in any single year. The requirements of Chapter IV of DOE 5400.5 will not specifically apply if NNSA/NSO chooses to continue to own and actively control access or use of the site. However, the radiation protection requirements in the other sections of DOE 5400.5 will apply to NNSA/NSO-owned and -maintained sites.

Due to the large spatial variability in background among sites, the “above background criterion” will be defined as the concentration of a specific radionuclide in soil that equals or exceeds its corresponding PAL. The source data for these radionuclide specific PALs will be taken directly from NCRP Report No. 129 Table 2.1, Construction, Commercial, Industrial Land-Use scenario column for a 25-mrem dose constraint (NCRP, 1999). The generic guidelines for residual concentrations of Radium (Ra)-226, Ra-228, Thorium (Th)-230, and Th-232 are found in Chapter IV of DOE Order 5400.5, Change 2 “Radiation Protection of the Public and Environment.”

Background radiation refers to the local area and includes:

- Concentration of naturally occurring radionuclides.
- Cosmic radiation.
- Radionuclides of anthropogenic origin that have been globally dispersed and are present at low concentrations such as fallout from nuclear weapons. (Note: This is not the case at the NTS.)

Due to the impracticality of determining "true" background, a dose constraint with no background subtraction will be used (i.e., a dose constraint not in excess of background). The use of the dose constraint with no background subtraction is a far more conservative and sensitive approach, because it does not deal with the uncertainty of natural background.

E.6.2 Description of Approved Scenarios

Based on the future land use as identified in the *Nevada Test Site Resource Management Plan* (DOE/NV, 1998), the following two exposure scenarios have been identified as "actual" and "likely" use scenarios. Stoller-Navarro Joint Venture has approval to use two scenarios (Scenario A and Scenario B) for use with the RESRAD computer code (NDEP, 2004). Both scenarios consider radiation exposures to the critical population group via the following pathways:

- Direct exposure to external radiation from the contaminated soil.
- Internal dose from inhalation of airborne radionuclides.
- Internal dose from ingestion of contaminated soil.

The two scenarios vary the parameters associated with the future land use of the site but use the same dose constraint parameter of 25 mrem/yr. Scenario A is approved for sites in Mercury or within 500 ft of an active building. Scenario B is approved for all other sites. Scenarios A and B are briefly described below.

For Scenario A, the future land use assumes continued industrial use of the site. This scenario addresses long-term exposure received by industrial workers exposed daily to residual levels of

radionuclides in soil during an average workday outdoors on site (EPA, 1991). Scenario A parameters are based on the following:

- A worker will be outdoors at the site for 250 days per year, 8 hours per day, for 25 years, for a total of 2,000 hours per year (hrs/yr).
- Indoor fraction time is zero, which means that the worker is outside being exposed for the entire workday.
- The outdoor time fraction is 0.228 and is calculated by dividing the total work hours at the site per year (2,000 hrs/yr) by the total number of hours in a year (8,760 hrs/yr).
- Worker exposures are limited to working hours and do not include contributions from ingestion of drinking water, plant foods, meat, or fish taken from the immediate area.

For Scenario B, the future land use assumes use restrictions with a low occupancy factor and lighter work activities at the site. The assumptions for Scenario B includes the following:

- A worker will be at the site and outdoors for a total of 335 hrs/yr for 25 years.
- The indoor fraction time is zero.
- The outdoor time fraction is 0.038, which is calculated by dividing the total work hours at the site per year (335 hrs/yr) by the total number of hours in a year (8,760 hrs/yr).
- The worker exposures are limited to working hours and do not include contributions from ingestion of drinking water, plant foods, meat or fish taken from the immediate area.

When Scenario B is selected, a use restriction will be included at closure that will state the use scenario and the requirement for an occupant agency or entity to re-evaluate the closure if site use changes to fit the parameters of Scenario A.

Table E.6-1 lists the pathways considered for Scenarios A and B.

Table E.6-1
Summary of Pathways Considered for Scenarios A and B

Pathway	Scenario A	Scenario B
External exposure	Yes	Yes
Particulate inhalation	Yes	Yes
Radon inhalation	No	No
Ingestion of soil	Yes	Yes
Ingestion of produce from on-site garden	No	No
Ingestion of meat from on-site livestock	No	No
Ingestion of milk from on-site livestock	No	No
Ingestion of fish from on-site pond	No	No
Ingestion of water from on-site well	No	No

E.6.3 RESRAD Parameters

The RESRAD User's Manual states that: "The RESRAD default parameter values were carefully selected and are realistic, although conservative, parameter values. (In most cases, use of these values will not result in underestimation of the dose or risk.) Site-specific parameters should always be used whenever possible. Therefore, use of default values that significantly overestimate the dose or risk for a particular site is discouraged" (Yu et al., 2001).

Table E.6-2 lists all of the RESRAD default values along with the site-specific RESRAD parameters approved for use with Scenarios A and B. A reference or reason is provided for parameters that require site-specific input.

E.6.4 Residual Radioactive Material Guidelines

The residual radioactive material guideline represents the concentration of residual radioactive material that can remain in place and still allow use of that area without radiological restrictions. Using site-specific parameters and sample analysis results, the radioactive material guideline, G, can be calculated for a given dose limit of H_{EL} for an individual as follows:

$$G = H_{EL} / DSR$$

Table E.6-2
Approved RESRAD Parameters
(Page 1 of 6)

Parameter	Units	Scenario A	Scenario B	Defaults	Reference/Rationale
Dose Conversion Factors					Use FGR 13 Morbidity
R02 Exposure Pathways					
Pathway 1- External Gamma		Active	Active		
Pathway 2- Inhalation		Active	Active		
Pathway 3- Plant Ingestion		Suppressed	Suppressed		
Pathway 4- Meat Ingestion		Suppressed	Suppressed		
Pathway 5- Milk Ingestion		Suppressed	Suppressed		
Pathway 6- Aquatic Foods		Suppressed	Suppressed		
Pathway 7- Drinking Water		Suppressed	Suppressed		
Pathway 8- Soil Ingestion		Active	Active		
Pathway 9- Radon		Suppressed	Suppressed		
R011 Contaminated Zone					
Area of CZ	m^2	Site Specific	Site Specific	1.000E+04	Maximum area of contamination out to two successive sample intervals below PALs. (~ 15 ft intervals laterally)
Thickness of CZ	m	Site Specific	Site Specific	2.000E+00	Maximum identified depth plus two successive intervals below PALs as identified during the site characterization. (~ 5 ft intervals vertically)
Length Parallel to Aquifer Flow	m	not used	not used	1.000E+02	Not used with the above pathway selection
Radiation Dose Limit	mrem/yr	25	25	2.5E+001	RESRAD Default (DOE, 1993)
Elapsed Time Since Placement of Material	yr	0.0	0.0	0.0	RESRAD Default
R012 Initial Principal Radionuclide					
Site-Specific Parent Radionuclide with half-life greater than 180 days, does not include naturally occurring and primordial radionuclides	pCi/g	Site Specific	Site Specific	0.0	The arithmetic mean plus the 95% UCL for the site.

Table E.6-2
Approved RESRAD Parameters
(Page 2 of 6)

Parameter	Units	Scenario A	Scenario B	Defaults	Reference/Rationale
R013 Cover and Contaminated Zone Hydrological Data					
Cover Depth	m	Site Specific	Site Specific	0.0	The minimum depth as identified during the site characterization
Density of Cover Material	g/cm^3	1.5	1.5	1.5	RESRAD Default unless site data significantly different
Cover Depth Erosion Rate	m/yr	1.000E-03	1.000E-03	1.000E-03	RESRAD Default unless site data significantly different
Density of Contaminated Zone	g/cm^3	1.5	1.5	1.5	RESRAD Default unless site data significantly different
Contamination Zone Erosion Rate	m/yr	1.000E-03	1.000E-03	1.000E-03	RESRAD Default unless site data significantly different
Contaminated Zone Total Porosity	-	4.000E-01	4.000E-01	4.000E-01	RESRAD Default unless site data significantly different
Contaminated Zone Field Capacity	-	2.000E-01	2.000E-01	2.000E-01	RESRAD Default unless site data significantly different
Contaminated Zone Hydraulic Conductivity	m/yr	1.000E+01	1.000E+01	1.000E+01	RESRAD Default unless site data significantly different
Contaminated Zone b Parameter	-	5.300E+00	5.300E+00	5.300E+00	RESRAD Default unless site data significantly different
Average Annual Wind Speed	m/sec	Site Specific	Site Specific	2.000E+00	Data from Air Resources Laboratory http://www.sord.nv.doe.gov/arlsord-1.htm
Humidity in Air	g/m^3	not used	not used	8.000E+00	Not used with the above pathway selection
Evapotranspiration Coefficient	-	5.000E-01	5.000E-01	5.000E-01	RESRAD Default not significant due to lack of groundwater pathway
Precipitation	m/yr	Site Specific	Site Specific	1.000E+00	Data from Air Resources Laboratory http://www.sord.nv.doe.gov/arlsord-1.htm
Irrigation	m/yr	0	0	2.000E-01	Assumes no artificial supply of water to soil
Irrigation Mode	-	overhead	overhead	overhead	RESRAD Default
Runoff Coefficient	-	4.000E-01	4.000E-01	2.000E-01	Open Sandy Loam 30% impervious Table 10.1 (Yu, et. al., 1993)
Watershed Area for Nearby Stream or Pond	m^2	not used	not used	1.000E+06	Not used with the above pathway selection

Table E.6-2
Approved RESRAD Parameters
(Page 3 of 6)

Parameter	Units	Scenario A	Scenario B	Defaults	Reference/Rationale
Accuracy for Water/Soil Computations	-	not used	not used	1.000E-03	Not used with the above pathway selection
R014 Saturated Zone Hydrological Data					
Density of Saturated Zone	g/cm^3	not used	not used	1.500E+00	Not used with the above pathway selection
Saturated Zone Total Porosity	-	not used	not used	4.000E-01	Not used with the above pathway selection
Saturated Zone Effective Porosity	-	not used	not used	2.000E-01	Not used with the above pathway selection
Saturated Zone Field Capacity	-	not used	not used	2.000E-01	Not used with the above pathway selection
Saturated Zone Hydraulic Conductivity	m/yr	not used	not used	1.000E+02	Not used with the above pathway selection
Saturated Zone Hydraulic Gradient	-	not used	not used	2.000E-02	Not used with the above pathway selection
Saturated Zone b Parameter	-	not used	not used	5.300E+00	Not used with the above pathway selection
Water Table Drop Rate	m/yr	not used	not used	1.000E-03	Not used with the above pathway selection
Well Pump Intake Depth	m	not used	not used	1.000E+01	Not used with the above pathway selection
Model: Nondispersion or Mass-Balance	-	ND	ND	ND	RESRAD Default
Well Pumping Rate	m^3/yr	not used	not used	2.500E+02	Not used with the above pathway selection
R015 Uncontaminated and Unsaturated Strata Hydrological Data					
Number of Unsaturated Zone Strata	-	not used	not used	1	Not used with the above pathway selection
Thickness	m	not used	not used	4.000E+00	Not used with the above pathway selection
Soil Density	g/cm^3	not used	not used	1.500E+00	Not used with the above pathway selection
Total Porosity	-	not used	not used	4.000E-01	Not used with the above pathway selection
Effective Porosity	-	not used	not used	2.000E-01	Not used with the above pathway selection
Field Capacity	-	not used	not used	2.000E-01	Not used with the above pathway selection
Soil-specific b Parameter	-	not used	not used	5.300E+00	Not used with the above pathway selection

Table E.6-2
Approved RESRAD Parameters
(Page 4 of 6)

Parameter	Units	Scenario A	Scenario B	Defaults	Reference/Rationale
Hydraulic Conductivity	m/yr	not used	not used	1.000E+01	Not used with the above pathway selection
R016 Distribution Coefficients and Leach Rates					
Contaminated Zone K_d (all Zones)	cm^3/g				RESRAD Defaults
Saturated Leach Rate	/yr	0.0	0.0	0.0	Not used
Solubility Constant	-	0.0	0.0	0.0	Not used
R017 Inhalation and External Gamma					
Inhalation Rate	m^3/yr	8.400E+03	1.230E+04	8.400E+03	RESRAD Default and for an individual performing outdoor activities, a typical activity mix can consist of 37% at a moderate activity level, 28% at both resting and light activity levels, and 7% at a heavy activity level, which results in a 1.4 m^3/h (12,300 m3/yr) inhalation rate. (Yu, et al., 1993)
Mass Loading for Inhalation	g/m^3	6.00E-04	6.00E-04	1E-04	The estimated mass loading for construction activities. (Yu, et al., 1993)
Exposure Duration	yr	25	25	30	Standard for Industrial/Commercial Scenario
Shielding Factor Inhalation	-	1	1	0.4	Assumes no indoor time fraction.
Shielding Factor External Gamma	-	1	1	0.7	Assumes no indoor time fraction.
Fraction of Time Spent Indoors	-	0.0	0.0	0.5	Assumes no indoor time fraction.
Fraction of Time Spent Outdoors	-	0.228	0.038	0.25	Based on Industrial/Commercial use scenarios for standard occupancy and low occupancy.
Shape Factor	-	1.0	1.0	1.0	RESRAD Default
R018 Ingestion Pathway Data, Dietary Parameters					
Fruits, Vegetables, and Grain Consumption	kg/yr	not used	not used	1.600E+02	Not used with the above pathway selection

Table E.6-2
Approved RESRAD Parameters
(Page 5 of 6)

Parameter	Units	Scenario A	Scenario B	Defaults	Reference/Rationale
Leafy Vegetable Consumption	kg/yr	not used	not used	1.400E+01	Not used with the above pathway selection
Milk Consumption	L/yr	not used	not used	9.200E+01	Not used with the above pathway selection
Meat and Poultry Consumption	kg/yr	not used	not used	6.300E+01	Not used with the above pathway selection
Fish Consumption	kg/yr	not used	not used	5.400E+00	Not used with the above pathway selection
Other Seafood Consumption	kg/yr	not used	not used	9.000E-01	Not used with the above pathway selection
Soil Ingestion Rate	g/yr	1.752E+02	1.752E+02	36.5	480 mg/day (EPA, 1991)
Drinking Water Intake	L/yr	not used	not used	5.100E+02	Not used with the above pathway selection
Drinking Water Contaminated Fraction	-	not used	not used	1.000E+00	Not used with the above pathway selection
Household Water Contaminated Fraction	-	not used	not used	1.000E+00	Not used with the above pathway selection
Livestock Water Contaminated Fraction	-	not used	not used	1.000E+00	Not used with the above pathway selection
Irrigation Water Contaminated Fraction	-	not used	not used	1.000E+00	Not used with the above pathway selection
Aquatic Food Contamination Fraction	-	not used	not used	5.000E-01	Not used with the above pathway selection
Plant Food Contamination Fraction	-	not used	not used	-1	Not used with the above pathway selection
Meat Contamination Fraction	-	not used	not used	-1	Not used with the above pathway selection
Milk Contamination Fraction	-	not used	not used	-1	Not used with the above pathway selection
R019 Ingestion Pathway Data, Nondietary					
Livestock Fodder Intake for Meat	kg/day	not used	not used	6.800E+01	Not used with the above pathway selection
Livestock Fodder Intake for Milk	kg/day	not used	not used	5.500E+01	Not used with the above pathway selection
Livestock Water Intake for Meat	L/day	not used	not used	5.000E+01	Not used with the above pathway selection
Livestock Water Intake for Milk	L/day	not used	not used	1.600E+02	Not used with the above pathway selection
Livestock Soil Intake	kg/day	not used	not used	5.000E-01	Not used with the above pathway selection

Table E.6-2
Approved RESRAD Parameters
(Page 6 of 6)

Parameter	Units	Scenario A	Scenario B	Defaults	Reference/Rationale
Mass Loading for Foliar Deposition	g/m^3	not used	not used	1.000E-04	Not used with the above pathway selection
Depth of Soil Mixing layer	m	not used	not used	1.500E-01	Not used with the above pathway selection
Depth of Roots	m	not used	not used	9.000E-01	Not used with the above pathway selection
Drinking Water Fraction from Groundwater	-	not used	not used	1.000E+00	Not used with the above pathway selection
Household Water Fraction from Groundwater	-	not used	not used	1.000E+00	Not used with the above pathway selection
Livestock Water Fraction from Groundwater	-	not used	not used	1.000E+00	Not used with the above pathway selection
Irrigation Fraction from Groundwater	-	not used	not used	1.000E+00	Not used with the above pathway selection
R021 Radon					
Radon Parameters Not Used					Not used with the above pathway selection

cm^3/g = Cubic centimeters per gram
CZ = Contamination Zone
ft = Foot
g/cm^3 = Grams per cubic centimeter
g/m^3 = Grams per cubic meter
g/yr = Grams per year
kg/day = Kilograms per day
kg/yr = Kilograms per year
L/day = Liters per day
L/yr = Liters per year
m = Meter
m^2 = Square meter
m/sec = Meters per second
m/yr = Meters per year
m^3/h = Cubic meters per hour
m^3/yr = Cubic meters per year
mrem/yr = Millirem per year
N/A = Not applicable
ND = Nondispersion
PAL = Preliminary action level
pCi/g = Picocuries per gram
yr = Year
/yr = Per year
UCL = Upper confidence level

where DSR is the total dose/source concentration ratio. The dose limit H_{EL}, used to derive the residual radioactive material guideline is 25 mrem/yr.

Single radionuclide guidelines are calculated for individual radionuclides such that the annual dose to industrial/construction workers at the site should not exceed an annual dose limitation of 25 mrem/yr. Sites contaminated with two or more radionuclides (i.e., a mixture of radionuclides) require further evaluation to ensure that collective exposures from individual radionuclides do not exceed the 25 mrem/yr annual dose constraint. This evaluation is performed using a sum of the fractions method. The initial soil concentration of each radionuclide is divided by the single radionuclide guideline for that radionuclide to produce a ratio. These ratios are then summed. If the sum is less than or equal to unity, then the collective annual dose from all radionuclides at the site should not exceed the 25 mrem/yr annual dose constraint. If the sum does exceed unity, the annual dose to industrial/construction workers could exceed the 25 mrem/yr dose constraint, even if the concentrations of residual radionuclides at the site are below the single radionuclide guideline values. For sites where the sum of the ratios exceeds unity, residual radioactive material guidelines for mixtures of radionuclides are calculated such that the following equation is satisfied;

$$\overline{M} = \sum_i \overline{S}_i(0) / G_i(t_m) \leq 1$$

Where:

$\overline{M}$ = Average mixture sum (dimensionless)

$\overline{S}_i(0)$ = Initial concentration of the ith principal radionuclide averaged over an area determined by scenario activities

$G_i(t_m)$ = Single radionuclide soil concentration guideline for the ith principal radionuclide at time t maximum.

For a site where the sum of the ratios does not exceed unity, the residual radioactive guidelines for single radionuclides are the radionuclide concentrations to be used as the FAL. For sites where the sum of the ratios exceeds unity, the residual radioactive guidelines for mixtures of radionuclides are mathematically adjusted such that the above equation is satisfied; these adjusted values are then used as the FAL.

E.7.0 RESRAD Calculations for Land Parcel 1

The Land Parcel 1 includes the four CAS (three muckpiles and the AST and stain). This section discusses the RESRAD calculations and results for the Land Parcel 1.

E.7.1 Selection of RESRAD Exposure Scenario

Scenario B was selected as the exposure scenario for the Land Parcel 1 because of the remote location of the site. Because Scenario B parameters will be used for these calculations, a use restriction will be implemented at closure that will state the use scenario and the requirement for an occupant agency or entity to re-evaluate the closure if site use changes to fit the parameters of Scenario A.

E.7.2 User Input Parameters

The RESRAD default parameters that were altered for the calculations performed for the three land parcels in this report and the site-specific values entered are presented in Table E.7-1 RESRAD Parameters Input Values for Land Parcels 1, 2 and 3. A complete list of the RESRAD default parameters and the parameters used for Land Parcels 1, 2, and 3 is provided in Table E-1 in Attachment A.

E.7.3 Radionuclide Concentrations and Dose Estimates for Land Parcel 1

Uncertainty in the derivation of dose estimates and dose/source contribution ratios comes from the distribution of possible input parameter values, as well as uncertainty in the conceptual model used to represent the site. The pathway contributions to the total annual dose at time zero are 37 percent for external exposure, 26 percent for inhalation, and 37 percent for soil ingestion pathways. Therefore, uncertainties in the following parameters: erosion rate, thickness of contaminated zone, occupancy factors, mass loading, inhalation rate, and wind speed have the greatest significance on the model predictions. The terrain at CAU 551 is steeply sloped and many areas cannot be safely accessed. These two conditions introduce additional uncertainties in the model predictions, which use parameters related to soil erosion, migration of contaminants into and out of the site boundary, and site occupancy factors. The detailed results for this RESRAD exposure scenario are provided in Exhibit 1, RESRAD Summary Report: CAU 551 Land Parcel 1.

Table E.7-1
RESRAD Parameters Input Values for Land Parcels 1, 2, and 3
(Page 1 of 2)

Parameter	Units	Parcel 1	Parcel 2	Parcel 3	Defaults	Reference/Rationale
R011 Contaminated Zone						
Area of CZ	m^2	1.848E+04	7.149E+04	8.997E+04	1.000E+04	Estimated using the site boundary
Thickness of CZ	m	1.200E+00	6.100E-01	1.200E+00	2.000E+00	Maximum depth from contaminated samples
R012 Initial Principal Radionuclide						
Americium-241 (soil)	pCi/g	3.370E+03	4.87E+02	3.370E+03	0.0	For Columns Parcel 1 and Parcel 3: The maximum concentration from either sample results or previous (historical) muckpile investigations.
Cesium-137 (soil)	pCi/g	3.050E+03	4.87E+01	3.050E+03	0.0	
Cobalt-60 (soil)	pCi/g	5.300E+00	N/A	5.300E+00	0.0	
Europium-152 (soil)	pCi/g	6.000E+01	1.740E+00	6.000E+01	0.0	For Column Parcel 2: Principal radionuclides are the contaminants of concern identified in the CAU 551 muckpiles. Initial concentrations are the maximum concentrations from sample results for this parcel.
Plutonium-238 (soil)	pCi/g	1.270E+02	6.000E+00	1.270E+02	0.0	
Plutonium-239 (soil)	pCi/g	1.320E+04	3.290E+02	1.320E+04	0.0	
R013 Cover and Contaminated Zone Hydrological Data						
Average Annual Wind Speed	m/sec	3.4	3.4	3.4	2.000E+00	Data from Air Resource Laboratory (2005)
Precipitation	m/yr	3.260E-01	3.260E-01	3.260E-01	1.000E+00	Data from Air Resources Laboratory
Runoff Coefficient	-	4.000E-01	4.000E-01	4.000E-01	2.000E-01	Open Sandy Loam 30% impervious Table 10.1 (Yu, et al., 1993)

Table E.7-1
RESRAD Parameters Input Values for Land Parcels 1, 2, and 3
(Page 2 of 2)

Parameter	Units	Parcel 1	Parcel 2	Parcel 3	Defaults	Reference/Rationale
R017 Inhalation and External Gamma						
Inhalation Rate	m^3/yr	1.230E+04	1.230E+04	1.230E+04	8.400E+03	RESRAD Default and for an individual performing outdoor activities, a typical activity mix can consist of 37% at a moderate activity level, 28% at both resting and light activity levels, and 7% at a heavy activity level, which results in a 1.4 m^3/h (12,300 m^3/yr) inhalation rate. (Yu, et al., 1993)
Mass Loading for Inhalation	g/m^3	6.00E-04	6.00E-04	6.00E-04	1E-04	The estimated mass loading for construction activities. (Yu, et al., 1993)
Exposure Duration	yr	25	25	25	30	Standard for Industrial/Commercial Scenario
Shielding Factor Inhalation	-	1.0	1.0	1.0	0.4	Assumes no indoor time fraction
Shielding Factor External Gamma	-	1.0	1.0	1.0	0.7	Assumes no indoor time fraction
Fraction of Time Spent Indoors	-	0.0	0.0	0.0	0.5	Assumes no indoor time fraction
Fraction of Time Spent Outdoors	-	0.038	0.038	0.038	0.25	Scenario specific based on Industrial/ Commercial Use Scenarios for standard occupancy and low occupancy.
Soil Ingestion Rate	g/yr	1.752E+02	1.752E+02	1.752E+02	36.5	EPA, 1991; 480 mg/day

g/m^3 = Grams per cubic meter
g/yr = Grams per year
m = Meter
m^2 = Square meter
m/sec = Meters per second
m/yr = Meters per year
m^3/h = Cubic meters per hour
m^3/yr = Cubic meters per year
mg/day = Milligrams per day
N/A = Not applicable
pCi/g = Picocuries per gram
yr = Year
UCL = Upper confidence level

The maximum dose contributions and total dose/source concentration ratios for the muckpile land parcel under Scenario B parameters have been predicted to occur at time zero. The calculated maximum dose contributions for all considered pathways are presented in Table E.7-2. Figure E.7-1 shows that at time zero, the TEDE to industrial/construction workers for the considered pathways is 1,058 mrem/yr and that the annual dose rate does not drop below 482 mrem/yr at anytime during the 1,000-year interval.

Figure E.7-2 shows the breakdown of the total dose into the component pathways. Together, Table E.7-1 and Figures E.7-1 and E.7-2 show that the dose from Pu-239 at time zero is 524 mrem/yr and only drops to 482 mrem/yr after the 1,000-year time interval. These data also show that the annual dose from external radiation (mostly from Cs-137) at time zero is 392 mrem/yr and is reduced to 39 mrem/yr within 100 years. Within 100 years, the annual dose for Pu-239 is calculated at 520 mrem/yr, which will account for 83 percent of the total annual dose.

Table E.7-2
Maximum Dose Contributions for Land Parcel 1 Using Scenario B (occurs at t=0)

Radionuclide	Ground		Inhalation		Soil		Total	
	Annual Dose (mrem/yr)	Fraction	Annual Dose (mrem/yr)	Fraction	Annual Dose (mrem/yr)	Fraction	Annual Dose (mrem/yr)	Fraction
Americium-241	5.438E-00	5.100E-03	5.600E+01	5.290E-02	8.138E+01	7.690E-02	1.428E+02	1.349E-01
Cobalt-60	2.896E+00	2.700E-03	4.085E-05	0.000E+00	8.894E-04	0.000E+00	2.897E+00	2.700E-03
Cesium-137	3.685E+02	3.481E-01	3.612E-03	0.000E+00	1.004E+00	9.000E-04	3.695E+02	3.491E-01
Europium-152	1.473E+01	1.390E-02	4.853E-04	0.000E+00	2.522E-03	0.000E+00	1.474E+01	1.390E-02
Plutonium-238	7.199E-04	0.000E+00	1.862E+00	1.800E-03	2.695E+00	2.500E-03	4.558E+00	4.300E-03
Plutonium-239	1.429E-01	1.000E-04	2.127E+02	2.010E-01	3.111E+02	2.939E-01	5.239E+02	4.950E-01
Total	3.917E+02	3.701E-01	2.706E+02	2.556E-01	3.962E+02	3.743E-01	1.058E+03	1.000E+00

mrem/yr = Millirem per year

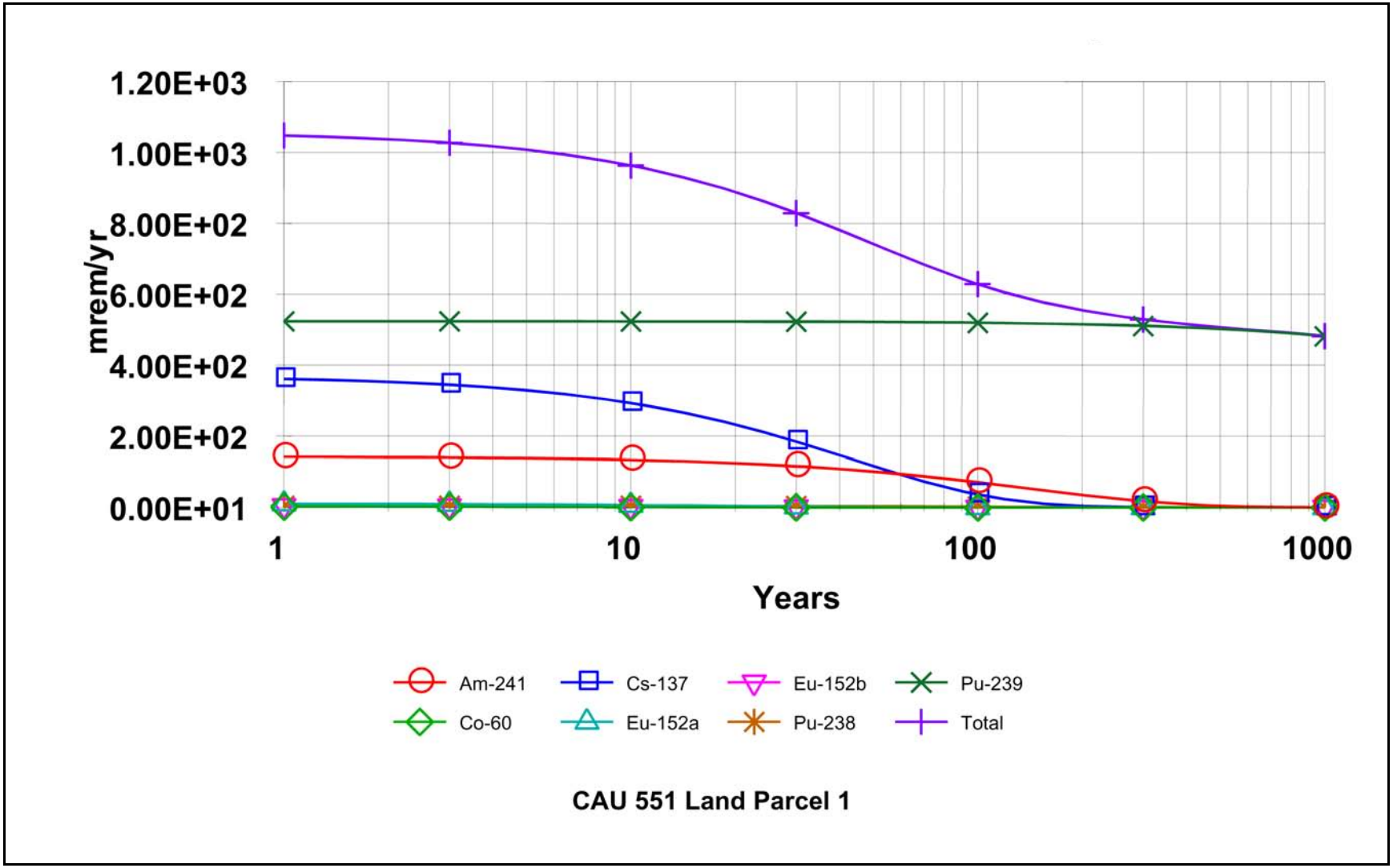


Figure E.7-1
CAU 551 Land Parcel 1 Scenario B:
Dose Rate Per Year All Radionuclides Summed, All Pathways Summed

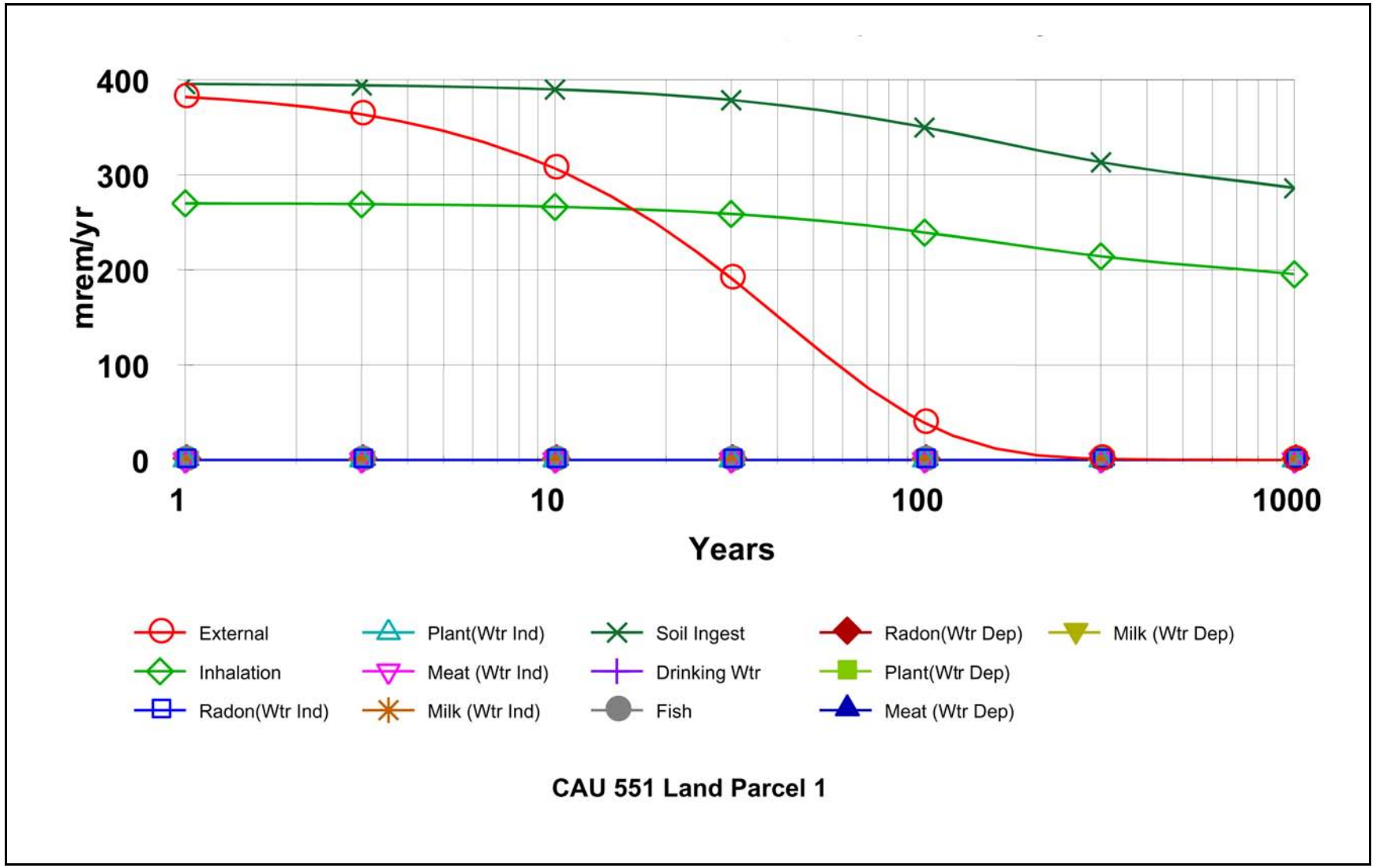


Figure E.7-2
Annual Dose All Radionuclides Summed, Component Pathways

Because Pu-239 has a half-life of 24,100 years, the concentration of Pu-239 at this site will not decay to a safe level through the radioactive decay processes within the 1,000-year time interval. Site remediation and/or controls that reduce workers exposures and minimize the spread of radioactive contamination into uncontaminated areas are recommended for this site.

E.7.4 Residual Radioactive Material Guidelines for Land Parcel 1

The sum of the ratios for Land Parcel 1 exceeded unity. Residual radioactive guidelines for mixtures of radionuclides were calculated for both of this land parcel. Table E.7-3 presents the calculations results for deriving guidelines for mixtures radionuclides for this land parcel. The residual radioactive material guidelines for single radionuclides and mixture radionuclides for all the three land parcel scenarios are listed in Table E.7-4. The FALs for the Land Parcel 1 scenario are the residual radioactive material guideline values for mixture radionuclides.

Table E.7-3
CAU 551 Land Parcel 1 Sum of Fractions and Proportional Scaling

Radionuclide	Initial Radionuclide Concentration (pCi/g)	% Contribution	Single Radionuclide Guidelines (pCi/g)	Ratio for Single Radionuclide Guideline	Mixture Radionuclides Guidelines	Ratio for Mixture Radionuclide Guidelines
Americium-241	3,370	0.170	589.9	5.713	79.631	0.135
Cobalt-60	5.3	0.000	45.74	0.116	0.125	0.003
Cesium-137	3,050	0.154	206.4	14.777	72.070	0.349
Europium-152	60	0.003	101.8	0.589	1.418	0.014
Plutonium-238	127	0.006	696.6	0.182	3.001	0.004
Plutonium-239	13,200	0.666	629.9	20.956	311.909	0.495
Total	19,812.3	1.000	2,270.34	42.333	468.155	1.000

pCi/g = Picocuries per gram

Table E.7-4
Residual Radioactive Material Guidelines for Single Radionuclides and Radionuclide Mixtures

Radionuclides	Land Parcel 1 Guidelines (pCi/g)		Land Parcel 2 Guidelines (pCi/g)		Land Parcel 3 Guidelines (pCi/g)	
	*Single Radionuclide	*Mixture Radionuclide	*Single Radionuclide	*Mixture Radionuclide	*Single Radionuclide	*Mixture Radionuclide
Americium-241	589.9	79.63	558.7	287.42	551.7	75.29
Cobalt-60	45.74	0.13	N/A	N/A**	44.39	0.12
Cesium-137	206.4	72.07	200.9	28.74	199.5	68.14
Europium-152	101.8	1.42	99.22	1.03	98.55	1.34
Plutonium-238	696.6	3.00	656.9	3.54	650.2	2.84
Plutonium-239	629.9	311.91	594.3	194.17	588.2	294.91

*Single radionuclide guidelines apply to areas uniformly contaminated with a single radionuclide. The mixture radionuclide guidelines apply to areas uniformly contaminated with a mixture of radionuclides. The final action levels for all three land parcels are the radionuclide guidelines for mixture radionuclides (i.e., Mixture Radionuclide columns).
**Cobalt-60 was not detected in samples taken within Land Parcel 2.

N/A = Not applicable
pCi/g = Picocuries per gram

E.8.0 RESRAD Calculations for Land Parcel 2

The Land Parcel 2 consists of the area downslope of the CAU 551 muckpiles. This section discusses the RESRAD calculations and results for the Land Parcel 2.

E.8.1 Selection of RESRAD Exposure Scenario

Scenario B was selected as the exposure scenario for the Land Parcel 2 because of its remote location. Because Scenario B parameters will be used for these calculations, a use restriction will be implemented at closure that will state the use scenario and the requirement for an occupant agency or entity to re-evaluate the closure if site use changes to fit the parameters of Scenario A.

E.8.2 User Input Parameters

The RESRAD default parameters that were altered for the calculations performed for the three land parcels in this report and the site-specific values entered are presented in Table E.7-1, RESRAD Parameters Input Values for Land Parcels 1, 2 and 3. A complete list of the RESRAD default parameters and the parameters used for Land Parcels 1, 2, and 3 is provided in Table E-1 of Attachment A.

E.8.3 Radionuclide Concentrations and Dose Estimates for Land Parcel 2

Uncertainty in the derivation of dose estimates and dose/source contribution ratios comes from the distribution of possible input parameter values, as well as uncertainty in the conceptual model used to represent the site. The pathway contributions to the total annual dose at time zero are 17 percent for external exposure, 37 percent for inhalation, and 46 percent for soil ingestion pathways. Therefore, uncertainties in the following parameters: erosion rate, thickness of contaminated zone, occupancy factors, mass loading, inhalation rate, and wind speed have the greatest significance on the model predictions. The Land Parcel 2 areas are adjacent to and downslope of the CAU 551 muckpiles. The RESRAD results for this land parcel do not include the affects of soil migration (contaminated or clean) into the site from the muckpiles or adjacent land areas. The input parameters entered the RESRAD code for this analysis is listed in Exhibit 2, RESRAD Summary Report: CAU 551 Land Parcel 2.

The maximum dose contributions and total dose/source concentration ratios for Land Parcel 2 under Scenario B parameters have been predicted to occur at time zero. The calculated maximum dose contributions for all considered pathways are presented in Table E.8-1. Figure E.8-1 shows that at time zero, the TEDE to industrial/construction workers for the considered pathways is 42.4 mrem/yr, which is above the 25 mrem/yr dose constraint.

Figure E.8-2 shows the breakdown of the total dose into the component pathways. Together, Table E.8-1 and Figures E.8-1 and E.8-2 show that at time zero, the annual dose from Pu-239 is 13.8 mrem/yr (33 percent of the total dose), Am-241 is 21.8 mrem/yr (51 percent of the total dose), and Cs-137 is 6.1 mrem/yr (14 percent of the total dose).

These data also show that the annual dose at time zero for external radiation is 7.3 mrem/yr, for inhalation 15.5 mrem/yr, and for ingestion of soil 19.6 mrem/yr. The calculated annual dose to industrial/construction workers for Land Parcel 2 is predicted to fall below the 25-mrem/yr dose constraint within 100 years.

Site remediation and/or controls that reduce worker exposure and minimize the spread of radioactive contamination into uncontaminated areas are recommended for this site. In addition, radioactive contamination from the CAU 551 muckpiles is migrating into this land parcel. As contamination from adjacent land areas erodes, the radionuclide concentrations within this land parcel are likely to increase over time. There are insufficient data to derive dose estimates for contamination that migrates into the site. It is recommended that controls be implemented to minimize the spread contamination from the muckpiles into uncontaminated areas and to prevent further contamination of Land Parcel 2.

E.8.4 Residual Radioactive Material Guidelines for Land Parcel 2

The sum of the ratios for Land Parcel 2 exceeded unity. Residual radioactive guidelines for mixtures of radionuclides were calculated for this land parcel. Table E.8-2 presents the calculations results for deriving guidelines for mixtures radionuclides for this land parcel. The residual radioactive material guidelines for single radionuclides and mixture radionuclides for all the three land parcel scenarios are listed in Table E.7-4. The FALs for the Land Parcel 2 scenario are the residual radioactive material guideline values for mixture radionuclides.

Table E.8-1
Maximum Dose Contributions for Land Parcel 2 Using Scenario B (occurs at t=0)

Radionuclide	Ground		Inhalation		Soil		Total	
	Annual Dose (mrem/yr)	Fraction	Annual Dose (mrem/yr)	Fraction	Annual Dose (mrem/yr)	Fraction	Annual Dose (mrem/yr)	Fraction
Americium-241	7.978E-01	1.88E-02	9.264E+00	2.187E-01	1.173E+01	2.769E-01	2.179E+01	5.144E-01
Cesium-137	6.045E+00	1.427E-01	6.620E-05	0.000E+00	1.602E-02	4.000E-04	6.061E+00	1.431E-01
Europium-152	4.383E-01	1.03E-02	1.615E-05	0.000E+00	7.314E-05	0.000E+00	4.384E-01	1.030E-02
Plutonium-238	3.421E-05	0.000E+00	1.010E-01	2.400E-03	1.273E-01	3.000E-03	2.282E-01	5.400E-03
Plutonium-239	3.632E-03	1.000E-04	6.084E+00	1.436E-01	7.753E+00	1.830E-01	1.384E+01	3.237E-01
Total	7.285E+00	1.720E-01	1.545E+01	3.647E-01	1.963E+01	4.633E-01	4.236E+01	1.000E+00

mrem/yr = Millirem per year

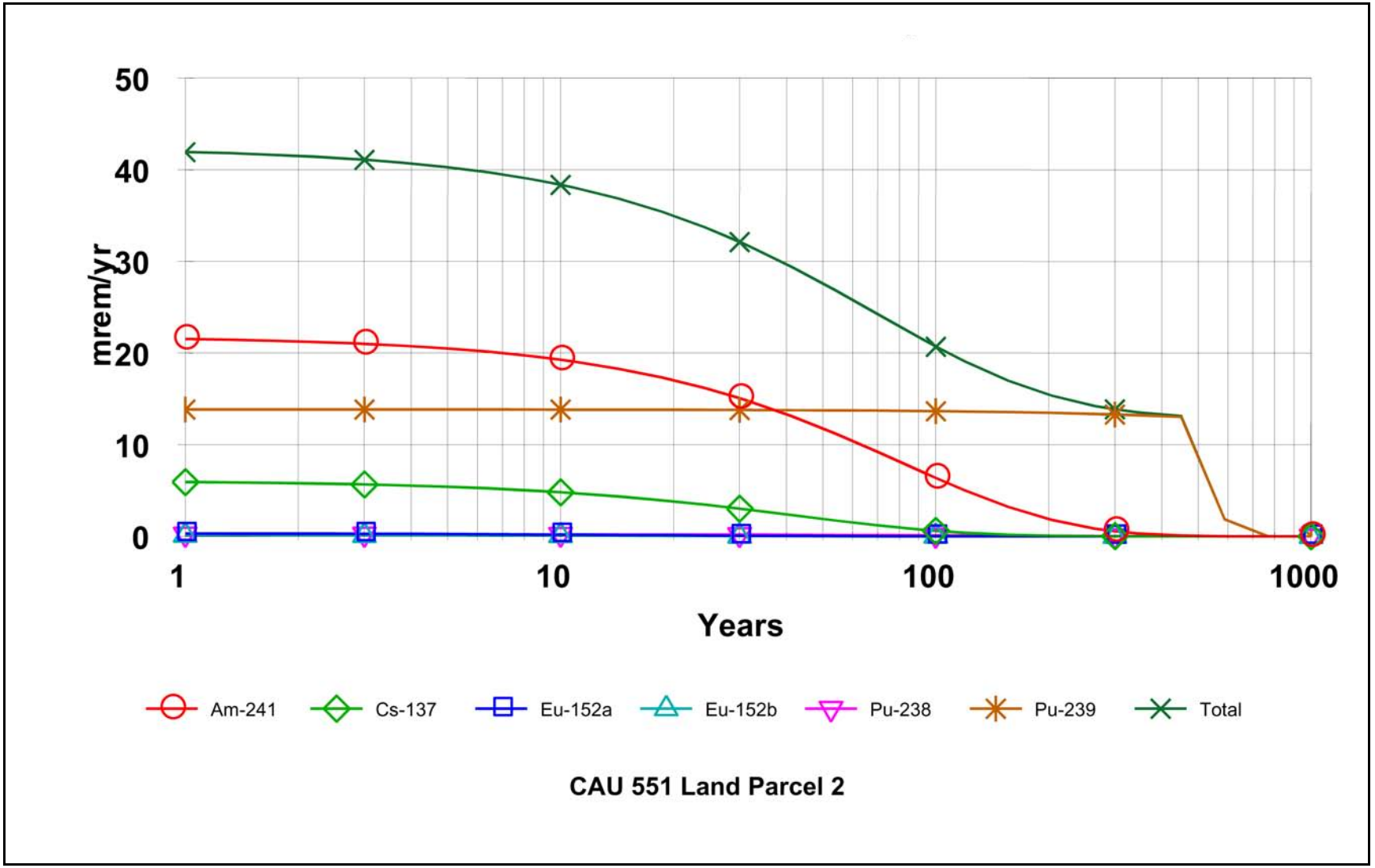


Figure E.8-1
CAU 551 Land Parcel 2 Scenario B:
Dose Rate Per Year All Radionuclides Summed, All Pathways Summed

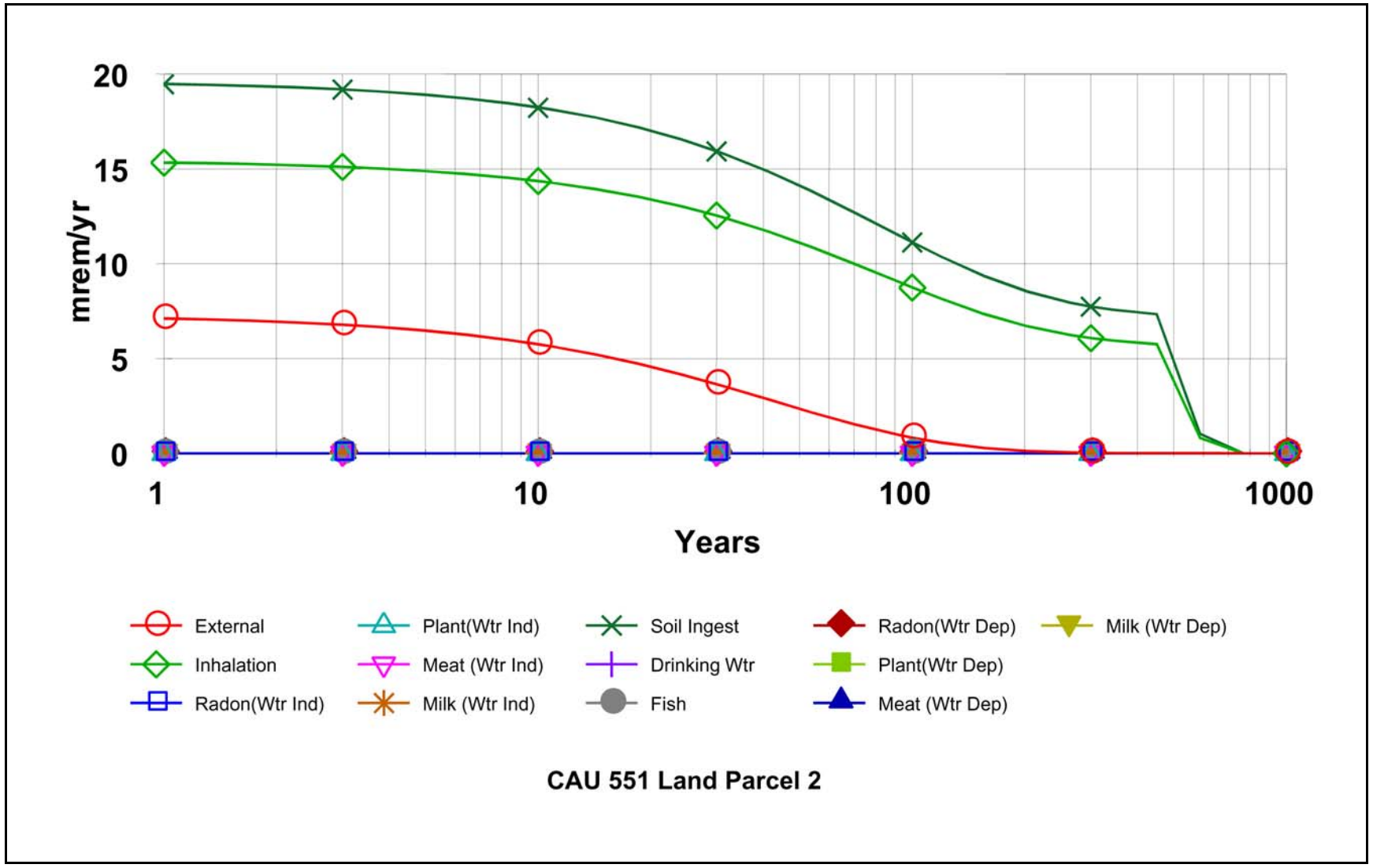


Figure E.8-2
CAU 551 Land Parcel 2 Scenario B:
Annual Dose All Radionuclides Summed, Component Pathways

Table E.8-2
CAU 551 Land Parcel 2 Sum of Fractions and Proportional Scaling

Radionuclide	Initial Radionuclide Concentration (pCi/g)	% Contribution	Single Radionuclide Guidelines (pCi/g)	Ratio for Single Radionuclide Guideline	Mixture Radionuclides Guidelines	Ratio for Mixture Radionuclide Guidelines
Americium-241	487.0	0.558	558.7	0.872	287.42	0.514
Cesium-137	48.7	0.0566	200.9	0.242	28.74	0.143
Europium-152	1.7	0.002	99.22	0.018	1.03	0.010
Plutonium-238	6.0	0.007	656.9	0.009	3.54	0.005
Plutonium-239	329.0	0.377	594.3	0.554	194.17	0.327
Total	872.4	1.000	2,110.02	1.694	547.90	1.000

pCi/g = Picocuries per gram

E.9.0 RESRAD Calculations for Land Parcel 3

The Land Parcel 3 includes the combined land areas investigated at CAU 551 (i.e., all three CASs (Land Parcel 1) and the downslope area (Land Parcel 2). This section discuses the RESRAD calculations and results for the Land Parcel 3.

E.9.1 Selection of RESRAD Exposure Scenario

Scenario B was selected as the exposure scenario for the Land Parcel 3 because of the remote location of the site. Because Scenario B parameters will be used for these calculations, a use restriction will be implemented at closure that will state the use scenario and the requirement for an occupant agency or entity to re-evaluate the closure if site use changes to fit the parameters of Scenario A.

E.9.2 User Input Parameters

The RESRAD default parameters that were altered for the calculations performed for the three land parcels in this report and the site-specific values entered are presented in Table E.7-1 RESRAD Parameters Input Values for Land Parcels 1, 2 and 3. A complete list of the RESRAD default parameters and the parameters used for Land Parcels 1, 2, and 3 is provided in Table E-1 of Attachment A.

E.9.3 Radionuclide Concentrations and Dose Estimates for Land Parcel 3

The RESRAD results for this land parcel are only slightly different from the results for Land Parcel 1. This evaluation applied the radionuclide concentrations for the muckpiles all of the areas investigated under this CAU. These land areas include both the Land Parcel 1 and Land Parcel 2 areas.

Uncertainty in the derivation of dose estimates and dose/source contribution ratios comes from the distribution of possible input parameter values, as well as uncertainty in the conceptual model used to represent the site. The pathway contributions to the total annual dose at time zero are 36 percent for external exposure, 29 percent for inhalation, and 35 percent for soil ingestion pathways. Therefore, uncertainties in the following parameters: erosion rate, thickness of contaminated zone, occupancy factors, mass loading, inhalation rate, and wind speed have the greatest significance on the model predictions. The terrain at CAU 551 is steeply sloped and many areas cannot be safely accessed.

These two conditions introduce additional uncertainties in the model predictions, which use parameters related to soil erosion, migration of contaminants into and out of the site boundary, and site occupancy factors. The detailed results for this RESRAD exposure scenario are provided in Exhibit 3, RESRAD Summary Report: CAU 551 Land Parcel 3.

The maximum dose contributions and total dose/source concentration ratios for Land Parcel 3 using Scenario B parameters have been predicted to occur at time zero. The calculated maximum dose contributions for all considered pathways are presented in Table E.9-1. Figure E.9-1 shows that at time zero, the TEDE to industrial/construction workers for the considered pathways is 1,119 mrem/yr and that the annual dose rate does not drop below 516 mrem/yr at anytime during the 1,000-year interval.

Figure E.9-2 shows the breakdown of the total doses into the component pathways. Together, Table E.9-1 and Figures E.9-1 and E.9-2 show that the dose from Pu-239 at time zero is 561 mrem/yr and only drops to 516 rem/yr after the 1,000-year time interval. These data also show that the annual dose from external radiation (mostly from Cs-137) at time zero is 405 mrem/yr and is reduced to 40 mrem/yr within 100 years. Within 100 years, the annual dose for Pu-239 is calculated at 556 mrem/yr, which will account for 83 percent of the total annual dose.

Because Pu-239 has a half-life of 24,100 years, the concentration of Pu-239 at this site will not decay to a safe level through the radioactive decay processes within the 1,000-year time interval. Site remediated or controls that reduce worker exposures and minimize the spread of radioactive contamination into uncontaminated areas are recommended for this site.

E.9.4 Residual Radioactive Material Guidelines for Land Parcel 3

The sum of the ratios for Land Parcel 3 exceeded unity. Residual radioactive guidelines for mixtures of radionuclides were calculated for both of this land parcel. Table E.9-2 presents the calculations results for deriving guidelines for mixtures radionuclides for this land parcel. The residual radioactive material guidelines for single radionuclides and mixture radionuclides for all the three land parcel scenarios are listed in Table E.7-4. The FALs for the Land Parcel 3 scenario are the residual radioactive material guideline values for mixture radionuclides.

Table E.9-1
Maximum Dose Contributions for Land Parcel 3 Using Scenario B (occurs at t=0)

Radionuclide	Ground		Inhalation		Soil		Total	
	Annual Dose (mrem/yr)	Fraction	Annual Dose (mrem/yr)	Fraction	Annual Dose (mrem/yr)	Fraction	Annual Dose (mrem/yr)	Fraction
Americium-241	5.559E+00	5.000E-03	6.578E+00	5.880E-02	8.138E+01	1.170E-02	1.527E+02	1.3650E-01
Cobalt-60	2.984E+00	2.700E-03	4.798E-05	0.000E+00	8.894E-04	0.000E+00	2.985E+00	2.700E-03
Cesium-137	3.812E+02	3.406E-01	4.243E-03	0.000E+00	1.004E+00	1.000E-03	3.822E+02	3.415E-01
Europium-152	1.522E+01	1.36E-02	5.700E-04	0.000E+00	2.522E-03	0.000E+00	1.522E+01	1.360E-02
Plutonium-238	7.251E-04	0.000E+00	2.188E+00	2.200E-03	2.695E+00	2.700E-03	4.883E+00	4.400E-03
Plutonium-239	1.464E-01	1.000E-04	2.498E+02	2.232E-01	3.111E+02	3.149E-01	5.611E+02	5.014E-01
Total	4.051E+02	3.620E-01	3.178E+02	2.840E-01	3.962E+02	3.540E-01	1.119E+03	1.000E+00

mrem/yr = Millirem per year

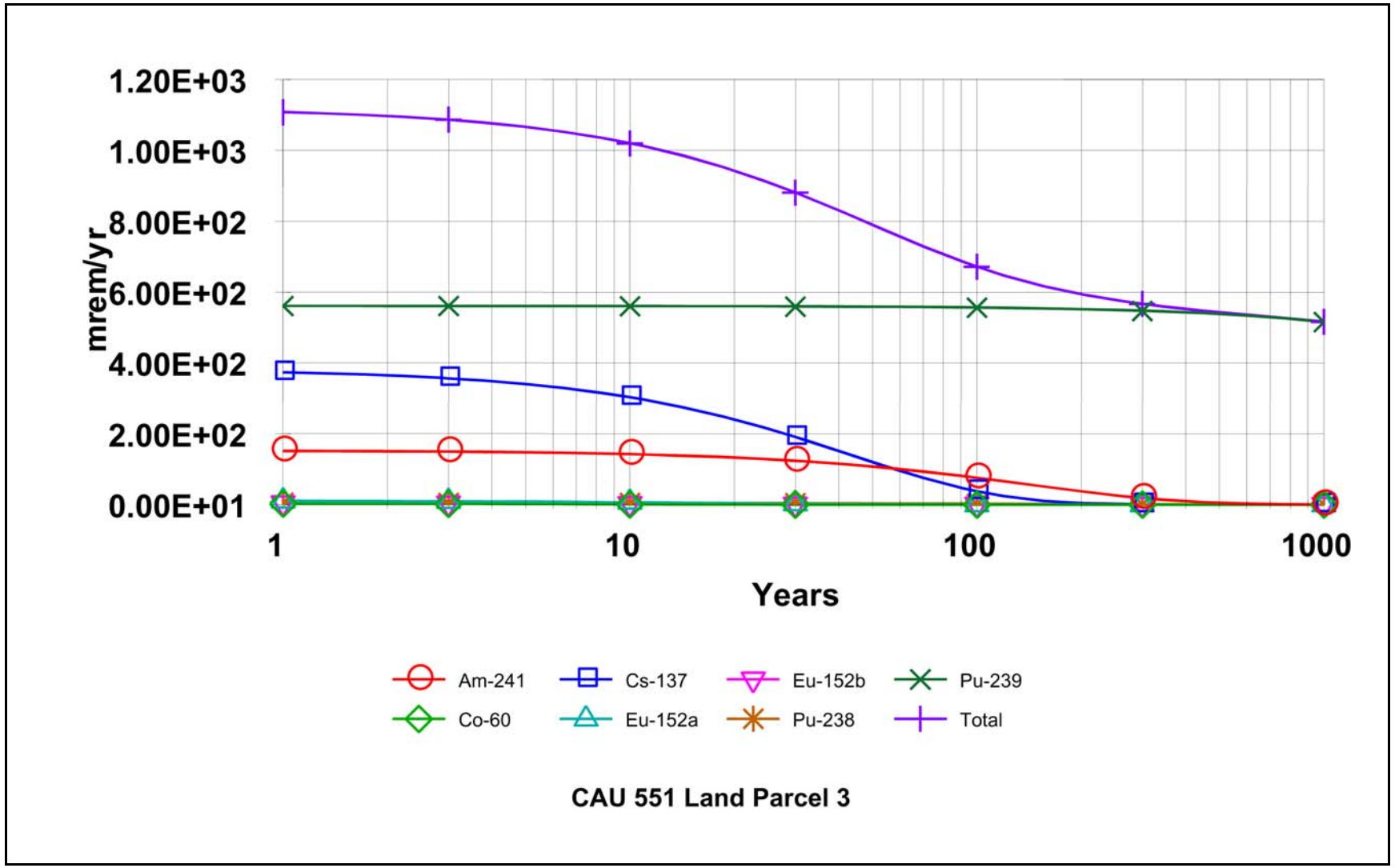


Figure E.9-1
CAU 551 Land Parcel 3 Scenario B:
Dose Rate Per Year All Radionuclides Summed, All Pathways Summed

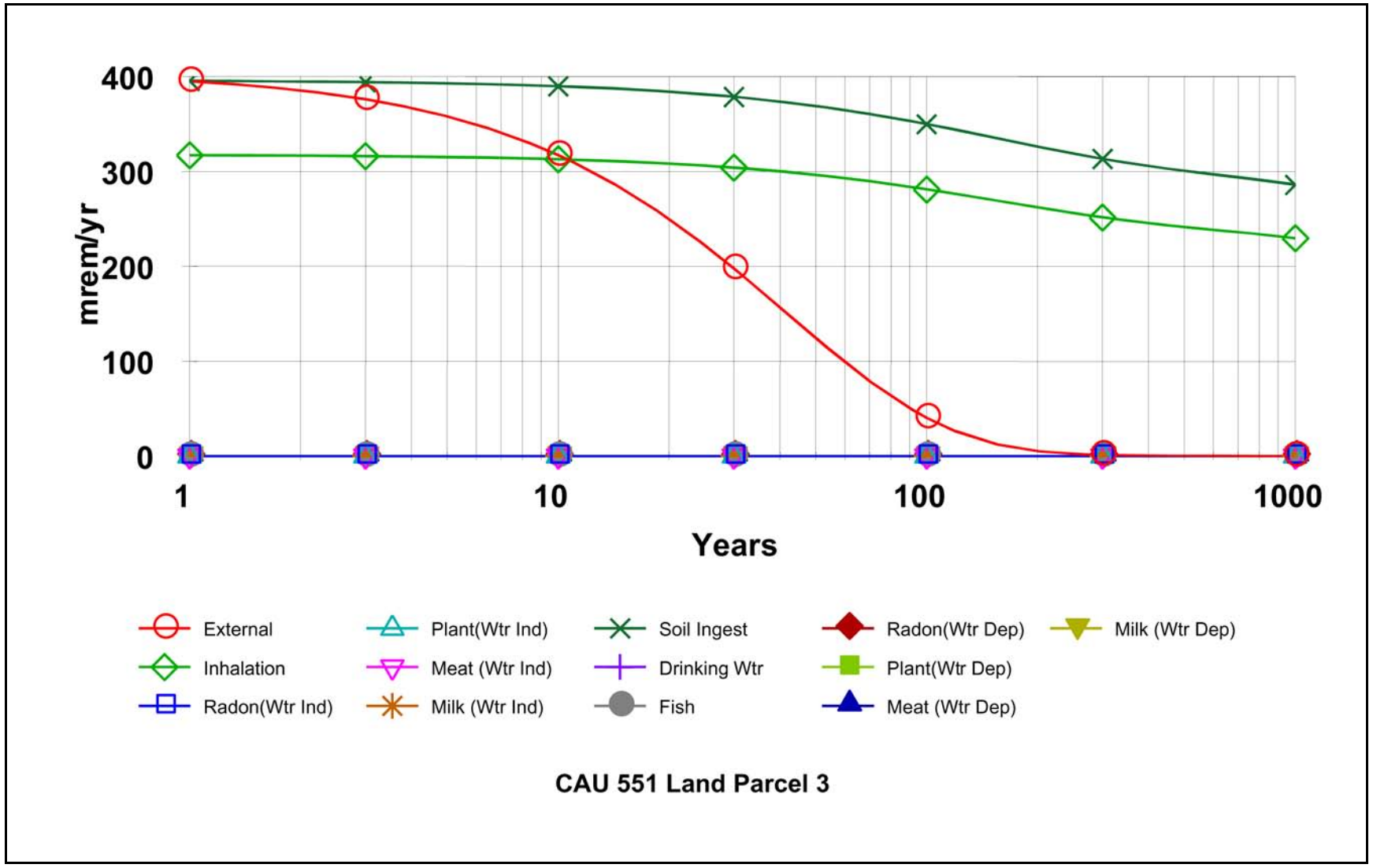


Figure E.9-2
CAU 551 Land Parcel 3 Scenario B:
Dose Rate Per Year All Radionuclides Summed, All Pathways Summed

Table E.9-2
CAU 551 Land Parcel 3 Sum of Fractions and Proportional Scaling

Radionuclide	Initial Radionuclide Concentration (pCi/g)	% Contribution	Single Radionuclide Guidelines (pCi/g)	Ratio for Single Radionuclide Guideline	Mixture Radionuclides Guidelines	Ratio for Mixture Radionuclide Guidelines
Americium-241	3,370	0.170	551.7	6.1084	75.290	0.1365
Cobalt-60	5.3	0.000	44.39	0.1194	0.118	0.0027
Cesium-137	3,050	0.154	199.5	15.2882	68.141	0.3416
Europium-152	60	0.003	98.55	0.6088	1.340	0.0136
Plutonium-238	127	0.006	650.2	0.1953	2.837	0.0044
Plutonium-239	13,200	0.666	588.2	22.4413	294.906	0.5014
Total	19,812.3	1.000	2,132.54	44.7615	442.634	1.0000

pCi/g = Picocuries per gram

E.10.0 References

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EPA, see U.S. Environmental Protection Agency.

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Attachment E-1

RESRAD Parameters Used for Analysis of CAU 551 Sites

The parametric values used in the RESRAD code for the analysis of the CAU 551 sites are listed in Table E-1. Some parameters are site specific, while other values are default RESRAD values. The dose conversion factors used for inhalation and ingestion were the default FGR 13 morbidity values and correspond to the guidance and recommendations per the August 9, 2002, memorandum from A. Lawrence, Office of Environmental Policy & Guidance, to Distribution, titled "Radiation Risk Estimation from Total Effective Dose Equivalents (TEDEs)" (EH-412-2002-1) (Lawrence, 2002).

Table Att. E-1
RESRAD Parameters
(Page 1 of 7)

Parameter	Units	Parcel 1	Parcel 2	Parcel 3	Defaults	Reference/Rationale
R011 Contaminated Zone						
Area of CZ	m^2	1.848E+04	7.149E+04	8.997E+04	1.000E+04	Estimated using the site boundary
Thickness of CZ	m	1.200E+00	6.100E-01	1.200E+00	2.000E+00	Maximum depth from contaminated samples
Length Parallel to Aquifer Flow	m	not used	not used	not used	1.000E+02	Not Used
Radiation Dose Limit	mrem/yr	2.5E+001	2.5E+001	2.5E+001	2.5E+001	RESRAD Default (Yu, et al., 1993)
Elapsed Time Since Placement of Material	yr	0.0	0.0	0.0	0.0	RESRAD Default
R012 Initial Principal Radionuclide						
Americium-241 (soil)	pCi/g	3.370E+03	4.87E+02	3.370E+03	0.0	For Columns Parcel 1 and Parcel 3: The maximum concentration from either sample results or previous (historical) muckpile investigations.
Cesium-137 (soil)	pCi/g	3.050E+03	4.87E+01	3.050E+03	0.0	
Cobalt-60 (soil)	pCi/g	5.300E+00	N/A	5.300E+00	0.0	
Europium-152 (soil)	pCi/g	6.000E+01	1.740E+00	6.000E+01	0.0	For Column Parcel 2: The arithmetic mean plus the 95% UCL for the site. Maximum sample concentration when the 95% UCL cannot be determined. Maximum value was used for Eu-152.
Plutonium-238 (soil)	pCi/g	1.270E+02	6.000E+00	1.270E+02	0.0	
Plutonium-239 (soil)	pCi/g	1.320E+04	3.290E+02	1.320E+04	0.0	
R013 Cover and Contaminated Zone Hydrological Data						
Cover Depth	m	0.0	0.0	0.0	0.0	No Cover Assumed
Density of Cover Material	g/cm^3	not used	not used	not used	1.5	No Cover Assumed
Cover Depth Erosion Rate	m/yr	not used	not used	not used	1.000E-03	No Cover Assumed

Table Att. E-1
RESRAD Parameters
(Page 2 of 7)

Parameter	Units	Parcel 1	Parcel 2	Parcel 3	Defaults	Reference/Rationale
Density of Contaminated Zone	g/cm^3	1.5	1.5	1.5	1.5	RESRAD Default
Contamination Zone Erosion Rate	m/yr	1.000E-03	1.000E-03	1.000E-03	1.000E-03	RESRAD Default
Contaminated Zone Total Porosity	-	4.000E-01	4.000E-01	4.000E-01	4.000E-01	RESRAD Default
Contaminated Zone Field Capacity	-	2.000E-01	2.000E-01	2.000E-01	2.000E-01	RESRAD Default
Contaminated Zone Hydraulic Conductivity	m/yr	1.000E+01	1.000E+01	1.000E+01	1.000E+01	RESRAD Default
Contaminated Zone b Parameter	-	5.300E+00	5.300E+00	5.300E+00	5.300E+00	RESRAD Default
Average Annual Wind Speed	m/sec	3.4	3.4	3.4	2.000E+00	Data from Air Resource Laboratory (2005)
Humidity in Air	g/m^3	not used	not used	not used	8.000E+00	Not used
Evapotranspiration Coefficient	-	5.000E-01	5.000E-01	5.000E-01	5.000E-01	RESRAD Default
Precipitation	m/yr	3.260E-01	3.260E-01	3.260E-01	1.000E+00	Data from Air Resources Laboratory
Irrigation	m/yr	2.000E-01	2.000E-01	2.000E-01	2.000E-01	RESRAD Default
Irrigation Mode	-	overhead	overhead	overhead	overhead	RESRAD Default
Runoff Coefficient	-	4.000E-01	4.000E-01	4.000E-01	2.000E-01	Open Sandy Loam 30% impervious Table 10.1 (Yu, et al., 1993)
Watershed Area for Nearby Stream or Pond	m^2	not used	not used	not used	1.000E+06	Not used
Accuracy for Water/Soil Computations	-	not used	not used	not used	1.000E-03	Not used
R014 Saturated Zone Hydrological Data						
Density of Saturated Zone	g/cm^3	not used	not used	not used	1.500E+00	Not used
Saturated Zone Total Porosity	-	not used	not used	not used	4.000E-01	Not used

Table Att. E-1
RESRAD Parameters
(Page 3 of 7)

Parameter	Units	Parcel 1	Parcel 2	Parcel 3	Defaults	Reference/Rationale
Saturated Zone Effective Porosity	-	not used	not used	not used	2.000E-01	Not used
Saturated Zone Field Capacity	-	not used	not used	not used	2.000E-01	Not used
Saturated Zone Hydraulic Conductivity	m/yr	not used	not used	not used	1.000E+02	Not used
Saturated Zone Hydraulic Gradient	-	not used	not used	not used	2.000E-02	Not used
Saturated Zone b Parameter	-	not used	not used	not used	5.300E+00	Not used
Water Table Drop Rate	m/yr	not used	not used	not used	1.000E-03	Not used
Well Pump Intake Depth	m	not used	not used	not used	1.000E+01	Not used
Model: Nondispersion or Mass-Balance	-	not used	not used	not used	ND	Not used
Well Pumping Rate	m^3/yr	not used	not used	not used	2.500E+02	Not used
R015 Uncontaminated and Unsaturated Strata Hydrological Data						
Number of Unsaturated Zone Strata	-	not used	not used	not used	1	Not used
Thickness	m	not used	not used	not used	4.000E+00	Not used
Soil Density	g/cm^3	not used	not used	not used	1.500E+00	Not used
Total Porosity	-	not used	not used	not used	4.000E-01	Not used
Effective Porosity	-	not used	not used	not used	2.000E-01	Not used
Field Capacity	-	not used	not used	not used	2.000E-01	Not used
Soil-specific b Parameter	-	not used	not used	not used	5.300E+00	Not used
Hydraulic Conductivity	m/yr	not used	not used	not used	1.000E+01	Not used

Table Att. E-1
RESRAD Parameters
(Page 4 of 7)

Parameter	Units	Parcel 1	Parcel 2	Parcel 3	Defaults	Reference/Rationale
R016 Distribution Coefficients and Leach Rates						
Contaminated Zone K_d (all Zones)	cm^3/g					RESRAD Default
Saturated Leach Rate	/yr	0.0	0.0	0.0	0.0	Not used
Solubility Constant	-	0.0	0.0	0.0	0.0	Not used
R017 Inhalation and External Gamma						
Inhalation Rate	m^3/yr	1.230E+04	1.230E+04	1.230E+04	8.400E+03	RESRAD Default and for an individual performing outdoor activities, a typical activity mix can consist of 37% at a moderate activity level, 28% at both resting and light activity levels, and 7% at a heavy activity level, which results in a 1.4 m^3/h (12,300 m^3/yr) inhalation rate. (Yu, et al., 1993)
Mass Loading for Inhalation	g/m^3	6.00E-04	6.00E-04	6.00E-04	1E-04	The estimated mass loading for construction activities. (Yu, et al., 1993)
Exposure Duration	yr	25	25	25	30	Standard for Industrial/Commercial Scenario
Shielding Factor Inhalation	-	1.0	1.0	1.0	0.4	Assumes no indoor time fraction
Shielding Factor External Gamma	-	1.0	1.0	1.0	0.7	Assumes no indoor time fraction
Fraction of Time Spent Indoors	-	0.0	0.0	0.0	0.5	Assumes no indoor time fraction
Fraction of Time Spent Outdoors	-	0.038	0.038	0.038	0.25	Scenario specific based on Industrial/ Commercial Use Scenarios for standard occupancy and low occupancy.
Shape Factor	-	1.0	1.0	1.0	1.0	RESRAD Default

Table Att. E-1
RESRAD Parameters
(Page 5 of 7)

Parameter	Units	Parcel 1	Parcel 2	Parcel 3	Defaults	Reference/Rationale
R018 Ingestion Pathway Data, Dietary Parameters						
Fruits, Vegetables, and Grain Consumption	kg/yr	not used	not used	not used	1.600E+02	Not used
Leafy Vegetable Consumption	kg/yr	not used	not used	not used	1.400E+01	Not used
Milk Consumption	L/yr	not used	not used	not used	9.200E+01	Not used
Meat and Poultry Consumption	kg/yr	not used	not used	not used	6.300E+01	Not used
Fish Consumption	kg/yr	not used	not used	not used	5.400E+00	Not used
Other Seafood Consumption	kg/yr	not used	not used	not used	9.000E-01	Not used
Soil Ingestion Rate	g/yr	1.752E+02	1.752E+02	1.752E+02	36.5	EPA, 1991; 480 mg/day
Drinking Water Intake	L/yr	not used	not used	not used	5.100E+02	Not used
Drinking Water Contaminated Fraction	-	not used	not used	not used	1.000E+00	Not used
Household Water Contaminated Fraction	-	not used	not used	not used	1.000E+00	Not used
Livestock Water Contaminated Fraction	-	not used	not used	not used	1.000E+00	Not used
Irrigation Water Contaminated Fraction	-	not used	not used	not used	1.000E+00	Not used
Aquatic Food Contamination Fraction	-	not used	not used	not used	5.000E-01	Not used
Plant Food Contamination Fraction	-	not used	not used	not used	-1	Not used
Meat Contamination Fraction	-	not used	not used	not used	-1	Not used
Milk Contamination Fraction	-	not used	not used	not used	-1	Not used

Table Att. E-1
RESRAD Parameters
(Page 6 of 7)

Parameter	Units	Parcel 1	Parcel 2	Parcel 3	Defaults	Reference/Rationale
R019 Ingestion Pathway Data, Nondietary						
Livestock Fodder Intake for Meat	kg/day	not used	not used	not used	6.800E+01	Not used
Livestock Fodder Intake for Milk	kg/day	not used	not used	not used	5.500E+01	Not used
Livestock Water Intake for Meat	L/day	not used	not used	not used	5.000E+01	Not used
Livestock Water Intake for Milk	L/day	not used	not used	not used	1.600E+02	Not used
Livestock Soil Intake	kg/day	not used	not used	not used	5.000E-01	Not used
Mass Loading for Foliar Deposition	g/m^3	not used	not used	not used	1.000E-04	Not used
Depth of Soil Mixing Layer	m	1.500E-01	1.500E-01	1.500E-01	1.500E-01	RESRAD Default
Depth of Roots	m	not used	not used	not used	9.000E-01	Not used
Drinking Water Fraction from Groundwater	-	not used	not used	not used	1.000E+00	Not used
Household Water Fraction from Groundwater	-	not used	not used	not used	1.000E+00	Not used
Livestock Water Fraction from Groundwater	-	not used	not used	not used	1.000E+00	Not used
Irrigation Fraction from Groundwater	-	not used	not used	not used	1.000E+00	Not used

Table Att. E-1
RESRAD Parameters
(Page 7 of 7)

Parameter	Units	Parcel 1	Parcel 2	Parcel 3	Defaults	Reference/Rationale
R021 Radon						
Radon Parameters Not Used						Not used
Drinking Water Fraction from Groundwater	-	not used	not used	not used	1.000E+00	Not used

cm^3/g = Cubic centimeters per gram
g/cm^3 = Grams per cubic centimeter
g/m^3 = Grams per cubic meter
g/yr = Grams per year
kg/day = Kilograms per day
kg/yr = Kilograms per year
L/day = Liters per day
L/yr = Liters per year
m = Meter
m^2 = Square meter
m/sec = Meters per second
m/yr = Meters per year
m^3/h = Cubic meters per hour
m^3/yr = Cubic meters per year
mg/day = Milligrams per day
mrem/yr = Millirem per year
N/A = Not applicable
pCi/g = Picocuries per gram
yr = Year
/yr = Per year
UCL = Upper confidence level

Exhibit 1

RESRAD Summary Report:
CAD 551 Land Parcel 1

(25 Pages)

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary

0 File: FGR 13 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Am-241	4.440E-01	4.440E-01	DCF2(2)
B-1	Co-60	2.190E-04	2.190E-04	DCF2(3)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(4)
B-1	Eu-152	2.210E-04	2.210E-04	DCF2(5)
B-1	Gd-152	2.430E-01	2.430E-01	DCF2(7)
B-1	Np-237+D	5.400E-01	5.400E-01	DCF2(8)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(9)
B-1	Pb-210+D	2.320E-02	2.320E-02	DCF2(10)
B-1	Pu-238	3.920E-01	3.920E-01	DCF2(11)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(12)
B-1	Ra-226+D	8.600E-03	8.600E-03	DCF2(13)
B-1	Th-229+D	2.160E+00	2.160E+00	DCF2(14)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(15)
B-1	U-233	1.350E-01	1.350E-01	DCF2(16)
B-1	U-234	1.320E-01	1.320E-01	DCF2(17)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(18)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Am-241	3.640E-03	3.640E-03	DCF3(2)
D-1	Co-60	2.690E-05	2.690E-05	DCF3(3)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(4)
D-1	Eu-152	6.480E-06	6.480E-06	DCF3(5)
D-1	Gd-152	1.610E-04	1.610E-04	DCF3(7)
D-1	Np-237+D	4.440E-03	4.440E-03	DCF3(8)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(9)
D-1	Pb-210+D	7.270E-03	7.270E-03	DCF3(10)
D-1	Pu-238	3.200E-03	3.200E-03	DCF3(11)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(12)
D-1	Ra-226+D	1.330E-03	1.330E-03	DCF3(13)
D-1	Th-229+D	4.030E-03	4.030E-03	DCF3(14)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(15)
D-1	U-233	2.890E-04	2.890E-04	DCF3(16)
D-1	U-234	2.830E-04	2.830E-04	DCF3(17)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(18)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(2,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(2,3)
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(3,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(3,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(3,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(4,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,3)
D-34	Eu-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(5,1)
D-34	Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(5,2)
D-34	Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(5,3)
D-34	Gd-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(7,2)
D-34	Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(7,3)
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(8,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(8,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(8,3)
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(9,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(9,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(9,3)
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(10,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(10,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(10,3)
D-34	Pu-238 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(11,1)
D-34	Pu-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(11,2)
D-34	Pu-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(11,3)
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(12,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(12,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(12,3)
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(13,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(13,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(13,3)
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(14,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(14,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(14,3)
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(15,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(15,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(15,3)
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(16,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(16,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(16,3)
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(17,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(17,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(17,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(18,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(18,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(18,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(2,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(2,2)
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(3,2)
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(4,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)
D-5	Eu-152 , fish	5.000E+01	5.000E+01	BIOFAC(5,1)
D-5	Eu-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(5,2)
D-5	Gd-152 , fish	2.500E+01	2.500E+01	BIOFAC(7,1)
D-5	Gd-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(7,2)
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(8,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(8,2)
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(9,2)
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(10,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(10,2)
D-5	Pu-238 , fish	3.000E+01	3.000E+01	BIOFAC(11,1)
D-5	Pu-238 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(11,2)
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(12,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(12,2)
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(13,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(13,2)
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(14,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(14,2)
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(15,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(15,2)
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(16,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(16,2)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(17,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(17,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(18,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(18,2)

0 Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.848E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.200E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	2.500E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Am-241	3.370E+03	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Co-60	5.300E+00	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Cs-137	3.050E+03	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Eu-152	6.000E+01	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Pu-238	1.270E+02	0.000E+00	---	S1(11)
R012	Initial principal radionuclide (pCi/g): Pu-239	1.320E+04	0.000E+00	---	S1(12)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Eu-152	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Pu-238	not used	0.000E+00	---	W1(11)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(12)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.400E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	3.260E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	4.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.440E-03	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.099E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.099E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Eu-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.332E-04	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Pu-238				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.494E-05	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(12,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.494E-05	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.440E-03	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Gd-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.332E-04	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.265E-04	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.189E-03	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.097E-03	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(13,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.565E-03	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(14)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(14,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(14)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.831E-06	ALEACH(14)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(14)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(15)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(15,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.831E-06	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(16)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(16,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.189E-03	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R016	Distribution coefficients for daughter U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(17)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(17,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(17)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.189E-03	ALEACH(17)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(17)
R016	Distribution coefficients for daughter U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(18)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(18,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(18)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.189E-03	ALEACH(18)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(18)
R017	Inhalation rate (m**3/yr)	1.230E+04	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	6.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	2.500E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	1.000E+00	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	1.000E+00	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	3.800E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

0 Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	1.752E+02	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD

0 Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	8.894E+01	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	18480.00 square meters	Am-241	3.370E+03
Thickness:	1.20 meters	Co-60	5.300E+00
Cover Depth:	0.00 meters	Cs-137	3.050E+03
		Eu-152	6.000E+01
		Pu-238	1.270E+02
		Pu-239	1.320E+04

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.058E+03	1.048E+03	1.027E+03	9.632E+02	8.291E+02	6.286E+02	5.290E+02	4.820E+02
M(t):	4.234E+01	4.191E+01	4.109E+01	3.853E+01	3.316E+01	2.514E+01	2.116E+01	1.928E+01

0Maximum TDOSE(t): 1.058E+03 mrem/yr at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	5.438E+00	0.0051	5.600E+01	0.0529	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.138E+01	0.0769
Co-60	2.896E+00	0.0027	4.085E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.894E-04	0.0000
Cs-137	3.685E+02	0.3481	3.612E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.004E+00	0.0009
Eu-152	1.473E+01	0.0139	4.853E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.522E-03	0.0000
Pu-238	7.199E-04	0.0000	1.862E+00	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.695E+00	0.0025
Pu-239	1.429E-01	0.0001	2.127E+02	0.2010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.111E+02	0.2939
Total	3.917E+02	0.3701	2.706E+02	0.2556	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.962E+02	0.3743

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.428E+02	0.1349
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.897E+00	0.0027
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.695E+02	0.3491
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.474E+01	0.0139
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.558E+00	0.0043
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.239E+02	0.4950
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.058E+03	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	5.400E+00	0.0052	5.561E+01	0.0531	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.081E+01	0.0771
Co-60	2.539E+00	0.0024	3.581E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.797E-04	0.0000
Cs-137	3.600E+02	0.3436	3.529E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.806E-01	0.0009
Eu-152	1.399E+01	0.0133	4.606E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.394E-03	0.0000
Pu-238	7.142E-04	0.0000	1.848E+00	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.674E+00	0.0026
Pu-239	1.429E-01	0.0001	2.127E+02	0.2030	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.111E+02	0.2969
Total	3.821E+02	0.3647	2.701E+02	0.2578	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.955E+02	0.3775

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.418E+02	0.1354
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.540E+00	0.0024
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.610E+02	0.3445
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.399E+01	0.0134
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.522E+00	0.0043
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.239E+02	0.5000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.048E+03	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	5.325E+00	0.0052	5.483E+01	0.0534	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.968E+01	0.0776
Co-60	1.951E+00	0.0019	2.752E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.992E-04	0.0000
Cs-137	3.437E+02	0.3346	3.369E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.361E-01	0.0009
Eu-152	1.260E+01	0.0123	4.150E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.157E-03	0.0000
Pu-238	7.030E-04	0.0000	1.819E+00	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.631E+00	0.0026
Pu-239	1.428E-01	0.0001	2.126E+02	0.2070	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.110E+02	0.3028
Total	3.637E+02	0.3541	2.693E+02	0.2621	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.943E+02	0.3838

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.398E+02	0.1361
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.952E+00	0.0019
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.446E+02	0.3355
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.260E+01	0.0123
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.451E+00	0.0043
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.238E+02	0.5099
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.027E+03	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	5.069E+00	0.0053	5.219E+01	0.0542	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.585E+01	0.0787
Co-60	7.766E-01	0.0008	1.095E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.385E-04	0.0000
Cs-137	2.921E+02	0.3033	2.864E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.957E-01	0.0008
Eu-152	8.749E+00	0.0091	2.881E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.497E-03	0.0000
Pu-238	6.649E-04	0.0000	1.720E+00	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.489E+00	0.0026
Pu-239	1.427E-01	0.0001	2.125E+02	0.2206	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.108E+02	0.3227
Total	3.069E+02	0.3186	2.664E+02	0.2766	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.900E+02	0.4048

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.331E+02	0.1382
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.769E-01	0.0008
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.929E+02	0.3041
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.750E+00	0.0091
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.210E+00	0.0044
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.235E+02	0.5434
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.632E+02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	4.403E+00	0.0053	4.534E+01	0.0547	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.588E+01	0.0795
Co-60	5.585E-02	0.0001	7.878E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.715E-05	0.0000
Cs-137	1.836E+02	0.2215	1.800E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.001E-01	0.0006
Eu-152	3.084E+00	0.0037	1.016E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.279E-04	0.0000
Pu-238	5.672E-04	0.0000	1.467E+00	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.123E+00	0.0026
Pu-239	1.425E-01	0.0002	2.122E+02	0.2559	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.103E+02	0.3743
Total	1.913E+02	0.2308	2.590E+02	0.3123	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.788E+02	0.4569

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.156E+02	0.1395
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.587E-02	0.0001
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.841E+02	0.2221
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.085E+00	0.0037
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.590E+00	0.0043
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.226E+02	0.6303
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.291E+02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	2.692E+00	0.0043	2.769E+01	0.0441	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.024E+01	0.0640
Co-60	5.571E-06	0.0000	7.859E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.711E-09	0.0000
Cs-137	3.616E+01	0.0575	3.545E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.848E-02	0.0002
Eu-152	8.022E-02	0.0001	2.642E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.373E-05	0.0000
Pu-238	3.253E-04	0.0000	8.408E-01	0.0013	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.216E+00	0.0019
Pu-239	1.417E-01	0.0002	2.109E+02	0.3356	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.085E+02	0.4908
Total	3.907E+01	0.0622	2.394E+02	0.3809	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.500E+02	0.5569

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.062E+01	0.1124
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.573E-06	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.626E+01	0.0577
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.023E-02	0.0001
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.057E+00	0.0033
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.195E+02	0.8266
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.286E+02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	6.622E-01	0.0013	6.771E+00	0.0128	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.839E+00	0.0186
Co-60	2.062E-17	0.0000	2.909E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.333E-21	0.0000
Cs-137	3.482E-01	0.0007	3.413E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.483E-04	0.0000
Eu-152	2.377E-06	0.0000	7.832E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.070E-10	0.0000
Pu-238	6.770E-05	0.0000	1.714E-01	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.479E-01	0.0005
Pu-239	1.394E-01	0.0003	2.074E+02	0.3921	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.034E+02	0.5735
Total	1.150E+00	0.0022	2.144E+02	0.4052	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.135E+02	0.5926

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.727E+01	0.0327
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.063E-17	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.491E-01	0.0007
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.378E-06	0.0000
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.193E-01	0.0008
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.109E+02	0.9659
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.290E+02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	9.028E-03	0.0000	5.106E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.420E-02	0.0002
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	2.979E-08	0.0000	2.990E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.308E-11	0.0000
Eu-152	3.216E-22	0.0000	1.652E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.940E-15	0.0000
Pu-238	8.693E-06	0.0000	6.900E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.605E-04	0.0000
Pu-239	1.315E-01	0.0003	1.956E+02	0.4058	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.861E+02	0.5936
Total	1.406E-01	0.0003	1.957E+02	0.4060	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.862E+02	0.5938

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.343E-01	0.0003
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.987E-08	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.846E-14	0.0000
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.659E-03	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.818E+02	0.9997
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.820E+02	1.0000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			DSR(j,t) (mrem/yr)/(pCi/g)							
Am-241	Am-241	1.000E+00	4.238E-02	4.208E-02	4.149E-02	3.950E-02	3.431E-02	2.095E-02	5.122E-03	3.699E-05
Am-241	Np-237	1.000E+00	1.449E-08	4.334E-08	1.004E-07	2.935E-07	7.923E-07	2.044E-06	3.334E-06	2.860E-06
Am-241	U-233	1.000E+00	1.659E-15	1.158E-14	6.084E-14	5.323E-13	4.212E-12	3.682E-11	1.859E-10	4.275E-10
Am-241	Th-229	1.000E+00	9.228E-19	1.381E-17	1.604E-16	4.183E-15	9.750E-14	2.960E-12	5.138E-11	5.734E-10
Am-241	§DSR(j)		4.238E-02	4.208E-02	4.149E-02	3.950E-02	3.431E-02	2.096E-02	5.125E-03	3.985E-05
0Co-60	Co-60	1.000E+00	5.466E-01	4.792E-01	3.683E-01	1.466E-01	1.054E-02	1.052E-06	3.892E-18	0.000E+00
0Cs-137	Cs-137	1.000E+00	1.211E-01	1.184E-01	1.130E-01	9.604E-02	6.037E-02	1.189E-02	1.145E-04	9.793E-12
0Eu-152	Eu-152	7.208E-01	1.770E-01	1.681E-01	1.514E-01	1.051E-01	3.706E-02	9.639E-04	2.857E-08	3.864E-24
0Eu-152	Eu-152	2.792E-01	6.858E-02	6.510E-02	5.865E-02	4.072E-02	1.435E-02	3.734E-04	1.107E-08	1.497E-24
Eu-152	Gd-152	2.792E-01	8.981E-18	2.633E-17	5.842E-17	1.476E-16	2.784E-16	3.449E-16	3.377E-16	3.076E-16
Eu-152	§DSR(j)		6.858E-02	6.510E-02	5.865E-02	4.072E-02	1.435E-02	3.734E-04	1.107E-08	3.076E-16
0Pu-238	Pu-238	1.000E+00	3.589E-02	3.561E-02	3.504E-02	3.315E-02	2.827E-02	1.620E-02	3.300E-03	1.259E-05
Pu-238	U-234	1.000E+00	9.687E-09	2.893E-08	6.683E-08	1.935E-07	5.085E-07	1.190E-06	1.437E-06	3.752E-07
Pu-238	Th-230	1.000E+00	6.762E-14	4.719E-13	2.478E-12	2.166E-11	1.708E-10	1.482E-09	7.465E-09	1.961E-08
Pu-238	Ra-226	1.000E+00	1.897E-16	2.837E-15	3.291E-14	8.546E-13	1.969E-11	5.737E-10	8.903E-09	6.713E-08
Pu-238	Pb-210	1.000E+00	1.407E-19	4.329E-18	1.073E-16	7.893E-15	4.732E-13	3.289E-11	8.192E-10	7.895E-09
Pu-238	§DSR(j)		3.589E-02	3.561E-02	3.504E-02	3.315E-02	2.827E-02	1.620E-02	3.302E-03	1.306E-05
0Pu-239	Pu-239	1.000E+00	3.969E-02	3.969E-02	3.968E-02	3.966E-02	3.959E-02	3.936E-02	3.871E-02	3.650E-02
Pu-239	U-235	1.000E+00	1.671E-11	5.009E-11	1.166E-10	3.471E-10	9.857E-10	3.005E-09	7.264E-09	1.286E-08
Pu-239	Pa-231	1.000E+00	4.357E-16	3.046E-15	1.605E-14	1.421E-13	1.163E-12	1.139E-11	7.629E-11	3.357E-10
Pu-239	Ac-227	1.000E+00	1.162E-17	1.727E-16	1.976E-15	4.883E-14	9.877E-13	2.031E-11	1.901E-10	9.460E-10
Pu-239	§DSR(j)		3.969E-02	3.969E-02	3.968E-02	3.966E-02	3.959E-02	3.936E-02	3.871E-02	3.650E-02

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
§ is used to indicate summation; the Greek sigma is not included in this font.
The DSR includes contributions from associated (half-life <= 0.5 yr) daughters.
0

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	5.899E+02	5.941E+02	6.025E+02	6.329E+02	7.287E+02	1.193E+03	4.878E+03	6.274E+05
Co-60	4.574E+01	5.217E+01	6.788E+01	1.706E+02	2.371E+03	2.377E+07	*1.131E+15	*1.131E+15
Cs-137	2.064E+02	2.112E+02	2.213E+02	2.603E+02	4.141E+02	2.103E+03	2.184E+05	2.553E+12
Eu-152	1.018E+02	1.072E+02	1.190E+02	1.714E+02	4.863E+02	1.870E+04	6.308E+08	*1.765E+14
Pu-238	6.966E+02	7.021E+02	7.134E+02	7.542E+02	8.843E+02	1.543E+03	7.572E+03	1.914E+06
Pu-239	6.299E+02	6.299E+02	6.300E+02	6.304E+02	6.315E+02	6.352E+02	6.459E+02	6.849E+02

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Am-241	3.370E+03	0.000E+00	4.238E-02	5.899E+02	4.238E-02	5.899E+02
Co-60	5.300E+00	0.000E+00	5.466E-01	4.574E+01	5.466E-01	4.574E+01
Cs-137	3.050E+03	0.000E+00	1.211E-01	2.064E+02	1.211E-01	2.064E+02
Eu-152	6.000E+01	0.000E+00	2.456E-01	1.018E+02	2.456E-01	1.018E+02
Pu-238	1.270E+02	0.000E+00	3.589E-02	6.966E+02	3.589E-02	6.966E+02
Pu-239	1.320E+04	0.000E+00	3.969E-02	6.299E+02	3.969E-02	6.299E+02

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	1.428E+02	1.418E+02	1.398E+02	1.331E+02	1.156E+02	7.061E+01	1.726E+01	1.246E-01
0Np-237	Am-241	1.000E+00	4.885E-05	1.461E-04	3.383E-04	9.889E-04	2.670E-03	6.887E-03	1.124E-02	9.638E-03
0U-233	Am-241	1.000E+00	5.592E-12	3.904E-11	2.050E-10	1.794E-09	1.419E-08	1.241E-07	6.266E-07	1.441E-06
0Th-229	Am-241	1.000E+00	3.110E-15	4.655E-14	5.406E-13	1.410E-11	3.286E-10	9.976E-09	1.732E-07	1.932E-06
0Co-60	Co-60	1.000E+00	2.897E+00	2.540E+00	1.952E+00	7.769E-01	5.587E-02	5.573E-06	2.063E-17	0.000E+00
0Cs-137	Cs-137	1.000E+00	3.695E+02	3.610E+02	3.446E+02	2.929E+02	1.841E+02	3.626E+01	3.491E-01	2.987E-08
0Eu-152	Eu-152	7.208E-01	1.062E+01	1.008E+01	9.085E+00	6.307E+00	2.223E+00	5.783E-02	1.714E-06	2.319E-22
Eu-152	Eu-152	2.792E-01	4.115E+00	3.906E+00	3.519E+00	2.443E+00	8.612E-01	2.240E-02	6.639E-07	8.981E-23
Eu-152	§DOSE(j)		1.474E+01	1.399E+01	1.260E+01	8.750E+00	3.085E+00	8.023E-02	2.378E-06	3.217E-22
0Gd-152	Eu-152	2.792E-01	5.388E-16	1.580E-15	3.505E-15	8.858E-15	1.670E-14	2.070E-14	2.026E-14	1.846E-14
0Pu-238	Pu-238	1.000E+00	4.558E+00	4.522E+00	4.451E+00	4.210E+00	3.590E+00	2.057E+00	4.191E-01	1.600E-03
0U-234	Pu-238	1.000E+00	1.230E-06	3.674E-06	8.488E-06	2.458E-05	6.458E-05	1.511E-04	1.825E-04	4.765E-05
0Th-230	Pu-238	1.000E+00	8.587E-12	5.994E-11	3.147E-10	2.750E-09	2.170E-08	1.882E-07	9.480E-07	2.491E-06
0Ra-226	Pu-238	1.000E+00	2.409E-14	3.603E-13	4.180E-12	1.085E-10	2.500E-09	7.286E-08	1.131E-06	8.526E-06
0Pb-210	Pu-238	1.000E+00	1.787E-17	5.498E-16	1.362E-14	1.002E-12	6.010E-11	4.178E-09	1.040E-07	1.003E-06
0Pu-239	Pu-239	1.000E+00	5.239E+02	5.239E+02	5.238E+02	5.235E+02	5.226E+02	5.195E+02	5.109E+02	4.818E+02
0U-235	Pu-239	1.000E+00	2.206E-07	6.612E-07	1.539E-06	4.581E-06	1.301E-05	3.966E-05	9.588E-05	1.698E-04
0Pa-231	Pu-239	1.000E+00	5.751E-12	4.021E-11	2.119E-10	1.876E-09	1.536E-08	1.503E-07	1.007E-06	4.431E-06
0Ac-227	Pu-239	1.000E+00	1.533E-13	2.280E-12	2.608E-11	6.446E-10	1.304E-08	2.681E-07	2.509E-06	1.249E-05

BRF(i) is the branch fraction of the parent nuclide.
§ is used to indicate summation; the Greek sigma is not included in this font.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	3.370E+03	3.346E+03	3.300E+03	3.141E+03	2.728E+03	1.666E+03	4.073E+02	2.941E+00
0Np-237	Am-241	1.000E+00	0.000E+00	1.087E-03	3.238E-03	1.052E-02	2.932E-02	7.651E-02	1.252E-01	1.075E-01
0U-233	Am-241	1.000E+00	0.000E+00	2.379E-09	2.127E-08	2.311E-07	1.952E-06	1.746E-05	8.875E-05	2.045E-04
0Th-229	Am-241	1.000E+00	0.000E+00	7.495E-14	2.014E-12	7.333E-11	1.887E-09	5.931E-08	1.040E-06	1.167E-05
0Co-60	Co-60	1.000E+00	5.300E+00	4.646E+00	3.571E+00	1.421E+00	1.022E-01	1.020E-05	3.774E-17	0.000E+00
0Cs-137	Cs-137	1.000E+00	3.050E+03	2.980E+03	2.845E+03	2.418E+03	1.520E+03	2.993E+02	2.882E+00	2.525E-07
0Eu-152	Eu-152	7.208E-01	4.325E+01	4.105E+01	3.699E+01	2.568E+01	9.052E+00	2.354E-01	6.978E-06	9.891E-22
Eu-152	Eu-152	2.792E-01	1.675E+01	1.590E+01	1.433E+01	9.946E+00	3.506E+00	9.120E-02	2.703E-06	3.831E-22
Eu-152	§S(j):		6.000E+01	5.695E+01	5.131E+01	3.562E+01	1.256E+01	3.266E-01	9.681E-06	1.372E-21
0Gd-152	Eu-152	2.792E-01	0.000E+00	1.048E-13	2.985E-13	8.373E-13	1.627E-12	2.029E-12	1.987E-12	1.810E-12
0Pu-238	Pu-238	1.000E+00	1.270E+02	1.260E+02	1.240E+02	1.173E+02	1.000E+02	5.732E+01	1.168E+01	4.457E-02
0U-234	Pu-238	1.000E+00	0.000E+00	3.582E-04	1.064E-03	3.423E-03	9.288E-03	2.198E-02	2.662E-02	6.957E-03
0Th-230	Pu-238	1.000E+00	0.000E+00	1.615E-09	1.444E-08	1.567E-07	1.319E-06	1.171E-05	5.937E-05	1.563E-04
0Ra-226	Pu-238	1.000E+00	0.000E+00	2.333E-13	6.261E-12	2.270E-10	5.772E-09	1.742E-07	2.730E-06	2.173E-05
0Pb-210	Pu-238	1.000E+00	0.000E+00	1.802E-15	1.434E-13	1.666E-11	1.141E-09	8.301E-08	2.093E-06	2.024E-05
0Pu-239	Pu-239	1.000E+00	1.320E+04	1.320E+04	1.320E+04	1.319E+04	1.317E+04	1.309E+04	1.287E+04	1.214E+04
0U-235	Pu-239	1.000E+00	0.000E+00	1.299E-05	3.887E-05	1.285E-04	3.770E-04	1.163E-03	2.820E-03	4.987E-03
0Pa-231	Pu-239	1.000E+00	0.000E+00	1.373E-10	1.232E-09	1.355E-08	1.184E-07	1.186E-06	7.997E-06	3.528E-05
0Ac-227	Pu-239	1.000E+00	0.000E+00	1.444E-12	3.820E-11	1.318E-09	2.940E-08	6.254E-07	5.904E-06	2.948E-05

BRF(i) is the branch fraction of the parent nuclide.
§ is used to indicate summation; the Greek sigma is not included in this font.
0RESCALC.EXE execution time = 3.75 seconds

Exhibit 2

RESRAD Summary Report: CAU 551 Land Parcel 2

(27 Pages)

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Am-241	4.440E-01	4.440E-01	DCF2(2)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(3)
B-1	Eu-152	2.210E-04	2.210E-04	DCF2(4)
B-1	Gd-152	2.430E-01	2.430E-01	DCF2(6)
B-1	Np-237+D	5.400E-01	5.400E-01	DCF2(7)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(8)
B-1	Pb-210+D	2.320E-02	2.320E-02	DCF2(9)
B-1	Pu-238	3.920E-01	3.920E-01	DCF2(10)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(11)
B-1	Ra-226+D	8.600E-03	8.600E-03	DCF2(12)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(13)
B-1	Th-229+D	2.160E+00	2.160E+00	DCF2(14)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(15)
B-1	U-233	1.350E-01	1.350E-01	DCF2(16)
B-1	U-234	1.320E-01	1.320E-01	DCF2(17)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(18)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(19)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Am-241	3.640E-03	3.640E-03	DCF3(2)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(3)
D-1	Eu-152	6.480E-06	6.480E-06	DCF3(4)
D-1	Gd-152	1.610E-04	1.610E-04	DCF3(6)
D-1	Np-237+D	4.440E-03	4.440E-03	DCF3(7)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(8)
D-1	Pb-210+D	7.270E-03	7.270E-03	DCF3(9)
D-1	Pu-238	3.200E-03	3.200E-03	DCF3(10)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(11)
D-1	Ra-226+D	1.330E-03	1.330E-03	DCF3(12)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(13)
D-1	Th-229+D	4.030E-03	4.030E-03	DCF3(14)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(15)
D-1	U-233	2.890E-04	2.890E-04	DCF3(16)
D-1	U-234	2.830E-04	2.830E-04	DCF3(17)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(18)
D-1	U-238+D	2.690E-04	2.690E-04	DCF3(19)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(2,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(2,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(3,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(3,3)
D-34	Eu-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(4,1)
D-34	Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(4,2)
D-34	Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(4,3)
D-34	Gd-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
D-34	Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(6,2)
D-34	Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(6,3)
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(7,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(7,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(7,3)
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(8,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(8,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(8,3)
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(9,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(9,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(9,3)
D-34	Pu-238 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(10,1)
D-34	Pu-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(10,2)
D-34	Pu-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(10,3)
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(11,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(11,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(11,3)
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(12,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(12,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(12,3)
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(13,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(13,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(13,3)
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(14,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(14,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(14,3)
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(15,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(15,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(15,3)
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(16,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(16,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(16,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(17,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(17,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(17,3)
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(18,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(18,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(18,3)
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(19,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(19,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(19,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(2,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(2,2)
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(3,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5	Eu-152 , fish	5.000E+01	5.000E+01	BIOFAC(4,1)
D-5	Eu-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(4,2)
D-5	Gd-152 , fish	2.500E+01	2.500E+01	BIOFAC(6,1)
D-5	Gd-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(6,2)
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(7,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(7,2)
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(8,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(8,2)
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(9,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(9,2)
D-5	Pu-238 , fish	3.000E+01	3.000E+01	BIOFAC(10,1)
D-5	Pu-238 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(10,2)
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(11,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(11,2)
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(12,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(12,2)
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(13,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(13,2)
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(14,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(14,2)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(15,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(15,2)
D-5				
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(16,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(16,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(17,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(17,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(18,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(18,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(19,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(19,2)

Menu	Site-Specific Parameter Summary — Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	7.149E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	6.100E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	2.500E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Am-241	2.565E+02	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Cs-137	4.272E+01	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Eu-152	1.740E+00	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Pu-238	6.030E+00	0.000E+00	---	S1(10)
R012	Initial principal radionuclide (pCi/g): Pu-239	2.695E+02	0.000E+00	---	S1(11)
R012	Initial principal radionuclide (pCi/g): Sr-90	4.100E+00	0.000E+00	---	S1(13)
R012	Initial principal radionuclide (pCi/g): U-234	3.140E+00	0.000E+00	---	S1(17)
R012	Initial principal radionuclide (pCi/g): U-235	2.500E-01	0.000E+00	---	S1(18)
R012	Initial principal radionuclide (pCi/g): U-238	2.460E+00	0.000E+00	---	S1(19)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Eu-152	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Pu-238	not used	0.000E+00	---	W1(10)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(11)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(13)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(17)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(18)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(19)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.400E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	3.260E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	4.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.070E-02	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.161E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Eu-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.620E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Pu-238				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.081E-04	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.081E-04	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	not used	3.000E+01	---	DCNUCU(13,1)
R016	Saturated zone (cm**3/g)	not used	3.000E+01	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.158E-03	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(17)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(17,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(17)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.306E-03	ALEACH(17)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(17)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(18)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(18,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(18)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.306E-03	ALEACH(18)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(18)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(19)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(19,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(19)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.306E-03	ALEACH(19)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(19)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.070E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Gd-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.620E-04	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	8.391E-04	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.306E-03	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.157E-03	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(12,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.079E-03	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(14)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(14,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(14)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.603E-06	ALEACH(14)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(14)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(15)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(15,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.603E-06	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(16)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(16,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.306E-03	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R017	Inhalation rate (m**3/yr)	1.230E+04	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	6.000E-04	1.000E-04	---	MLINH

0 Menu	Site-Specific Parameter Summary (continued) Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Exposure duration	2.500E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	1.000E+00	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	1.000E+00	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	3.800E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	1.752E+02	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	8.894E+01	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	71490.00 square meters	Am-241	2.565E+02
Thickness:	0.61 meters	Cs-137	4.272E+01
Cover Depth:	0.00 meters	Eu-152	1.740E+00
		Pu-238	6.030E+00
		Pu-239	2.695E+02
		Sr-90	4.100E+00
		U-234	3.140E+00
		U-235	2.500E-01
		U-238	2.460E+00

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	2.887E+01	2.858E+01	2.802E+01	2.622E+01	2.220E+01	1.520E+01	1.121E+01	0.000E+00
M(t):	1.155E+00	1.143E+00	1.121E+00	1.049E+00	8.880E-01	6.080E-01	4.485E-01	0.000E+00

0Maximum TDOSE(t): 2.887E+01 mrem/yr at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	4.202E-01	0.0146	4.880E+00	0.1690	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.178E+00	0.2140
Cs-137	5.303E+00	0.1837	5.807E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.406E-02	0.0005
Eu-152	4.383E-01	0.0152	1.615E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.314E-05	0.0000
Pu-238	3.438E-05	0.0000	1.015E-01	0.0035	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.280E-01	0.0044
Pu-239	2.975E-03	0.0001	4.984E+00	0.1726	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.351E+00	0.2200
Sr-90	3.665E-03	0.0001	2.280E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.112E-03	0.0001
U-234	4.747E-05	0.0000	1.783E-02	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.903E-03	0.0002
U-235	7.043E-03	0.0002	1.323E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.436E-04	0.0000
U-238	1.381E-02	0.0005	1.249E-02	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.396E-03	0.0002
Total	6.189E+00	0.2144	9.997E+00	0.3462	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.269E+01	0.4394

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.148E+01	0.3976
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.317E+00	0.1841
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.384E-01	0.0152
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.295E-01	0.0079
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.134E+01	0.3927
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.005E-03	0.0003
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.378E-02	0.0008
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.809E-03	0.0003
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.069E-02	0.0011
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.887E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	4.151E-01	0.0145	4.820E+00	0.1686	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.103E+00	0.2135
Cs-137	5.181E+00	0.1812	5.673E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.373E-02	0.0005
Eu-152	4.160E-01	0.0146	1.533E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.941E-05	0.0000
Pu-238	3.410E-05	0.0000	1.007E-01	0.0035	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.269E-01	0.0044
Pu-239	2.975E-03	0.0001	4.983E+00	0.1743	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.350E+00	0.2222
Sr-90	3.553E-03	0.0001	2.210E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.987E-03	0.0001
U-234	4.727E-05	0.0000	1.775E-02	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.878E-03	0.0002
U-235	7.013E-03	0.0002	1.318E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.421E-04	0.0000
U-238	1.375E-02	0.0005	1.243E-02	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.377E-03	0.0002
Total	6.039E+00	0.2113	9.936E+00	0.3476	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.261E+01	0.4411

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.134E+01	0.3967
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.194E+00	0.1817
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.161E-01	0.0146
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.276E-01	0.0080
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.134E+01	0.3966
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.761E-03	0.0003
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.368E-02	0.0008
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.772E-03	0.0003
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.056E-02	0.0011
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.858E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	4.050E-01	0.0145	4.703E+00	0.1678	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.954E+00	0.2125
Cs-137	4.944E+00	0.1764	5.414E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.311E-02	0.0005
Eu-152	3.747E-01	0.0134	1.381E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.252E-05	0.0000
Pu-238	3.356E-05	0.0000	9.908E-02	0.0035	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.249E-01	0.0045
Pu-239	2.974E-03	0.0001	4.982E+00	0.1778	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.349E+00	0.2266
Sr-90	3.340E-03	0.0001	2.078E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.748E-03	0.0001
U-234	4.689E-05	0.0000	1.760E-02	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.828E-03	0.0002
U-235	6.953E-03	0.0002	1.307E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.391E-04	0.0000
U-238	1.363E-02	0.0005	1.233E-02	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.340E-03	0.0002
Total	5.751E+00	0.2052	9.815E+00	0.3503	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.246E+01	0.4445

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.106E+01	0.3948
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.958E+00	0.1769
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.748E-01	0.0134
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.240E-01	0.0080
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.133E+01	0.4045
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.295E-03	0.0003
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.348E-02	0.0008
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.699E-03	0.0003
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.030E-02	0.0011
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.802E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	3.716E-01	0.0142	4.315E+00	0.1646	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.463E+00	0.2083
Cs-137	4.200E+00	0.1602	4.599E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.113E-02	0.0004
Eu-152	2.599E-01	0.0099	9.577E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.337E-05	0.0000
Pu-238	3.173E-05	0.0000	9.368E-02	0.0036	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.181E-01	0.0045
Pu-239	2.971E-03	0.0001	4.977E+00	0.1898	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.343E+00	0.2419
Sr-90	2.689E-03	0.0001	1.673E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.017E-03	0.0001
U-234	4.575E-05	0.0000	1.708E-02	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.655E-03	0.0002
U-235	6.747E-03	0.0003	1.272E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.293E-04	0.0000
U-238	1.323E-02	0.0005	1.196E-02	0.0005	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.211E-03	0.0002
Total	4.857E+00	0.1852	9.416E+00	0.3591	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.195E+01	0.4557

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.015E+01	0.3871
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.211E+00	0.1606
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.600E-01	0.0099
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.118E-01	0.0081
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.132E+01	0.4318
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.874E-03	0.0002
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.278E-02	0.0009
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.448E-03	0.0003
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.940E-02	0.0011
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.622E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	2.906E-01	0.0131	3.374E+00	0.1520	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.271E+00	0.1924
Cs-137	2.634E+00	0.1187	2.885E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.983E-03	0.0003
Eu-152	9.137E-02	0.0041	3.368E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.525E-05	0.0000
Pu-238	2.704E-05	0.0000	7.982E-02	0.0036	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.006E-01	0.0045
Pu-239	2.963E-03	0.0001	4.963E+00	0.2236	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.325E+00	0.2849
Sr-90	1.448E-03	0.0001	9.006E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.624E-03	0.0001
U-234	4.392E-05	0.0000	1.568E-02	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.191E-03	0.0002
U-235	6.194E-03	0.0003	1.184E-03	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.044E-04	0.0000
U-238	1.213E-02	0.0005	1.097E-02	0.0005	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.864E-03	0.0002
Total	3.039E+00	0.1369	8.445E+00	0.3804	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.072E+01	0.4827

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.935E+00	0.3575
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.641E+00	0.1190
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.139E-02	0.0041
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.805E-01	0.0081
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.129E+01	0.5087
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.162E-03	0.0001
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.091E-02	0.0009
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.783E-03	0.0004
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.697E-02	0.0012
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.220E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.229E-01	0.0081	1.426E+00	0.0938	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.805E+00	0.1187
Cs-137	5.146E-01	0.0339	5.638E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.365E-03	0.0001
Eu-152	2.353E-03	0.0002	8.680E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.931E-07	0.0000
Pu-238	1.545E-05	0.0000	4.557E-02	0.0030	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.745E-02	0.0038
Pu-239	2.935E-03	0.0002	4.916E+00	0.3234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.265E+00	0.4122
Sr-90	1.657E-04	0.0000	1.031E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.860E-04	0.0000
U-234	5.068E-05	0.0000	1.162E-02	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.847E-03	0.0003
U-235	4.597E-03	0.0003	9.409E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.337E-04	0.0000
U-238	8.971E-03	0.0006	8.120E-03	0.0005	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.859E-03	0.0002
Total	6.566E-01	0.0432	6.408E+00	0.4216	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.136E+00	0.5352

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.354E+00	0.2206
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.160E-01	0.0339
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.354E-03	0.0002
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.030E-01	0.0068
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.118E+01	0.7358
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.620E-04	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.552E-02	0.0010
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.871E-03	0.0004
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.995E-02	0.0013
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.520E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.070E-02	0.0010	1.218E-01	0.0109	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.542E-01	0.0138
Cs-137	4.851E-03	0.0004	5.315E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.286E-05	0.0000
Eu-152	6.751E-08	0.0000	2.508E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.135E-11	0.0000
Pu-238	3.164E-06	0.0000	9.190E-03	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.158E-02	0.0010
Pu-239	2.864E-03	0.0003	4.783E+00	0.4266	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.096E+00	0.5437
Sr-90	3.413E-07	0.0000	2.109E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.804E-07	0.0000
U-234	1.208E-04	0.0000	4.962E-03	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.651E-03	0.0001
U-235	1.970E-03	0.0002	4.831E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.850E-04	0.0000
U-238	3.782E-03	0.0003	3.434E-03	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.209E-03	0.0001
Total	2.429E-02	0.0022	4.923E+00	0.4391	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.265E+00	0.5587

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.867E-01	0.0256
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.864E-03	0.0004
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.752E-08	0.0000
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.077E-02	0.0019
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.088E+01	0.9706
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.427E-07	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.733E-03	0.0006
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.638E-03	0.0002
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.425E-03	0.0008
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.121E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			DSR(j,t) (mrem/yr)/(pCi/g)							
Am-241	Am-241	1.000E+00	4.475E-02	4.420E-02	4.312E-02	3.957E-02	3.093E-02	1.307E-02	1.116E-03	0.000E+00
Am-241	Np-237	1.000E+00	1.511E-08	4.508E-08	1.038E-07	2.977E-07	7.617E-07	1.665E-06	1.995E-06	0.000E+00
Am-241	U-233	1.000E+00	1.832E-15	1.276E-14	6.671E-14	5.732E-13	4.313E-12	3.196E-11	1.096E-10	0.000E+00
Am-241	Th-229	1.000E+00	9.961E-19	1.489E-17	1.722E-16	4.431E-15	9.947E-14	2.671E-12	3.490E-11	0.000E+00
Am-241	§DSR(j)		4.475E-02	4.420E-02	4.312E-02	3.957E-02	3.093E-02	1.307E-02	1.118E-03	0.000E+00
0Cs-137	Cs-137	1.000E+00	1.245E-01	1.216E-01	1.160E-01	9.857E-02	6.182E-02	1.208E-02	1.139E-04	0.000E+00
0Eu-152	Eu-152	7.208E-01	1.816E-01	1.724E-01	1.553E-01	1.077E-01	3.786E-02	9.750E-04	2.797E-08	0.000E+00
0Eu-152	Eu-152	2.792E-01	7.035E-02	6.677E-02	6.014E-02	4.171E-02	1.466E-02	3.777E-04	1.083E-08	0.000E+00
Eu-152	Gd-152	2.792E-01	1.017E-17	2.980E-17	6.612E-17	1.669E-16	3.139E-16	3.855E-16	3.678E-16	0.000E+00
Eu-152	§DSR(j)		7.035E-02	6.677E-02	6.014E-02	4.171E-02	1.466E-02	3.777E-04	1.083E-08	0.000E+00
0Pu-238	Pu-238	1.000E+00	3.806E-02	3.775E-02	3.715E-02	3.513E-02	2.993E-02	1.709E-02	3.444E-03	0.000E+00
Pu-238	U-234	1.000E+00	1.071E-08	3.197E-08	7.369E-08	2.118E-07	5.441E-07	1.171E-06	1.069E-06	0.000E+00
Pu-238	Th-230	1.000E+00	7.525E-14	5.249E-13	2.753E-12	2.393E-11	1.861E-10	1.534E-09	6.708E-09	0.000E+00
Pu-238	Ra-226	1.000E+00	1.940E-16	2.901E-15	3.358E-14	8.665E-13	1.959E-11	5.345E-10	6.842E-09	0.000E+00
Pu-238	Pb-210	1.000E+00	1.410E-19	4.334E-18	1.072E-16	7.835E-15	4.609E-13	2.999E-11	6.203E-10	0.000E+00
Pu-238	§DSR(j)		3.806E-02	3.775E-02	3.715E-02	3.513E-02	2.993E-02	1.709E-02	3.445E-03	0.000E+00
0Pu-239	Pu-239	1.000E+00	4.207E-02	4.206E-02	4.205E-02	4.201E-02	4.190E-02	4.150E-02	4.038E-02	0.000E+00
Pu-239	U-235	1.000E+00	1.736E-11	5.199E-11	1.208E-10	3.568E-10	9.919E-10	2.816E-09	5.734E-09	0.000E+00
Pu-239	Pa-231	1.000E+00	4.604E-16	3.215E-15	1.690E-14	1.481E-13	1.179E-12	1.047E-11	5.438E-11	0.000E+00
Pu-239	Ac-227	1.000E+00	1.267E-17	1.879E-16	2.140E-15	5.206E-14	1.008E-12	1.820E-11	1.281E-10	0.000E+00
Pu-239	§DSR(j)		4.207E-02	4.206E-02	4.205E-02	4.201E-02	4.190E-02	4.150E-02	4.038E-02	0.000E+00
0Sr-90	Sr-90	1.000E+00	1.952E-03	1.893E-03	1.779E-03	1.433E-03	7.712E-04	8.829E-05	1.812E-07	0.000E+00
0U-234	U-234	1.000E+00	7.573E-03	7.541E-03	7.476E-03	7.254E-03	6.655E-03	4.922E-03	2.079E-03	0.000E+00
U-234	Th-230	1.000E+00	7.976E-08	2.388E-07	5.549E-07	1.640E-06	4.565E-06	1.302E-05	2.686E-05	0.000E+00
U-234	Ra-226	1.000E+00	2.741E-10	1.914E-09	1.007E-08	8.844E-08	7.079E-07	6.422E-06	3.502E-05	0.000E+00
U-234	Pb-210	1.000E+00	2.486E-13	3.697E-12	4.230E-11	1.046E-09	2.113E-08	4.222E-07	3.377E-06	0.000E+00
U-234	§DSR(j)		7.573E-03	7.541E-03	7.477E-03	7.256E-03	6.660E-03	4.942E-03	2.144E-03	0.000E+00
0U-235	U-235	1.000E+00	3.524E-02	3.508E-02	3.478E-02	3.375E-02	3.097E-02	2.291E-02	9.708E-03	0.000E+00
U-235	Pa-231	1.000E+00	1.402E-06	4.189E-06	9.691E-06	2.821E-05	7.516E-05	1.831E-04	2.309E-04	0.000E+00
U-235	Ac-227	1.000E+00	5.131E-08	3.540E-07	1.811E-06	1.444E-05	8.934E-05	3.960E-04	6.120E-04	0.000E+00
U-235	§DSR(j)		3.524E-02	3.509E-02	3.480E-02	3.379E-02	3.113E-02	2.349E-02	1.055E-02	0.000E+00
0U-238	U-238	1.000E+00	1.248E-02	1.242E-02	1.232E-02	1.195E-02	1.096E-02	8.109E-03	3.423E-03	0.000E+00
U-238	U-234	1.000E+00	1.073E-08	3.206E-08	7.417E-08	2.159E-07	5.754E-07	1.403E-06	1.772E-06	0.000E+00
U-238	Th-230	1.000E+00	7.532E-14	5.260E-13	2.765E-12	2.424E-11	1.931E-10	1.722E-09	9.046E-09	0.000E+00
U-238	Ra-226	1.000E+00	1.942E-16	2.905E-15	3.369E-14	8.749E-13	2.014E-11	5.838E-10	8.662E-09	0.000E+00
U-238	Pb-210	1.000E+00	1.411E-19	4.339E-18	1.075E-16	7.897E-15	4.716E-13	3.238E-11	7.729E-10	0.000E+00
U-238	§DSR(j)		1.248E-02	1.242E-02	1.232E-02	1.195E-02	1.096E-02	8.110E-03	3.425E-03	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
§ is used to indicate summation; the Greek sigma is not included in this font.
The DSR includes contributions from associated (half-life <= 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

0Nuclide

(i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	5.587E+02	5.656E+02	5.797E+02	6.319E+02	8.082E+02	1.912E+03	2.237E+04	*3.430E+12
Cs-137	2.009E+02	2.056E+02	2.154E+02	2.536E+02	4.044E+02	2.070E+03	2.196E+05	*8.701E+13
Eu-152	9.922E+01	1.045E+02	1.161E+02	1.673E+02	4.760E+02	1.848E+04	6.442E+08	*1.765E+14
Pu-238	6.569E+02	6.622E+02	6.729E+02	7.117E+02	8.353E+02	1.463E+03	7.257E+03	*1.711E+13
Pu-239	5.943E+02	5.943E+02	5.945E+02	5.951E+02	5.967E+02	6.024E+02	6.192E+02	*6.212E+10
Sr-90	1.280E+04	1.321E+04	1.405E+04	1.745E+04	3.242E+04	2.831E+05	1.380E+08	*1.365E+14
U-234	3.301E+03	3.315E+03	3.344E+03	3.446E+03	3.754E+03	5.059E+03	1.166E+04	*6.245E+09
U-235	7.095E+02	7.125E+02	7.185E+02	7.398E+02	8.031E+02	1.064E+03	2.369E+03	*2.160E+06
U-238	2.004E+03	2.013E+03	2.030E+03	2.092E+03	2.280E+03	3.083E+03	7.300E+03	*3.360E+05

*At specific activity limit

0

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Am-241	2.565E+02	0.000E+00	4.475E-02	5.587E+02	4.475E-02	5.587E+02
Cs-137	4.272E+01	0.000E+00	1.245E-01	2.009E+02	1.245E-01	2.009E+02
Eu-152	1.740E+00	0.000E+00	2.520E-01	9.922E+01	2.520E-01	9.922E+01
Pu-238	6.030E+00	0.000E+00	3.806E-02	6.569E+02	3.806E-02	6.569E+02
Pu-239	2.695E+02	0.000E+00	4.207E-02	5.943E+02	4.207E-02	5.943E+02
Sr-90	4.100E+00	0.000E+00	1.952E-03	1.280E+04	1.952E-03	1.280E+04
U-234	3.140E+00	0.000E+00	7.573E-03	3.301E+03	7.573E-03	3.301E+03
U-235	2.500E-01	0.000E+00	3.524E-02	7.095E+02	3.524E-02	7.095E+02
U-238	2.460E+00	0.000E+00	1.248E-02	2.004E+03	1.248E-02	2.004E+03

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated
DOSE(j,t), mrem/yr

0Nuclide (j)	Parent (i)	BRF(i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	1.148E+01	1.134E+01	1.106E+01	1.015E+01	7.935E+00	3.353E+00	2.862E-01	0.000E+00
0Np-237	Am-241	1.000E+00	3.877E-06	1.156E-05	2.664E-05	7.637E-05	1.954E-04	4.271E-04	5.118E-04	0.000E+00
0U-233	Am-241	1.000E+00	4.701E-13	3.274E-12	1.711E-11	1.470E-10	1.106E-09	8.200E-09	2.812E-08	0.000E+00
0Th-229	Am-241	1.000E+00	2.555E-16	3.818E-15	4.418E-14	1.137E-12	2.552E-11	6.851E-10	8.953E-09	0.000E+00
0Cs-137	Cs-137	1.000E+00	5.317E+00	5.194E+00	4.958E+00	4.211E+00	2.641E+00	5.160E-01	4.864E-03	0.000E+00
0Eu-152	Eu-152	7.208E-01	3.160E-01	2.999E-01	2.701E-01	1.874E-01	6.587E-02	1.697E-03	4.867E-08	0.000E+00
Eu-152	Eu-152	2.792E-01	1.224E-01	1.162E-01	1.046E-01	7.258E-02	2.552E-02	6.572E-04	1.885E-08	0.000E+00
Eu-152	§DOSE(j)		4.384E-01	4.161E-01	3.748E-01	2.600E-01	9.139E-02	2.354E-03	6.752E-08	0.000E+00
0Gd-152	Eu-152	2.792E-01	1.769E-17	5.186E-17	1.150E-16	2.905E-16	5.462E-16	6.708E-16	6.400E-16	0.000E+00
0Pu-238	Pu-238	1.000E+00	2.295E-01	2.276E-01	2.240E-01	2.118E-01	1.805E-01	1.030E-01	2.077E-02	0.000E+00
0U-234	Pu-238	1.000E+00	6.461E-08	1.928E-07	4.444E-07	1.277E-06	3.281E-06	7.062E-06	6.447E-06	0.000E+00
U-234	U-234	1.000E+00	2.378E-02	2.368E-02	2.347E-02	2.278E-02	2.090E-02	1.546E-02	6.528E-03	0.000E+00
U-234	U-238	1.000E+00	2.639E-08	7.886E-08	1.825E-07	5.312E-07	1.416E-06	3.450E-06	4.359E-06	0.000E+00
U-234	§DOSE(j)		2.378E-02	2.368E-02	2.348E-02	2.278E-02	2.090E-02	1.547E-02	6.539E-03	0.000E+00
0Th-230	Pu-238	1.000E+00	4.538E-13	3.165E-12	1.660E-11	1.443E-10	1.122E-09	9.250E-09	4.045E-08	0.000E+00
Th-230	U-234	1.000E+00	2.505E-07	7.499E-07	1.742E-06	5.149E-06	1.433E-05	4.089E-05	8.433E-05	0.000E+00
Th-230	U-238	1.000E+00	1.853E-13	1.294E-12	6.801E-12	5.964E-11	4.750E-10	4.237E-09	2.225E-08	0.000E+00
Th-230	§DOSE(j)		2.505E-07	7.500E-07	1.742E-06	5.150E-06	1.434E-05	4.090E-05	8.440E-05	0.000E+00
0Ra-226	Pu-238	1.000E+00	1.170E-15	1.749E-14	2.025E-13	5.225E-12	1.181E-10	3.223E-09	4.126E-08	0.000E+00
Ra-226	U-234	1.000E+00	8.606E-10	6.011E-09	3.161E-08	2.777E-07	2.223E-06	2.016E-05	1.100E-04	0.000E+00
Ra-226	U-238	1.000E+00	4.777E-16	7.146E-15	8.289E-14	2.152E-12	4.955E-11	1.436E-09	2.131E-08	0.000E+00
Ra-226	§DOSE(j)		8.606E-10	6.011E-09	3.161E-08	2.777E-07	2.223E-06	2.017E-05	1.100E-04	0.000E+00
0Pb-210	Pu-238	1.000E+00	8.502E-19	2.613E-17	6.463E-16	4.725E-14	2.779E-12	1.809E-10	3.740E-09	0.000E+00
Pb-210	U-234	1.000E+00	7.807E-13	1.161E-11	1.328E-10	3.285E-09	6.636E-08	1.326E-06	1.060E-05	0.000E+00
Pb-210	U-238	1.000E+00	3.471E-19	1.067E-17	2.644E-16	1.943E-14	1.160E-12	7.965E-11	1.901E-09	0.000E+00
Pb-210	§DOSE(j)		7.807E-13	1.161E-11	1.328E-10	3.285E-09	6.637E-08	1.326E-06	1.061E-05	0.000E+00
0Pu-239	Pu-239	1.000E+00	1.134E+01	1.134E+01	1.133E+01	1.132E+01	1.129E+01	1.118E+01	1.088E+01	0.000E+00
0U-235	Pu-239	1.000E+00	4.679E-09	1.401E-08	3.255E-08	9.615E-08	2.673E-07	7.590E-07	1.545E-06	0.000E+00
U-235	U-235	1.000E+00	8.809E-03	8.771E-03	8.696E-03	8.438E-03	7.741E-03	5.727E-03	2.427E-03	0.000E+00
U-235	§DOSE(j)		8.809E-03	8.771E-03	8.696E-03	8.438E-03	7.742E-03	5.727E-03	2.429E-03	0.000E+00
0Pa-231	Pu-239	1.000E+00	1.241E-13	8.665E-13	4.554E-12	3.992E-11	3.176E-10	2.823E-09	1.466E-08	0.000E+00
Pa-231	U-235	1.000E+00	3.504E-07	1.047E-06	2.423E-06	7.052E-06	1.879E-05	4.577E-05	5.772E-05	0.000E+00
Pa-231	§DOSE(j)		3.504E-07	1.047E-06	2.423E-06	7.052E-06	1.879E-05	4.577E-05	5.774E-05	0.000E+00
0Ac-227	Pu-239	1.000E+00	3.414E-15	5.065E-14	5.767E-13	1.403E-11	2.717E-10	4.906E-09	3.452E-08	0.000E+00
Ac-227	U-235	1.000E+00	1.283E-08	8.850E-08	4.527E-07	3.610E-06	2.234E-05	9.899E-05	1.530E-04	0.000E+00
Ac-227	§DOSE(j)		1.283E-08	8.850E-08	4.527E-07	3.610E-06	2.234E-05	9.900E-05	1.530E-04	0.000E+00

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Sr-90	Sr-90	1.000E+00	8.005E-03	7.761E-03	7.295E-03	5.874E-03	3.162E-03	3.620E-04	7.427E-07	0.000E+00
0U-238	U-238	1.000E+00	3.069E-02	3.056E-02	3.030E-02	2.940E-02	2.697E-02	1.995E-02	8.420E-03	0.000E+00

BRF(i) is the branch fraction of the parent nuclide.
§ is used to indicate summation; the Greek sigma is not included in this font.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated
S(j,t), pCi/g

0Nuclide (j)	Parent (i)	BRF(i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	2.565E+02	2.534E+02	2.472E+02	2.268E+02	1.773E+02	7.494E+01	6.395E+00	1.161E-03
0Np-237	Am-241	1.000E+00	0.000E+00	8.254E-05	2.444E-04	7.784E-04	2.057E-03	4.546E-03	5.452E-03	3.130E-03
0U-233	Am-241	1.000E+00	0.000E+00	1.806E-10	1.607E-09	1.715E-08	1.377E-07	1.044E-06	3.603E-06	3.768E-06
0Th-229	Am-241	1.000E+00	0.000E+00	5.694E-15	1.524E-13	5.475E-12	1.356E-10	3.771E-09	4.972E-08	3.176E-07
0Cs-137	Cs-137	1.000E+00	4.272E+01	4.174E+01	3.983E+01	3.383E+01	2.122E+01	4.148E+00	3.910E-02	3.180E-09
0Eu-152	Eu-152	7.208E-01	1.254E+00	1.190E+00	1.072E+00	7.437E-01	2.615E-01	6.741E-03	1.947E-07	2.522E-23
Eu-152	Eu-152	2.792E-01	4.858E-01	4.611E-01	4.153E-01	2.881E-01	1.013E-01	2.611E-03	7.542E-08	9.767E-24
Eu-152	§S(j):		1.740E+00	1.651E+00	1.488E+00	1.032E+00	3.628E-01	9.351E-03	2.701E-07	3.498E-23
0Gd-152	Eu-152	2.792E-01	0.000E+00	3.037E-15	8.654E-15	2.425E-14	4.699E-14	5.809E-14	5.543E-14	4.614E-14
0Pu-238	Pu-238	1.000E+00	6.030E+00	5.982E+00	5.887E+00	5.566E+00	4.742E+00	2.707E+00	5.457E-01	2.007E-03
0U-234	Pu-238	1.000E+00	0.000E+00	1.699E-05	5.035E-05	1.607E-04	4.265E-04	9.287E-04	8.505E-04	6.060E-05
U-234	U-234	1.000E+00	3.140E+00	3.126E+00	3.100E+00	3.008E+00	2.759E+00	2.041E+00	8.620E-01	4.222E-02
U-234	U-238	1.000E+00	0.000E+00	6.944E-06	2.065E-05	6.680E-05	1.839E-04	4.533E-04	5.746E-04	9.390E-05
U-234	§S(j):		3.140E+00	3.127E+00	3.100E+00	3.008E+00	2.760E+00	2.042E+00	8.634E-01	4.237E-02
0Th-230	Pu-238	1.000E+00	0.000E+00	7.663E-11	6.840E-10	7.385E-09	6.129E-08	5.170E-07	2.275E-06	4.295E-06
Th-230	U-234	1.000E+00	0.000E+00	2.821E-05	8.425E-05	2.766E-04	7.953E-04	2.295E-03	4.748E-03	6.408E-03
Th-230	U-238	1.000E+00	0.000E+00	3.130E-11	2.801E-10	3.050E-09	2.593E-08	2.367E-07	1.251E-06	3.118E-06
Th-230	§S(j):		0.000E+00	2.821E-05	8.425E-05	2.766E-04	7.954E-04	2.296E-03	4.752E-03	6.415E-03
0Ra-226	Pu-238	1.000E+00	0.000E+00	1.107E-14	2.965E-13	1.068E-11	2.666E-10	7.538E-09	9.827E-08	4.595E-07
Ra-226	U-234	1.000E+00	0.000E+00	6.107E-09	5.467E-08	5.965E-07	5.097E-06	4.736E-05	2.622E-04	7.212E-04
Ra-226	U-238	1.000E+00	0.000E+00	4.519E-15	1.213E-13	4.397E-12	1.118E-10	3.357E-09	5.074E-08	3.165E-07
Ra-226	§S(j):		0.000E+00	6.107E-09	5.467E-08	5.965E-07	5.098E-06	4.737E-05	2.624E-04	7.220E-04
0Pb-210	Pu-238	1.000E+00	0.000E+00	8.550E-17	6.791E-15	7.836E-13	5.263E-11	3.586E-09	7.508E-08	4.222E-07
Pb-210	U-234	1.000E+00	0.000E+00	6.279E-11	1.661E-09	5.735E-08	1.278E-06	2.642E-05	2.131E-04	6.669E-04
Pb-210	U-238	1.000E+00	0.000E+00	3.491E-17	2.777E-15	3.221E-13	2.196E-11	1.579E-09	3.815E-08	2.888E-07
Pb-210	§S(j):		0.000E+00	6.279E-11	1.661E-09	5.735E-08	1.278E-06	2.642E-05	2.132E-04	6.676E-04
0Pu-239	Pu-239	1.000E+00	2.695E+02	2.695E+02	2.694E+02	2.691E+02	2.684E+02	2.658E+02	2.587E+02	2.350E+02
0U-235	Pu-239	1.000E+00	0.000E+00	2.648E-07	7.910E-07	2.596E-06	7.454E-06	2.141E-05	4.361E-05	5.466E-05
U-235	U-235	1.000E+00	2.500E-01	2.489E-01	2.468E-01	2.395E-01	2.197E-01	1.625E-01	6.869E-02	3.371E-03
U-235	§S(j):		2.500E-01	2.489E-01	2.468E-01	2.395E-01	2.197E-01	1.625E-01	6.873E-02	3.426E-03
0Pa-231	Pu-239	1.000E+00	0.000E+00	2.800E-12	2.505E-11	2.727E-10	2.316E-09	2.107E-08	1.101E-07	2.581E-07
Pa-231	U-235	1.000E+00	0.000E+00	5.267E-06	1.566E-05	5.066E-05	1.394E-04	3.435E-04	4.346E-04	7.057E-05
Pa-231	§S(j):		0.000E+00	5.267E-06	1.566E-05	5.066E-05	1.394E-04	3.435E-04	4.347E-04	7.083E-05
0Ac-227	Pu-239	1.000E+00	0.000E+00	2.942E-14	7.744E-13	2.629E-11	5.614E-10	1.049E-08	7.437E-08	1.924E-07
Ac-227	U-235	1.000E+00	0.000E+00	8.278E-08	7.202E-07	7.128E-06	4.702E-05	2.129E-04	3.304E-04	5.725E-05
Ac-227	§S(j):		0.000E+00	8.278E-08	7.202E-07	7.128E-06	4.702E-05	2.129E-04	3.305E-04	5.744E-05

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Sr-90	Sr-90	1.000E+00	4.100E+00	3.975E+00	3.736E+00	3.008E+00	1.620E+00	1.854E-01	3.792E-04	1.467E-13
0U-238	U-238	1.000E+00	2.460E+00	2.449E+00	2.428E+00	2.356E+00	2.162E+00	1.599E+00	6.759E-01	3.317E-02

BRF(i) is the branch fraction of the parent nuclide.
§ is used to indicate summation; the Greek sigma is not included in this font.
0RESCALC.EXE execution time = 3.44 seconds

Exhibit 3

RESRAD Summary Report: CAU 551 Land Parcel 3

(25 Pages)

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Summary:CAU 551 Land Parcel 3 File: CAU 551 Land Parcel 3 6-14-05.RAD File: FGR 13 Morbidity

Dose Conversion Factor (and Related) Parameter Summary

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Am-241	4.440E-01	4.440E-01	DCF2(2)
B-1	Co-60	2.190E-04	2.190E-04	DCF2(3)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(4)
B-1	Eu-152	2.210E-04	2.210E-04	DCF2(5)
B-1	Gd-152	2.430E-01	2.430E-01	DCF2(7)
B-1	Np-237+D	5.400E-01	5.400E-01	DCF2(8)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(9)
B-1	Pb-210+D	2.320E-02	2.320E-02	DCF2(10)
B-1	Pu-238	3.920E-01	3.920E-01	DCF2(11)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(12)
B-1	Ra-226+D	8.600E-03	8.600E-03	DCF2(13)
B-1	Th-229+D	2.160E+00	2.160E+00	DCF2(14)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(15)
B-1	U-233	1.350E-01	1.350E-01	DCF2(16)
B-1	U-234	1.320E-01	1.320E-01	DCF2(17)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(18)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Am-241	3.640E-03	3.640E-03	DCF3(2)
D-1	Co-60	2.690E-05	2.690E-05	DCF3(3)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(4)
D-1	Eu-152	6.480E-06	6.480E-06	DCF3(5)
D-1	Gd-152	1.610E-04	1.610E-04	DCF3(7)
D-1	Np-237+D	4.440E-03	4.440E-03	DCF3(8)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(9)
D-1	Pb-210+D	7.270E-03	7.270E-03	DCF3(10)
D-1	Pu-238	3.200E-03	3.200E-03	DCF3(11)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(12)
D-1	Ra-226+D	1.330E-03	1.330E-03	DCF3(13)
D-1	Th-229+D	4.030E-03	4.030E-03	DCF3(14)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(15)
D-1	U-233	2.890E-04	2.890E-04	DCF3(16)
D-1	U-234	2.830E-04	2.830E-04	DCF3(17)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(18)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(2,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(2,3)
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(3,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(3,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(3,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(4,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,3)
D-34				
D-34	Eu-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(5,1)
D-34	Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(5,2)
D-34	Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(5,3)
D-34				
D-34	Gd-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(7,2)
D-34	Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(7,3)
D-34				
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(8,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(8,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(8,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(9,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(9,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(9,3)
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(10,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(10,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(10,3)
D-34	Pu-238 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(11,1)
D-34	Pu-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(11,2)
D-34	Pu-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(11,3)
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(12,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(12,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(12,3)
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(13,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(13,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(13,3)
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(14,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(14,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(14,3)
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(15,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(15,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(15,3)
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(16,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(16,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(16,3)
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(17,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(17,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(17,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(18,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(18,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(18,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(2,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(2,2)
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(3,2)
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(4,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)
D-5	Eu-152 , fish	5.000E+01	5.000E+01	BIOFAC(5,1)
D-5	Eu-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(5,2)
D-5	Gd-152 , fish	2.500E+01	2.500E+01	BIOFAC(7,1)
D-5	Gd-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(7,2)
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(8,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(8,2)
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(9,2)
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(10,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(10,2)
D-5	Pu-238 , fish	3.000E+01	3.000E+01	BIOFAC(11,1)
D-5	Pu-238 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(11,2)
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(12,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(12,2)
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(13,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(13,2)
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(14,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(14,2)
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(15,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(15,2)
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(16,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(16,2)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(17,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(17,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(18,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(18,2)

Site-Specific Parameter Summary Page 6

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	8.997E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.200E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	2.500E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Am-241	3.370E+03	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Co-60	5.300E+00	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Cs-137	3.050E+03	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Eu-152	6.000E+01	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Pu-238	1.270E+02	0.000E+00	---	S1(11)
R012	Initial principal radionuclide (pCi/g): Pu-239	1.320E+04	0.000E+00	---	S1(12)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Eu-152	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Pu-238	not used	0.000E+00	---	W1(11)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(12)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.400E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	3.260E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	4.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.440E-03	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.099E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.099E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Eu-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.332E-04	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Pu-238				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.494E-05	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(12,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.494E-05	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.440E-03	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Gd-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.332E-04	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.265E-04	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.189E-03	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.097E-03	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(13,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.565E-03	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(14)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(14,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(14)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.831E-06	ALEACH(14)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(14)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(15)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(15,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.831E-06	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(16)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(16,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.189E-03	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R016	Distribution coefficients for daughter U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(17)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(17,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(17)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.189E-03	ALEACH(17)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(17)
R016	Distribution coefficients for daughter U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(18)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(18,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(18)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.189E-03	ALEACH(18)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(18)
R017	Inhalation rate (m**3/yr)	1.230E+04	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	6.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	2.500E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	1.000E+00	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	1.000E+00	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	3.800E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

Menu	Site-Specific Parameter Summary (continued) Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	1.752E+02	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD

Summary : CAU 551 Land Parcel 3 Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	8.894E+01	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	89970.00 square meters	Am-241	3.370E+03
Thickness:	1.20 meters	Co-60	5.300E+00
Cover Depth:	0.00 meters	Cs-137	3.050E+03
		Eu-152	6.000E+01
		Pu-238	1.270E+02
		Pu-239	1.320E+04

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.119E+03	1.108E+03	1.087E+03	1.020E+03	8.809E+02	6.717E+02	5.664E+02	5.161E+02
M(t):	4.476E+01	4.432E+01	4.347E+01	4.081E+01	3.523E+01	2.687E+01	2.266E+01	2.065E+01

0Maximum TDOSE(t): 1.119E+03 mrem/yr at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	5.559E+00	0.0050	6.578E+01	0.0588	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.138E+01	0.0727
Co-60	2.984E+00	0.0027	4.798E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.894E-04	0.0000
Cs-137	3.812E+02	0.3406	4.243E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.004E+00	0.0009
Eu-152	1.522E+01	0.0136	5.700E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.522E-03	0.0000
Pu-238	7.251E-04	0.0000	2.188E+00	0.0020	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.695E+00	0.0024
Pu-239	1.464E-01	0.0001	2.498E+02	0.2232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.111E+02	0.2780
Total	4.051E+02	0.3620	3.178E+02	0.2840	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.962E+02	0.3540

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.527E+02	0.1365
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.985E+00	0.0027
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.822E+02	0.3415
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.522E+01	0.0136
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.883E+00	0.0044
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.611E+02	0.5014
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.119E+03	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	5.520E+00	0.0050	6.532E+01	0.0590	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.081E+01	0.0729
Co-60	2.616E+00	0.0024	4.207E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.797E-04	0.0000
Cs-137	3.725E+02	0.3361	4.146E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.806E-01	0.0009
Eu-152	1.444E+01	0.0130	5.411E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.394E-03	0.0000
Pu-238	7.194E-04	0.0000	2.170E+00	0.0020	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.674E+00	0.0024
Pu-239	1.464E-01	0.0001	2.498E+02	0.2255	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.111E+02	0.2807
Total	3.952E+02	0.3567	3.173E+02	0.2864	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.955E+02	0.3570

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.517E+02	0.1369
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.617E+00	0.0024
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.734E+02	0.3370
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.445E+01	0.0130
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.845E+00	0.0044
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.610E+02	0.5063
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.108E+03	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	5.443E+00	0.0050	6.441E+01	0.0593	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.968E+01	0.0733
Co-60	2.011E+00	0.0019	3.233E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.992E-04	0.0000
Cs-137	3.556E+02	0.3272	3.958E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.361E-01	0.0009
Eu-152	1.301E+01	0.0120	4.875E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.157E-03	0.0000
Pu-238	7.080E-04	0.0000	2.136E+00	0.0020	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.631E+00	0.0024
Pu-239	1.464E-01	0.0001	2.498E+02	0.2298	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.110E+02	0.2862
Total	3.762E+02	0.3461	3.163E+02	0.2911	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.943E+02	0.3628

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.495E+02	0.1376
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.011E+00	0.0019
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.565E+02	0.3280
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.302E+01	0.0120
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.768E+00	0.0044
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.609E+02	0.5161
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.087E+03	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	5.181E+00	0.0051	6.131E+01	0.0601	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.585E+01	0.0743
Co-60	8.003E-01	0.0008	1.287E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.385E-04	0.0000
Cs-137	3.022E+02	0.2962	3.364E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.957E-01	0.0008
Eu-152	9.035E+00	0.0089	3.385E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.497E-03	0.0000
Pu-238	6.697E-04	0.0000	2.020E+00	0.0020	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.489E+00	0.0024
Pu-239	1.463E-01	0.0001	2.496E+02	0.2447	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.108E+02	0.3046
Total	3.174E+02	0.3111	3.130E+02	0.3067	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.900E+02	0.3822

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.423E+02	0.1395
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.005E-01	0.0008
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.030E+02	0.2970
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.037E+00	0.0089
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.510E+00	0.0044
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.606E+02	0.5494
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.020E+03	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	4.501E+00	0.0051	5.325E+01	0.0605	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.588E+01	0.0748
Co-60	5.755E-02	0.0001	9.254E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.715E-05	0.0000
Cs-137	1.900E+02	0.2157	2.115E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.001E-01	0.0006
Eu-152	3.185E+00	0.0036	1.193E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.279E-04	0.0000
Pu-238	5.713E-04	0.0000	1.723E+00	0.0020	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.123E+00	0.0024
Pu-239	1.461E-01	0.0002	2.492E+02	0.2829	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.103E+02	0.3523
Total	1.979E+02	0.2246	3.042E+02	0.3453	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.788E+02	0.4300

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.236E+02	0.1404
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.757E-02	0.0001
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.905E+02	0.2162
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.186E+00	0.0036
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.847E+00	0.0044
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.597E+02	0.6354
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.809E+02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	2.752E+00	0.0041	3.253E+01	0.0484	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.024E+01	0.0599
Co-60	5.741E-06	0.0000	9.231E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.711E-09	0.0000
Cs-137	3.741E+01	0.0557	4.164E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.848E-02	0.0001
Eu-152	8.285E-02	0.0001	3.103E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.373E-05	0.0000
Pu-238	3.277E-04	0.0000	9.876E-01	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.216E+00	0.0018
Pu-239	1.452E-01	0.0002	2.477E+02	0.3688	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.085E+02	0.4593
Total	4.039E+01	0.0601	2.813E+02	0.4187	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.500E+02	0.5211

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.552E+01	0.1124
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.743E-06	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.751E+01	0.0558
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.286E-02	0.0001
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.204E+00	0.0033
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.564E+02	0.8283
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.717E+02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	6.770E-01	0.0012	7.953E+00	0.0140	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.839E+00	0.0174
Co-60	2.125E-17	0.0000	3.417E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.333E-21	0.0000
Cs-137	3.602E-01	0.0006	4.009E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.483E-04	0.0000
Eu-152	2.455E-06	0.0000	9.200E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.070E-10	0.0000
Pu-238	6.822E-05	0.0000	2.013E-01	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.479E-01	0.0004
Pu-239	1.429E-01	0.0003	2.436E+02	0.4301	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.034E+02	0.5356
Total	1.180E+00	0.0021	2.518E+02	0.4445	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.135E+02	0.5534

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.847E+01	0.0326
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.125E-17	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.611E-01	0.0006
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.456E-06	0.0000
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.492E-01	0.0008
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.471E+02	0.9660
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.664E+02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	9.204E-03	0.0000	5.998E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.420E-02	0.0001
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	3.025E-08	0.0000	3.513E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.308E-11	0.0000
Eu-152	3.265E-22	0.0000	1.940E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.940E-15	0.0000
Pu-238	8.816E-06	0.0000	8.105E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.605E-04	0.0000
Pu-239	1.335E-01	0.0003	2.298E+02	0.4452	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.861E+02	0.5543
Total	1.427E-01	0.0003	2.298E+02	0.4453	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.862E+02	0.5544

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.434E-01	0.0003
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.033E-08	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.134E-14	0.0000
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.780E-03	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.160E+02	0.9997
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.161E+02	1.0000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			DSR(j,t) (mrem/yr)/(pCi/g)							
Am-241	Am-241	1.000E+00	4.532E-02	4.500E-02	4.437E-02	4.224E-02	3.669E-02	2.241E-02	5.477E-03	3.955E-05
Am-241	Np-237	1.000E+00	1.527E-08	4.567E-08	1.058E-07	3.092E-07	8.348E-07	2.153E-06	3.513E-06	2.994E-06
Am-241	U-233	1.000E+00	1.868E-15	1.304E-14	6.851E-14	5.993E-13	4.742E-12	4.145E-11	2.093E-10	4.813E-10
Am-241	Th-229	1.000E+00	1.012E-18	1.515E-17	1.759E-16	4.586E-15	1.069E-13	3.246E-12	5.634E-11	6.257E-10
Am-241	§DSR(j)		4.532E-02	4.500E-02	4.437E-02	4.224E-02	3.669E-02	2.241E-02	5.481E-03	4.255E-05
0Co-60	Co-60	1.000E+00	5.632E-01	4.938E-01	3.795E-01	1.510E-01	1.086E-02	1.084E-06	4.010E-18	0.000E+00
0Cs-137	Cs-137	1.000E+00	1.253E-01	1.224E-01	1.169E-01	9.935E-02	6.245E-02	1.230E-02	1.184E-04	9.944E-12
0Eu-152	Eu-152	7.208E-01	1.829E-01	1.736E-01	1.564E-01	1.086E-01	3.827E-02	9.955E-04	2.950E-08	3.924E-24
0Eu-152	Eu-152	2.792E-01	7.083E-02	6.723E-02	6.057E-02	4.205E-02	1.482E-02	3.856E-04	1.143E-08	1.520E-24
Eu-152	Gd-152	2.792E-01	1.038E-17	3.044E-17	6.755E-17	1.707E-16	3.219E-16	3.988E-16	3.904E-16	3.557E-16
Eu-152	§DSR(j)		7.083E-02	6.723E-02	6.057E-02	4.205E-02	1.482E-02	3.856E-04	1.143E-08	3.557E-16
0Pu-238	Pu-238	1.000E+00	3.845E-02	3.815E-02	3.755E-02	3.551E-02	3.029E-02	1.736E-02	3.536E-03	1.349E-05
Pu-238	U-234	1.000E+00	1.091E-08	3.258E-08	7.528E-08	2.180E-07	5.728E-07	1.340E-06	1.618E-06	4.226E-07
Pu-238	Th-230	1.000E+00	7.669E-14	5.353E-13	2.811E-12	2.456E-11	1.938E-10	1.681E-09	8.467E-09	2.225E-08
Pu-238	Ra-226	1.000E+00	1.954E-16	2.923E-15	3.391E-14	8.805E-13	2.028E-11	5.911E-10	9.173E-09	6.808E-08
Pu-238	Pb-210	1.000E+00	1.412E-19	4.343E-18	1.076E-16	7.918E-15	4.747E-13	3.300E-11	8.218E-10	7.920E-09
Pu-238	§DSR(j)		3.845E-02	3.815E-02	3.755E-02	3.551E-02	3.029E-02	1.736E-02	3.537E-03	1.401E-05
0Pu-239	Pu-239	1.000E+00	4.250E-02	4.250E-02	4.249E-02	4.247E-02	4.240E-02	4.215E-02	4.145E-02	3.909E-02
Pu-239	U-235	1.000E+00	1.752E-11	5.250E-11	1.222E-10	3.638E-10	1.033E-09	3.149E-09	7.614E-09	1.335E-08
Pu-239	Pa-231	1.000E+00	4.656E-16	3.255E-15	1.715E-14	1.519E-13	1.243E-12	1.217E-11	8.152E-11	3.584E-10
Pu-239	Ac-227	1.000E+00	1.289E-17	1.916E-16	2.192E-15	5.418E-14	1.096E-12	2.253E-11	2.109E-10	1.047E-09
Pu-239	§DSR(j)		4.250E-02	4.250E-02	4.249E-02	4.247E-02	4.240E-02	4.215E-02	4.145E-02	3.909E-02

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
§ is used to indicate summation; the Greek sigma is not included in this font.
The DSR includes contributions from associated (half-life <= 0.5 yr) daughters.
0

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	5.517E+02	5.556E+02	5.634E+02	5.919E+02	6.814E+02	1.116E+03	4.562E+03	5.876E+05
Co-60	4.439E+01	5.063E+01	6.588E+01	1.655E+02	2.301E+03	2.307E+07	*1.131E+15	*1.131E+15
Cs-137	1.995E+02	2.042E+02	2.139E+02	2.516E+02	4.003E+02	2.033E+03	2.111E+05	2.514E+12
Eu-152	9.855E+01	1.038E+02	1.152E+02	1.660E+02	4.708E+02	1.810E+04	6.108E+08	*1.765E+14
Pu-238	6.502E+02	6.554E+02	6.659E+02	7.040E+02	8.254E+02	1.440E+03	7.067E+03	1.784E+06
Pu-239	5.882E+02	5.882E+02	5.883E+02	5.887E+02	5.897E+02	5.931E+02	6.031E+02	6.395E+02

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Am-241	3.370E+03	0.000E+00	4.532E-02	5.517E+02	4.532E-02	5.517E+02
Co-60	5.300E+00	0.000E+00	5.632E-01	4.439E+01	5.632E-01	4.439E+01
Cs-137	3.050E+03	0.000E+00	1.253E-01	1.995E+02	1.253E-01	1.995E+02
Eu-152	6.000E+01	0.000E+00	2.537E-01	9.855E+01	2.537E-01	9.855E+01
Pu-238	1.270E+02	0.000E+00	3.845E-02	6.502E+02	3.845E-02	6.502E+02
Pu-239	1.320E+04	0.000E+00	4.250E-02	5.882E+02	4.250E-02	5.882E+02

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated
DOSE(j,t), mrem/yr

0Nuclide (j)	Parent (i)	BRF(i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	1.527E+02	1.517E+02	1.495E+02	1.423E+02	1.236E+02	7.551E+01	1.846E+01	1.333E-01
0Np-237	Am-241	1.000E+00	5.147E-05	1.539E-04	3.565E-04	1.042E-03	2.813E-03	7.257E-03	1.184E-02	1.009E-02
0U-233	Am-241	1.000E+00	6.296E-12	4.395E-11	2.309E-10	2.020E-09	1.598E-08	1.397E-07	7.054E-07	1.622E-06
0Th-229	Am-241	1.000E+00	3.410E-15	5.104E-14	5.927E-13	1.546E-11	3.603E-10	1.094E-08	1.899E-07	2.109E-06
0Co-60	Co-60	1.000E+00	2.985E+00	2.617E+00	2.011E+00	8.005E-01	5.757E-02	5.743E-06	2.125E-17	0.000E+00
0Cs-137	Cs-137	1.000E+00	3.822E+02	3.734E+02	3.565E+02	3.030E+02	1.905E+02	3.751E+01	3.611E-01	3.033E-08
0Eu-152	Eu-152	7.208E-01	1.097E+01	1.041E+01	9.383E+00	6.514E+00	2.296E+00	5.973E-02	1.770E-06	2.354E-22
Eu-152	Eu-152	2.792E-01	4.250E+00	4.034E+00	3.634E+00	2.523E+00	8.895E-01	2.314E-02	6.857E-07	9.119E-23
Eu-152	§DOSE(j)		1.522E+01	1.445E+01	1.302E+01	9.037E+00	3.186E+00	8.286E-02	2.456E-06	3.266E-22
0Gd-152	Eu-152	2.792E-01	6.231E-16	1.827E-15	4.053E-15	1.024E-14	1.931E-14	2.393E-14	2.343E-14	2.134E-14
0Pu-238	Pu-238	1.000E+00	4.883E+00	4.845E+00	4.768E+00	4.510E+00	3.847E+00	2.204E+00	4.490E-01	1.714E-03
0U-234	Pu-238	1.000E+00	1.386E-06	4.138E-06	9.560E-06	2.769E-05	7.274E-05	1.702E-04	2.055E-04	5.367E-05
0Th-230	Pu-238	1.000E+00	9.740E-12	6.798E-11	3.570E-10	3.120E-09	2.461E-08	2.135E-07	1.075E-06	2.825E-06
0Ra-226	Pu-238	1.000E+00	2.482E-14	3.713E-13	4.306E-12	1.118E-10	2.576E-09	7.507E-08	1.165E-06	8.646E-06
0Pb-210	Pu-238	1.000E+00	1.793E-17	5.516E-16	1.366E-14	1.006E-12	6.029E-11	4.191E-09	1.044E-07	1.006E-06
0Pu-239	Pu-239	1.000E+00	5.611E+02	5.610E+02	5.609E+02	5.606E+02	5.597E+02	5.564E+02	5.471E+02	5.160E+02
0U-235	Pu-239	1.000E+00	2.312E-07	6.930E-07	1.613E-06	4.802E-06	1.364E-05	4.157E-05	1.005E-04	1.762E-04
0Pa-231	Pu-239	1.000E+00	6.145E-12	4.296E-11	2.264E-10	2.005E-09	1.641E-08	1.606E-07	1.076E-06	4.731E-06
0Ac-227	Pu-239	1.000E+00	1.701E-13	2.529E-12	2.893E-11	7.152E-10	1.447E-08	2.975E-07	2.784E-06	1.382E-05

BRF(i) is the branch fraction of the parent nuclide.
§ is used to indicate summation; the Greek sigma is not included in this font.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	3.370E+03	3.346E+03	3.300E+03	3.141E+03	2.728E+03	1.666E+03	4.073E+02	2.941E+00
0Np-237	Am-241	1.000E+00	0.000E+00	1.087E-03	3.238E-03	1.052E-02	2.932E-02	7.651E-02	1.252E-01	1.075E-01
0U-233	Am-241	1.000E+00	0.000E+00	2.379E-09	2.127E-08	2.311E-07	1.952E-06	1.746E-05	8.875E-05	2.045E-04
0Th-229	Am-241	1.000E+00	0.000E+00	7.495E-14	2.014E-12	7.333E-11	1.887E-09	5.931E-08	1.040E-06	1.167E-05
0Co-60	Co-60	1.000E+00	5.300E+00	4.646E+00	3.571E+00	1.421E+00	1.022E-01	1.020E-05	3.774E-17	0.000E+00
0Cs-137	Cs-137	1.000E+00	3.050E+03	2.980E+03	2.845E+03	2.418E+03	1.520E+03	2.993E+02	2.882E+00	2.525E-07
0Eu-152	Eu-152	7.208E-01	4.325E+01	4.105E+01	3.699E+01	2.568E+01	9.052E+00	2.354E-01	6.978E-06	9.891E-22
Eu-152	Eu-152	2.792E-01	1.675E+01	1.590E+01	1.433E+01	9.946E+00	3.506E+00	9.120E-02	2.703E-06	3.831E-22
Eu-152	§S(j):		6.000E+01	5.695E+01	5.131E+01	3.562E+01	1.256E+01	3.266E-01	9.681E-06	1.372E-21
0Gd-152	Eu-152	2.792E-01	0.000E+00	1.048E-13	2.985E-13	8.373E-13	1.627E-12	2.029E-12	1.987E-12	1.810E-12
0Pu-238	Pu-238	1.000E+00	1.270E+02	1.260E+02	1.240E+02	1.173E+02	1.000E+02	5.732E+01	1.168E+01	4.457E-02
0U-234	Pu-238	1.000E+00	0.000E+00	3.582E-04	1.064E-03	3.423E-03	9.288E-03	2.198E-02	2.662E-02	6.957E-03
0Th-230	Pu-238	1.000E+00	0.000E+00	1.615E-09	1.444E-08	1.567E-07	1.319E-06	1.171E-05	5.937E-05	1.563E-04
0Ra-226	Pu-238	1.000E+00	0.000E+00	2.333E-13	6.261E-12	2.270E-10	5.772E-09	1.742E-07	2.730E-06	2.173E-05
0Pb-210	Pu-238	1.000E+00	0.000E+00	1.802E-15	1.434E-13	1.666E-11	1.141E-09	8.301E-08	2.093E-06	2.024E-05
0Pu-239	Pu-239	1.000E+00	1.320E+04	1.320E+04	1.320E+04	1.319E+04	1.317E+04	1.309E+04	1.287E+04	1.214E+04
0U-235	Pu-239	1.000E+00	0.000E+00	1.299E-05	3.887E-05	1.285E-04	3.770E-04	1.163E-03	2.820E-03	4.987E-03
0Pa-231	Pu-239	1.000E+00	0.000E+00	1.373E-10	1.232E-09	1.355E-08	1.184E-07	1.186E-06	7.997E-06	3.528E-05
0Ac-227	Pu-239	1.000E+00	0.000E+00	1.444E-12	3.820E-11	1.318E-09	2.940E-08	6.254E-07	5.904E-06	2.948E-05

 BRF(i) is the branch fraction of the parent nuclide.
 § is used to indicate summation; the Greek sigma is not included in this font.
0RESCALC.EXE execution time = 3.10 seconds

Appendix F

Disposition of Drummed IDW for CAU 551

F.1.0 Disposition of Drummed IDW for CAU 551

Nine drums of IDW were generated as a result of this investigation. Six were emptied in the A23 lagoons (see Attachment F-1 for Bill of Lading). The solids were disposed of at the u10C Industrial Landfill (see Attachment F-1 for Load Verification Forms); one drum was disposed of in the A6 Hydrocarbon Landfill (see Attachment F-1 for Load Verification Forms), and two were disposed of at the A5 Radioactive Waste Management Facility (see Attachment F-1 for Certificate of Disposal).

Attachment F-1

CAU 551 Load Verification Forms

(4 Pages)

Bechtel Nevada

NTS Landfill Load Verification

(Waste definitions are available on page 2)

SWO USE (Circle One Area) AREA ~~3~~ **6** ~~9~~ **LANDFILL**

For waste characterization, approval, and/or assistance, contact Solid Waste Operation (SWO) at 5-7898.

REQUIRED: WASTE GENERATOR INFORMATION

(This form is for rolloffs, dump trucks, and other onsite disposal of materials.)

Waste Generator: Stoller-Navarro Joint Venture Phone Number: 5-2033

Location / Origin: CAU 551, Area 12, NTS (drums 551A01)

Waste Category: (check one)		☐ Commercial	☒ Industrial	
Waste Type: (check one)	☐ NTS	☐ Putrescible	☒ FFACO-onsite	☐ WAC Exception
	☐ Non-Putrescible	☐ Asbestos Containing Material	☐ FFACO-offsite	☐ Historic DOE/NV
Pollution Prevention Category: (check one)		☒ Environmental management	☐ Defense Projects	☐ YMP
Pollution Prevention Category: (check one)		☒ Clean-Up	☐ Routine	
Method of Characterization: (check one)		☒ Sampling & Analysis	☐ Process Knowledge	☐ Contents

Prohibited Waste at all three NTS landfills: Radioactive waste; RCRA waste; Hazardous waste; Free liquids, PCBs above TSCA regulatory levels-, and Medical wastes (needles, sharps, bloody clothing).

Additional Prohibited Waste at the Area 9 U10c Landfill: Sewage Sludge; Animal carcasses-, Wet garbage (food waste); and Friable asbestos

REQUIRED: WASTE CONTENTS ALLOWABLE WASTES

Check all allowable wastes that are contained within this load:

NOTE: Waste disposed at the Area 6 Hydrocarbon Landfill must have come into contact with petroleum hydrocarbons or coolants such as: gasoline (no benzene, lead); jet fuel; diesel fuel; lubricants and hydraulics; kerosene; asphaltic petroleum hydrocarbon; and ethylene glycol.

Acceptable waste at any NTS landfill:

☒ Paper	☐ Rocks / unaltered geologic materials	☐ Empty containers			
☐ Asphalt	☐ Metal	☐ Wood	☐ Soil	☐ Rubber (excluding tires)	☐ Demolition debris
☒ Plastic	☐ Wire	☐ Cable	☒ Cloth	☐ Insulation (non-Asbestosform)	☐ Cement & concrete

☒ Manufactured items: (swamp coolers, furniture, rugs, carpet, electronic components, PPE, etc.)

Additional waste accepted at the Area 23 Mercury Landfill: ☐ Office waste ☐ Food Waste ☐ Animal Carcasses

☐ Asbestos: ☐ Friable ☐ Non-Friable (contact SWO if regulated load) Quantity: _____

Additional waste accepted at the Area 9 U10c Landfill:

☐ Non-friable asbestos	☐ Drained automobiles and military vehicles	☐ Solid fractions from sand/oil/water separators
☐ Light ballasts (contact SWO)	☐ Drained fuel filters (gas & diesel)	☐ Deconned Underground and Above Ground
☐ Hydrocarbons (contact SWO)	☐ Other _____	☐ Tanks

Additional waste accepted at the Area 6 Hydrocarbon Landfill: ☐ Other _____

☐ Septic sludge	☐ Rags	☐ Drained fuel filters (gas & diesel)	☐ Crushed non-terne plated oil filters
☐ Plants	☐ Soil	☐ Sludge from sand/oil/water separators	☐ PCBs below 50 parts per million

REQUIRED: WASTE GENERATOR SIGNATURE

Initials: _____ ***(If initialed, no radiological clearance is necessary.)***

The above mentioned waste was generated outside of a Controlled Waste Management Area (CWMA) and to the best of my knowledge, does not contain radiological materials.

To the best of my knowledge, the waste described above contains only those materials that are allowed for disposal at this site. I have verified this through the waste characterization method identified above and a review of the above-mentioned prohibited and allowable waste items.

Print Name: DAVID SCHRECK

Signature: David Schreck Date: 7/27/05

Note: Food waste, office trash and/or animal carcasses are considered not to contain require a radiological clearance.

Radiation Survey Release for Waste Disposal

RCT Initials	
DS	☒ This container/load is free of external radioactive contamination.
	☐ This container/load is exempt from survey due to process knowledge and origin.
	☐ This container/load is free of radioactive contamination based on radioanalysis.

SIGNATURE: _____ DATE: _____

BN-0545 (09/99)

SWO USE ONLY

Load Weight (net from scale or estimate): 50 Signature of Certifier: Robert W Russell

Retention Code: ENV 6.b

BN-0918 (04/03)

(2)

Bechtel Nevada

NTS Landfill Load Verification

(Waste definitions are available on page 2)

SWO USE (Circle One Area) AREA ~~6~~ ~~23~~ (9) **LANDFILL**

For waste characterization, approval, and/or assistance, contact Solid Waste Operation (SWO) at 5-7898.

REQUIRED: WASTE GENERATOR INFORMATION
(This form is for rolloffs, dump trucks, and other onsite disposal of materials.)

Waste Generator: Stoller-Navarro Joint Venture Phone Number: 5-2033

Location / Origin: CAU 551, Area 12 Lagoon, NTS (Empty drums)

Waste Category: (check one)	☐ Commercial	☒ Industrial	
Waste Type: (check one)	☐ NTS / ☐ Non-Putrescible	☐ Putrescible / ☐ Asbestos Containing Material	☒ FFACO-onsite / ☐ FFACO-offsite	☐ WAC Exception / ☐ Historic DOE/NV
Pollution Prevention Category: (check one)	☒ Environmental management	☐ Defense Projects	☐ YMP
Pollution Prevention Category: (check one)	☒ Clean-Up	☐ Routine	
Method of Characterization: (check one)	☒ Sampling & Analysis	☐ Process Knowledge	☐ Contents

Prohibited Waste at all three NTS landfills: Radioactive waste; RCRA waste; Hazardous waste; Free liquids, PCBs above TSCA regulatory levels, and Medical wastes (needles, sharps, bloody clothing).

Additional Prohibited Waste at the Area 9 U10c Landfill: Sewage Sludge; Animal carcasses, Wet garbage (food waste); and Friable asbestos

REQUIRED: WASTE CONTENTS ALLOWABLE WASTES
Check all allowable wastes that are contained within this load:

NOTE: Waste disposed at the Area 6 Hydrocarbon Landfill must have come into contact with petroleum hydrocarbons or coolants such as: gasoline (no benzene, lead); jet fuel; diesel fuel; lubricants and hydraulics; kerosene; asphaltic petroleum hydrocarbon; and ethylene glycol.

Acceptable waste at any NTS landfill: ☐ Paper ☐ Rocks / unaltered geologic materials ☐ Empty containers
☐ Asphalt ☒ Metal ☐ Wood ☐ Soil ☒ Rubber (excluding tires) ☐ Demolition debris
☒ Plastic ☐ Wire ☐ Cable ☐ Cloth ☐ Insulation (non-Asbestosform) ☐ Cement & concrete
☒ Manufactured items: (swamp coolers, furniture, rugs, carpet, electronic components, PPE, etc.)

Additional waste accepted at the Area 23 Mercury Landfill: ☐ Office waste ☐ Food Waste ☐ Animal Carcasses
☐ Asbestos: ☐ Friable ☐ Non-Friable (contact SWO if regulated load) Quantity: ____

Additional waste accepted at the Area 9 U10c Landfill:
☐ Non-friable asbestos ☐ Drained automobiles and military vehicles ☐ Solid fractions from sand/oil/water separators
☐ Light ballasts (contact SWO) ☐ Drained fuel filters (gas & diesel) ☐ Deconned Underground and Above Ground
☐ Hydrocarbons (contact SWO) ☐ Other ____ ☐ Tanks

Additional waste accepted at the Area 6 Hydrocarbon Landfill: ☐ Other ____
☐ Septic sludge ☐ Rags ☐ Drained fuel filters (gas & diesel) ☐ Crushed non-terne plated oil filters
☐ Plants ☐ Soil ☐ Sludge from sand/oil/water separators ☐ PCBs below 50 parts per million

REQUIRED: WASTE GENERATOR SIGNATURE

Initials: ____ *(If initialed, no radiological clearance is necessary.)*

The above mentioned waste was generated outside of a Controlled Waste Management Area (CWMA) and to the best of my knowledge, does not contain radiological materials.

To the best of my knowledge, the waste described above contains only those materials that are allowed for disposal at this site. I have verified this through the waste characterization method identified ab[...] prohibited and allowable waste items.

Print Name: David Schrock

Signature: David Schrock Date: 7/27/05

Note: Food waste, office trash and/or animal carcasses are considered not to contain [...] require a radiological clearance.

Radiation Survey Release for Waste Disposal

RCT Initials
☒ This container/load is free of external radioactive contamination.
☐ This container/load is exempt from survey due to process knowledge and origin.
☐ This container/load is free of radioactive contamination based on lab analysis.

SIGNATURE: [signature] DATE: ____

BN-0546 (05/99)

SWO USE ONLY

Load Weight (net from scale or estimate) 1800 Signature of Certifier: Keith Kozar

Retention Code: ENV 8.b

BN-0818 (04/02)

Shipper: ***BECHTEL NEVADA FOR USDOE***

Shipper No.: _____

Date: _____

Purchase/Customer Order No. _____

RECEIVED, subject to the classifications and tariffs in effect on the date of the issue of this Bill of Lading the property described below, in apparent good order, except as noted (contents and condition of contents of packages unknown) marked, consigned, and destined shown below, which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, as to each carrier of all or any said property over all or any portion of said route to destination, and as to each party at any time interested in all or any of said property, that every service to be performed hereunder shall be subject to all the terms and conditions of the Uniform Domestic Straight Bill of Lading set forth (1) in Uniform Freight Classification in effect on the date hereof, if this is a rail or rail-water shipment, or (2) in the applicable motor carrier classification or tariff if this is a motor carrier shipment.

Shipper hereby certifies that he is familiar with all the terms and conditions of the said bill of lading, including those on the back thereof, set forth in the classification or tariff which governs the transportation of this shipment and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

Consignee:

Stoller-Navarro Joint Venture
CAU 551 IDW Rinsate removal

Carrier:

PRO NO.:

CAR OR VEHICLE INITIALS & NO.: **SEAL #:**

Route:

CARRIER NO. **SECTION 13712 TENDER NO.:**

No. PKGS.	HM	Description of Articles (Subject to Correction), Kind of Package, Special Marks and Exemptions (See NMFC Item (Rule) 360)	Weight (Subject to Correction)	Class	Rate	Charges
6		Sanitary Rinsate, 55 gallon DM Drum Numbers: 551A02, 551B01, 551C02, 551D01, 551E02, 551E03				

Subject to Section 7 of conditions, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement: The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

Bechtel Nevada
Signature of Consignor

If freight charges are to be prepaid write or stamp here **"TO BE PREPAID"**

Note: Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property. The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding

$_____ per lb.

*Job order, reference, account, or work order number

Savings:
$_____

IN THE EVENT OF AN EMERGENCY, PHONE _____ **- 24 HOUR**

ITEM NO.	NMFC 100-	NPM NO.		

*Label(s) applied

Remarks: (If you receive this shipment damaged, please note on delivery receipt. Contact Bechtel Nevada Traffic at (702) 295-3266, Reference Shippers Number).

This form used for SNJV tracking purposes to track rinsate being emptied in the A23 Lagoon prior to the emptied drums (e.g. solids) to the A9, 10c landfill for disposal.

DS 9-28-05

* **Placard(s) Required**

TECHNICAL CONTACT: Pri: D. Schrock 5-2147; ALT: B. White 5-5404

This is to certify that the above named materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation. (Applicable for Hazardous Materials Only.)

Shipper: **BECHTEL NEVADA for USDOE, P.O. Box 98521, Las Vegas, NV 89193**

Acting under contract DCACO896NV11718 with U.S. Dept of Energy

Per: _____ Date: _____

P. O. Box 98521, Las Vegas, NV 89193
TRANSPORTATION DEPT. - Permanent Post Office Address Of Shipper

This shipment is for U.S. Department of Energy and the actual total transportation charges paid *to* the carrier(s) by the consignor or consignee are assignable to, and shall be reimbursed by, the U.S. Government and is subject to the terms and conditions set forth in the standard form of the U.S. Government Bill of Lading and to any available special rates or changes (41 CFR 109-40.50 and 41 CFR 40.3)

☐ YES ☐ NO

* The addition on the face hereof and to the terms and conditions are here by noted:

Carrier: _____

Per: _____ Date: _____

BN-0948 (05/00)

UNCONTROLLED when Printed

Certificate of Disposal

This is to certify that the Waste Stream No. LITN000000006, Rev. 07, shipment number ITL05004, with container numbers 551C01, 551E01, 511A08, and 511A09 was shipped and received at the Nevada Test Site Radioactive Waste Management Site in Area 5 for disposal as stated below.

William C. Nicosia	Stoller-Navarro Joint Venture	Health Physicist
Shipped by	Organization	Title
Will C. Nico		8-3-05
Signature		Date
Pat Scheuermann	Bechtel	Admin. Assist
Received by	Organization	Title
Pat Scheuermann		8/3/05
Signature		Date

Appendix G

Nevada Division of Environmental Protection Comments

(2 Pages)

ndep
NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
protecting the future for generations

STATE OF NEVADA
Department of Conservation & Natural Resources
DIVISION OF ENVIRONMENTAL PROTECTION

Kenny C. Guinn, Governor
Allen Biaggi, Director
Leo M. Drozdoff, P.E., Administrat

October 23, 2006

John B. Jones
Acting Environmental Restoration Federal Project Director
Environmental Restoration Project
National Nuclear Security Administration
Nevada Site Office
P. O. Box 98518
Las Vegas, NV 89193-8518

RE: Review of the draft Corrective Action Decision Document / Closure Report (CADD/CR) Corrective Action Unit (CAU) 551: Area 12 Muckpiles *Federal Facility Agreement and Consent Order*

Dear Mr. Jones,

The Nevada Division of Environmental Protection, Bureau of Federal Facilities (NDEP) staff has received and reviewed the draft Corrective Action Decision Document / Closure Report (CADD/CR) for Corrective Action Unit (CAU) 551: Area 12 Muckpiles. NDEP's review of this document did not indicate any deficiencies.

Address any questions regarding this matter to either Greg Raab at (702) 486-2850, ext. 242, or me at (702) 486-2850, ext. 229.

Sincerely,

Don Elle

Don Elle, Ph.D.
Supervisor
Bureau of Federal Facilities

DRE/ GR:gr

ACTION
INFO ERP
NSO/MGR
AMEM
AMNS
AMSO
AMSP
AMSS

1771 E. Flamingo Road, Suite 121-A • Las Vegas, Nevada 891

cc: Federal Project Director, WMP, NNSA/NSO
FFACO Group, SNJV, Las Vegas, NV
Tiffany Lantow, DTRA/CXT1, M/S 645, Mercury, NV
Kevin Cabble, ERP, NNSA/NSO, Las Vegas, NV
Pete Sanders, ERP, NNSA/NSO, Las Vegas, NV
Sabine Curtis, ERP, NNSA/NSO, Las Vegas, NV
Jeff Smith, NSTec, Las Vegas, NV
Robert Boehlecke, SNJV, Las Vegas, NV

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