CORRECTIVE ACTION DECISION DOCUMENT/CLOSURE REPORT FOR CORRECTIVE ACTION UNIT 478: AREA 12 T-TUNNEL PONDS, NEVADA TEST SITE



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Revision No.: 0

May 2007 (Republished March 2010)

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CORRECTIVE ACTION DECISION DOCUMENT/CLOSURE REPORT FOR CORRECTIVE ACTION UNIT 478: AREA 12 T-TUNNEL PONDS, NEVADA TEST SITE

Prepared by
Defense Threat Reduction Agency
Mercury, Nevada

Controlled Copy No. ____

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CORRECTIVE ACTION DECISION DOCUMENT/CLOSURE REPORT FOR CORRECTIVE ACTION UNIT 478: AREA 12 T-TUNNEL PONDS, NEVADA TEST SITE

Approved by:		Date:	
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List of Acronyms and Abbreviations

ALARA As low as reasonably achievable

ASTM American Society for Testing and Materials

bgs Below ground surface

CADD Corrective Action Decision Document

CAI Corrective Action Investigation

CAIP Corrective Action Investigation Plan

CAS Corrective Action Site

CAU Corrective Action Unit

cm³/g Cubic centimeters per gram

COC Contaminant of concern

COPC Contaminant of potential concern

cps Counts per second

CR Closure Report

Cs Cesium

CSM Conceptual site model

CZ Contaminated Zone

Decon Decontamination

DoD U.S. Department of Defense

DOE U.S. Department of Energy

DQA Data quality assessment

DQI Data quality indicator

DQO Data quality objective

DRO Diesel-range organics

DTRA Defense Threat Reduction Agency

EPA U.S. Environmental Protection Agency

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List of Acronyms and Abbreviations (continued)

EPC Exposure point concentration

EZ Exclusion Zone

FAL Final action level

FFACO Federal Facility Agreement and Consent Order

FGR Federal Guidance Report

ft Foot

g/cm³ Grams per cubic centimeter

g/m³ Grams per cubic meter

g/yr Grams per year

GPS Global Positioning System

H&S Health and safety

hr/yr Hours per year

HWAA Hazardous waste accumulation area

IDW Investigation-derived waste

IT IT Corporation

kg/day Kilograms per day

kg/yr Kilograms per year

L/day Liters per day

L/yr Liters per year

m Meter

m/sec Meters per second

m/yr Meters per year

m² Square meter

m³/h Cubic meters per hour

m³/yr Cubic meters per year

M&O Management and operating

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List of Acronyms and Abbreviations (continued)

mg/day Milligrams per day

mg/kg Milligrams per kilogram

mg/L Milligrams per liter

mrem Millirem

mrem/yr Millirem per year

MS Matrix spike

MSD Matrix spike duplicate

N/A Not applicable

NAC Nevada Administrative Code

NCRP National Council on Radiation Protection and Measurements

ND Nondetect

NDEP Nevada Division of Environmental Protection and Measurements

NNSA/NSO U.S. Department of Energy, National Nuclear Security Administration

Nevada Site Office

NTS Nevada Test Site

PAI Paragon Analytics, Inc.

PAL Preliminary action level

pCi/g Picocuries per gram

pCi/L Picocuries per liter

PID Photoionization detector

POC Performance Objective for the Certification of Nonradioactive Hazardous Waste

PPE Personal protective equipment

PRG Preliminary remediation goal

Pu Plutonium

QA Quality assurance

QAPP Quality Assurance Project Plan

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List of Acronyms and Abbreviations (continued)

QC Quality control

Ra Radium

RCRA Resource Conservation and Recovery Act

RCT Radiological control technician

REOP Real Estate/Operations Permit

RESRAD Residual Radioactive

RPD Relative percent difference

RT Regulatory threshold

SAPS Small-area plastic scintillation

Sr Strontium

SSHASP Site-Specific Health and Safety Plan

SSTL Site-specific target level

SNJV Stoller-Navarro Joint Venture

SVOC Semivolatile organic compound

TD Total depth

TEDE Total Effective Dose Equivalent

Th Thorium

TID Tamper-indicating device

TPH Total petroleum hydrocarbons

UCL Upper confidence limit

VOC Volatile organic compound

yr Year

/yr Per year

μg/kg Micrograms per kilogram

μg/L Micrograms per liter

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Executive Summary

This Corrective Action Decision Document (CADD)/Closure Report (CR) was prepared by the Defense Threat Reduction Agency (DTRA) for Corrective Action Unit (CAU) 478, Area 12 T-Tunnel Ponds. This CADD/CR is consistent with the requirements of the *Federal Facility Agreement and Consent Order* (FFACO) agreed to by the State of Nevada, the U.S. Department of Energy (DOE), and the U.S. Department of Defense. Corrective Action Unit 478 is comprised of one corrective action site (CAS):

• 12-23-01, Ponds (5) RAD Area

The purpose of this CADD/CR is to provide justification and documentation supporting the recommendation for closure in place with use restrictions for CAU 478. A CADD was originally submitted for CAU 478 and approved by the Nevada Division of Environmental Protection (NDEP). However, following an agreement between NDEP, DTRA, and the DOE, National Nuclear Security Administration Nevada Site Office to change to a risk-based approach for assessing the corrective action investigation (CAI) data, NDEP agreed that the CAU could be re-evaluated using the risk-based approach and a CADD/CR prepared to close the site. To support this recommendation, a CAI was performed in April and May 2003. The purpose of the CAI was to fulfill the following data needs as defined during the Data Quality Objective (DQO) process:

- Determine whether chemical and radiological contaminants of potential concern (COPCs) are present within or beneath the ponds at concentrations above the preliminary action level (PAL).
- Determine whether chemical and/or radiological COPCs are present in the channels between the muckpile and the ponds, between the ponds, and downgradient of the last pond.
- Provide sufficient information and data to develop acceptable strategies for closing the ponds. These strategies are evaluated in this CADD/CR.

The CAU 478 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 (Appendix C).

Analytes detected during the CAI were evaluated against final action levels (FALs) established in this document. Tier 2 FALS were determined for the hazardous constituents of total

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petroleum hydrocarbon (TPH)-diesel-range organics (DRO), and the radionuclides cesium (Cs)-137 and plutonium (Pu)-239 using site-specific information. Under the Tier 2 evaluation, the hazardous constituents of TPH-DRO were compared to the PALs defined in the Corrective Action Investigation Plan (CAIP), and because none of the PALs were exceeded, the PALs were established as the FALs. The radionuclide FALs were calculated using the Residual Radioactive (RESRAD) code (version 6.3) for the occasional use scenario. The RESRAD calculation determined the activities of all radionuclides that together would sum to an exposure dose of 25 millirem per year to a site receptor based on the relative abundance of individual radionuclides at the site. Based on the field investigation, Cs-137 exceeded the FAL in the pond sediments in one random and one biased sample, and Pu-239 exceeded the FAL in one random channel sample. The analytical results for arsenic, Cs-137, and TPH-DRO were entered into the SW-846 formula to determine whether the site had been characterized to the 90 percent confidence level. Enough samples were collected to adequately characterize the site with respect to these analytes.

Based on the data and risk evaluations, the DQO data needs presented in the CAIP were met, and the data accurately represent the radiological and chemical risk present at CAU 478. Based on the results of the CAI data evaluation, it was determined that closure in place with use restrictions is the appropriate corrective action for CAU 478 and that use restrictions will effectively control exposure to future land users. This is based on the fact that even though the site is contaminated with Cs-137 and Pu-239 as described above, this remote, controlled access site poses only limited risk overall to public health and the environment. Therefore, DTRA provides the following recommendations:

- Close the radionuclides in place at CAU 478 with a use restriction.
- No further action for CAU 478.
- A Notice of Completion be issued to DTRA by the Nevada Division of Environmental Protection for closure of CAU 478.
- Move CAU 478 from Appendix III to Appendix IV of the FFACO.

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1.0 Introduction

This Corrective Action Decision Document (CADD)/Closure Report (CR) has been prepared for Corrective Action Unit (CAU) 478, Area 12 T-Tunnel Ponds. The corrective action proposed in this document complies 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 T-Tunnel Ponds are identified under FFACO classification as CAU 478, Area 12 T-Tunnel Ponds. The CAU consists of one corrective action site (CAS): 12-23-01 (Ponds (5) RAD Area). The T-Tunnel Ponds are located approximately 45 miles north of Mercury in Area 12 of the Nevada Test Site (NTS) (Figure 1-1).

A CADD was originally submitted for CAU 478 and approved by the Nevada Division of Environmental Protection (NDEP). However, following an agreement between NDEP, the Defense Threat Reduction Agency (DTRA), and the DOE, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) to change to a risk-based approach for assessing the corrective action investigation (CAI) data, NDEP agreed that the CAU could be re-evaluated using the risk-based approach and a CADD/CR prepared to close the site.

This CADD/CR describes the corrective action that is selected as a result of the investigation activities and the rationale for its selection. The rationale consists of a justification for closure in place with use restrictions in accordance with Sections IV.8 and IV.11 of the FFACO (1996).

1.1 Purpose

The purpose of this CADD/CR is to provide justification for the closure of CAU 478 with use restrictions based on the results of the CAI. The CAI was conducted in accordance with the *Corrective Action Investigation Plan* (CAIP) *for Corrective Action Unit 478: Area 12 T-Tunnel Ponds, Nevada Test Site* (DTRA, 2003), which provides additional information on the history, planning, and scope of the investigation.

The T-Tunnel was used for six nuclear weapons effects tests and two high explosives tests between 1970 and 1987. The ponds were used as settling ponds for groundwater encountered during tunnel excavation, construction water, and water produced during re-entry activities following each test. In 1993, effluent discharge elimination plugs were constructed in the tunnel as part of the T-Tunnel mothball program. No water or sediments have been discharged to the

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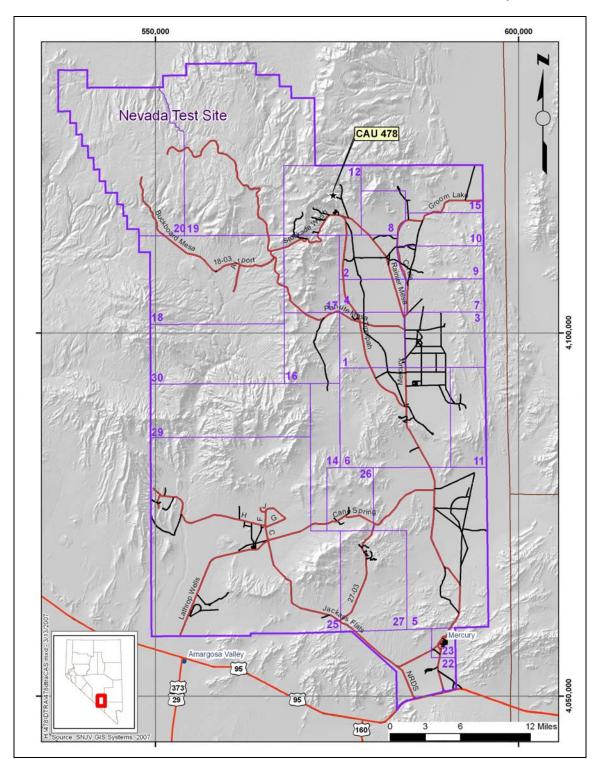


Figure 1-1 CAU 478 Location Map

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ponds since that time. Due to the unregulated disposal activities commonly associated with early tunnel activities, an investigation of the site was conducted. Additional information relating to the site history, planning, and scope of the investigation is presented in the CAIP (DTRA, 2003).

1.2 Scope

The scope of this CADD/CR is to justify and recommend that closure in place with use restrictions is the appropriate action at CAU 478, Area 12 T-Tunnel Ponds. To achieve this scope, the following actions were implemented:

- Evaluation of current site conditions, including the nature and extent of contaminants of concern (COCs).
- Closure in place with use restrictions to prevent exposure of industrial and construction workers to unacceptable risks.

To obtain the information necessary to meet the scope of this effort, the Data Quality Objective (DQO) process was used for planning the investigation. The decision statement identified in the DQO process is:

• Are there concentrations of contaminants of potential concern (COPCs) present in the ponds that exceed the preliminary action levels (PALs) and, if so, do they pose a threat to human health and/or the environment.

The data quality indicators (DQIs) as defined in the Industrial Sites Quality Assurance Project Plan (QAPP) (NNSA/NV, 2002) were achieved, and the DQOs established in the CAIP (DTRA, 2003) were met.

Subsequent to approval of the CAIP and completion of the CAI, NDEP approved a risk-based approach for developing final action levels (FALs) to evaluate contaminant concentrations. That approach was used to evaluate the potential hazards at CAU 478.

1.3 CADD/CR Contents

This CADD/CR is divided into the following sections:

- Section 1.0 Introduction: Summarizes the purpose, scope, and contents of this CADD/CR.
- Section 2.0 CAI Summary: Summarizes the investigation field activities, the results of the investigation, and the DQO assessment.

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- Section 3.0 Recommendation: States why no further action is required.
- Section 4.0 References: Lists all documents referenced in the CADD/CR.
- Appendix A Corrective Action Investigation Report for CAU 478: Area 12 T-Tunnel Ponds
- Appendix B Data Quality Objective Process for CAU 478, Area 12 T-Tunnel Ponds
- Appendix C Data Assessment
- Appendix D Risk Assessment for CAU 478
- Appendix E Closure Summary

All work was performed in accordance with the following documents:

- Corrective Action Investigation Plan for Corrective Action Unit 478: Area 12 T-Tunnel Ponds, Nevada Test Site, Rev. 0 (DTRA, 2003).
- Industrial Sites QAPP, Rev. 0 (NNSA/NV, 2002)
- Federal Facility Agreement and Consent Order (FFACO, 1996)
- ITLV Site-Specific Health and Safety Plan: Corrective Action Unit 475, Area 12 P-Tunnel Muckpile; CAU 478, Area 12 Ponds; CAU 480, Area 12 N-Tunnel Ponds (IT, 2003).

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2.0 Corrective Action Investigation Summary

The following sections describe and summarize the results of the CAI activities conducted at CAU 478. For detailed CAI results, refer to Appendix A.

2.1 Investigation Activities

From April 30 through May 7, 2003, CAI field activities were performed at the T-Tunnel Ponds as set forth in the CAIP (DTRA, 2003). The purpose of the CAI was to determine whether or not the T-Tunnel Ponds, the underlying native soils, and/or the channels have been impacted by COPCs at concentrations that exceed regulatory limits, and to provide sufficient information and data to develop appropriate corrective action strategies for the ponds and channels. In accordance with the CAIP (DTRA, 2003), the following tasks were performed:

- Walkover radiological surveys Before commencing drilling and sampling, walkover radiological surveys were conducted to identify surface and near-surface areas with elevated radiological readings. The walkover surveys were conducted in the ponds and drainage channels.
- Pond sediments and underlying native material sampling Nineteen locations were drilled in the ponds to characterize the pond sediments and the native material under the ponds. A total of 159 feet (ft) were drilled in 19 boreholes ranging from 5 to 13.5 ft deep. Up to three samples were collected from each location. During the characterization, 42 environmental samples were collected. These included 20 pond sediment samples and 22 native material samples from below the sediment. All samples were sent to Paragon Analytics, Inc., for analysis. Analyses performed included volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH)-diesel-range organics (DRO), total *Resource Conservation and Recovery Act* (RCRA) metals, beryllium, and radionuclides. The samples were archived so that once the results were received and evaluated, 25 percent of the samples could be analyzed for strontium (Sr)-90 and isotopic plutonium (Pu) for waste management purposes.
- Channel sampling Thirty-one locations were drilled or hand sampled to characterize the channels between the ponds. A total of 111 ft were drilled in 21 boreholes ranging from 4.5 to 7.5 ft deep. Ten locations were sampled by hand. One or two samples were collected from each location. During the characterization, 43 environmental samples were collected. All samples were sent to Paragon Analytics, Inc., to be analyzed for the same analytes as the pond samples.
- **Background soil sampling** Background soil samples were not collected around the ponds. When CAU 476 (T-Tunnel Muckpile) was characterized, three background samples were collected at undisturbed locations around the muckpile. The samples were analyzed for RCRA metals and radionuclides. These locations were also used to represent background for the CAU 478 pond characterization.

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The conceptual site model (CSM) postulated the following:

- The majority of the ponds do not contain COPCs, and if any are present, they are probably in isolated locations within the ponds or along the channels.
- The location of buried COPCs cannot be predicted, but surface radiological surveys can be used to increase the probability of finding impacted areas.
- It is possible that the native soil beneath the ponds has been impacted by downward migration of COPCs.
- It is possible that migration of contaminants is occurring in the drainage below the ponds.

The ponds were shown to be contaminated with radiological constituents at activities above their PALs. The surface radiological surveys identified areas in five of the six ponds and the drainage between Ponds 3 and 4 with elevated radiological readings that, when sampled, were shown to have concentrations of radionuclides exceeding the PALs. However, of these only two pond samples and one channel sample had activities that exceeded the FALs as determined in the risk assessment (Appendix D). The CAI also proved that contaminants were not leaching into the native materials below the pond sediments. Although the first CSM postulate was inaccurate, the other postulates and the assumptions used to develop the CSM (DTRA, 2003) were not violated, and the discovery of contamination beyond what was predicted was accounted for during the investigation. Therefore the CSM is valid for this site.

2.2 Results

The following is a summary of the data obtained during the CAI.

2.2.1 Summary of Analytical Data

The COPCs were established in the DQO process and are listed in the CAIP (DTRA, 2003). Analytical results obtained from the CAI were evaluated to determine whether COPCs were detected above the PALs. If the PALs were exceeded, those constituents were moved to a Tier 2 evaluation, and FALs were determined (Appendix D). If concentrations of the constituents exceeded the FALs, they became COCs for CAU 478 and require corrective action. Based on the results of this evaluation, cesium (Cs)-137 and Pu-239 were identified as the only COCs for the site.

The future use for the T-Tunnel Ponds, as defined in the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (DOE/NV, 1996), is assumed to be similar to its current use (Nuclear and High Explosive Test Zone). The industrial

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preliminary remediation goals (PRGs) for evaluating contaminated sites assume exposure pathway scenarios that are most comparable to the activities conducted at similar DTRA sites on the NTS (i.e., training, high explosive tests, and other industrial uses). Under industrial scenarios, the potential exposure pathways are ingestion, inhalation, and dermal contact with contaminated soil (EPA, 2004). Site workers could potentially be exposed to contaminated soil during excavation activities associated with general maintenance or through construction and maintenance of underground utilities. The results for samples collected in the probable zone of intrusion indicate the limited presence of Cs-137 and Pu-239. Therefore, only man-made radionuclides must be considered during evaluation of the identified exposure pathways of ingestion, inhalation, and dermal contact with contaminated soil.

As part of the CAIP (DTRA, 2003), the conceptual model developed for CAU 478 identified potential pathways for migration of contaminants through large precipitation events and by percolation of water through the pond sediments, the underlying alluvium, and into the groundwater. There is no physical evidence that large precipitation events have moved a significant quantity of material downgradient from the ponds. There is radiological contamination in the drainage below Pond 6; however, it is most likely the result of fallout from the Des Moines test, conducted at U12j-Tunnel in June 1962, rather than from migration of contaminants from Pond 6 because, based on process knowledge, Pond 6 never contained enough water to reach the outfall pipe. Analytical results from samples in the native material beneath the ponds show only a single instance of TPH-DRO being present in the native material and no radiological contamination in the underlying native material. The fact that TPH-DRO is the only analyte found in the native material demonstrates the limited mobility of the constituents in the ponds.

The CAI analytical results (Appendix A) indicate the following:

- Diesel-range organics were detected in two samples from Pond 1 and one from Pond 2 in concentrations that exceeded the PAL of 100 milligrams/kilogram (mg/kg) (NAC, 2003b); however, a Tier 2 evaluation showed that none of the hazardous constituents in TPH-DRO exceeded their FALs, so TPH-DRO was not identified as a COC (Appendix D).
- Radionuclide results were compared to the recommended screening limits in the National Council of Radiation Protection and Measurements (NCRP) Report No. 129 (NCRP, 1999) as required by the CAIP (DTRA, 2003). Man-made radionuclides (Cs-137 and Pu-238) were detected above the FALs in three samples. The man-made radionuclide Cs-137 was found in two surface samples in Pond 2, and Pu-239 was found

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in a single native soil sample below Pond 6, which is probably the result of the Des Moines test as discussed above.

 No other COCs were identified in concentrations that exceeded the FALs in any of the samples.

Details of the methods used and results found during the CAI are presented in Appendix A. A statistical analysis of the analytical data from the CAI has demonstrated that the number of samples taken was sufficient and resulted in a greater than 90 percent confidence level that the mean concentrations are representative of the ponds and channels. Based on these results, the nature and extent of COCs at CAU 478 have been adequately identified and were used to develop and evaluate corrective action alternatives.

2.2.1.1 Pond Sediments (CAS 12-23-01)

Except as noted above, none of the chemical constituents were detected above the PALs, so the PALs were identified as the FALs for those constituents. For those constituents that did exceed the PALs, site-specific target levels (SSTLs) were calculated using the limited remote reuse scenario, which then became the FALs for those constituents. The maximum concentration of each detected chemical constituent at this CAS is listed in Table 2-1. A more detailed discussion of the constituents and the determination of the FALs is provided in Appendix D.

Table 2-1
Maximum Reported Chemical Values for CAS 12-23-01, Pond Sediments

(Page 1 of 2)

Contaminant	Result (mg/kg)	Sample No.	Depth (ft bgs)	Final Action Level (mg/kg)
Acetone	0.02	478PS0404	3.5 – 4.5	54,000 ^a
Arsenic	7.7	478PS0602	1.5 – 2.5	23 ^b
Barium	6,400	478PS0602	1.5 – 2.5	67,000 ^a
Beryllium	1.7	478PS150.5	0 – 1.0	1,900 ^a
Bis(2-ethylhexyl)phthalate	2.1	478PS040.5	0 – 1.0	120 ^a
Cadmium	0.5	478PSB020.5	0 – 1.0	450 ^a
Chromium	8.5	478PS030.5	0 – 1.0	450 ^a
Diesel-Range Organics	220	478PS0105.5	5.0 - 6.0	See footnote ^c
Lead	43	478PSBX020.5	0 – 1.0	800 ^a
Mercury	0.084	478PSBX020.5	0 – 1.0	310 ^a

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Table 2-1 Maximum Reported Chemical Values for CAS 12-23-01, Pond Sediments

(Page 2 of 2)

Contaminant	Result (mg/kg)	Sample No.	Depth (ft bgs)	Final Action Level (mg/kg)
Methylene Chloride	0.033	478PS0701	0.5 – 1.5	21 ^a
O-Xylene	0.00077	478PS0404	3.5 – 4.5	420 ^a
P-Isopropyltoluene	0.0014	478PS0404	3.5 – 4.5	2,000 ^a
Selenium	0.34	478PS0404	3.5 – 4.5	5,100 ^a

^aFinal action level based on Region 9 Preliminary Remediation Goals (PRGs) (EPA, 2004).

DRO = Diesel range organics

ft bgs = Feet below ground surface

mg/kg = Milligrams per kilogram

TPH = Total petroleum hydrocarbons

Except as noted above, none of the radionuclides were detected above their PALs, so the PALs were identified as the FALs for those radionuclides. For those radionuclides that did exceed the PALs, SSTLs were calculated using the Residual Radioactive (RESRAD) computer code (Yu et al., 2001), which then became the FALs for those constituents. The maximum concentration of each detected radionuclide at this CAS is listed in Table 2-2. A more detailed discussion of the radionuclides and the determination of the FALs is provided in Appendix D.

Table 2-2
Maximum Reported Radiological Values for CAS 12-23-01, Pond Sediments

(Page 1 of 2)

Contaminant	Result (pCi/g)	Sample No.	Depth (ft bgs)	Final Action Level (pCi/g)
Actinium-228	3.4	478PS050.5	0 – 1.0	5 ^a
Americium-241	3.4	478PS150.5	0 – 1.0	12.7 ^a
Antimony-125	8.3	478PSB040.5	0 – 1.0	18.1 ^a
Bismuth-214	1.24	478PS0701	0.5 – 1.5	5 ^a
Cesium-137	366	478PSB020.5	0 – 1.0	259.2 ^b
Lead-212	3.3	478PSB020.5	0 – 1.0	5 ^a
Lead-214	1.65	478PS120.5	0 – 1.0	5 ^a
Plutonium-238	1.53	478PSB040.5	0 – 1.0	13 ^a
Plutonium-239	15.3	478PSB040.5	0 – 1.0	55.9 ^b

^bNevada Test Site background plus two standard deviations.

^cFinal action level for TPH-DRO is the preliminary action levels for the hazardous constituents found in TPH-DRO.

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Table 2-2 **Maximum Reported Radiological Values for** CAS 12-23-01, Pond Sediments

(Page 2 of 2)

Contaminant	Result (pCi/g)	Sample No.	Depth (ft bgs)	Final Action Level (pCi/g)
Strontium-90	22.8	478PSB020.5	0 – 1.0	838 ^a
Thallium-208	1.09	478PS0701	0.5 – 1.0	5 ^a

^aFinal action level based on background or the National Council on Radiation Protection and Measurements Report No. 129 recommended screening limits for construction, commercial, and industrial land-use scenario (NCRP, 1999) scaled from 25- to 15-millirem-per-year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5

Bold indicates the result exceeds the FAL.

FAL = Final action level ft bgs = Feet below ground surface pCi/g = Picocuries per gram RESRAD = Residual Radioactive

2.2.1.2 Native Material Under the Pond Sediments

None of the chemical constituents found in the native material beneath the pond sediments exceeded the PALs as identified in the CAIP (DTRA, 2003) except for TPH-DRO, so the PALs are identified as the FALs for those constituents. The maximum concentration of each detected chemical contaminant found in the native material at this CAS is listed in Table 2-3.

Table 2-3 **Maximum Reported Chemical Values for Native Material Under the Pond Sediments**

(Page 1 of 2)

Contaminant	Result (mg/kg)	Sample No.	Depth (ft bgs)	Final Action Level (mg/kg)
2-Hexanone	0.33	478PS130.5	0 – 1.0	110,000 ^a
Acetone	0.039	478PS0112	11.5 – 12.5	54,000 ^a
Arsenic	6.6	478PS0906.5	6.0 – 7.0	23 ^b
Barium	2,400	478PS0607.5	7.0 – 8.0	67,000 ^a
Beryllium	2.4	478PS0906.5	6.0 – 7.0	1,900 ^a
Bis(2-ethylhexyl)phthalate	0.23	478PS0112	11.5 – 12.5	120 ^a
Cadmium	0.26	478PS0112	11.5 – 12.5	450 ^a
Chromium	9.7	478PS0607.5	7.0 – 8.0	450 ^a
Diesel-Range Organics	150	478PS0112	11.5 – 12.5	See footnote ^c
Lead	25	478PS0906.5	6.0 - 7.0	800 ^a

⁶Final action level based on RESRAD calculation (Yu et al., 2001) for remote use scenario.

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Table 2-3
Maximum Reported Chemical Values for
Native Material Under the Pond Sediments
(Page 2 of 2)

Contaminant	Result (mg/kg)	Sample No.	Depth (ft bgs)	Final Action Level (mg/kg)
Mercury	0.037	478PS1204.5	4.0 - 5.0	310 ^a
Methylene Chloride	0.035	478PS1505.5	5.0 - 6.0	21 ^a
Selenium	0.84	478PS0906.5	6.0 – 7.0	5,100 ^a
Silver	0.1	478PS1304.5	4.0 – 5.0	5,100 ^a

^aFinal action level based on Region 9 Preliminary Remediation Goals (PRGs) (EPA, 2004).

DRO = Diesel range organics ft bgs = Feet below ground surface mg/kg = Milligrams per kilogram TPH = Total petroleum hydrocarbons

None of the radionuclides found in the native material under the pond sediments exceeded the PALs as defined in the CAIP (DTRA, 2003), so the PALs for those radionuclides are identified as the FALs. The maximum concentration of each detected radionuclide found in the native material under the pond sediments at this CAS is listed in Table 2-4.

Table 2-4
Maximum Reported Radiological Values for
Native Material Under the Pond Sediments

Contaminant	Result (pCi/g)	Sample No.	Depth (ft bgs)	Final Action Level (pCi/g) ^a
Actinium-228	3.36	478PS1106.5	6.0 - 7.0	15
Bismuth-214	2.1	478PSB0109.5	9.0 – 10.0	15
Cesium-137	7.6	478PS1003	2.5 - 3.5	12.2
Lead-212	3.3	478PS1106.5	6.0 - 7.0	15
Lead-214	1.87	478PSB0209.5	9.0 – 10.0	15
Plutonium-239	0.47	478PS0607.5	7.0 – 8.0	12.7
Thallium-208	1.28	478PS0906.5	6.0 – 7.0	15

^aFinal action level based on background or the National Council on Radiation Protection and Measurements Report No. 129 recommended screening limits for construction, commercial, and industrial land-use scenario (NCRP, 1999) scaled from 25- to 15-millirem-per-year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).

ft bgs = Feet below ground surface

pCi/g = Picocuries per gram

^bNevada Test Site background plus two standard deviations.

^cFinal action level for TPH-DRO is the preliminary action levels for the hazardous constituents found in TPH-DRO.

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2.2.1.3 Channel Soils

None of the chemical constituents found in the channel soils exceeded the PALs as identified in the CAIP (DTRA, 2003), so the PALs are identified as the FALs. The maximum concentration of each detected chemical contaminant found in the channel soils at this CAS is listed in Table 2-5.

Table 2-5
Maximum Reported Chemical Values for Channel Soils

Contaminant	Result (mg/kg)	Sample No.	Depth (ft bgs)	Final Action Level (mg/kg)
2-Hexanone	0.044	478CSB0303	2.5 – 3.5	110,000 ^a
Acetone	0.028	478CS0603	2.5 – 3.5	54,000°
Arsenic	3.6	478CS080.5	0 – 1.0	23 ^b
Barium	980	478CS1501	0.5 – 1.5	67,000 ^a
Benzoic Acid	0.93	478CS210.5	0 – 1.0	100,000 ^a
Beryllium	1.8	478CS1703	2.5 – 3.5	1,900 ^a
Bis(2-ethylhexyl)phthalate	0.37	478CS1703	2.5 – 3.5	120 ^a
Cadmium	0.14	478CS190.5	0 – 1.0	450°
Chromium	6.3	478CS080.5	0 – 1.0	450°
Diesel-Range Organics	17	478CS170.5	0 – 1.0	100 ^c
Lead	20	478CS010.5	0 – 1.0	800°
M+P-Xylene	0.0034	478CS020.5	0 – 1.0	420°
Mercury	0.031	478CS020.5	0 – 1.0	310 ^a
Methylene Chloride	0.031	478CS2301.5	1.0 – 2.0	21 ^a
O-Xylene	0.0015	478CS020.5	0 – 1.0	420 ^a
Selenium	0.45	478CS200.5	0 – 1.0	5,100 ^a

^aFinal action level based on Region 9 Preliminary Remediation Goals (PRGs) (EPA, 2004).

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

None of the radionuclides found in the channel soils exceeded the PALs as defined in the CAIP (DTRA, 2003) except for Cs-137 and Pu-239, so the PALs for those radionuclides are identified as the FALs. For those radionuclides that exceeded the PALs, SSTLs were calculated using the RESRAD computer code (Yu et al., 2001). The SSTLs then became the FALs for those constituents. The maximum concentration of each detected radionuclide found in the native material under the pond sediments at this CAS is listed in Table 2-6.

^bNevada Test Site background plus two standard deviations.

^cNevada Administrative Code 445A.2272 (NAC, 2003b)

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Table 2-6
Maximum Reported Radiological
Values for Channel Soils

Contaminant	Result (pCi/g)	Sample No.	Depth (ft bgs)	Final Action Level (pCi/g)
Actinium-228	3.23	478CS040.5	0 – 1.0	5 ^a
Americium-241	11	478CS190.5	0 – 1.0	12.7 ^a
Bismuth-212	4.7	478CS040.5	0 – 1.0	5 ^a
Bismuth-214	1.7	478CS140.5	0 – 1.0	5 ^a
Cesium-137	65	478CS170.5	0 – 1.0	259.2 ^b
Europium-152	1.12	478CSX230.5	0 – 1.0	5.7 ^a
Lead-212	3.17	478CS2403	2.5 - 3.5	5 ^a
Lead-214	1.61	478CSB0205.5	5.0 – 6.0	5 ^a
Plutonium-238	7.06	478CS260.5	0 – 1.0	13 ^a
Plutonium-239	79	478CS260.5	0 – 1.0	55.9 ^b
Strontium-90	5.2	478CS190.5	0 – 1.0	838 ^a
Thallium-208	1.09	478CS1001.5	1.0 – 2.0	5 ^a

^aFinal action level based on background or the National Council on Radiation Protection and Measurements Report No. 129 recommended screening limits for construction, commercial, and industrial land-use scenario (NCRP, 1999) scaled from 25- to 15-millirem-per-year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).

Bold indicates the result exceeds the FAL.

FAL = Final action level ft bgs = Feet below ground surface pCi/g = Picocuries per gram RESRAD = Residual Radioactive

2.2.1.4 T-Tunnel Background

Table 2-7 shows the maximum concentration of chemical constituents found in the background samples. Table 2-8 shows the maximum concentration of radionuclides found in the background samples.

Table 2-7
Maximum Reported Chemical Values for T-Tunnel Background
(Page 1 of 2)

Contaminant	Result (mg/kg)	Sample No.	Depth (ft bgs)	Final Action Level (mg/kg)
Arsenic	3.8	TS-B3-01	0.5 – 1.5	23 ^a
Barium	110	TS-B3-01	0.5 – 1.5	67,000 ^b
Cadmium	0.088	TS-B3-01	0.5 – 1.5	450 ^b

^bFinal action level based on RESRAD calculation (Yu et al., 2001) for remote use scenario.

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Table 2-7 **Maximum Reported Chemical Values for T-Tunnel Background** (Page 2 of 2)

Contaminant	Result (mg/kg)	Sample No.	Depth (ft bgs)	Final Action Level (mg/kg)
Chromium	6	TS-B3-01	0.5 – 1.5	450 ^b
Lead	12	TS-B2-01	0.5 – 1.5	800 ^b

^aNevada Test Site background plus two standard deviations.

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

> Table 2-8 Maximum Reported Radiological Values for T-Tunnel Background

Contaminant	Result (pCi/g)	Sample No.	Depth (ft bgs)	Final Action Level (pCi/g)
Actinium-228	3.2	TS-B2-01	0.5 – 1.5	5ª
Americium-241	2.8	TS-B2-01	0.5 – 1.5	12.7 ^a
Bismuth-214	2.4	TS-B2-01	0.5 – 1.5	5 ^a
Cesium-137	13.5	TS-B2-01	0.5 – 1.5	259.2 ^b
Lead-212	2.76	TS-B3-01	0.5 – 1.5	5 ^a
Lead-214	1.59	TS-B1-01	0.5 – 1.5	5 ^a
Plutonium-238	1.03	TS-B2-01	0.5 – 1.5	13 ^a
Plutonium-239	9.6	TS-B2-01	0.5 – 1.5	12.7 ^a
Thallium-208	0.88	TS-B1-01	0.5 – 1.5	5 ^a

^aFinal action level based on background or the National Council on Radiation Protection and Measurements Report No. 129 recommended screening limits for construction, commercial, and industrial land-use scenario (NCRP, 1999) scaled from 25- to 15-millirem-per-year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993). ^bFinal action level based on RESRAD calculation (Yu et al., 2001) for remote use scenario.

ft bgs = Feet below ground surface pCi/g = Picocuries per gram RESRAD = Residual Radioactive

2.2.2 Data Assessment Summary

The data quality assessment (DQA) is presented in Appendix C 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 are available to support the resolution of those decisions at an appropriate level of

^bFinal action level based on Region 9 Preliminary Remediation Goals (PRGs) (EPA, 2004).

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confidence. Using both the DQO and DQA processes helps ensure that DQO decisions are sound and defensible.

The DQA process as presented in Appendix C 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.

Sample locations that support the presence and/or extent of contamination at CAU 478 are shown in Appendix A. Based on the results of the DQA presented in Appendix C, the DQO requirements have been met, and the close in place with use restrictions corrective action alternative was selected as the closure alternative for CAU 478 (Area 12 T-Tunnel Ponds). The DQA also determined that information generated during the investigation supports the CSM assumptions, and the data collected support the intended use in the decision-making process.

2.3 Justification for No Further Action

Use restrictions with no further corrective action is justified based on an evaluation of risk (see Appendix D) to ensure protection of the public and the environment in accordance with *Nevada Administrative Code* (NAC) 445A (NAC, 2003a), feasibility, and cost effectiveness. The corrective action was determined from DQO decision statements based on a comparison of the analyte concentrations detected in CAI soil samples to the FALs defined in Section 2.3.1. Because the extent of the COCs is limited and the CAI demonstrated that there is no vertical migration through the pond sediments into the native material below, the corrective action to close in place with administrative controls is justified at CAU 478. Appendix D presents an evaluation of risk associated with the recommended closure alternative.

2.3.1 Final Action Levels

The CAU 478 FALs are risk-based cleanup goals that, if met, will ensure that each release site will not pose an unacceptable risk to human health or the environment under the occasional use exposure scenario, and that the conditions at each site are in compliance with all applicable laws and regulations. The process described in this section to define and determine the FALs conforms to NAC Section 445A.2272 (NAC, 2003b), which lists the requirements for sites with soil contamination. For the evaluation of corrective actions, NAC Section 445A.22705 (NAC, 2003c) recommends the use of American Society for Testing and Materials (ASTM)

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Method E 1739-95 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."

The ASTM procedure (ASTM, 1995) defines three tiers (or levels) of evaluation involving increasingly sophisticated analyses as follows.

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 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 are not used for risk-based decisions under Tier 2 or Tier 3. Rather, the individual hazardous constituents in TPH are compared to their SSTLs.

Alternatively, the Tier 2 risk-based corrective action process SSTLs may be compared to the predicted concentration or activity of the contaminant at the point of exposure based on attenuation from the source using relatively simplistic mathematical models. Points of exposure are defined as those locations at which an individual or population may come in contact with a COC originating from a CAS. If a Tier 2 evaluation is conducted, the calculations used to derive the SSTLs and the contaminant attenuation calculations will be provided as an appendix to the investigation report. If remediation to Tier 2 SSTLs is not practical, a Tier 3 evaluation may be conducted.

Tier 3 Evaluation – A Tier 3 evaluation is conducted by calculating SSTLs on the basis of more sophisticated risk analyses using methodologies described in ASTM Method E 1739-95 that consider site-, pathway-, and receptor-specific parameters. Tier 3 evaluation is much more complex than Tiers 1 and 2, because it may include additional site characterization, probabilistic evaluations, and sophisticated chemical fate/transport models. The Tier 3 SSTLs are then compared to the upper 95 percent confidence limit of the mean of sample results from reasonable points of exposure (as opposed to individual sample results as is done in Tier 2). Contaminant concentrations exceeding Tier 3 SSTLs require corrective action. If a Tier 3 evaluation is

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conducted, the calculations used to derive the SSTLs and the upper confidence limit of the means will be provided as an appendix to the investigation report.

A Tier 1 evaluation was conducted for all COPCs to determine whether contaminant levels satisfy the criteria for regulatory closure or warrant a more site-specific assessment. This was accomplished by comparing individual source area contaminant concentration results to the Tier 1 actions levels (the PALs established in the CAIP). The Tier 1 PALs were for the industrial use scenario.

The constituents detected at CAU 478 that exceeded Tier 1 action levels were:

- TPH-DRO
- Cs-137
- Pu-239

The concentrations of all constituents not listed above were below Tier 1 action levels, and the corresponding PALs were established as the Tier 1 FALs. The constituents that exceeded Tier 1 action levels were moved to a Tier 2 evaluation.

The Tier 2 evaluation of TPH-DRO compared the concentrations of the individual hazardous constituents of TPH-DRO to the Tier 1 action levels in the sample that exceeded for TPH-DRO. No hazardous constituents were found in the samples and therefore did not exceed Tier 1 action levels, so site-specific action levels were not calculated. The PALs were established as the FALs for the hazardous constituents in TPH-DRO at CAU 478. The FALs are presented in Table 2-9. Additional details of the Tier 2 evaluation are provided in Appendix D.

Table 2-9 Tier 2 SSTLs and CAU 478 Results for Hazardous Constituents of Diesel (Page 1 of 2)

CAS No.	Common Name	SSTL (mg/kg)	Maximum Reported Value (mg/kg)
108-67-8	1,3,5-Trimethylbenzene	70	ND
91-57-6	2-Methylnaphthalene ^a	190	ND
120-12-7	Anthracene	100,000	ND
71-43-2	Benzene	1.4	ND
56-55-3	Benzo(a)anthracene	2.1	ND
50-32-8	Benzo(a)pyrene	0.21	ND
205-99-2	Benzo(b)fluoranthene	2.1	ND

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Table 2-9
Tier 2 SSTLs and CAU 478 Results for Hazardous Constituents of Diesel
(Page 2 of 2)

CAS No.	Common Name	SSTL (mg/kg)	Maximum Reported Value (mg/kg)
191-24-2	Benzo(g,h,i)perylene	29,000	ND
207-08-9	Benzo(k)fluoranthene	21	ND
218-01-9	Chrysene	210	ND
100-41-4	Ethylbenzene	400	ND
206-44-0	Fluoranthene	22,000	ND
86-73-7	Fluorene	26,000	ND
91-20-3	Naphthalene	190	ND
104-51-8	N-Butylbenzene	240	ND
103-65-1	N-Propylbenzene	240	ND
85-01-8	Phenanthrene	100,000	ND
129-00-0	Pyrene	29,000	ND
108-88-3	Toluene	520	ND
1330-20-7	Total Xylene ^b	420	ND

^aUses PRG for naphthalene as surrogate

CAS = Chemical Abstracts Service mg/kg = Milligrams per kilograms ND = Nondetect

SSTL = Site-specific target level

None of the other chemical constituents exceeded the PALs, so a Tier 2 evaluation was not conducted. The PALs were established as the FALs for the chemical constituents other than TPH-DRO.

The Tier 2 evaluation for the radionuclides was conducted by entering site-specific radionuclide information and physical characteristics of the site into the RESRAD program (Yu et al., 2001) to calculate the site-specific action levels. This calculated the site-specific minimum activities needed to sum to an exposure dose of 25 millirem per year (mrem/yr) to a site receptor. These calculated concentrations were established as the FALs for each radionuclide at the CAS that exceeded a Tier 1 action level. The Tier 2 calculated FALs are presented in Table 2-10. Additional details of the Tier 2 evaluation are provided in Appendix D.

^bTotal of m-, o-, and p-xylenes

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Table 2-10 Final Action Levels

COPCs	Tier 1 FALs	Tier 2 FALs	Tier 3 FALs
VOCs	PALs	N/A	N/A
SVOCs	PALs	N/A	N/A
RCRA metals	PALs	N/A	N/A
TPH-DRO	PALs	TPH-DRO hazardous constituent PALs	N/A
Radionuclides	PALs except as listed under Tier 2	Cs-137, 259 pCi/g; Pu-239, 55.9 pCi/g	N/A

COPC = Contaminant of potential concern

Cs = Cesium

DRO = Diesel-range organics

FAL = Final action level N/A = Not applicable

PAL = Preliminary action level

pCi/g = Picocuries per gram

Pu = Plutonium

RCRA = Resource Conservation and Recovery Act SVOC = Semivolatile organic compound TPH = Total petroleum hydrocarbons VOC = Volatile organic compound

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3.0 Recommendations

The data generated by the CAI show that the FALs were exceeded for Cs-137 and Pu-239 at CAU 478, Area 12 T-Tunnel Ponds. Therefore, closure in place with use restrictions is considered the best option for closing this site. This recommendation is based on the fact that even though the FALs were exceeded for Cs-137 and Pu-239, this remote, controlled access site poses only limited risk overall to public health and the environment. The future use of CAU 478 will be restricted from any activity unless concurrence is obtained from NDEP. The use restriction will prevent inadvertent contact with the COCs, and meets all applicable state and federal regulations for closure of the site.

In conclusion, DTRA 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.

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Appendix A

Corrective Action Investigation Report for CAU 478: Area 12 T-Tunnel Ponds, Nevada Test Site

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Executive Summary

The Corrective Action Investigation (CAI) of the T-Tunnel Ponds, identified under the *Federal Facility Agreement and Consent Order* (FFACO) (1996) classification as Corrective Action Unit 478, consists of one Corrective Action Site (CAS): 12-23-01, Ponds (5), RAD Area. Although the FFACO mentions five ponds, there are actually six ponds at T-Tunnel. The activities completed during the CAI were a walkover radiological survey, rotosonic drilling and soil sampling, and hand soil sampling.

In February 2003, IT Corporation personnel conducted walkover radiological surveys of the Area 12 T-Tunnel Ponds and associated channels between the muckpile and ponds, between the ponds, and downgradient of Pond 6. The survey showed the gamma radiation emission rate was elevated in Ponds 1, 2, and 3, with the highest rate in Pond 3.

The next stage of the investigation consisted of rotosonic drilling to collect soil samples from within and beneath the ponds and channels. This was conducted over eight work days between April 30 and May 7, 2003. Fifty locations were drilled or hand sampled to characterize the pond sediments, the native material under the ponds, and the channels. A total of 270 feet (ft) were drilled in 40 boreholes ranging from 4 to 13.5 ft deep. Ten locations were sampled by hand. One to three samples were collected from each location. During the characterization, 85 environmental samples were collected. These included 20 pond sediment samples, 22 native material samples, and 43 channel samples. Five duplicate and five lab quality control (QC) soil samples were collected for QC purposes. Forty-one QC water samples were collected (5 equipment rinsate samples, 5 field blank samples, and 31 trip blanks). All soil and water samples were sent to Paragon Analytics, Inc., for analysis. Analyses performed included volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH)-diesel-range organics (DRO), total *Resource Conservation and Recovery Act* (RCRA) metals and beryllium, radionuclides, and isotopic plutonium and strontium for waste management purposes.

The RCRA metals, radionuclides, VOCs, SVOCs, and TPH were detected in soil samples from the channels, the pond sediments, and the native soil under the pond sediments.

During the CAI, 11 drums of investigation-derived waste were accumulated, 10 drums of rinsate from decontamination activities and 1 drum of PPE. The environmental sample analytical results were used to make the waste determination that none of the drums were considered to contain hazardous waste or radiological constituents above the performance objective criteria. All of the drums were disposed of as sanitary waste.

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A.1.0 Introduction

The Corrective Action Investigation (CAI) of the Area 12 T-Tunnel Ponds and associated channels was conducted in accordance with the *Federal Facility Agreement and Consent Order* (FFACO) (1996) that was agreed to by the U.S. Department of Defense, the U.S. Department of Energy, and the Nevada Division of Environmental Protection. The investigation was controlled and guided by the Corrective Action Unit (CAU) 478 Corrective Action Investigation Plan (CAIP) (DTRA, 2003a); Field Instructions (DTRA, 2003b), which referenced the operational checklists; and the site-specific health and safety plan (SSHASP) (IT, 2003). The Area 12 T-Tunnel Ponds are identified in the FFACO as CAU 478, which contains one corrective action site (CAS), 12-23-01, Ponds (5), RAD Area. In addition to the ponds, the channels between the muckpile and the ponds, the area between the ponds, and below the last pond were also investigated. This report presents a summary of the field activities and the data collected during the field effort.

Section A.1.0 of this report is the introduction, which includes a description of the purpose and scope of the project. Section A.2.0 is the project description. Section A.3.0 covers the Area 12 T-Tunnel Ponds investigation and provides a description of the sample collection activities and locations. Section A.4.0 is a summary of the sample analytical results from the samples collected during the CAI. Section A.5.0 provides a description of the waste management activities. Section A.6.0 covers the health and safety aspects of the project, and Section A.7.0 lists the references.

A.1.1 Purpose

The purpose of the Area 12 T-Tunnel Ponds CAI was to determine whether the Area 12 T-Tunnel Ponds, the underlying native soils, and/or the associated channels have been impacted by contaminants of potential concern (COPCs) at concentrations that exceed regulatory limits. The data collected during the field effort, which are presented in this report, will enable the Defense Threat Reduction Agency (DTRA) to make informed decisions about the future use or closure of the site. The ponds primarily consist of fine-grained sediments that settled out of water drained from the T-Tunnel workings during excavation, construction, and operations in support of nuclear weapons effects testing. The investigation was conducted to achieve the following goals:

 Determine whether chemical and radiological COPCs are present within or beneath the ponds.

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• Determine whether chemical and radiological COPCs are present in the channels between the muckpile and the ponds, between the ponds, and downgradient of the last pond.

 Provide sufficient information and data to develop appropriate corrective action strategies for the ponds. These strategies are evaluated in the Corrective Action Decision Document/Closure Report.

A.1.2 Scope of Work

The scope of the Area 12 T-Tunnel Ponds investigation included the following:

- Conduct walkover radiological surveys using field-screening instruments to locate areas with elevated radiological levels in the CAU.
- Drill boreholes using the dry rotosonic drilling method to collect subsurface environmental soil samples for laboratory analysis.
- Conduct volatile organic compound (VOC) and radiological field screening for health and safety monitoring and to help direct biased sample collection.
- Visually inspect the drill cores to describe soil characteristics and identify the sediment/native material contact, and field screen the core with hand-held instruments to identify subsurface layers or areas with elevated radiological readings.
- Conduct laboratory analysis of the soil samples to determine the presence or absence of COPCs.

The drilling and sampling locations were randomly selected using a stratified random sampling approach as described in Chapter 5 of *Statistical Methods for Environmental Pollution Monitoring* (Gilbert, 1987). Biased locations for surface and subsurface samples were selected based on the results of the walkover radiological survey.

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A.2.0 Project Description

The Area 12 T-Tunnel Ponds, CAU 478, are located approximately 42 miles north of Mercury in Area 12 of the Nevada Test Site (Figure A.2-1). Corrective Action Unit 478 consists of one CAS, 12-23-01, Ponds (5), RAD Area. Between 1970 and 1987, T-Tunnel was used for six nuclear weapons effects tests and two high explosive tests. The T-Tunnel Ponds (Figure A.2-2) were used as settling ponds for groundwater encountered during tunnel excavation, construction water, and water produced during re-entry activities following each test. The T-Tunnel Ponds consist of six unlined ponds, ranging from 80 to 160 feet (ft) long and 50 to 170 ft wide. The ponds are located beside one another in an easterly trend with an earthen berm separating each pond from the one below it. Open channels connect each pond with the next pond, and extend downgradient from the last pond. The upgradient end of the first pond is buried by the muckpile. The last earthen berm is approximately 1,260 ft east of the muckpile. The channel was characterized to about 100 ft below the last pond berm. In 1993, effluent discharge elimination plugs were emplaced in the tunnel as part of the T-Tunnel mothball program. No water or sediments have been discharged to the ponds since that time. The ponds are dry and have not contained water since the tunnels were mothballed.

A.2.1 Surface Radiological Surveys

Before commencing drilling and sampling, walkover radiological surveys were conducted to identify surface and near surface areas with elevated readings.

A.2.2 Pond Sample Locations

The pond borehole locations at CAU 478 were identified using a stratified random sampling strategy as defined in Gilbert (1987). Before commencing the drilling operations, IT Corporation (IT) scientists used a Trimble Global Positioning System (GPS) total station surveying instrument to identify and mark the proposed location of each of the random boreholes. A total of 19 pond sampling locations were identified in the 6 ponds (4 biased and 15 random).

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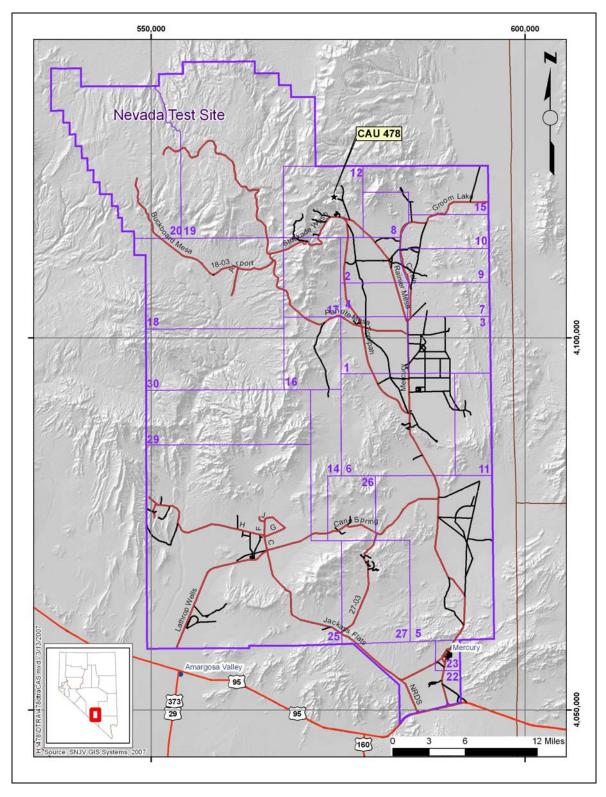


Figure A.2-1
T-Tunnel Ponds Location Map, Area 12, Nevada Test Site

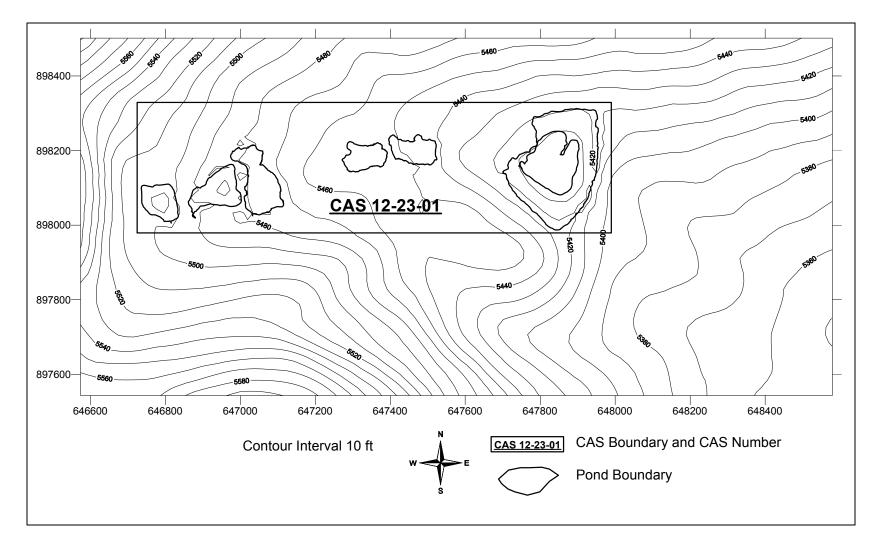


Figure A.2-2 CAU 478 CAS Location Map

Uncontrolled When Printed

A.2.3 Channel Sample Locations

In addition to the pond sample locations, 31 channel sample locations were identified (4 biased and 27 random). The channel sample locations were identified using a stratified random sampling strategy as defined in Gilbert (1987). Before commencing drilling operations, IT scientists used a Trimble GPS total station surveying instrument to identify and mark the proposed sample locations.

A.2.4 Other Sample Locations

Three background samples were collected during the CAU 476 T-Tunnel Muckpile investigation in 2000 at biased locations in undisturbed areas around the muckpile (DTRA, 2000). These samples were used as the background samples for this investigation.

A.2.5 Checklists

To increase the efficiency and completeness of the field effort, checklists were used during the T-Tunnel Ponds characterization to track individual field tasks. Table A.2-1 contains a list of the checklists, as well as detailing when and how often each checklist was used.

Table A.2-1 Checklists (Page 1 of 3)

Checklist	Purpose	Responsible Persons	Frequency	Timing
Waste Management Pre-Field	Ensure that all appropriate documentation has been prepared and issued and everything is ready to properly handle all waste streams generated at the site.	Waste Management Coordinator	Once	Before mobilization
RCT - Initial	Ensure documentation is in place and has been reviewed and signed, that required monitoring instruments are available and operational. These tasks mitigate the potential for personnel exposure.	Site RCT	Once	At project initiation

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Table A.2-1 Checklists (Page 2 of 3)

Checklist	Purpose	Responsible Persons	Frequency	Timing
Health & Safety Prefield and Mobilization	Ensure all documents and required forms have been prepared, are available, that all facilities have been notified, that all personnel have the required training and certifications, that all H&S monitoring equipment is available and operational, and that all H&S supplies are available at the site. This will mitigate potential exposures to personnel and reduce the risk of accidents.	Site Safety Officer	Once	Before and during mobilization
Mobilization	Ensure that the site is ready for the field activities, that all documentation is in place, and that equipment and supplies are available on site.	Site Supervisor	Once	Before fieldwork begins
Rig Geologist	Ensure the hole is properly field screened and logged, all required information is entered on the borehole log, and that the hole is properly abandoned and marked.	DTRA Representative	One for each borehole	During and after drilling
Drill Rig Safety Inspection	Ensure the drill rig meets all required safety standards to mitigate possible personnel injury resulting from faulty or worn equipment, and/or inadequate safety devices.	Site Supervisor and/or Rig Geologist and Site Safety Officer	Once	Before the start of fieldwork
Sampling	Ensure all supplies are ready for the days sampling, that the samples are collected and handled properly, that required QA/QC samples are collected, and that all paperwork is completed correctly.	Sampler	Daily	Before, during, and after sampling
Decontamination	Ensure adequate decon equipment and supplies are available for the day, that deconned equipment is properly handled and screened if contamination is encountered, and that the rinsate and any sediment generated is properly handled.	Rig Geologist and/or Sampler	Daily on days when decon is done	Before, during, and after deconning

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Table A.2-1 Checklists (Page 3 of 3)

Checklist	Purpose	Responsible Persons	Frequency	Timing
RCT Daily	Ensure equipment is operational, there is adequate PPE, and that monitoring information is collected and disseminated as required.	Site RCT	Daily	Before, during, and after fieldwork
General Equipment Inspection	Ensure equipment (other than H&S monitoring equipment) used during site activities, including heavy equipment and portable power tools, is safe and operational.	Equipment Operator	Initial entry to site, daily before use	Before use of the equipment
Health and Safety Periodic Inspection	Ensure safety equipment is available and up to date, that all postings are current, and that monitoring results are being disseminated to the workers.	Site Safety Officer	Weekly	During field effort

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A.3.0 Ponds Investigation

The CAI of the T-Tunnel Ponds and Channels was conducted over eight work days between April 30 and May 7, 2003. The walkover radiological surveys were conducted on February 10 and 11, 2003. The drillers mobilized to the site from P-Tunnel on April 29 and 30. Drilling commenced on April 30 and continued to May 7. Sampling was completed May 7, and the job site was demobilized on May 7 and 8.

A.3.1 Work Packages

The Defense Threat Reduction Agency is the primary Real Estate/Operations Permit (REOP) holder (REOP Number DTRA-0008) and is responsible for safety at the site. Five Work Packages were prepared by Shaw and Stoller-Navarro and approved by DTRA so that the work could be conducted under the DTRA REOP.

A.3.2 Surface Radiological Surveys

The walkover radiological surveys were conducted on February 10 and 11, 2003. No drive-over radiological surveys were conducted because the ponds were not accessible by vehicles. Results from the walkover surveys are shown in Figure A.3-1.

The walkover radiological surveys were conducted by walking over the channels and ponds with a TSA Model PRM-470B small-area plastic scintillation (SAPS) detector, and a Trimble Pathfinder Pro XRSTM GPS receiver with a TSC1TM data logger. Each radiological measurement was taken with the SAPS detector and recorded on the TSC1 data logger and stored with its related GPS coordinate in a combined file.

Approximately 3 acres were surveyed and a total of 15,310 gamma measurements were recorded. The highest gamma measurement detected was 3,687 counts per second (cps) at Nevada State Plane coordinates E646,980.0, N898,062.6. This level is 13.3 times larger than the undisturbed background radiation emission rate of 278 cps. The mean gamma radiation emission rate is 837 cps. The elevated readings are confined to the first five ponds, with the highest level occurring in Pond 3 (Figure A.3-1).

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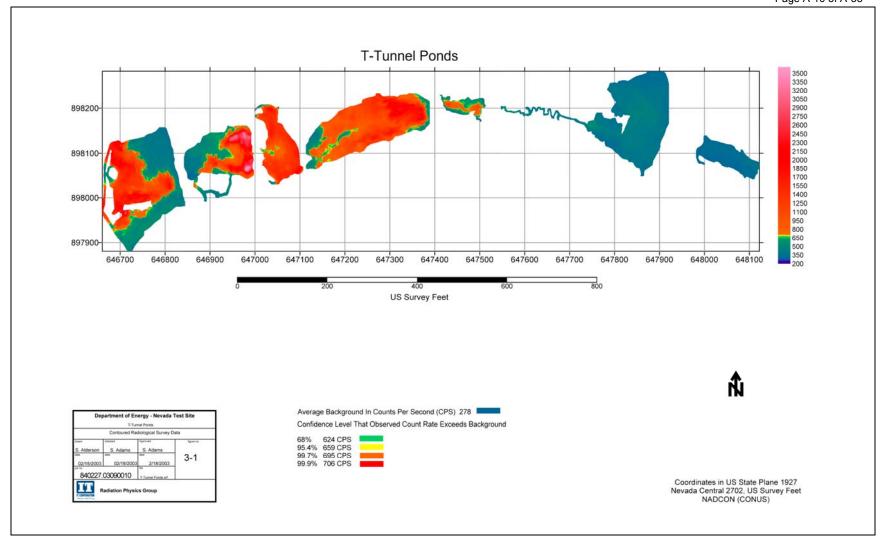


Figure A.3-1 CAU 478 Radiological Survey

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A.3.3 Pond Samples; CAS 12-23-01 Ponds (5), RAD Area

The pond sediment sampling consisted of drilling boreholes through the sediment into the native material underneath using a rotosonic drill. If the native material was alluvial in nature, the borehole was advanced 5 ft into the native material. If the native material was bedrock, the borehole was only advanced 2 ft into the native material or until refusal. Copies of the soil boring logs are in Attachment A. A total of 159 ft of rotosonic drilling was completed in 19 boreholes to characterize the pond sediments and the native material under the ponds. Cross sections of the ponds are in Attachment B. As-built borehole and sample locations are shown on Figures A.3-2 through A.3-4. Fifteen of the borehole locations were selected using the stratified random sampling strategy. These locations were designated as TPH01 through TPH15.

In addition to the 15 random sample locations, 4 biased sample locations were selected. The location for the biased samples was determined using the results of the walkover radiological surveys. One biased hole was drilled at each of the 4 locations with the highest gamma readings. One location was picked in Ponds 1, 2, 4, and 5. These locations were designated as TPB01 through TPB04.

Two soil samples were collected from each random borehole, one at a randomly selected depth (the z-depth) and one from the bottom of the borehole. Two samples were also collected from each biased borehole, one from the interval with the highest field screening result and one from the bottom of the hole. In addition, four optional samples were collected from the random boreholes at intervals which exceeded field-screening levels. From the 19 sample locations, 20 environmental soil samples were collected to characterize the pond sediments and 22 environmental soil samples were collected to characterize the native material underneath the pond sediments. Radiation Material Determination Worksheets were prepared when cores exceeded field-screening levels. All of the soil samples were sent to an offsite laboratory to be analyzed for VOCs, semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH)-diesel-range organics (DRO), total *Resource Conservation and Recovery Act* (RCRA) metals with beryllium, and radionuclides. The samples were archived so that once the results were received and evaluated, 25 percent of the samples could be analyzed for strontium (Sr)-90 and isotopic plutonium (Pu) for waste management purposes.

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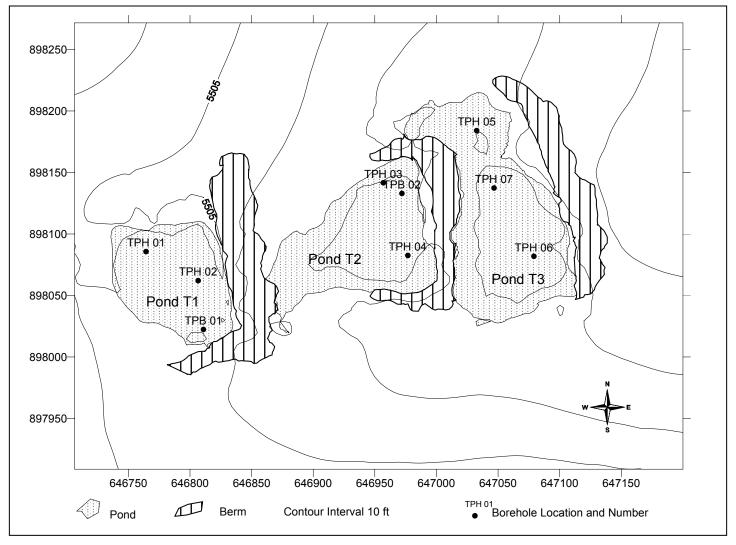


Figure A.3-2 T-Tunnel Ponds 1 to 3, Boreholes; Biased 1 & 2, Random 1 to 7

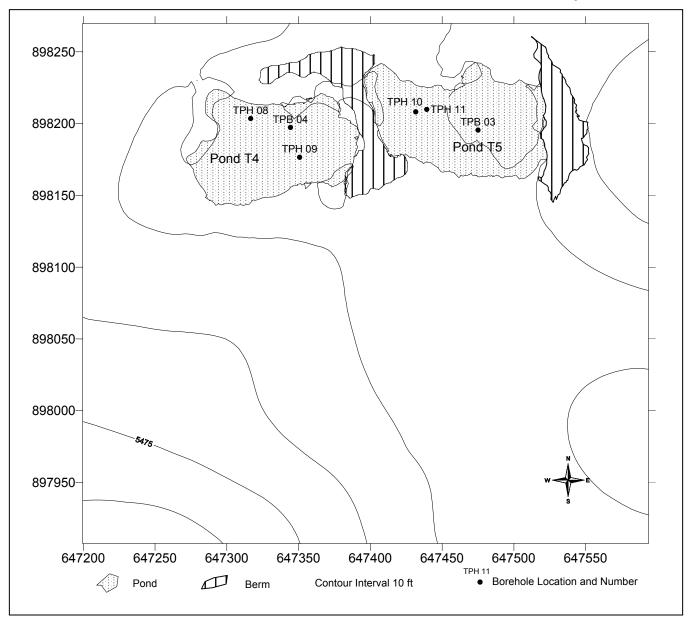


Figure A.3-3
T-Tunnel Ponds 4 & 5, Boreholes; Biased 3 & 4, Random 8 to 11

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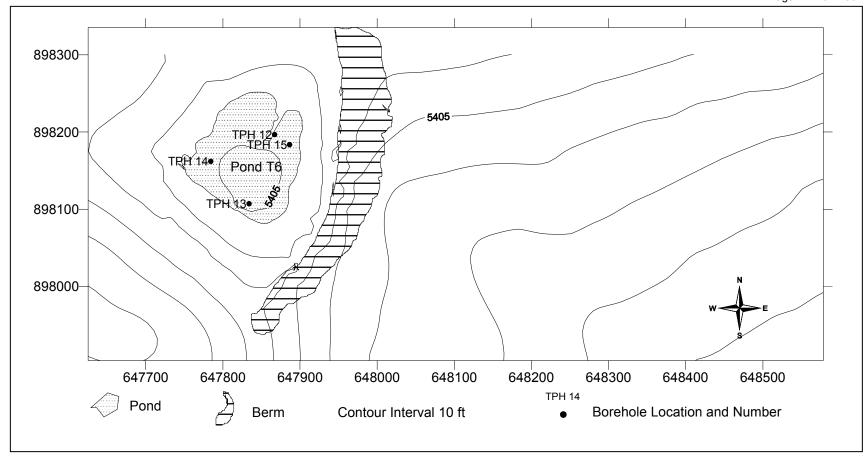


Figure A.3-4 T-Tunnel Pond 6, Boreholes; Random 12 to 15

A.3.4 Channel Soil Samples

Of the 31 locations sampled in the channels, the rotosonic drill rig was used to sample 18 of the random and 3 of the biased locations. The other 9 random and 1 biased locations were sampled using hand tools. At most of the locations sampled with the rotosonic drill rig, a hole was drilled to a depth of 5 ft. At the hand sampled locations, a hole was dug between 0.5 and 2.5 ft deep depending on the hardness of the ground. A total of 111 ft of rotosonic drilling and 12 ft of hand digging were completed in 21 boreholes and 10 hand-sample locations to characterize the channels. Once the core was recovered it was field screened and sampled. If the field screening did not identify elevated readings for any sections of core, a sample was collected between 0 and 1 ft and no other samples were collected. If field-screening levels were exceeded, the 0 to 1 ft sample was collected and the section with elevated readings was also collected. The same strategy was followed for the random hand-sample locations. The biased hand sample was collected from the bottom of the hole. A total of 43 environmental soil samples, 31 regular samples and 12 optional samples were collected from 31 locations to characterize the soil in the channels. Random sample locations at this CAS were designated TCH01 through TCH27, and biased sample locations were designated TCB01 through TCB04. All of the soil samples were sent to an off-site laboratory to be analyzed for SVOCs, TPH-DRO, total RCRA metals with beryllium, and radionuclides. The laboratory archived the samples once they were analyzed pending the decision as to which samples would be analyzed for Sr-90 and isotopic Pu. As-built sample location coordinates are shown in Table A.3-1 and depicted on Figures A.3-5 to A.3-8.

Table A.3-1
CAU 478 T-Tunnel Borehole Locations
(Page 1 of 3)

Hole #	Easting	Northing	Elevation	Drill TD	Hand TD	Sampling Method	# of Samples					
	Biased Channel Locations											
TCB01	646732.7	897976.9	5524.688		2	hand	1					
TCB02	646779.8	897957.5	5517.15	7.5		drill	2					
TCB03	646715.1	897934	5525.852	7.5		drill	2					
TCB04	646734.9	897836.7	5529.717	7.5		drill	1					
	Totals			22.5	2		6					

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Table A.3-1 CAU 478 T-Tunnel Borehole Locations

(Page 2 of 3)

Hole #	Easting	Northing	Elevation	Drill TD	Hand TD	Sampling Method	# of Samples					
Random Channel Locations												
TCH01	646587.5	897825.3	5554.578		0.5	hand	1					
TCH02	646646.3	897846.8	5543.103		0.5	hand	1					
TCH03	646659.5	897833	5538.415	5		drill	1					
TCH04	646656.8	897846.9	5538.843	5		drill	1					
TCH05	646677	897895.6	5534.027	5		drill	1					
TCH06	646687.5	897887.7	5532.926	5		drill	2					
TCH07	646697	897876.1	5531.259	5		drill	1					
TCH08	646727.8	897886.6	5527.057	5		drill	1					
TCH09	646734.9	897937.1	5523.096	5		drill	2					
TCH10	646756.7	897927.1	5521.005	5		drill	1					
TCH11	646817.1	897967	5514.95	5		drill	1					
TCH12	646827.4	897984.2	5512.655	5		drill	2					
TCH13	647142.1	898095.3	5478.244		1.5	hand	1					
TCH14	647143.4	898102.5	5478.746		0.75	hand	1					
TCH15	647162.6	898121.9	5471.972		1	hand	1					
TCH16	647241.8	898155.4	5465.51	5		drill	2					
TCH17	647252.4	898157.8	5464.818	5		drill	2					
TCH18	647262.1	898160.3	5464.656	4		drill	2					
TCH19	647272.5	898162.6	5463.764	4.5		drill	2					
TCH20	647586.6	898195.5	5439.513		1.5	hand	2					
TCH21	647628	898188.6	5434.635		0.5	hand	1					
TCH22	647660.4	898189.6	5431.529		2.33	hand	1					
TCH23	647682.7	898182.5	5430.068		1.5	hand	2					
TCH24	647709.7	898178.8	5427.684	5		drill	2					
TCH24A	647732	898167.5	5424.83									
TCH25	648013.3	898111.3	5407.088	5		drill	1					
TCH26	648025.7	898111.9	5405.746	5		drill	1					
TCH27	648059	898100.4	5403.877	5		drill	1					
	Totals			88.5	10.08		37					

Table A.3-1 CAU 478 T-Tunnel Borehole Locations

(Page 3 of 3)

Hole #	Easting	Northing	Elevation	Drill TD	Hand TD	Sampling Method	# of Samples						
	Biased Pond Locations												
TPB01	646811	898022.4	5514.271	10		drill	2						
TPB02	646972	898132.9	5494.397	10		drill	2						
TPB03	647475	898195.5	5450.294	7		drill	2						
TPB04	647344.3	898197.4	5459.909	7		drill	2						
	Totals			34			8						
		Rar	ndom Pond I	ocations									
TPH01	646764.4	898085.7	5516.506	12.5		drill	3						
TPH02	646806.7	898062.1	5515.328	10		drill	3						
TPH03	646956.8	898141.6	5495.568	12.5		drill	2						
TPH04	646976.8	898082.5	5493.27	9.5		drill	3						
TPH05	647032.6	898184	5485.624	7.5		drill	2						
TPH06	647079.1	898081.9	5482.967	13.5		drill	2						
TPH07	647046.7	898137.4	5482.596	7.5		drill	2						
TPH08	647316.6	898203.6	5461.747	7		drill	2						
TPH09	647350.7	898176.6	5459.782	7		drill	2						
TPH10	647431.6	898208.2	5454.835	7		drill	3						
TPH11	647439.3	898210	5453.976	7		drill	2						
TPH12	647867	898196.7	5419.95	7		drill	2						
TPH13	647833.9	898107.1	5417.061	5		drill	2						
TPH14	647784.3	898162	5419.377	5		drill	2						
TPH15	647886.4	898183.7	5417.862	7		drill	2						
	Totals			125			34						
		Background	Sample Lo	cations (C	AU 476)								
TS-B1	645736	898507	5791	1.5		drill	1						
TS-B2	646482	897306	5614	1.5		drill	1						
TS-B3	644916	897518	5720	1.5		drill	1						
	Totals			4.5			3						

TD = Total depth

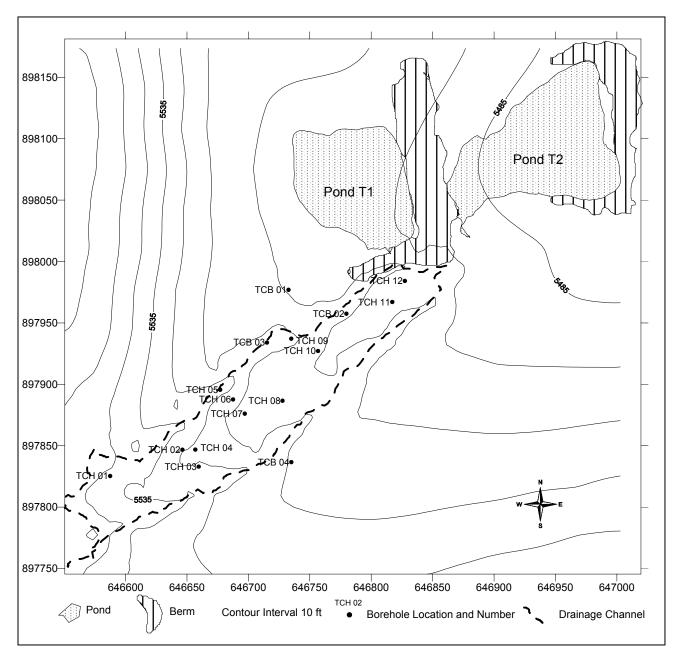


Figure A.3-5
T-Tunnel Channel Boreholes; Biased 1 to 4, Random 1 to 12

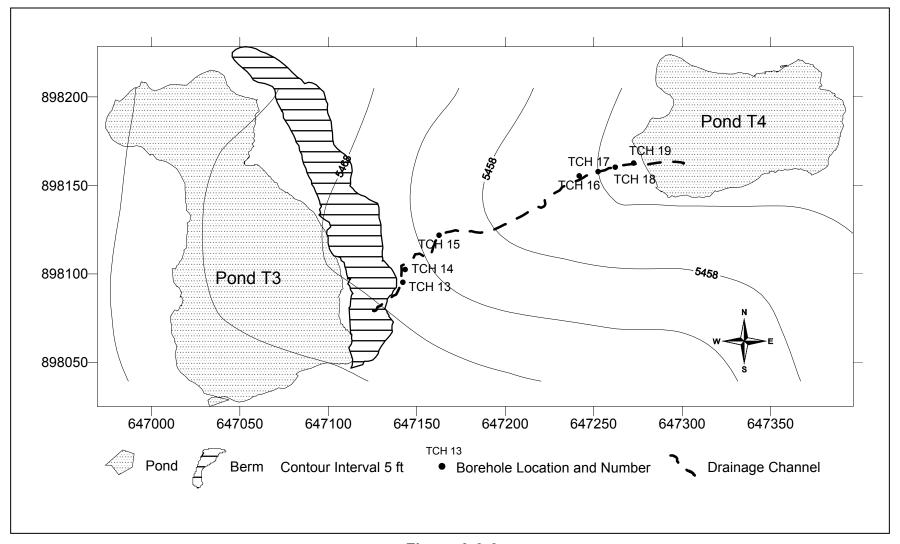


Figure A.3-6
T-Tunnel Channel Boreholes; Random 13 to 19

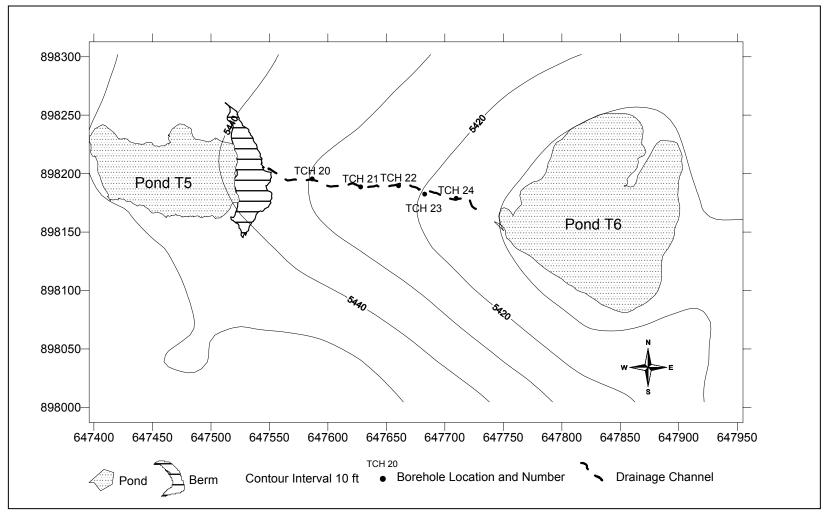


Figure A.3-7
T-Tunnel Channel Boreholes; Random 20 to 24

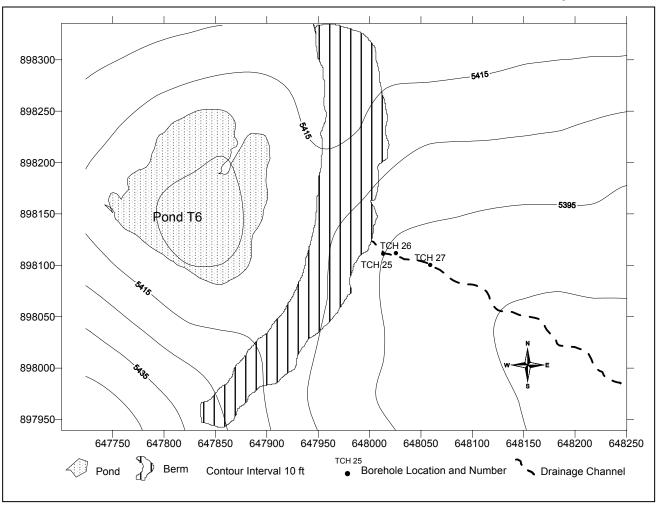


Figure A.3-8
T-Tunnel Channel Boreholes; Random 25 to 27

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A.3.5 Background Native Soil Samples

Additional background soil samples were not collected around the ponds. When CAU 476 (T-Tunnel Muckpile) was characterized, three background samples were collected at undisturbed locations around the muckpile. The samples were analyzed for metals and radionuclides. The data from these samples was used as the background information for the pond sampling. As-built sample location coordinates are shown in Table A.3-1.

A.3.6 Other Sampling

In addition to the environmental samples, 51 quality assurance (QA)/quality control (QC) samples were collected during drilling and surface soil sampling. These QA/QC samples included 5 blind duplicate samples, collected and analyzed to check on the laboratory's precision; 5 laboratory QC samples, collected to check for matrix interference; 5 rinsate samples, collected to check on the effectiveness of the decontamination procedures; 5 field blanks, collected to check on possible environmental interferences; and 31 trip blanks, sent with the VOC samples. All of the QC samples were sent to the offsite laboratory to be analyzed for VOCs, SVOCs, TPH-DRO, total RCRA metals, beryllium, and radionuclides.

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A.4.0 Results

A table of the analytical results from the CAU 478 Area 12 T-Tunnel Ponds investigation is provided in Attachment C. The table includes only those analytical results where COPCs were detected, even if the detect was qualified as estimated (J qualifier). A detect merely indicates that the parameter was identified in the sample and does not have any reference to action levels or regulatory limits. The analytical results from the investigation are summarized in the following tables. Table A.4-1 is a summary of the analytical results from the soil and QC water samples, for VOCs, SVOCs, TPH-DRO, total RCRA metals, and beryllium detected. Table A.4-2 is a summary of the analytical results from the soil and QC water samples, for the radionuclides detected. Field duplicate soil sample results are included in Tables A.4-1 and A.4-2. Table A.4-3 is a summary of the Area 12 T-Tunnel Muckpile (CAU 476) analytical results from the background samples, which were analyzed for total RCRA metals and radionuclides. An analysis of the data, including comparisons to action levels and regulatory limits, is included in this Corrective Action Decision Document/Closure Report (Appendices C and D).

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Table A.4-1 VOCs, SVOCs, TPH-DRO, and Total Metal Detects for T-Tunnel Ponds Investigation^a

	Cha	nnel	Ponds (Se	diment)	Ponds (Native)	QC	Water
Volatile Compounds	Range	No. of	Range	No. of	Range	No. of	Range	No. of
	μg/kg	Detects		Detects	μg/kg	Detects	μg/L	Detects
2-Hexanone	25-44	3	ND	0	5.5-330	3	ND	0
Acetone	12-28	2	14-20	2	9.3-39	6	8.3-29	5
Chloroform	ND	0	ND	0	ND	0	1.2	1
M+P-Xylene	3.4	1	ND	0	ND	0	ND	0
Methylene Chloride	4.5-31	12	3.2-33	14	3.2-35	16	1.5-8.6	13
O-Xylene	1.5	1	0.77	1	ND	0	ND	0
P-Isopropyltoluene	ND	0	1.4	1	ND	0	ND	0
Semivolatile Compounds	μg/kg		μg/kg		μg/kg		μg/L	
Benzoic Acid	930	1	ND	0	ND	0	ND	0
Bis(2-Ethylhexyl)Phthalate	170-370	3	160-2100	6	230	1	ND	0
Petroleum Hydrocarbons	mg/kg		mg/kg		mg/kg		mg/L	
Diesel-Range Organics	2.4-17	17	24-220	22	13-150	2	ND	0
Metals	mg/kg		mg/kg		mg/kg		mg/L	
Arsenic	1.2-3.6	46	1.8-7.7	22	1.5-6.6	22	ND	0
Barium	34-980	46	47-6,400	22	32-2,400	22	ND	0
Beryllium	0.55-1.8	35	0.62-1.7	21	0.54-2.4	14	ND	0
Chromium	1.2-6.3	44	1.5-8.5	22	1.4-9.7	22	ND	0
Lead	1.8-20	46	4.0-43	22	2.7-25	22	ND	0
Selenium	ND	0	0.59	1	0.84	1	ND	0
Total Number Collected	46		22		22		41	

^a Includes "Field Duplicate" sample analysis

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

ND = Nondetect

μg/kg = Micrograms per kilogram

μg/L = Micrograms per liter

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Table A.4-2 Radionuclide Detects for T-Tunnel Ponds Investigation^a

Radionuclide	Channel		Ponds (S	ediment)	Ponds	(Native)	QC Water	
	Range	No. of	Range	No. of	Range	No. of	Range	No. of
	pCi/g	detects	pCi/g	detects	pCi/g	detects	pCi/L	detects
Actinium-228	1.42-3.23	45	1.69-3.4	22	1.8-3.36	21	30	1
Aluminum-26	0.15	1	0.15-0.17	2	ND	0	ND	0
Americium-241	0.26-11	17	1.3-4.5	5	ND	0	ND	0
Bismuth-212	3.0-6.2	9	4.2-5.6	3	3.4-4.1	5	ND	0
Bismuth-214	0.6-1.7	40	0.77-1.49	11	0.78-2.1	22	ND	0
Cobalt-58	0.35	1	ND	0	ND	0	ND	0
Cobalt-60	0.3	1	0.41-0.77	4	0.28	1	ND	0
Cesium-137	0.45-65	38	0.97-366	22	0.47-7.6	13	ND	0
Europium-152	0.9-1.12	2	1.3	1	0.79	1	ND	0
Europium-155	ND	0	ND	0	0.44	1	17	1
Potassium-40	21-42.4	46	21.1-34.6	22	12-36.7	22	ND	0
Lead-212	1.64-3.17	46	1.67-3.3	22	1.77-3.3	22	ND	0
Lead-214	0.55-1.61	45	1.0-1.99	12	1.05-1.87	22	ND	0
Plutonium-238	0.48-7.06	10	0.096-1.53	11	0.046	1	ND	0
Plutonium-239	6.23-79	10	1.24-15.3	11	0.47	1	ND	0
Anitmony-125	1.11	1	1.6-8.3	6	0.51-0.55	2	ND	0
Strontium-90	0.52-5.2	10	1.42-22.8	11	0.52	1	ND	0
Thorium-234	2.9-3.6	3	ND	0	2.3-4.7	6	ND	0
Thallium-208	0.45-1.09	46	0.51-1.09	17	0.59-1.28	12	ND	0
Total Numbe	r Collected	46		22		22		41

^a Includes "Field Duplicate" sample analysis

ND = Nondetect

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

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Table A.4-3
Total Metal and Radionuclide Detects for T-Tunnel Background Samples (CAU 476)

TOLAT IV	ietai anu Kaulon	uclide Detects for	1-Tunner Backgro	ound Samples (C	JAU 476)		
	Back	ground]	Вас	Background		
Radionuclide	Range	No. of Detects	Metals	Range	No. of Detects		
	pCi/g	No. of Detects		mg/kg	No. of Detects		
Actinium-228	2.11-3.2	3	Arsenic	2.0-3.8	3		
Americium-241	2.8	1	Barium	78-110	3		
Bismuth-212	1.3-3.6	2	Chromium	3.5-6.0	3		
Bismuth-214	1.16-2.4	3	Lead	9.1-12	3		
Cesium-137	1.14-13.5	2	Total Numb	er Collected	3		
Lead-212	2.12-2.76	3					
Lead-214	1.27-1.59	3					
Plutonium-238	0.307-1.03	2					
Plutonium-239	0.095-9.6	3					

2

3

3

mg/kg - Milligrams per kilogram pCi/g - Picocuries per gram

Strontium-90

Thallium-208

SQ - Spectral Quality prevents accurate quantitation

Total Number Collected

0.28-1.13

0.7-0.88

A.5.0 Waste Management

Management of the investigation-derived waste (IDW) was guided by the CAU 478 CAIP (DTRA, 2003a) requirements, field observations, and the results of the laboratory analysis of the pond and channel characterization samples. Administrative controls were used to minimize the amount of waste generated during the investigation.

A.5.1 Waste Segregation

All wastes generated on the site were divided into either sanitary waste or IDW. The sanitary waste was disposed of in the dumpster located by Building 153. The IDW was segregated into solid (personal protective equipment [PPE] and plastic) and liquid (rinsate) waste streams to limit the amount of potentially contaminated waste.

A.5.2 Waste Generation and Accumulation

Waste generated during the fieldwork was either sanitary waste or IDW. The sanitary waste consisted mostly of paper and kitchen debris generated in the field office. In accordance with the waste minimization strategy, all PPE that was not visibly contaminated and was not used when elevated field-screening results were found, was disposed of as sanitary waste. The IDW consisted of potentially contaminated PPE, plastic, and all rinsates. This waste was dealt with as described in the rest of this section.

All IDW was put in U.S. Department of Transportation-compliant, 55-gallon, steel drums. For drums receiving solid IDW, an absorbent (Stergo®) pad was placed in the bottom and a plastic liner was inserted. After receiving waste, the drums were stored on plastic pallets in the fenced hazardous waste accumulation area (HWAA). The plastic pallets served as spill protection in the event one of the drums leaked. The HWAA was also designated a radiation materials area. After a drum received waste, it was marked with a unique identification number and labeled with "Hazardous Waste Pending Analysis" and "Radioactive Material Pending Analysis" stickers and was secured with a tamper-indicating device (TID). A waste management log book was used to track the drums used, the contents of each drum, and an estimate of how much material was in each drum. The volume of material recorded for each drum is an estimate of what was put in the drum.

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A.5.2.1 Rinsates

Decontamination operations at the main decontamination facility and rig-side decontamination tub generated rinsate. The main decontamination facility was a rectangular area lined with a 20 mil Herculine[®] liner. The liner was approximately 800 ft square and was held in place with sandbags. Decontamination activities conducted at the main decontamination facility included decontamination of the drill rig, pipe truck, drill pipe, core barrel, and drill bits at the beginning and end of the project. The equipment and tools were decontaminated by backing the pipe truck into the decontamination sump and washing everything with high-pressure hot water and Alconox[®]. After being decontaminated, the core barrels and drill bits were cased in plastic sleeves and the drill rods were covered with plastic to prevent them from getting contaminated before being used. All rinsate from the decontamination pad was containerized.

The rinsates generated at the rig-side decon tub were from decontamination of the core barrels, drill bits, and the non-disposable sampling equipment (stainless-steel bowls, trowels, and spoons). Once the core barrels, drill bits, and sampling equipment were decontaminated, they were put in plastic sleeves to protect them from becoming contaminated before their next use.

Rinsates from decontamination activities were accumulated on a daily basis from the rig-side decon tub. Accumulated rinsate was pumped from the tub into unlined 55-gallon drums staged next to the decontamination trailer. When a drum was filled (leaving some ullage) it was labeled, sealed with a TID, and moved to the HWAA. If the drum was not full, it was labeled, sealed with a TID, and left inside the exclusion zone (EZ) for the night.

A.5.2.2 Soil

No significant quantity of soil accumulated in the bottom of the decontamination tub, nor was any soil contaminated by spills; therefore, no soil required disposal other than the drill core, which was disposed of in the borehole it came from.

A.5.2.3 PPE, Sampling Equipment, and Plastic Sleeves

The PPE used in the EZ consisted of Tyvek® anticontamination clothing, cotton gloves, and nitrile gloves. At the end of each shift, the PPE was evaluated with respect to the field-screening data and the presence of visible contamination. If there were no field screening hits and there was no visible contamination, the PPE was determined to be sanitary waste and was disposed of in the roll off bin at Building 153. If there were field screening hits or visible contamination, the solid waste was bagged, and the bag was sealed with tape and marked with the associated sample

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numbers for the EZs; no other waste was put in that bag. The date, waste tracking tag number, and associated sample numbers were written on the bag. The bag was then placed in a lined 55-gallon drum, and recorded in the waste management log book.

The disposable sampling equipment was collected in a plastic bag inside the EZ as the sampling was conducted. Waste was accumulated until the bag was filled, and then it was taped closed. Once the bag was filled, it was handled in the same manner as the PPE.

Plastic sleeves were used to keep the decontaminated core barrels clean before use and to containerize slough and core as it was removed from the boreholes. After sampling, the core and slough material was returned to the borehole. The empty sleeves were containerized in a clear plastic bag and handled in the same manner as the PPE.

A.5.2.4 Plastic Liners

Plastic liners were used under the drill rig, the support truck, and the decontamination tub to prevent hydrocarbon leaks from getting on the ground. To minimize waste generation, each liner was used at several locations unless it was damaged, leaked on, or field screening of the core samples indicated the presence of contamination, in which case the liner was replaced, at the completion of the hole. When a plastic liner was replaced the used liner was placed in a lined drum and moved to the HWAA.

A.5.3 Waste Characterization

The IDW was considered potentially contaminated waste only by virtue of contact with potentially contaminated media. Therefore, additional sampling and analysis of the IDW, separate from the borehole soil sampling and analysis, was not required, unless the sample results showed the potential for the IDW to be contaminated. The data generated as a result of the site characterization were used to make the IDW waste determinations.

The IDW was characterized by identifying the borehole samples associated with each waste container and then comparing the analytical results from those samples to various standards. For the hazardous waste determination, the borehole sample results were compared to the RCRA waste characterization levels for hazardous waste (CFR, 2002). For total petroleum hydrocarbon wastes, the sample results were compared to the *Nevada Administrative Code* for TPH-DRO determination (NAC, 2002). For the low-level radioactive waste determination, the sample results were compared to concentrations in soil and water samples taken from background

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locations in the western and southwestern United States, and to the "rad added" screening levels of the *Nevada Test Site Performance Objective for Certification of Nonradioactive Hazardous Waste* (POC) (BN, 1995).

A.5.4 Waste Disposal

The hazardous waste determination did not identify any drums that were associated with samples that contained a high enough concentration of hazardous constituents to be considered hazardous.

The preliminary radiological waste determination identified five drums associated with samples that were considered to have potential "rad added" in excess of the POC screening levels. The three drums associated with the highest "rad added" samples were sampled to determine whether the IDW was contaminated. Based on the analytical results from these samples, the drums were determined to not have radiation levels in excess of the POC screening levels and could be disposed of as sanitary waste. All of the drums of IDW were disposed of as sanitary waste.

A.6.0 Health and Safety

At the start of the project, a preliminary hazard assessment was prepared and used to guide the preparation of the SSHASP (IT, 2003), the Radiation Work Permit, and the CAIP (DTRA, 2003a). The work was performed in accordance with these documents.

Prefield health and safety preparation was accomplished using a project-specific health and safety checklist. The checklist was developed to ensure that all required items were verified and/or available before mobilization to the field.

A.6.1 Physical Hazards

The primary physical hazards fell into three general categories: fatigue; heat stress; and slip, trip, and fall. The sources of these hazards were the long drive to and from the work site, the general hazards of working around moving machinery, the high ambient air temperatures on the Test Site at that time of year, and working on uneven ground in and around the ponds.

The hazards associated with fatigue, heat stress, and slip, trip, and fall were dealt with by discussing the long drive, the hazards involved with the machinery, heat stress symptoms, and site-specific slip, trip, and fall hazards during the morning tailgate safety meetings. The length of the work day was limited and workers were observed by the Site Safety Officer and Site Supervisor for fatigue and heat stress and were encouraged to drink water. This ensured that workers did not become overly fatigued and could safely drive back to Mercury at the end of the day.

A.6.2 Chemical and Radiological Hazards

Chemical hazards possibly contained in the ponds and channels included mostly hydrocarbon products, epoxies, and chemical grouts that may have been disposed of on the muckpile or be in the water from the tunnel. These products were used for fuels, ground support, and various other applications during mining operations. Preliminary soil sampling indicated no contaminants that could potentially pose an inhalation hazard. Radiological hazards were thought to have come from the waste rock deposited on the muckpile during re-entry mining operations following testing and from water discharged to the ponds from the mine workings.

Products brought on site to assist with the characterization investigation were required to have a material safety data sheet before receiving approval for use. These items generally consisted of fuels, lubricants, cooling and cleaning agents, and grout.

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Action levels for the chemical constituents and radiological hazards were posted on the tailgate safety briefing as noted in the SSHASP (IT, 2003). All intrusive work required that real-time monitoring be conducted and the results documented on the Sample Collection Logs and the Soil Classification Logs. Field-screening results established that action limits for occupational threats to personnel during the drilling and sampling operations were not exceeded.

As a precaution, all personnel wore gloves and Tyvek® anti-contamination clothing in the EZ.

A.6.3 Drilling

An equipment inspection of the Boart-Longyear drill rig was performed by IT personnel upon its arrival on site. The inspection was documented on the Drill Rig Inspection form as described in the Field Instruction. A daily inspection was conducted by the driller before starting the rig. This inspection was documented on the drillers daily inspection form. All safety devices were present and operational. Copies of the inspection sheets are in the project files.

The rotosonic drill rig was operated safely and reliably throughout the project. The drilling team from Boart-Longyear was very competent and worked both efficiently and safely.

A.6.4 Noise

During rotosonic drilling operations personnel exposure to noise is always a concern. Noise-level monitoring was conducted before startup and during actual drilling, with a sound-level meter set on the "A" scale with a slow response. Measurements indicated that average noise levels of 85 to 110 decibels were common within 35 ft of the drill rig. With this knowledge, all personnel working or observing operations within this distance were required to wear hearing protection. Personnel were also diligent in watching out for each other to make certain that hearing protection was available and in use before equipment startup.

A.6.5 Air Monitoring

A Photovac 2020 photoionization detector was used for real-time air monitoring for VOCs during all intrusive work. The 2020 measures concentrations of photoionizable gases and records the values. It cannot distinguish between individual pollutants, it merely lets the operator know that something is present. During drilling activities at the Area 12 T-Tunnel Ponds, the 2020 was used to measure concentrations in a worker's breathing zone. All concentrations logged during field activities were well below the established action level of one part per million sustained in the breathing zone.

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In addition to the VOC monitoring, radiation monitoring was conducted daily through high-volume air sampling. One air sample was collected in the EZ side of the sample van and another sample was collected in the clean side of the sample van. These samples were collected by continuously drawing air through the two filters during work hours. Once work ceased for the day, the filters were removed and counted on a Ludlum Model 2929 alpha/beta scaler. The results were discussed at the next morning's tailgate safety briefing. No airborne radioactive particles were detected in the high volume air sample filters during field activities.

A.6.6 Personnel Monitoring

All personnel were required to wear a thermal luminescent dosimeter while working at the T-Tunnel site

A.6.7 Training

Before assignment, all necessary training documentation for specific tasks was reviewed and verified as to current status. By verifying all documentation before personnel arrived on site, delays to track down missing or incomplete training documentation were minimized.

Training requirements for this project were outlined in the SSHASP (IT, 2003) and included 40-hour Hazardous Waste Operations and Emergency Response, annual 8-hour refresher, medical surveillance with respirator qualification, and Radiological Worker II. Additional training for specific personnel included 8-hour supervisory training, first aid and cardiopulmonary resuscitation, blood-borne pathogens training, and classroom and field waste management training.

A.7.0 References

BN, see Bechtel Nevada.

- Bechtel Nevada. 1995. Nevada Test Site Performance Objective for Certification of Nonradioactive Hazardous Waste, Rev. 0, G-E11/96.01, Waste Management Program. Las Vegas, NV.
- CFR, see Code of Federal Regulations.
- DTRA, see Defense Threat Reduction Agency.
- Code of Federal Regulations. 2002. Title 40 Part 260 282, "RCRA Regulations." Washington, DC: Government Printing Office.
- Defense Threat Reduction Agency. 2000. Corrective Action Investigation Plan for Corrective Action Unit 476: Area 12 T-Tunnel Muckpile, Nevada Test Site, Rev. 0. Prepared by IT Corporation. Las Vegas, NV.
- Defense Threat Reduction Agency. 2003a. *Corrective Action Investigation Plan for Corrective Action Unit 478: Area 12 T-Tunnel Ponds, Nevada Test Site*, Rev. 0. Prepared by IT Corporation. Las Vegas, NV.
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- FFACO, see Federal Facility Agreement and Consent Order.
- Federal Facility Agreement and Consent Order. 1996 (as amended). Agreed to by the State of Nevada, the U.S. Department of Energy, and the U.S. Department of Defense. Las Vegas, NV.
- Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*, Chapter 4. New York, NY: Van Nostrand Reinhold.
- IT, see IT Corporation.
- IT Corporation. 2003. ITLV Site-Specific Health and Safety Plan: Corrective Action Unit 475, Area 12 P-Tunnel Muckpile; CAU 478, Area 12 Ponds; CAU 480, Area 12 N-Tunnel Ponds, Rev. 0. North Las Vegas, NV.
- NAC, see Nevada Administrative Code.
- *Nevada Administrative Code.* 2002. NAC 445A.2272, "Contamination of Soils: Establishment of Action Levels." Carson City, NV.

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SNJV GIS Systems, see Stoller-Navarro Joint Venture Geographic Information Systems.

Stoller-Navarro Joint Venture Geographic Information Systems. 2007. ESRI Arc GIS Software.

Attachment A Soil Boring Logs

(50 Pages)

Borehole Number: TCB-01
Logged By: Barb Deshler
Drilled By: Barb Deshler
Drilling Method: Hand Dug

Date Started: 5/04/03

Date Completed: 5/04/03

Floration: 5524 69

Elevation: 5524.69
Northing: 897977
Easting: 646733
Total Depth: 2 ft

prilling met	noa: nana	νug		Total Depth: 2 It		
Depth (ft) Percent Recovery	Drilling Rate (ft/min)	Sample Number	Lithology	Lithologic Description Comments	 Screening Alpha (dpm)	Results Beta (dpm)
0-100 Contact @ N	0-5 ^α	e 478CSBO	102.			

Γ°		Native: Medium brown fmc			
2002		sand, dry	0.5	85	9311
			0.7	50	4792
	478CSB0102	-	0.7	57	4769

Borehole Number: TCB-02 Logged By: Mike Valesky

Drilled By: Boart-Longyear
Drilling Method: Rotosonic

Date Started: 5/06/03

Date Completed: 5/06/03

Elevation: 5517.15 Northing: 897958 Easting: 646780

Total Depth: 7.5 ft

		e.				1100 00 00 00 00 00 00 00 00 00 00 00 00	Field	Screening	Results
Depth (ft)	- Percent - Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

□ 0 P777777MSMITHT I		587	86	37
	Muck: Light gray to light brown to gray tuff fragments, some sand, moist			
	Native: Medium dark pinkish gray fmc sand and tuff fragments, dry to slightly moist	0.0	вкс	>3000 <4000
		0.0	BKG	>3000 <4000
478CSB0204.5	Native: Light pinkish to brownish gray fmc sand and tuff fragments, dry to slightly moist	0.0	70	4288
478CSB0205.5		0.0	28	3706
		0.0	вкс	BKG
			l s	

Project Name: CAU 478 T-Tunnel PondsDate Started: 5/06/03Project Number: 840227.03090015Date Completed: 5/06/03

Borehole Number: TCB-03 Elevation: 5525.85
Logged By: Mike Valesky Northing: 897934
Drilled By: Boart-Longyear Easting: 646715
Drilling Method: Rotosonic Total Depth: 7.5 ft

	Appropriate the second of the	e,					Field	Screening	Results
Depth (ft)	- Percent - Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

_ 0	179.75	8	<u> </u>	20
	Muck: Multi-color tuff fragments and fmc sand, very moist, wet from 1 to 2 ft			
	0000			
	Native: Brownish to pinkish gray tuff and fmc sand	0.0	BKG	>3000 <4000
478CSB		0.0	7	4887
		0.0		1007
		2.8	BKG	>3000
5	Native: Dark brown silty sand, some gravel, trace clay, dry to slightly moist, stiff	2.0	BrG	<4000
478CSB	1 1 J	0.0	26	3765
		0.0	BKG	BKG
			i s	

Project Name: CAU 478 T-Tunnel Ponds
Project Number: 840227.03090015

Date Completed: 5/06/03

Borehole Number: TCB-04 Elevation: 5529.72

Logged By: Mike Valesky Northing: 897837

Drilled By: Boart-Longyear Easting: 646735

Drilling Method: Rotosonic Total Depth: 7.5 ft

DITT	rring mer	nou. N	500,	Sourc		TOCAL Depoil. (.)	IC		
Depth (ft)	Percent Recovery	Drilling Rate (ft/min)	le Interval	Sample Number	ithology	Lithologic Description Comments		Screening Alpha (dpm)	Results Beta (dpm)
Cont	0-100	0-3	Samp	ຫຼິດ ample 4780	l l	.5.			

_ 0	2999	(N)	86	50 E
478CSB	Muck: Multi-color tuff fragments and fmc sand, moist	0.0	14	3628
	Native: Dark brown fmc sand, some gravel, some silt, some organic root material	0.0	BKG	BKG
	Native: Light pinkish gray	0.0	BKG	BKG
5	fmc sand and tuff fragments, dry to slightly moist			
	Native: Light brownish to whitish gray tuff, dry to slightly moist	0.0	BKG	BKG
		-		
			16	

Project Name: CAU 478 T-Tunnel Ponds Date Started: 5/01/03 Project Number: 840227.03090015 Date Completed: 5/01/03 Borehole Number: TCH-01 Elevation: 5554.58 Logged By: Mike Valesky Northing: 897825 Drilled By: Barb Deshler Easting: 646587 Drilling Method: Hand Dug Total Depth: 0.5 ft Field Screening Results Drilling Rate Interval (ft/min) Sample Number Lithologic Description Recovery Percent Lithology Depth (ft) Comments VOCs Alpha Beta Sample (ppm) (dpm) (dpm) 0-100 0-5

Contact @ N/A. Sample 478CS010.5.

_ 0	9 NONE NO DE COMO DE C	80 44	597	is .	98 99
858		Native: Light brownish gray			
	F////AHHHHH	mc sand, some tuff fragments			
	478CS010.5	up to 4 inches in diameter	0.14	14	4161
	V/////Abbbbbxx		\$2500 CO	1952	35,405,500
			1		
323	1818181818181818181				
3 23					
323					
323					
	1				
L -5		J	22	2	St. St.

Project Name: CAU 478 T-Tunnel Ponds Date Started: 5/01/03 Project Number: 840227.03090015 Date Completed: 5/01/03 Borehole Number: TCH-02 Elevation: 5543.1 Logged By: Mike Valesky Northing: 897847 Drilled By: Barb Deshler **Easting:** 646646 Total Depth: 0.5 ft Drilling Method: Hand Dug Field Screening Results Drilling Rate Interva (ft/min) Sample Number Lithologic Description Recovery Percent Lithology Comments Depth (ff) VOCs Alpha Beta Sample (dpm) (dpm) (ppm)

0-100

0-5

Contact @ N/A. Sample 478CSO20.5.

Native: Light grayish brown mc sand, some small (<1 478CS020.5 inch) tuff fragments, dry 21 3918

Project Number: 840227.03090015

Borehole Number: TCH-03 Logged By: Mike Valesky Drilled By: Boart-Longyear Date Started: 4/30/03

Date Completed: 4/30/03 Elevation: 5538.42

Northing: 897833 **Easting:** 646660

Drill	Ling Met	hod: R	otos	sonic		Total Depth: 5.0 :	ft		
Depth (ft)	O Percent C Recovery	O Drilling Rate	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Screening Alpha (dpm)	Results Beta (dpm)
Cont	act @ N	/A. Sa	mple	≙ 478CSO3	30.5.		88		

[°	478CS030.5	brownion gray carr	3.8	14	3890
3.2	^ ^ ^ ^	fragments, dry to slightly moist (boulder or bedrock)	E 1	P.V.C	PAC
321	^ ^ ^		5.1	BKG	BKG
3 <u>-</u> 3	^ ^ ^		4.4	BKG	BKG
	^ ^ ^ ^		6.1	BKG	BKG
	^			is.	

Project Name: CAU 478 T-Tunnel Ponds

Project Number: 840227.03090015

Borehole Number: TCH-04

Date Started: 4/30/03

Date Completed: 4/30/03

Elevation: 5538.84

Logged By: Mike Valesky

Northing: 897847

Drilled By: Boart-Longyear

Easting: 646657

Drilling Method: Rotosonic

Total Depth: 5.0 ft

	10/21/14/00/2001	οŭ				•	Field	Screening	Results
Depth (ft)	5 6	Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

_ 0	F7777777851717777	x x a			10	100
854			Muck: Light to medium brownish gray tuff fragments/chips, dry to slightly moist	0.0	85	4224
		478CSO40.5 478CSXO40.5	Native: Medium to dark brown silty fmc sand, some gravel	0.0	BKG	BKG
(12)						
			Native: Light to medium gray tuff, dry to slightly moist			
(2)			^	0.0	ВKG	BKG
			^	\$ 2500	4500000	
			^			
1						
			^			
_			^			
			^			
			^			
L -5			<u> </u>		Es.	

Borehole Number: TCH-05
Logged By: Mike Valesky
Drilled By: Boart-Longyear
Drilling Method: Rotosonic

Date Started: 4/30/03
Date Completed: 4/30/03

Elevation: 5534.03 Northing: 897896 Easting: 646677 Total Depth: 5.0 ft

DITT	rring mer	nou. r	0000	SOHIC		TOCAL Depoit. 3.0	10		
Depth (ft)	Percent Recovery	rilling Rate (ft/min)	Sample Interval	Sample Number	ithology	Lithologic Description Comments		Screening Alpha (dpm)	Results Beta (dpm)
	0-100	0-5	Sa	w	-				
Cont	act 0 2	ft. S	amp l	le 478CSO	50.5.			27 27	

478CS050.	00000	0.0	49	3914
	Native: Medium to dark brown silty sand, some gravel, some clay, some organic root material, slightly moist	1.8	BKG	BKG
		5.8	BKG	BKG
		2.7	BKG	BKG

Borehole Number: TCH-06
Logged By: Mike Valesky
Drilled By: Boart-Longyear
Drilling Method: Rotosonic

Date Started: 4/30/03
Date Completed: 4/30/03
Elevation: 5532.93

Elevation: 5532.93
Northing: 897888
Easting: 646688
Total Depth: 5.0 ft.

	ACCOUNT ALL DESCRIPTION OF THE PARTY OF THE	a					Field	Screening	Results
Depth (ft)	- Percent - Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

	478CS0601	Muck: Light gray tuff fragments/chips, some fmc sand, dry Native: Medium to dark brown silty sand, some gravel, some rock fragments/cobbles, trace clay, some organic root material, moist	0.7	BKG	BKG 4337
		Native: Light to medium brownish gray tuff, dry to slightly moist	4.7	BKG	вкс
	478CS0603		6.6	64	3675
5		^ ^ ^ ^	4.6	BKG	вкс

Project Name: CAU 478 T-Tunnel Ponds
Project Number: 840227.03090015

Date Started: 4/30/03

Date Completed: 4/30/03

Borehole Number: TCH-07

Logged By: Mike Valesky

Drilled By: Boart-Longyear

Drilling Method: Rotosonic

Total Denth: 5.0 ft

ntititing wer	mou: Kot	COSOUIC		TOTAL Deptil: 5.0	T C		
Depth (ft) Percent Recovery	Drilling Rate (ft/min)	ple Number	ithology	Lithologic Description Comments		Screening Alpha (dpm)	Results Beta (dpm)
0-100	0-5 K	, v	lı				

	478CS070.5	Muck: Medium brownish gray tuff fragments/chips, some fmc sand, moist, some organic root material at base Native: Light to medium gray tuff, dry to moist	2.0	28	3706
			2.3	BKG	BKG
-			1.2	вкс	BKG
		^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^	1.2	BKG	BKG

Borehole Number: TCH-08

Logged By: Mike Valesky

Drilled By: Boart-Longyear

Drilling Method: Rotosonic

Date Started: 5/01/03
Date Completed: 5/01/03

Elevation: 5527.06
Northing: 897887
Easting: 646728
Total Depth: 5.0 ft

C 0 177777777777777777777777777777777777		(8)	36	58 59
478CS080.5	Native: Dark brown silty sand, some gravel, some rock fragments, trace clay, some organic root material, moist	3.0	50	4036
	Native: Medium brownish to pinkish gray tuff, weathered, moist, less weathering with depth	5.3	BKG	BKG
	\(\)\(\)\(\)\(\)\(\)\(\)\(\)\(\	4.3	BKG	BKG
-5	^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^ ^	4.6	BKG	BKG

Borehole Number: TCH-09 Logged By: Mike Valesky Drilled By: Boart-Longyear Date Started: 5/01/03
Date Completed: 5/01/03

Elevation: 5523.1 Northing: 897937 Easting: 646735 Total Depth: 5.0 ft

n) n) ral	Field	Screening	Dea. 1+-
Lithologic	Description ments VOCs (ppm)	Alpha (dpm)	Beta (dpm)

	478C	O gray Nati	: Light gray to pinkish tuff fragments, dry ve: Medium to dark brown y sand, some gravel, organic root material, t, dry to slightly moist w 2.0 ft	4.0	21	4310
				1.6	вкс	BKG
	478C	s0903 C		0.0	36	4173
5				0.0	ВКG	BKG

Project Name: CAU 478 T-Tunnel Ponds

Project Number: 840227.03090015

Borehole Number: TCH-10

Date Started: 5/01/03

Date Completed: 5/01/03

Elevation: 5521.01

Logged By: Mike Valesky

Drilled By: Boart-Longyear

Drilling Method: Rotosonic

Elevation: 3321.01

Northing: 897927

Easting: 646757

Total Depth: 5.0 ft

		ų.					Field	Screening	Results
Depth (ft)	- Percent - Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

- 0	P	10 10		40	100
35.73		Muck: Light brownish gray fmc sand and tuff fragments	0.0	BKG	6000
323	478CS10	Native: Dark brown silty sand, some gravel, some	0.0	21	(7000) 4149
		Native: Light brownish to pinkish gray tuff, slightly weathered, dry to moist, more competent with depth	0.0	BKG	BKG
223					
8143			9.2	BKG	вкс

Project Number: 840227.03090015

Borehole Number: TCH-11 Logged By: Mike Valesky

Drilled By: Boart-Longyear
Drilling Method: Rotosonic

Date Started: 5/01/03
Date Completed: 5/01/03

Elevation: 5514.95 Northing: 897967 Easting: 646817 Total Depth: 5.0 ft

		e.		8 C C C C C C C C C C C C C C C C C C C		Top work was to decorate the control of the control	Field	Screening	Results
Depth (ft)	- Percent C Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

L 0	F777771: K5541:	ERM	10:1	CONTROL DESCRIPTION DESCRIPTION OF THE PROPERTY OF THE PROPERT	(8)	K	
100000		[: ₩]	Ŏ.	Muck: Light brownish gray			
		1;₩	0	tuff fragments, some fmc sand, slightly moist			
		1:100	0:1	Sand, Slightly moist			
		478CS110.5	000			20	2077
		1: XX 4/805110.5			0.0	28	3977
			121				
		: ⊠					
3 <u>4</u> 3		: 22					
				Native: Medium grayish brown			
				silty sand, some gravel, some organic root material			
			9.16	at top of interval, moist to			
				slightly moist with depth			
					0.0	BKG	BKG
					0.0	DVQ	DKG
8 1 2							
			112				
			1				
-			7				
			7				
			7				
			-				
			7		0.0	BKG	BKG
			-		250000000	20043000	100000000000000000000000000000000000000
F			1				
			5				
			1				
			9				
L _5							
5							

Project Number: 840227.03090015

Borehole Number: TCH-12 Logged By: Mike Valesky Drilled By: Boart-Longyear

Drilled By: Boart-Longyear
Drilling Method: Rotosonic

Date Started: 5/01/03
Date Completed: 5/01/03

Elevation: 5512.66 Northing: 897984 Easting: 646827

Total Depth: 5.0 ft

		e e					Field	Screening	Results
Depth (ft)	O Percent O Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

_ 0	(N) A(N) (N)		8	4	10
	00000	Muck: Gray, pinkish gray, brown tuff fragments, some fmc sand, moist	0.0	вкс	5000
	478CS1201	Native: Dark to light brown silty sand, some gravel, some organic root material, moist, rock fragments below 2.0 ft.	0.0	43	5624
			0.0	BKG	5000
	478CS1203	Native: Light brownish gray fmc sand, some gravel and large tuff framents, dry to slightly moist	0.0	28	4188
			0.0	BKG	вкс
5					

Project Number: 840227.03090015

Borehole Number: TCH-13 Logged By: Barb Deshler

Drilled By: Barb Deshler and Mike Valesky

Drilling Method: Hand Dug

Date Started: 5/04/03
Date Completed: 5/04/03

Elevation: 5478.24 Northing: 898095 Easting: 647142 Total Depth: 1.42 ft.

		e C					Field	Screening	Results
Depth (ft)	O Percent O Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs (ppm)	Alpha (dpm)	Beta (dpm)

_ 0		is of	58		50 50
553	1 //// 1	Mative: Dark brown fmc sand,			
	P////X:::::::::::::::::::::::::::::::::	some gravel and rock			
	<i>P////</i> /#888881 1	fragments up to 4 inches,		0.0	4006
	Y////X:::::::::::::::::::::::::::::::::	moist	0.0	36	4706
	<i>777777</i>				(>FSL)
	V////X:::::::::::::::::::::::::::::::::	(4) A			
	Y////X:::::::::::::::::::::::::::::::::	id .	0.0	57	4663
	Y //// X 333331 1		0.0	01	(>FSL)
929	///// #####	[A			(2136)
	Y////#####₩				
	V////ABBBBBB				
	478CS1301.5		0.0	36	5459
			1		(>FSL)
3043					
1					
10-2					
	[4] [4] [4] [4] [4] [4] [4]				
000					
	[3] 3[3] 3[3] 3[3] 3[3] 1				
	131313131313131 T				
	[1] [1] [1] [1] [1] [1] [1] [1] [1] [1]				
L -5		I	22	Li.	8 9

Project Name: CAU 478 T-Tunnel Ponds Date Started: 5/04/03 Project Number: 840227.03090015 Date Completed: 5/04/03 Borehole Number: TCH-14 Elevation: 5478.75 Logged By: Barb Deshler Northing: 898103 Drilled By: Barb Deshler **Easting:** 647143 Drilling Method: Hand Dug Total Depth: 0.67 ft Field Screening Results Drilling Rate Interval (ft/min) Sample Number Lithologic Description Recovery Percent Lithology Depth (ft) Comments VOCs Alpha Beta Sample (ppm) (dpm) (dpm)

Contact @ N/A. Refusal encountered at 0.67 ft. Sample 478CS140.5.

0-100

0-5

_ o			(8)	10	
\$58		Native: Dark brown fmc sand,			
	<i>V////</i> /::::::::::::::::::::::::::::::::	some gravel and rock			
	1 ////////////////////////////////////	fragments up to 4 inches,	0.0	64	5043
	478CS140.5	moist	200000000	120000	(>FSL)
	<i>\///////</i> HHHHH₩	/			CONTRACTOR OF THE PARTY OF THE
	[/////dilililili		0.0	43	4165
			80.000.000	100.000	(>FSL)

323	1813131313131313131				
	144444444				
	13131313131313131				
323					
1					
	1444444444				
323					
1					
	184844444				
	144444444				
200					
T.					
	14 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4				
	13131313131313131				
	1888888888 T				
200.00	19191919191919191 L				
L -5	The state of the s	Age and the second seco	Line .	Lo.	

Project Name: CAU 478 T-Tunnel Ponds
Project Number: 840227.03090015

Date Started: 5/04/03

Date Completed: 5/04/03

Borehole Number: TCH-15
Logged By: Barb Deshler
Drilled By: Barb Deshler
Drilling Method: Hand Dug
Elevation: 5471.97
Northing: 898122
Easting: 647163
Total Depth: 1.0 ft

DITT	rring mer	nou. n	anu	Dug	735 325	TOTAL Deptil. 1.0	10		
Depth (ft)	Percent Recovery	Drilling Rate (ft/min)	le Interval	Sample Number	thology	Lithologic Description Comments		Screening Alpha (dpm)	Result: Beta
Cont	0-100	0-5 /A. Rei	dungs tus		ij tered	at 1.0 ft. Sample 478CS1501.			

- 0	Tarana and the same and the sam	<u>(1 / /)</u>	SW .	10	58 59
858	P////XIIIIIIII	Mative: Dark brown fmc sand,			
	<i>V////</i> ######	some gravel and rock			
	V////A:::::::::::::::::::::::::::::::::	fragments up to 4 inches,	0.0	21	5102
	Y////X:::::::::::::::::::::::::::::::::	moist	NESTONS.	22.00	(>FSL)
	1///// 1111111111111111111111111111111				(>1.51.51)
	V/////BBBB	[7]			
	1/////1999988	<u></u>			
	478CS1501		0.0	21	4416
	V////1999998		2000000000	10.00	(>FSL)
1	 {{{\frac{4}{1}}}}{ {\frac{4}{1}}} {\frac{4}{1}} {\frac{4}{1}} 		1		M62/22/20
	18 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8				
	144444444				
	18131813131313131				
3 - 3					
	19131919191919191				
20					
	14141414141				
	18 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8				
	1313131313131313131				
12 6/3					
	19191919191919191				
	19191919191919191				
	[4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4				
	[1441444HHHH				
L -5		I g	82	Li.	82 9

Project Name: CAU 478 T-Tunnel Ponds
Project Number: 840227.03090015

Date Started: 5/03/03

Date Completed: 5/03/03

Borehole Number: TCH-16 Elevation: 5465.51
Logged By: Mike Valesky Northing: 898155
Drilled By: Boart-Longyear Easting: 647242
Drilling Method: Rotosonic Total Depth: 5.0 ft

					735 785				
Depth (ft)	Percent Recovery	illing Rate (ft/min)	le Interval	Number	thology	Lithologic Description Comments	Field	Screening Alpha	Beta
	0-100	년 0-5 /A. San	Samp	พา เร 478CS16	Li	478CS1602, 478CSX160.5	(ppm)	(dpm)	(dpm)

478CS160.5 478CSX160.1	Native: Dark brown fmc sand, some fine gravel, some silt, moist, less than a 1 inch layer of muck on top, light grayish brown in color	1.0	7	5585
	Native: Light pinkish gray tuff, dry, light gray to	1.0	BKG	BKG
478CS1602	grayish white tuff below 2.5	1.0	21	5381
		4.1	BKG	BKG
	^ ^	1.8	BKG	BKG
		1.0	DIG	DNO

Borehole Number: TCH-17 Logged By: Mike Valesky Drilled By: Boart-Longyear

Elevation: 5464.82 Northing: 898158 Easting: 647252 Total Depth: 5.0 ft

Date Started: 5/03/03

Date Completed: 5/03/03

Drilling Method: Rotosonic

Depth (ft) (ft) Recovery Sample Interval Sample Number Sample Number sample Number out state of the state of	Screening	Results
0-100 0-5 0	Alpha (dpm)	Beta (dpm)

- 0	F777777715511111	· K.X.I	() () () () () () () () () ()	(8)	10	30
		478CS170.5	Native: Dark brown fmc sand, some silt, some gravel, some organic root material, moist, few tuff fragments at top	0.0	21	7428
31 <u>1</u> 3				0.7	BKG	6000
31 <u>2</u> 3			Native: Light whitish gray tuff, dry to slightly moist, top 1.0 ft moderately weathered	0.7	BKG	5000
323		478CS1703		1.0 -		
020			^ ^	6.9	BKG	BKG
			^ ^ ^			

Borehole Number: TCH-18 Logged By: Mike Valesky Drilled By: Boart-Longyear Date Started: 5/03/03

Date Completed: 5/03/03

Elevation: 5464.66

Elevation: 5464.66
Northing: 898160
Easting: 647262
Total Depth: 4.0 ft

		t e					Field	Screening	Results
Depth (ft)	O Percent O Recovery	O Drilling Ra G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

C 0 627777778011111	\$4555 CHON	\$1 A	58	180	58 59
	478CS180.5	Native: Dark brown fmc sand, some gravel, some silt, some organic root material, moist	0.5	29	5934
		Native: Whitish gray tuff, dry to slightly moist, weathered	1.6	вкс	BKG
	478CS1803		1.0	43	4522
-5		^	1.9	BKG	BKG

Project Name: CAU 478 T-Tunnel Ponds

Project Number: 840227.03090015

Date Started: 5/03/03

Date Completed: 5/03/03

Borehole Number: TCH-19
Logged By: Mike Valesky
Northing: 898163

Drilled By: Boart-Longyear
Easting: 647273

Drilling Method: Rotosonic
Total Depth: 4.5 ft

		e e				110 miles (m. 11.00, 100, 100, 100, 100, 100, 100, 1	Field	Screening	Results
Depth (ft)	O Percent O Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

	478CS190.5	Native: Dark brown fmc sand, some gravel, some silt, some organic root material, moist, some large tuff fragments below 2 ft	1.0	36	11000
			0.1	BKG	BKG
	478CS1903	Native: Whitish gray tuff, dry to slightly moist	0.1	21	4663
5		^ ^ ^	2.8	вкс	ВКG

Borehole Number: TCH-20
Logged By: Barb Deshler
Drilled By: Barb Deshler
Drilling Method: Hand Dug

Date Completed: 5/06/03 Elevation: 5439.51 Northing: 898195 Easting: 647587

Date Started: 5/06/03

Total Depth: 1.5 ft

According to the Control of the Cont	TOCAL Depos. 1.5 1			
Depth (ft) (ft) C Percent C Becovery C Drilling Rate C (ft/min) Sample Interval Sample Number Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

_ 0	478CS200.5	Native: Dark brown fmc sand, some gravel, moist, moisture increases with depth	0.0	36	4439
-			0.0	36	4196
	478CS2001.5		0.0	28	3808
_					
-					
1 -					
L -5					

Project Name: CAU 478 T-Tunnel Ponds
Project Number: 840227.03090015

Borehole Number: TCH-21

Logged By: Rick Deshler

Drilled By: Rick Deshler

Drilling Method: Hand Dug

	ACADINE MAN DESCRIPTION	200000000000000000000000000000000000000					
Depth (ft) Percent Recovery	Drilling Rate (ft/min) ample Interval	Sample Number	4	Lithologic Description Comments	VOCs	Alpha (dpm)	Results Beta (dpm)
0-100	0-5 g	-	1				

Γ°	478CS210.5	Muck: Dark brown fine sand, some gravel, damp, brattice cloth @ 0.5 ft with rock underneath	0.0	85	4137
8 2 3					
828					
9 L 3					
			S.	i s	

Project Number: 840227.03090015

Borehole Number: TCH-22 Logged By: Rick Deshler Drilled By: Rick Deshler

Drilling Method: Hand Dug

Date Started: 5/05/03
Date Completed: 5/05/03

Elevation: 5431.53 Northing: 898190 Easting: 647660

Total Depth: 2.33 ft

	And the second second second second	e e					Field	Screening	Results
Depth (ft)	- Percent - Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

F.	478CS2201	Native: Dark brown fine sand, some gravel, damp below 2 inches, last 1 inch gravel layer	0.0	57	4483
8 2 8					
:2:					

Borehole Number: TCH-23
Logged By: Rick Deshler
Drilled By: Rick Deshler
Drilling Method: Hand Dug

Date Completed: 5/05/03 Elevation: 5430.07 Northing: 898182

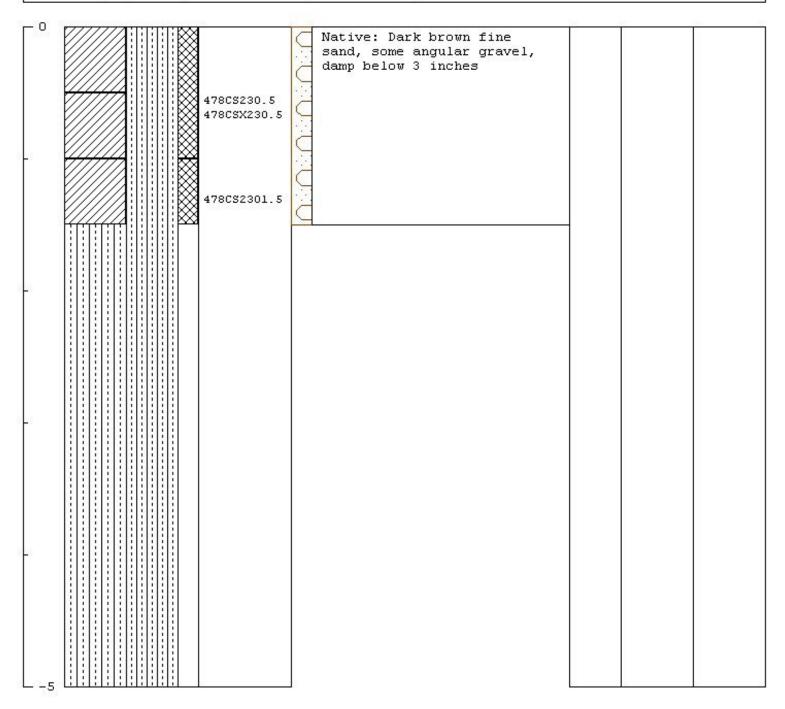
Date Started: 5/05/03

Northing: 898182

Easting: 647683

Total Depth: 1 5 ft

	Rate n) val		Topocodos - calcustration at upo - vicino de	Field	Screening	Results
epth ft) rcent covery	prilling Ka (ft/min) ample Interva	Sample Number Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)
0-100 0)-5 M	ı, ı				



Project Name: CAU 478 T-Tunnel Ponds
Project Number: 840227.03090015

Date Started: 5/05/03

Date Completed: 5/05/03

Borehole Number: TCH-24
Logged By: Mike Valesky
Drilled By: Boart-Longyear
Drilling Method: Rotosonic
Elevation: 5427.68
Northing: 898179
Easting: 647710
Total Depth: 5.0 ft

		e e					Field	Screening	Results
Depth (ft)	O Percent C Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

	478CS240.5	Native: Medium to dark brown fmc sand, some silt, trace gravel, some organic root material, gravel content increases with depth	1.2	43	4298
		Native: Pinkish gray tuff, dry, tuff below 3.5 ft is medium brownish gray to pinkish gray in color, weathered, dry to slightly moist	0.0	вкс	>3616 <4000
	478CS2403	\(\text{moist} \) \(\lambda \) \(\lambda \)	0.0	43	3545
5		^	0.0	вкс	BKG

Project Name: CAU 478 T-Tunnel Ponds

Project Number: 840227.03090015

Borehole Number: TCH-25 Logged By: Barb Deshler

Drilled By: Boart-Longyear
Drilling Method: Rotosonic

Date Started: 5/06/03

Date Completed: 5/06/03

Elevation: 5407.09 Northing: 898111 Easting: 648013

Total Depth: 5.0 ft

		ey .				(pp. 67.00 %) * (0.00 67.00 %) * (0.00 67.00 %)	Field	Screening	Results
Depth (ft)	O Percent O Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

	478	(some gr	: Dark brown fmc sand, ravel and rock nts up to 3 inches,	1.4	28	4067
				0.0	28	4165
				0.0	вкс	BKG
5				0.0	вкс	BKG

Borehole Number: TCH-26
Logged By: Barb Deshler
Drilled By: Boart-Longyear
Drilling Method: Rotosonic

Date Started: 5/06/03

Date Completed: 5/06/03

Floration: 5405-75

Elevation: 5405.75 Northing: 898112 Easting: 648026 Total Depth: 5.0 ft

ודדזת	ring mer	nou: K	000	Sourc		TOTAL Deptil: 5.0	10		
Depth (ft)	Percent Recovery	Drilling Rate (ft/min)	ample Interval	Sample Number	Lithology	Lithologic Description Comments		Screening Alpha (dpm)	Result
	0-100	0-5	လို	01					

	478CS260.5	Native: Medium grayish brown fmc sand, some gravel, moist at top	0.0	7	4388
		Native: Light brownish gray fm sand and rock fragments from grinding up rock (tuff)	0.0	вкс	BKG
-			0.0	BKG	BKG
			0.0	BKG	BKG

Project Name: CAU 478 T-Tunnel Ponds

Project Number: 840227.03090015

Borehole Number: TCH-27 Logged By: Barb Deshler

Drilled By: Boart-Longyear Drilling Method: Rotosonic

Date Started: 5/06/03
Date Completed: 5/06/03

Elevation: 5403.88
Northing: 898100
Easting: 648059

Total Depth: 5.0 ft

		e e					Field	Screening	Results
Depth (ft)	- Percent - Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

478CS270.5	28	43 69
	BKG	BKG
Native: Light gray ^ pulverized tuff/rock pieces		
Native: Medium grayish brown fmc sand, some gravel and tuff rock fragments		
	BKG	BKG

Project Name: CAU 478 T-Tunnel Ponds

Project Number: 840227.03090015

Date Completed: 5/02/03

Borehole Number: TPB-01 Elevation: 5514.27

Logged By: Mike Valesky Northing: 898022

Drilled By: Boart-Longyear Easting: 646811

Drilling Method: Rotosonic Total Depth: 10 ft

		e.					Field	Screening	Results
Depth (ft)	O Percent O Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs (ppm)	Alpha (dpm)	Beta (dpm)

	₩ 000000	Muck: Light grayish brown fmc sand, some silt, trace clay with some sandy silt layers interbedded, some organic root material, white clayey silt layer 0.25 ft thick at 4.5 ft	1.2	BKG	>4290 <6000
	478PSB0101.5	thick at 4.5 It	1.2	14	9389
	8080808		1.2	BKG	>4290 <6000
	0000000		4.9	BKG	>4290 <6000
5		Native: Medium to dark brown fmc sand, some gravel, some silt, moist Native: Light pinkish gray	3.0	BKG	>4290 <6000
		tuff fragments (drilled through boulder), dry to slightly moist	0.0	36	4585
		Native: Medium to dark brown fmc sand, some gravel, some silt, moist			
			0.0	BKG	>4290 <5000
	478PSB0109.5	Native: Medium brown fmc sand, some gravel, some silt, trace clay	0.0	21	4236
	Troppedia C	DIIO, OLGGE OLG	0.0	7.1	7230

Project Name: CAU 478 T-Tunnel Ponds

Project Number: 840227.03090015

Date Completed: 5/07/03

Borehole Number: TPB-02 Elevation: 5494.4

Logged By: Mike Valesky Northing: 898133

Drilled By: Boart-Longyear Easting: 646972

Drilling Method: Rotosonic Total Depth: 10 ft

	And the second s	e e				100 mil 10 mil - 10 mil	Field	Screening	Results
Depth (ft)	Percent H C Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs (ppm)	Alpha (dpm)	Beta (dpm)

L 0	(A) Manda Tanks be maden.		1	1 1
478PSB020.5	[HTT 유명	1.5	1.0	10 200
478PSBX020.5	Cil iliable, 100se, aly co moisc	1.5	14	10,300
1 1//// NIII 1/075BX02013	XX			
	8 1			
	0			
	ŏi			
	8	3.5	BKG	>4000
	Ō: 1			<5000
	<u>ත්</u>			
	O:			
	Ø.			
	Native: Dark pinkish gray to			
	brown fmc sand and tuff			
	fragments, dry to slightly			
	moist	1.8	BKG	>6000
	選	10.00000	78040000	<7000
	\subseteq			0300570.70.08
	<u>/</u>			
-5 -7/////				
	↑ Native: Yellowish gray to	1		
	brown to dark pinkish gray	6.5	BKG	>3000
	∧ to brown tuff, severely	0.235623	78,68,5075	<4000
	weathered			317.5.5.51
	\wedge			
F [////A:::::::::::::::::::::::::::::::::	\wedge	3.1	BKG	4075
	A	0.1	Dito	10,10
	^			
<u> </u>				
		2.7	BKG	>3000
				<4000
		4		
	Native: Medium pinkish gray			
478PSB0209.	1000 CONTROL C	0 0	50	1,050
1 /////		0.0	50	3859
L -10 ^K //// A	[/ 5]		la control	4 S

Borehole Number: TPB-03

Logged By: Mike Valesky

Drilled By: Boart-Longyear

Drilling Method: Rotosonic

Date Started: 5/04/03

Date Completed: 5/04/03

Elevation: 5450.29 Northing: 898195 Easting: 647475 Total Depth: 7 ft

ALC: NO.	Ling Met				11	Total Depth: 7 It		Screening	Results
Depth (ft)	O Percent C Recovery	O Drilling Rate G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

C 0 P7777771 SNITH 100 100 100 100 100 100 100 100 100 10	1	0	37
Muck: Light grayish brown fmc sand, some silt, some gravel, some organic root material, dry to slightly moist	0.0	36	5824
Native: Medium grayish to pinkish brown fmc sand and gravel, some silt, some tuff fragments/cobbles, dry to slightly moist	0.0	BKG	>5000 <6000
Native: Light grayish to pinkish brown fmc sand, some tuff fragments/cobbles, dry to slightly moist, tuff fragments/cobbles increase in quantity and size with depth	0.0	BKG	>4000 <5000
5	0.0	BKG	>3000 <4000
	0.0	BKG	>3000 <4000
478PSB0306.5	0.0	28	3526

Borehole Number: TPB-04
Logged By: Mike Valesky
Drilled By: Boart-Longyear
Drilling Method: Rotosonic

Date Started: 5/04/03

Date Completed: 5/04/03

Elevation: 5459.91

Elevation: 5459.91 Northing: 898197 Easting: 647344 Total Depth: 7 ft

		TT	Jonic	- T T	Total Depth. 7 10	- 1	Screening	Deenlte
Depth (ft) O Percent C Recovery	O O Drilling Rate O (ft/min)	Inter	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

- 0	77777745 9111111434	(8)		(N)
-	Muck: Dark brown organic rich sandy silt, some clay, very moist			
	478PSB040.5 very moist Native: Medium to dark brown	0.0	28	8535
	fmc sand, some gravel, some silt, moist	0.5	BKG	>5000 <8000
	Native: Pinkish to grayish brown fmc sand, some tuff fragments/cobbles, dry to slightly moist, tuff fragments/cobbles increase in quantity and size with	0.5	вкG	>5000 <6000
2	depth	0.7	BKG	>5000 <6000
5		0.7	BKG	BKG
-	478PSB0405.5	0.5	21	5447
-		1.8	BKG	BKG
81 2 3				
828				
10				

Project Name: CAU 478 T-Tunnel Ponds
Project Number: 840227.03090015

Date Started: 5/01/03

Date Completed: 5/02/03

Borehole Number: TPH-01 Elevation: 5516.51
Logged By: Mike Valesky Northing: 898086
Drilled By: Boart-Longyear Easting: 646764
Drilling Method: Rotosonic Total Depth: 12.5 ft

	AND THE RESERVE OF THE PERSON	e .					Field	Screening	Results
Depth (ft)	O Percent D Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)
Cont	act 0 7	.5 ft.	s	amples 478	3PSO1	lo.5, 478PS0105.5, 478PS0112.	55.		i j

_ 0	<u> </u>	(8)	<u> </u>	30
478PS010.5	 ○ Muck: Light to medium brown ○ fmc sand, some gravel/tuff ○ fragments, some organic root ○ material, moist, boulder ○ encountered at 2.5 ft 	0.0	21	3769
	0000	0.0	BKG	вкG
	Muck: Light to medium gray multi-color interbedded silty sand and clayey silt, wet			
5	000	0.0	BKG	>4290 <5000
478PS0105.5	0.000	0.0	14	5769
	O D D D D D D D D D D D D D D D D D D D	0.0	BKG	>4290 <5000
	silty sand, some fine gravel, trace clay, slightly moist to moist			
10	Native: Light brown to dark gray to black silty clay, some fine gravel, wet, organic like odor	0.0	BKG	BKG
		0.0	BKG	BKG
478PS0112	<u></u>	0.0	o	3910
		60	T _S	

Project Name: CAU 478 T-Tunnel Ponds

Project Number: 840227.03090015 Borehole Number: TPH-02

Logged By: Mike Valesky
Drilled By: Boart-Longyear
Drilling Method: Rotosonic

Date Started: 5/02/03
Date Completed: 5/02/03

Elevation: 5515.33 Northing: 898062 Easting: 646807 Total Depth: 10 ft

		e e					Field	Screening	Results
Depth (ft)	- Percent - Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

[k: Medium orangish brown	v 3		
47	78PS020.5 🔾 som	sand and tuff fragments, e silt	2.2	28	4106
	med:	k: Light grayish brown to ium gray to dark gray ty sand, some clay, trace vel, some organic root	2.1	BKG	>4290 <8000
47	78PS0202 mate		2.1	21	7895
	00000				
	0000		1.9	BKG	>4290 <4500
5	O. Not	ive: Medium brown fmc			
	sand silt	d, some gravel, some t, trace clay, trace bles, moist			
			2.7	BKG	BKG
			0.0	BKG	BKG
	J			33330	
47	78980209.5		0.0	36	4137

Borehole Number: TPH-03
Logged By: Mike Valesky
Drilled By: Boart-Longyear
Drilling Method: Rotosonic

Date Started: 5/07/03

Date Completed: 5/07/03

Elevation: 5495.57 Northing: 898142 Easting: 646957 Total Depth: 12.5 ft.

ntitiing wer	nou. Noci	JSUNIC		TOTAL Deptil: 12.5	ILC		
Depth (ft) Percent Recovery	Drilling Rate (ft/min)	Sample Number	Lithology	Lithologic Description Comments		Screening Alpha (dpm)	Result: Beta (dpm)
0-100	0-5 K	02					

- 0 P7777777 S 911111111	2020a 2	9900	(8)	36	58 59
	478PS030.5	Muck: Light whitish gray sandy silt, trace tuff fragments (<1/2 inch in size), moist	4.0	28	10800
		Native: Medium to dark brown fmc sand, some silt, some gravel, trace clay, some organic root material, moist. Note: medium to light	4.0	BKG	>5000 <8000
		pinkish brown below 2 ft, dry to slightly moist	0.0	BKG	>5000 <6000
-5			0.0	BKG	>4000 <5000
					10000
			0.0	BKG	>4000 <5000
-10	××	Native: Medium brown fmc sand and gravel, some silt, moist	0.0	BKG	>4000 <5000
	478PS0312	Native: Light pinkish gray to brown fmc sand, and some tuff fragments, dry to slightly moist	0.0	36	3765
15				T4	

Project Name: CAU 478 T-Tunnel Ponds
Project Number: 840227.03090015

Date Started: 5/07/03

Date Completed: 5/07/03

Borehole Number: TPH-04 Elevation: 5493.27

Logged By: Mike Valesky Northing: 898083

Drilled By: Boart-Longyear Easting: 646977

Drilling Method: Rotosonic Total Depth: 9.5 ft

		e e	l . l				Field	Screening	Results
Depth (ft)	O Percent H O Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs (ppm)	Alpha (dpm)	Beta (dpm)

L 0	[777777; K\\YII]	CEXA	K) + , +	[N	1	
			Muck: Native soil intermixed with muck, moist			
		478PS040.5		2.1	36	7620
					-5/075	162563
1			Muck: Dark gray cement,	1		
			firm, dry			
				1		
L			muck: Light whitish gray and	2.6	BKG	>5000
			L'interhedded levers of silt			<6000
			slightly firm			
8 2			[8]	2.4	BKG	>3500
				2.4	BKG	<4500
						1,1000
			Mal			
1		478PS0404		4.6	36	3969
		:₩		25056035	-3000	Steel And Color March
			Native: Medium to dark			
5			pinkish brown tuff, severely	4.6	BKG	>3500
8.58			weathered, moist to very moist with depth			<4500
			20			
		:	$ \wedge $			
8 - 2						
200				3.9	BKG	>3000
T					10000000	<4000
323				4.0	DWG.	
			***	4.3	BKG	>3000 <4000
						74000
929		478PS0409		2.8	36	3 683
			$ \wedge $	A 100 (100)	25000	DESCRIPTION:
				1		
L _1				E :		J. S
122-5-	53					

Project Name: CAU 478 T-Tunnel Ponds

Project Number: 840227.03090015

Date Started: 5/02/03

Date Completed: 5/02/03

Borehole Number: TPH-05
Logged By: Mike Valesky
Drilled By: Boart-Longyear
Drilling Method: Rotosonic
Elevation: 5485.62
Northing: 898184
Easting: 647033
Total Depth: 7.5 ft

		e.				100 MOVIMENT - 100 MO	Field	Screening	Results
Depth (ft)	- Percent - Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

- 0	677771111111111111111111111111111111111	T K A A	IZX vocazona vocazona seconomica e con establista		700	
2		478PS050.5	Muck: Medium to dark brown clayey silt, some sand, trace gravel, moist, sandier with depth and some organic root material in top several inches	4.1	21	6251
_			Native: Light pinkish gray to medium orangish gray	7.1	BKG	>5000 <6000
_			tuff, weathered to very weathered, dry to slightly moist to moist with depth			
_				5.4	BKG	BKG
5				0.3	BKG	вкG
_				NEA-4-E	1.00.0	
-		478PS0506.5	Λ	3.6 3.6	7 BKG	5087 BKG
			Native: Light pinkish gray tuff, slightly weathered, dry			
_						
3 <u>1</u> 3						
					i s	

Project Name: CAU 478 T-Tunnel Ponds

Project Number: 840227.03090015

Borehole Number: TPH-06
Logged By: Mike Valesky
Drilled By: Boart-Longyear

Drilling Method: Rotosonic

Date Started: 5/02/03
Date Completed: 5/02/03

Elevation: 5482.97

Northing: 898082 Easting: 647079

Total Depth: 13.7 ft

		e.					Field	Screening	Results
Depth (ft)	- Percent - Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

F°	∞		000000	Muck: Light grayish brown fmc sand, some gravel, some silt, some organic root material, moist	1.8	BKG	>5000 <6000
		478PS0602	0000		1.0	28	6393
5				Native: Medium to dark brown fmc sand, some silt, some gravel, some silt, trace clay, moist	0.4	BKG	BKG
					3.5	BKG	BKG
-		478PS0607.5			3.5	36	5071
10	6				0.0	BKG	BKG
-					0.0	BKG	BKG
-			٨	Native: Pinkish gray tuff			

Borehole Number: TPH-07
Logged By: Mike Valesky
Drilled By: Boart-Longyear
Drilling Method: Rotosonic

Date Started: 5/03/03

Date Completed: 5/03/03

Elevation: 5482.6 Northing: 898137 Easting: 647047 Total Depth: 7.5 ft

		ey.					Field	Screening	Results
Depth (ft)	- Percent - Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs (ppm)	Alpha (dpm)	Beta (dpm)

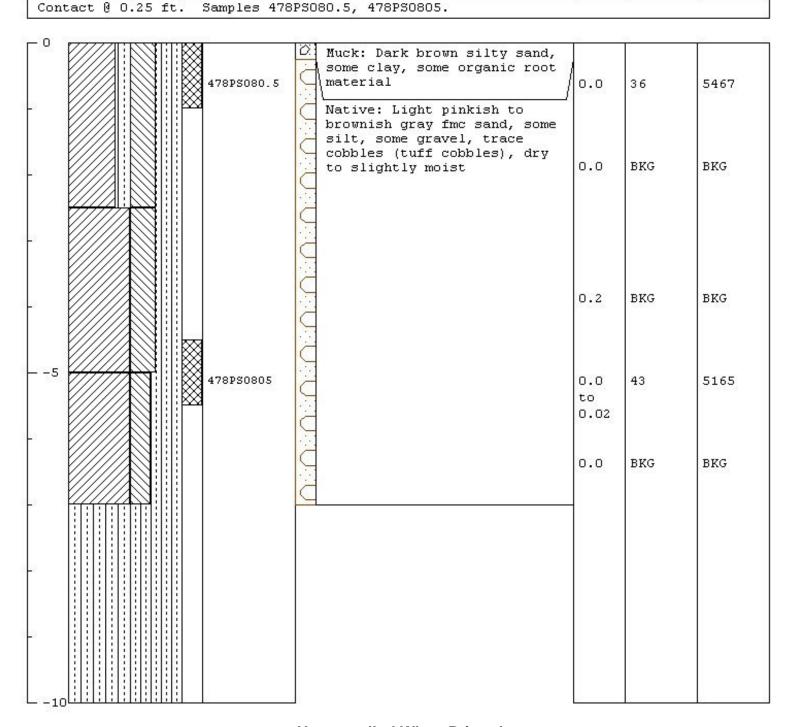
C 0 62222211Annun 1	ANGOL	(8)	16	(N) (V)
	Muck: Light grayish to brownish gray sandy silt, some clay, some tuff fragments, moist, cloth like	1.6	BKG	>5491 <6000
478PS0701	material at 1.5 ft	1.6	21	5726
	Native: Medium pinkish gray tuff, severely weathered below 1.75 ft and medium to dark brown in color	3.4	BKG	BKG
	Native: Light pinkish gray tuff, dry to slightly moist	1		
		6	BKG	BKG
-5	^			
	Native: Light brown to grayish brown tuff, severely	-		
	weathered, dry to slightly moist	5.3	BKG	BKG
478PS0707				
	J			9

Project Name: CAU 478 T-Tunnel Ponds Date Started: 5/03/03 Project Number: 840227.03090015 Date Completed: 5/03/03 Borehole Number: TPH-08 Elevation: 5461.75 Logged By: Mike Valesky Northing: 898204 Drilled By: Boart-Longyear **Easting:** 647317 Drilling Method: Rotosonic Total Depth: 7 ft Field Screening Results Drilling Rate Interva (ft/min) Sample Number Lithologic Description Recovery Percent Lithology Comments Depth (ff) VOCs Alpha Beta Sample (dpm) (ppm) (dpm)

0-100

Contact @ 0.25 ft.

0-5



Project Name: CAU 478 T-Tunnel Ponds
Project Number: 840227.03090015
Borehole Number: TPH-09
Logged By: Mike Valesky
Drilled By: Boart-Longyear
Drilling Method: Rotosonic

Date Started: 5/03/03
Date Completed: 5/03/03
Elevation: 5459.78
Northing: 898177
Easting: 647351
Total Depth: 7.5 ft

e de la companya de l	Participal Control	a)				Total Depen. 1.5	Field	Screening	Results
Depth (ft)	O Percent O Recovery	O Drilling Rate (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

478PS090.5	Muck: Light whitish gray silt, some sand, some organic root material, moist, sandier with depth and darker in color Native: Dark brown fmc sand,	0.0	36	6785
	some gravel, trace silt, moist	0.0	BKG	>5000 <7000
5	Native: Pinkish gray tuff, dry to slightly moist	0.0	BKG	ВКG
	Native: Light to medium whitish gray tuff, severely weathered, moist, some iron staining, brittle	0.0	BKG	BKG
478PS0906.5	^ ^	5.1	11	4561
		82		

Project Name: CAU 478 T-Tunnel Ponds

Project Number: 840227.03090015

Date Completed: 5/04/03

Borehole Number: TPH-10 Elevation: 5454.84
Logged By: Mike Valesky Northing: 898208
Drilled By: Boart-Longyear Easting: 647432
Drilling Method: Rotosonic Total Depth: 7 ft

		e e	l., l				Field	Screening	Results
Depth (ft)	O Percent C Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs (ppm)	Alpha (dpm)	Beta (dpm)

F °	478PS100.5	Muck: Tuff fragments, dry to slightly moist Native: Dark brown to medium brown fmc sand, some gravel, some silt, some organic root	0.9	21	4996
_	***	material, with some pinkish gray tuff fragments/cobbles below 1.5 ft	0.0	ВKG	>4000 <5000
323	478PS1003		0.8	50	3867
5		Native: Light pinkish to grayish brown fmc sand and gravel, some silt, some large tuff fragments/cobbles, dry to slightly moist	0.5	вкс	>4000 <5000
323			0.0	ВКG	BKG
	478PS1006.5		0.0	ВКG	3306

Project Name: CAU 478 T-Tunnel Ponds

Project Number: 840227.03090015

Date Completed: 5/04/03

Borehole Number: TPH-11 Elevation: 5453.98
Logged By: Mike Valesky Northing: 898210
Drilled By: Boart-Longyear Easting: 647439
Drilling Method: Rotosonic Total Depth: 7 ft

	Appropriate National Appropriate Con-	ų.				100-000-000 - x0-00-000-000-000-000-000-0	Field	Screening	Results
Depth (ft)	- Percent - Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs (ppm)	Alpha (dpm)	Beta (dpm)

_ 0 <i>p</i>			100	<u> </u>	25.
	478PS110.5	Muck: Light grayish brown fm sand, some silt, some organic root material, dry Native: Medium to dark to pinkish brown fmc sand, some	0.0	21	7667
		gravel, some silt, some pinkish gray tuff fragments/cobbles, dry to slightly moist	0.0	BKG	>5000 <6000
			0.0	BKG	>4000 <5000
5		Native: Light pinkish to grayish brown fmc sand and gravel, some silt, some large tuff fragments/cobbles, dry to slightly moist	0.0	BKG	>5000 <6000
			0.0	BKG	>4000 <5000
	478PS1106.5		0.0	17	3535
-					

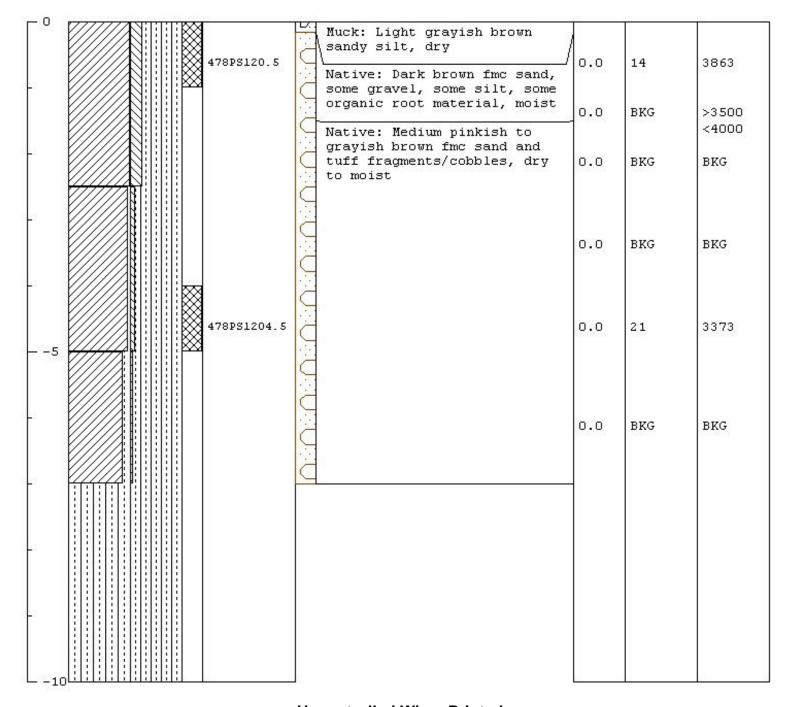
Project Name: CAU 478 T-Tunnel Ponds

Project Number: 840227.03090015

Date Completed: 5/05/03

Borehole Number: TPH-12 Elevation: 5419.95
Logged By: Mike Valesky Northing: 898197
Drilled By: Boart-Longyear Easting: 647867
Drilling Method: Rotosonic Total Depth: 7 ft

	A PROCESS AND	a					Field	Screening	Results
Depth (ft)	- Percent - Recovery	Drilling Rator (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs (ppm)	Alpha (dpm)	Beta (dpm)



Borehole Number: TPH-13
Logged By: Mike Valesky
Drilled By: Boart-Longyear
Drilling Method: Rotosonic

Date Started: 5/05/03
Date Completed: 5/05/03

Elevation: 5417.06 Northing: 898107 Easting: 647834 Total Depth: 5 ft

DITTING MECHOU.			708 988	Total Deptil. 5 It	3 500		
th ent ery ling Rate	(it/min) Sample Interval	Sample Number	Lithology	Lithologic Description Comments		Screening Alpha (dpm)	Result: Beta (dpm)
0-100 0-5 Contact @ N/A. S							

	478PS130.5	Native: Medium to dark brown fmc sand, some gravel, trace silt, some organic root material, moist	0.0	36	3643
2.2			0.0	BKG	BKG
	^ ^ ^	Native: Pinkish gray tuff	0.0	BKG	BKG
50 2 3	^ ^		0.0	BKG	BKG
	478PS1304.5		0.0	43	3608

Project Name: CAU 478 T-Tunnel Ponds
Project Number: 840227.03090015

Date Started: 5/05/03

Date Completed: 5/05/03

Borehole Number: TPH-14 Elevation: 5419.38

Logged By: Mike Valesky Northing: 898162

Drilled By: Boart-Longyear Easting: 647784

Drilling Method: Rotosonic Total Depth: 5 ft

	Appropriate National Assessment Co.	e.				110 PO 10 PO	Field	Screening	Results
Depth (ft)	- Percent - Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs	Alpha (dpm)	Beta (dpm)

L 0 62222224Z41111116004	Total Accordance voluments of according to the contract of		*	
	Native: Medium to dark brown fmc sand, some gravel, trace silt	0.0	21	3726
	Native: Pinkish gray fmc			
	sand and tuff fragments/cobbles, dry to moist			>3500 <4000
		0.0	BKG	BKG
	Native: Pinkish gray tuff, severely weathered			
	^			
		0.0	BKG	BKG
4781	081404.5	3.6	43	3545
	^			6

Project Name: CAU 478 T-Tunnel Ponds

Project Number: 840227.03090015

Borehole Number: TPH-15

Date Started: 5/05/03

Date Completed: 5/05/03

Elevation: 5417.86

Logged By: Mike Valesky

Drilled By: Boart-Longyear

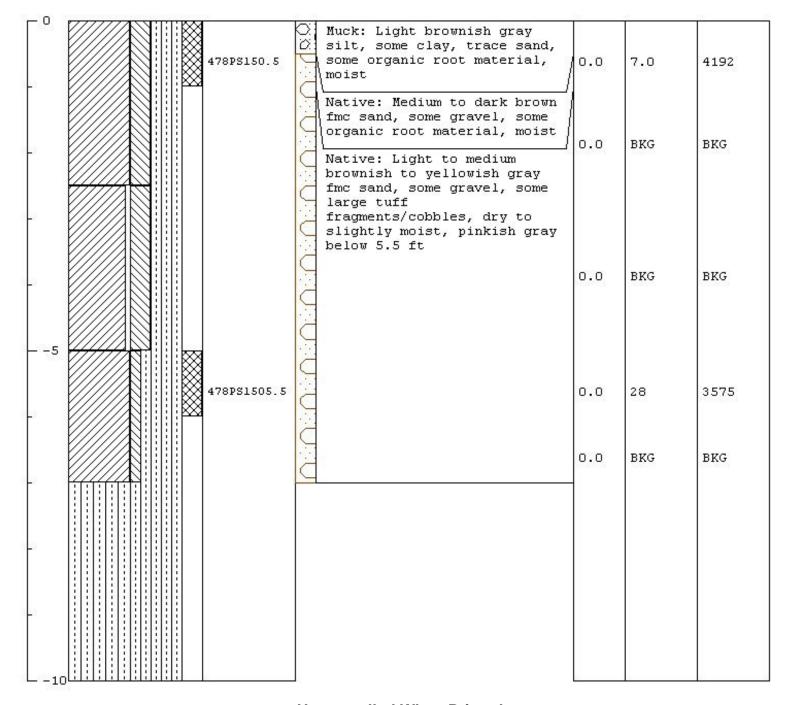
Drilling Method: Rotosonic

Northing: 898184

Easting: 647886

Total Depth: 7 ft

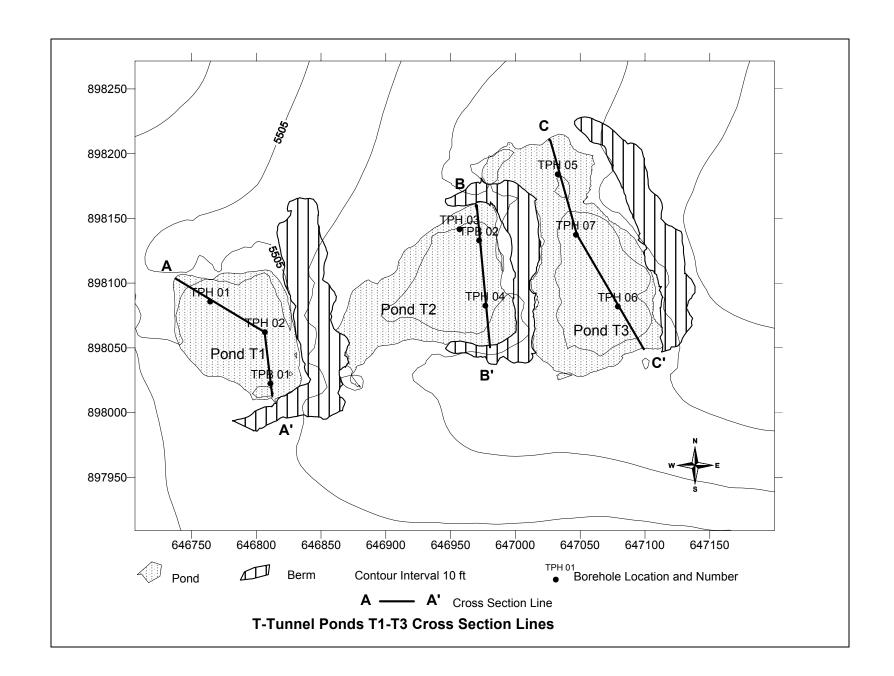
	A PROCESS IS THE STREET STREET	ø.				\$100 PER PROPERTY AND BEST OF THE PROPERTY OF	Field	Screening	Results
Depth (ft)	- Percent - Recovery	O Drilling Rat G (ft/min)	Sample Interval	Sample Number	Lithology	Lithologic Description Comments	VOCs (ppm)	Alpha (dpm)	Beta (dpm)

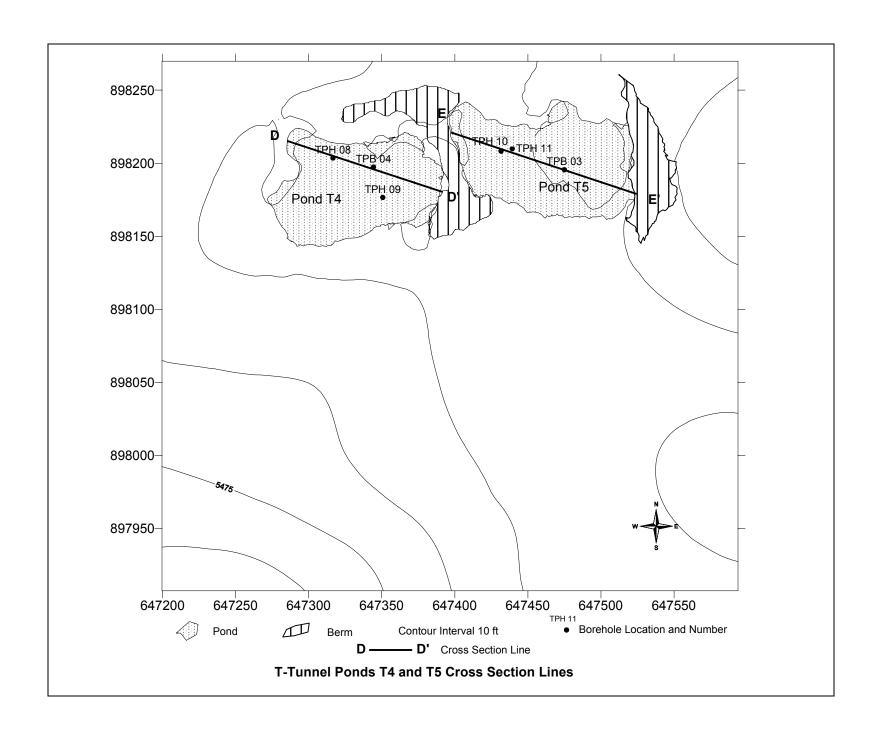


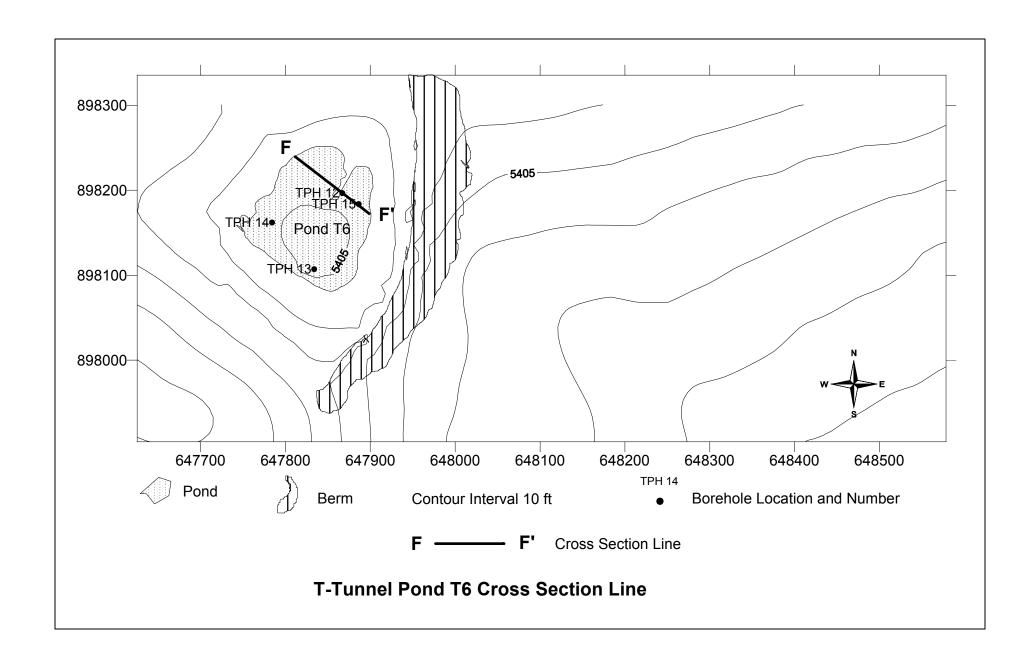
Attachment B

Cross Sections

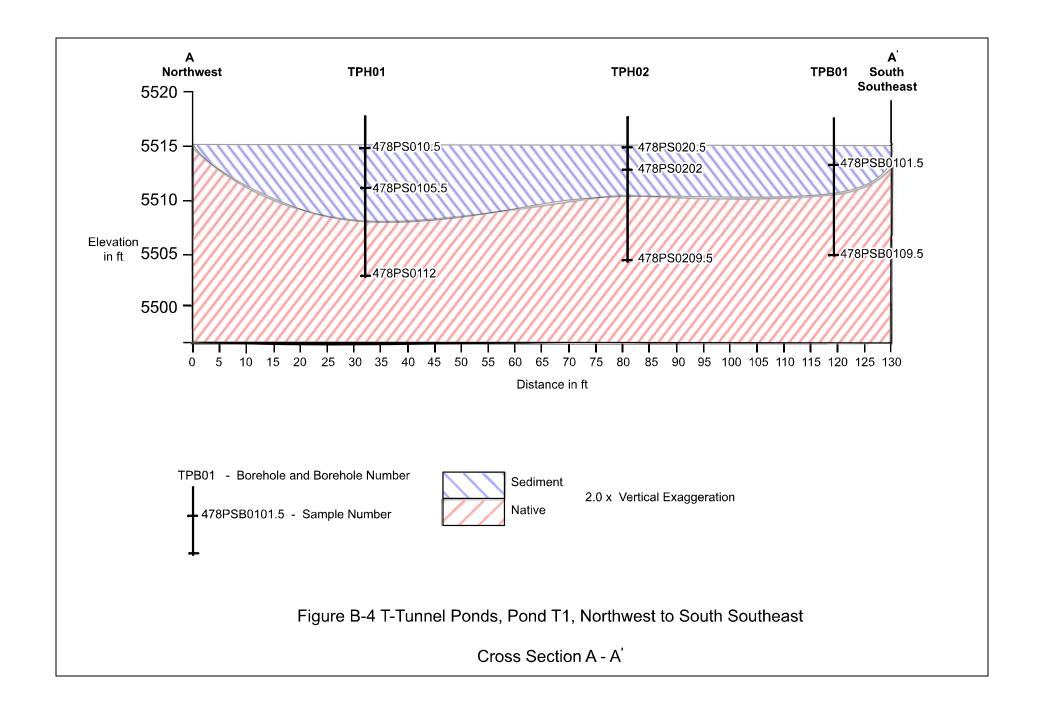
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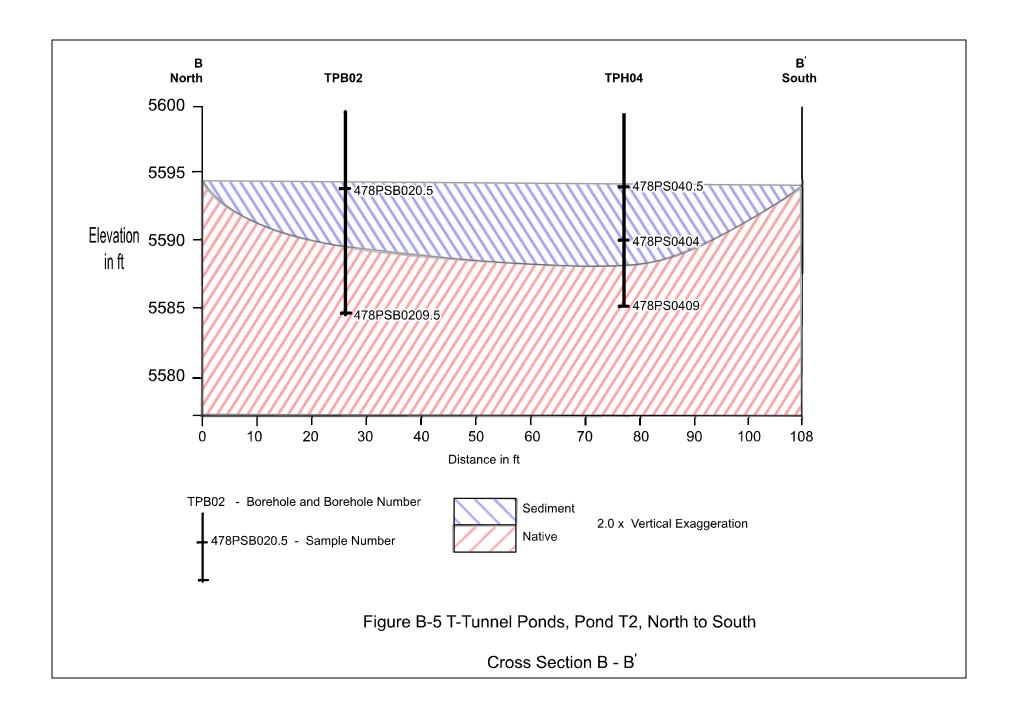


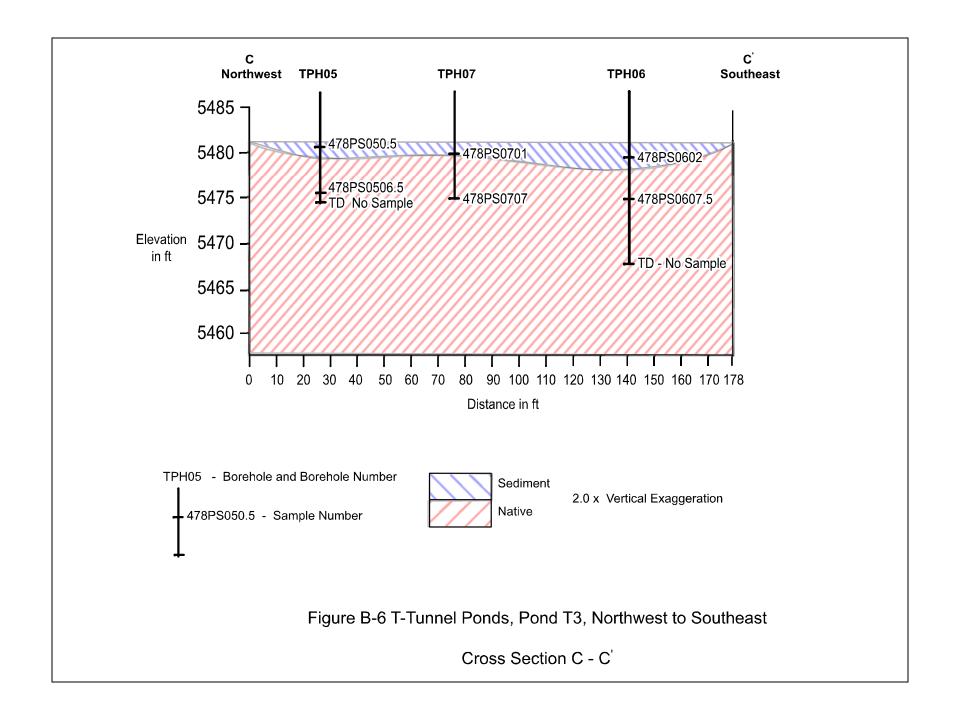


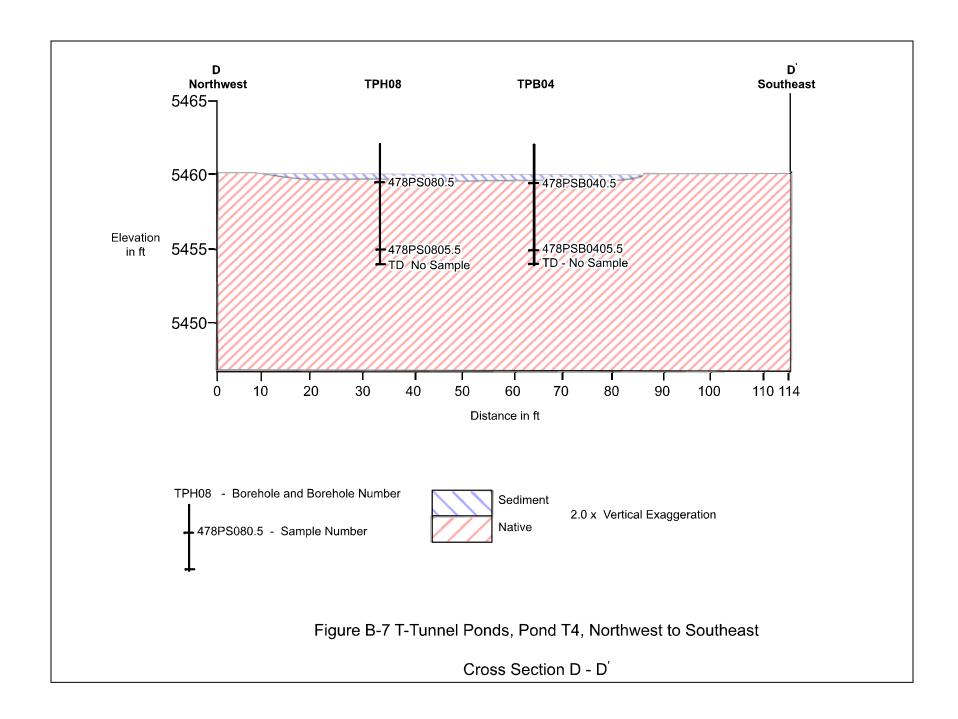


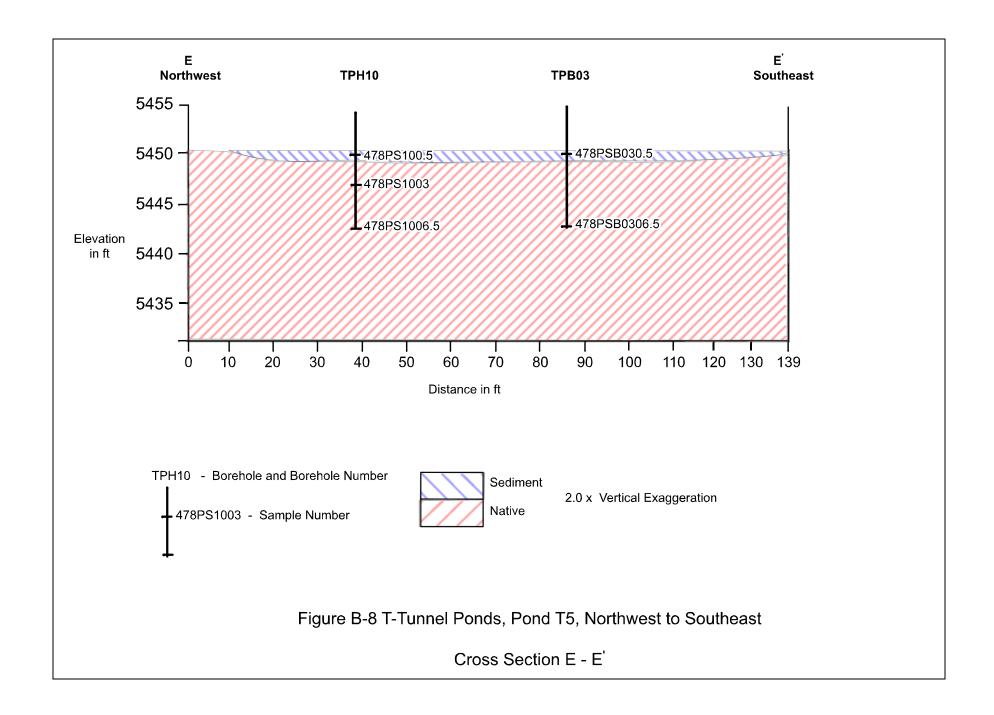
Uncontrolled When Printed

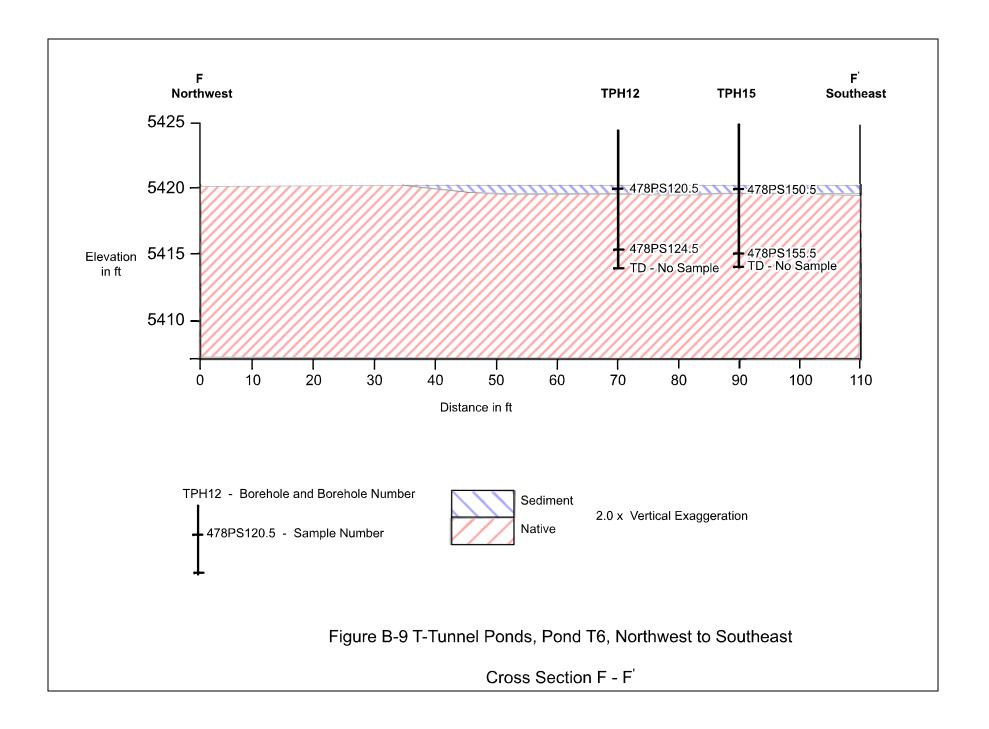












Attachment C Analytical Results Tables

(32 Pages)

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478CS010.5	5/1/2003	SOIL	HASL300	Ac-228	2.6	pCi/g	1	40112111211	0.94
478CS010.5	5/1/2003	SOIL	EPA6010	Arsenic	3.3	mg/kg	1.2		0.0.
478CS010.5	5/1/2003	SOIL	EPA6010	Barium	710	mg/kg	12		
478CS010.5	5/1/2003	SOIL	EPA6010	Beryllium	1.5	mg/kg	0.61		
478CS010.5	5/1/2003	SOIL	HASL300	Bi-214	0.61	pCi/g	0.55		0.39
478CS010.5	5/1/2003	SOIL	EPA6010	Chromium	1.5	mg/kg	1.2		0.00
478CS010.5	5/1/2003	SOIL	HASL300	Cs-137	21.5	pCi/g	0.32		3.7
478CS010.5	5/1/2003	SOIL	HASL300	K-40	31.2	pCi/g	3.1		7.5
478CS010.5	5/1/2003	SOIL	EPA6010	Lead	20	mg/kg	0.37		
478CS010.5	5/1/2003	SOIL	HASL300	Pb-212	1.94	pCi/g	0.46		0.52
478CS010.5	5/1/2003	SOIL	HASL300	Pb-214	1	pCi/g	0.74		0.45
478CS010.5	5/1/2003	SOIL	HASL300	TI-208	0.56	pCi/g	0.32		0.26
478CS020.5	5/1/2003	SOIL	HASL300	Ac-228	1.74	pCi/g	1.4		0.73
478CS020.5	5/1/2003	SOIL	EPA6010	Arsenic	3.6	mg/kg	1.1		
478CS020.5	5/1/2003	SOIL	EPA6010	Barium	830	mg/kg	11		
478CS020.5	5/1/2003	SOIL	EPA6010	Beryllium	1.4	mg/kg	0.57		
478CS020.5	5/1/2003	SOIL	HASL300	Bi-212	4.3	pCi/g	3.5	TI	2.7
478CS020.5	5/1/2003	SOIL	HASL300	Bi-214	0.74	pCi/g	0.59	TI	0.45
478CS020.5	5/1/2003	SOIL	EPA6010	Chromium	2.3	mg/kg	1.1		
478CS020.5	5/1/2003	SOIL	HASL300	Cs-137	11.3	pCi/g	0.35		2.1
478CS020.5	5/1/2003	SOIL	HASL300	K-40	32.2	pCi/g	5.2		8.5
478CS020.5	5/1/2003	SOIL	EPA6010	Lead	14	mg/kg	0.34		
478CS020.5	5/1/2003	SOIL	EPA8260	M+P-Xylene	3.4	μg/kg	5.7	J	
478CS020.5	5/1/2003	SOIL	EPA8260	O-Xylene	1.5	μg/kg	5.7	J	
478CS020.5	5/1/2003	SOIL	HASL300	Pb-212	1.74	pCi/g	0.51		0.51
478CS020.5	5/1/2003	SOIL	HASL300	Pb-214	0.71	pCi/g	0.59		0.34
478CS020.5	5/1/2003	SOIL	HASL300	TI-208	0.47	pCi/g	0.3		0.24
478CS030.5	4/30/2003	SOIL	HASL300	Ac-228	1.87	pCi/g	0.81		0.60
478CS030.5	4/30/2003	SOIL	EPA6010	Arsenic	1.8	mg/kg	1.1		
478CS030.5	4/30/2003	SOIL	EPA6010	Barium	330	mg/kg	11		
478CS030.5	4/30/2003	SOIL	EPA6010	Beryllium	0.94	mg/kg	0.57		
478CS030.5	4/30/2003	SOIL	HASL300	Bi-214	0.94	pCi/g	0.54		0.43
478CS030.5	4/30/2003	SOIL	EPA6010	Chromium	3	mg/kg	1.1		
478CS030.5	4/30/2003	SOIL	HASL300	Cs-137	2.04	pCi/g	0.28		0.48
478CS030.5	4/30/2003	SOIL	HASL300	K-40	22.9	pCi/g	2.8		5.7
478CS030.5	4/30/2003	SOIL	EPA6010	Lead	7	mg/kg	0.34		
478CS030.5	4/30/2003	SOIL	HASL300	Pb-212	2.14	pCi/g	0.42		0.52
478CS030.5	4/30/2003	SOIL	HASL300	Pb-214	0.76	pCi/g	0.46		0.36
478CS030.5	4/30/2003	SOIL	HASL300	TI-208	0.76	pCi/g	0.21		0.25
478CS040.5	4/30/2003	SOIL	HASL300	Ac-228	3.23	pCi/g	0.95		0.87
478CS040.5	4/30/2003	SOIL	HASL300	Am-241	0.56	pCi/g	0.33		0.25

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478CS040.5	4/30/2003	SOIL	EPA6010	Arsenic	2.6	mg/kg	1.1		
478CS040.5	4/30/2003	SOIL	EPA6010	Barium	400	mg/kg	11		
478CS040.5	4/30/2003	SOIL	EPA6010	Beryllium	0.88	mg/kg	0.55		
478CS040.5	4/30/2003	SOIL	HASL300	Bi-212	4.7	pCi/g	2.3	TI	2.3
478CS040.5	4/30/2003	SOIL	HASL300	Bi-214	1.33	pCi/g	0.55		0.50
478CS040.5	4/30/2003	SOIL	EPA6010	Chromium	3.8	mg/kg	1.1		
478CS040.5	4/30/2003	SOIL	HASL300	Cs-137	5.9	pCi/g	0.26		1.1
478CS040.5	4/30/2003	SOIL	EPA8015	Diesel-Range Organics	8	mg/kg	5.5	Н	
478CS040.5	4/30/2003	SOIL	HASL300	K-40	26.1	pCi/g	4		6.6
478CS040.5	4/30/2003	SOIL	EPA6010	Lead	9.1	mg/kg	0.33		
478CS040.5	4/30/2003	SOIL	HASL300	Pb-212	2.07	pCi/g	0.37		0.50
478CS040.5	4/30/2003	SOIL	HASL300	Pb-214	1.43	pCi/g	0.55		0.42
478CS040.5	4/30/2003	SOIL	HASL300	TI-208	0.74	pCi/g	0.24		0.25
478CS050.5	4/30/2003	SOIL	HASL300	Ac-228	2.75	pCi/g	1.1		0.88
478CS050.5	4/30/2003	SOIL	EPA6010	Arsenic	2.3	mg/kg	1.2		0.00
478CS050.5	4/30/2003	SOIL	EPA6010	Barium	340	mg/kg	12		
478CS050.5	4/30/2003	SOIL	EPA6010	Beryllium	1.3	mg/kg	0.61		
478CS050.5	4/30/2003	SOIL	EPA6010	Chromium	1.3	mg/kg	1.2		
478CS050.5	4/30/2003	SOIL	HASL300	Cs-137	12.1	pCi/g	0.4		2.2
478CS050.5	4/30/2003	SOIL	HASL300	K-40	36.1	pCi/g	3.9		8.7
478CS050.5	4/30/2003	SOIL	EPA6010	Lead	8.9	mg/kg	0.37		<u> </u>
478CS050.5	4/30/2003	SOIL	HASL300	Pb-212	2.22	pCi/g	0.54		0.59
478CS050.5	4/30/2003	SOIL	HASL300	Pb-214	1	pCi/g	0.86		0.47
478CS050.5	4/30/2003	SOIL	HASL300	TI-208	0.51	pCi/g	0.34		0.26
478CS0601	4/30/2003	SOIL	HASL300	Ac-228	2.1	pCi/g	1.1		0.84
478CS0601	4/30/2003	SOIL	EPA6010	Arsenic	2.8	mg/kg	1.1		0.01
478CS0601	4/30/2003	SOIL	EPA6010	Barium	210	mg/kg	11		
478CS0601	4/30/2003	SOIL	EPA6010	Beryllium	0.94	mg/kg	0.57		
478CS0601	4/30/2003	SOIL	HASL300	Bi-212	3.6	pCi/g	3.4		2.5
478CS0601	4/30/2003	SOIL	HASL300	Bi-214	0.81	pCi/g	0.51		0.41
478CS0601	4/30/2003	SOIL	EPA6010	Chromium	4.2	mg/kg	1.1		0.11
478CS0601	4/30/2003	SOIL	HASL300	Cs-137	7	pCi/g	0.29		1.3
478CS0601	4/30/2003	SOIL	EPA8015	Diesel-Range Organics	2.4	mg/kg	5.7	J	1.0
478CS0601	4/30/2003	SOIL	HASL300	K-40	28.6	pCi/g	3.5		7.0
478CS0601	4/30/2003	SOIL	EPA6010	Lead	8.8	mg/kg	0.34		
478CS0601	4/30/2003	SOIL	HASL300	Pb-212	2.56	pCi/g	0.39		0.59
478CS0601	4/30/2003	SOIL	HASL300	Pb-214	1.22	pCi/g	0.48		0.39
478CS0601	4/30/2003	SOIL	HASL300	TI-208	0.97	pCi/g	0.29		0.31
478CS0603	4/30/2003	SOIL	HASL300	Ac-228	1.53	pCi/g	1		0.66
478CS0603	4/30/2003	SOIL	EPA8260	Acetone	28	μg/kg	23		0.00
478CS0603	4/30/2003	SOIL	EPA6010	Arsenic	2.5	mg/kg	1.2		
478CS0603	4/30/2003	SOIL	EPA6010	Barium	350	mg/kg	12		

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478CS0603	4/30/2003	SOIL	EPA6010	Beryllium	0.91	mg/kg	0.58		
478CS0603	4/30/2003	SOIL	EPA6010	Chromium	6.2	mg/kg	1.2		
478CS0603	4/30/2003	SOIL	HASL300	K-40	21	pCi/g	4.6		5.9
478CS0603	4/30/2003	SOIL	EPA6010	Lead	7.7	mg/kg	0.35		
478CS0603	4/30/2003	SOIL	HASL300	Pb-212	1.84	pCi/g	0.41		0.47
478CS0603	4/30/2003	SOIL	HASL300	Pb-214	0.55	pCi/g	0.41		0.30
478CS0603	4/30/2003	SOIL	HASL300	TI-208	0.7	pCi/g	0.3		0.27
478CS070.5	4/30/2003	SOIL	HASL300	Ac-228	1.42	pCi/g	1.2	TI	0.72
478CS070.5	4/30/2003	SOIL	EPA6010	Arsenic	1.8	mg/kg	1.1		-
478CS070.5	4/30/2003	SOIL	EPA6010	Barium	280	mg/kg	11		
478CS070.5	4/30/2003	SOIL	EPA6010	Beryllium	0.84	mg/kg	0.55		
478CS070.5	4/30/2003	SOIL	EPA6010	Chromium	3.1	mg/kg	1.1		
478CS070.5	4/30/2003	SOIL	HASL300	Cs-137	0.88	pCi/g	0.27		0.31
478CS070.5	4/30/2003	SOIL	HASL300	K-40	24	pCi/g	4.1		6.8
478CS070.5	4/30/2003	SOIL	EPA6010	Lead	8.3	mg/kg	0.33		
478CS070.5	4/30/2003	SOIL	HASL300	Pb-212	1.64	pCi/g	0.35		0.45
478CS070.5	4/30/2003	SOIL	HASL300	Pb-214	0.78	pCi/g	0.52		0.33
478CS070.5	4/30/2003	SOIL	HASL300	TI-208	0.45	pCi/g	0.25		0.22
478CS080.5	5/1/2003	SOIL	HASL300	Ac-228	1.96	pCi/g	1.4		0.80
478CS080.5	5/1/2003	SOIL	EPA6010	Arsenic	3.6	mg/kg	1.1		
478CS080.5	5/1/2003	SOIL	EPA6010	Barium	240	mg/kg	11		
478CS080.5	5/1/2003	SOIL	EPA6010	Beryllium	0.79	mg/kg	0.55		
478CS080.5	5/1/2003	SOIL	HASL300	Bi-214	0.98	pCi/g	0.59		0.46
478CS080.5	5/1/2003	SOIL	EPA6010	Chromium	6.3	mg/kg	1.1		
478CS080.5	5/1/2003	SOIL	HASL300	Cs-137	1.21	pCi/g	0.33		0.37
478CS080.5	5/1/2003	SOIL	HASL300	K-40	25.8	pCi/g	4.9		6.8
478CS080.5	5/1/2003	SOIL	EPA6010	Lead	13	mg/kg	0.33		
478CS080.5	5/1/2003	SOIL	HASL300	Pb-212	2.06	pCi/g	0.47		0.52
478CS080.5	5/1/2003	SOIL	HASL300	Pb-214	1.2	pCi/g	0.6		0.42
478CS080.5	5/1/2003	SOIL	HASL300	TI-208	0.92	pCi/g	0.32		0.31
478CS090.5	5/1/2003	SOIL	HASL300	Ac-228	2.3	pCi/g	0.99		0.73
478CS090.5	5/1/2003	SOIL	EPA6010	Arsenic	3.1	mg/kg	1.2		
478CS090.5	5/1/2003	SOIL	EPA6010	Barium	180	mg/kg	12		
478CS090.5	5/1/2003	SOIL	EPA6010	Beryllium	0.88	mg/kg	0.58		
478CS090.5	5/1/2003	SOIL	HASL300	Bi-214	1.22	pCi/g	0.57		0.49
478CS090.5	5/1/2003	SOIL	EPA6010	Chromium	2.6	mg/kg	1.2		- · · · ·
478CS090.5	5/1/2003	SOIL	HASL300	Cs-137	12.8	pCi/g	0.3		2.3
478CS090.5	5/1/2003	SOIL	HASL300	K-40	30.8	pCi/g	3.8		7.3
478CS090.5	5/1/2003	SOIL	EPA6010	Lead	10	mg/kg	0.35		
478CS090.5	5/1/2003	SOIL	HASL300	Pb-212	2.15	pCi/g	0.47		0.54
478CS090.5	5/1/2003	SOIL	HASL300	Pb-214	1.26	pCi/g	0.56		0.41
478CS090.5	5/1/2003	SOIL	HASL300	TI-208	0.87	pCi/g	0.28		0.29

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478CS0903	5/1/2003	SOIL	HASL300	Ac-228	2.08	pCi/g	1.1	40112111211	0.72
478CS0903	5/1/2003	SOIL	EPA6010	Arsenic	1.5	mg/kg	1.1		
478CS0903	5/1/2003	SOIL	EPA6010	Barium	56	mg/kg	11		
478CS0903	5/1/2003	SOIL	HASL300	Bi-214	1.02	pCi/g	0.67		0.49
478CS0903	5/1/2003	SOIL	EPA6010	Chromium	2.2	mg/kg	1.1		
478CS0903	5/1/2003	SOIL	HASL300	Cs-137	0.78	pCi/g	0.32		0.28
478CS0903	5/1/2003	SOIL	HASL300	K-40	32.8	pCi/g	4.1		7.4
478CS0903	5/1/2003	SOIL	EPA6010	Lead	5.3	mg/kg	0.33		
478CS0903	5/1/2003	SOIL	HASL300	Pb-212	1.99	pCi/g	0.38		0.47
478CS0903	5/1/2003	SOIL	HASL300	Pb-214	1.36	pCi/g	0.44		0.38
478CS0903	5/1/2003	SOIL	HASL300	TI-208	0.69	pCi/g	0.29		0.25
478CS1001.5	5/1/2003	SOIL	HASL300	Ac-228	2.06	pCi/g	1.4		0.76
478CS1001.5	5/1/2003	SOIL	HASL300	Al-26	0.15	pCi/g	0.1	TI	0.15
478CS1001.5	5/1/2003	SOIL	HASL300	Am-241	0.64	pCi/g	0.33		0.26
478CS1001.5	5/1/2003	SOIL	EPA6010	Arsenic	1.8	mg/kg	1.1		
478CS1001.5	5/1/2003	SOIL	EPA6010	Barium	110	mg/kg	11		
478CS1001.5	5/1/2003	SOIL	EPA6010	Beryllium	0.6	mg/kg	0.55		
478CS1001.5	5/1/2003	SOIL	HASL300	Bi-214	0.76	pCi/g	0.63		0.46
478CS1001.5	5/1/2003	SOIL	EPA6010	Chromium	3	mg/kg	1.1		
478CS1001.5	5/1/2003	SOIL	HASL300	Cs-137	4.85	pCi/g	0.29		0.99
478CS1001.5	5/1/2003	SOIL	HASL300	K-40	26.3	pCi/g	3.9		7.1
478CS1001.5	5/1/2003	SOIL	EPA6010	Lead	7	mg/kg	0.33		
478CS1001.5	5/1/2003	SOIL	HASL300	Pb-212	2.22	pCi/g	0.48		0.57
478CS1001.5	5/1/2003	SOIL	HASL300	Pb-214	1.28	pCi/g	0.51		0.41
478CS1001.5	5/1/2003	SOIL	HASL300	TI-208	1.09	pCi/g	0.33		0.35
478CS110.5	5/1/2003	SOIL	HASL300	Ac-228	1.91	pCi/g	1.1	TI	0.94
478CS110.5	5/1/2003	SOIL	HASL300	Am-241	0.26	pCi/g	0.26		0.18
478CS110.5	5/1/2003	SOIL	EPA6010	Arsenic	2.2	mg/kg	1.1		
478CS110.5	5/1/2003	SOIL	EPA6010	Barium	620	mg/kg	11		
478CS110.5	5/1/2003	SOIL	EPA6010	Beryllium	1.1	mg/kg	0.57		
478CS110.5	5/1/2003	SOIL	HASL300	Bi-214	0.88	pCi/g	0.48		0.41
478CS110.5	5/1/2003	SOIL	EPA6010	Chromium	2.5	mg/kg	1.1		
478CS110.5	5/1/2003	SOIL	HASL300	Cs-137	10.9	pCi/g	0.28		2.0
478CS110.5	5/1/2003	SOIL	HASL300	K-40	42.4	pCi/g	3.9		9.5
478CS110.5	5/1/2003	SOIL	EPA6010	Lead	8	mg/kg	0.34		
478CS110.5	5/1/2003	SOIL	HASL300	Pb-212	1.94	pCi/g	0.46		0.51
478CS110.5	5/1/2003	SOIL	HASL300	Pb-214	1.02	pCi/g	0.59		0.39
478CS110.5	5/1/2003	SOIL	HASL300	TI-208	0.83	pCi/g	0.32		0.30
478CS1201	5/1/2003	SOIL	EPA8260	2-Hexanone	25	μg/kg	22		
478CS1201	5/1/2003	SOIL	HASL300	Ac-228	2.5	pCi/g	1.1		0.75
478CS1201	5/1/2003	SOIL	HASL300	Am-241	5.7	pCi/g	1.7		1.7
478CS1201	5/1/2003	SOIL	EPA6010	Arsenic	2.6	mg/kg	1.1		

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478CS1201	5/1/2003	SOIL	EPA6010	Barium	110	mg/kg	11		-
478CS1201	5/1/2003	SOIL	EPA6010	Beryllium	0.6	mg/kg	0.54		
478CS1201	5/1/2003	SOIL	HASL300	Bi-212	3	pCi/g	2.9	TI	2.1
478CS1201	5/1/2003	SOIL	HASL300	Bi-214	1.42	pCi/g	0.48		0.47
478CS1201	5/1/2003	SOIL	EPA6010	Chromium	2.7	mg/kg	1.1		
478CS1201	5/1/2003	SOIL	HASL300	Cs-137	18.7	pCi/g	0.29		3.2
478CS1201	5/1/2003	SOIL	EPA8015	Diesel-Range Organics	3.7	mg/kg	5.4	J	
478CS1201	5/1/2003	SOIL	HASL300	K-40	33.4	pCi/g	2.2		7.2
478CS1201	5/1/2003	SOIL	EPA6010	Lead	11	mg/kg	0.32		
478CS1201	5/1/2003	SOIL	HASL300	Pb-212	2.47	pCi/g	0.47		0.57
478CS1201	5/1/2003	SOIL	HASL300	Pb-214	1.28	pCi/g	0.64		0.43
478CS1201	5/1/2003	SOIL	UGTAISOPU	Pu-238	1.75	pCi/g	0.03		0.32
478CS1201	5/1/2003	SOIL	UGTAISOPU	Pu-239	18.6	pCi/g	0.035		2.9
478CS1201	5/1/2003	SOIL	SR7500	SR-90	1.04	pCi/g	0.33		0.32
478CS1201	5/1/2003	SOIL	HASL300	TI-208	0.7	pCi/g	0.24		0.24
478CS1203	5/1/2003	SOIL	HASL300	Ac-228	2.11	pCi/g	1.3		0.70
478CS1203	5/1/2003	SOIL	EPA6010	Arsenic	1.9	mg/kg	1		
478CS1203	5/1/2003	SOIL	EPA6010	Barium	70	mg/kg	10		
478CS1203	5/1/2003	SOIL	HASL300	Bi-214	1.07	pCi/g	0.58		0.46
478CS1203	5/1/2003	SOIL	EPA6010	Chromium	2.3	mg/kg	1		
478CS1203	5/1/2003	SOIL	HASL300	K-40	27	pCi/g	4.2		6.5
478CS1203	5/1/2003	SOIL	EPA6010	Lead	4	mg/kg	0.31		
478CS1203	5/1/2003	SOIL	HASL300	Pb-212	2.37	pCi/g	0.38		0.52
478CS1203	5/1/2003	SOIL	HASL300	Pb-214	1.45	pCi/g	0.37		0.37
478CS1203	5/1/2003	SOIL	HASL300	TI-208	0.71	pCi/g	0.25		0.24
478CS1301.5	5/4/2003	SOIL	HASL300	Ac-228	2.1	pCi/g	1.9		1.0
478CS1301.5	5/4/2003	SOIL	HASL300	Am-241	6.8	pCi/g	3.1		2.5
478CS1301.5	5/4/2003	SOIL	EPA6010	Arsenic	2.6	mg/kg	1.1		
478CS1301.5	5/4/2003	SOIL	EPA6010	Barium	76	mg/kg	11		
478CS1301.5	5/4/2003	SOIL	EPA6010	Beryllium	0.62	mg/kg	0.55		
478CS1301.5	5/4/2003	SOIL	EPA6010	Chromium	2.9	mg/kg	1.1		
478CS1301.5	5/4/2003	SOIL	HASL300	Co-58	0.35	pCi/g	0.32	TI	0.24
478CS1301.5	5/4/2003	SOIL	HASL300	Cs-137	31.6	pCi/g	0.75		5.4
478CS1301.5	5/4/2003	SOIL	HASL300	K-40	32	pCi/g	6.7		8.7
478CS1301.5	5/4/2003	SOIL	EPA6010	Lead	14	mg/kg	0.33		
478CS1301.5	5/4/2003	SOIL	HASL300	Pb-212	2.36	pCi/g	0.75		0.68
478CS1301.5	5/4/2003	SOIL	HASL300	Pb-214	1.15	pCi/g	1.1		0.63
478CS1301.5	5/4/2003	SOIL	UGTAISOPU	Pu-238	2.86	pCi/g	0.014		0.47
478CS1301.5	5/4/2003	SOIL	UGTAISOPU	Pu-239	30.1	pCi/g	0.014		4.5
478CS1301.5	5/4/2003	SOIL	SR7500	SR-90	1.48	pCi/g	0.34		0.42
478CS1301.5	5/4/2003	SOIL	HASL300	TI-208	0.68	pCi/g	0.51		0.37
478CS140.5	5/4/2003	SOIL	HASL300	Ac-228	3	pCi/g	1.3		1.0

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478CS140.5	5/4/2003	SOIL	HASL300	Am-241	3.98	pCi/g	0.54		0.83
478CS140.5	5/4/2003	SOIL	EPA6010	Arsenic	2.6	mg/kg	1.1		
478CS140.5	5/4/2003	SOIL	EPA6010	Barium	450	mg/kg	11		
478CS140.5	5/4/2003	SOIL	EPA6010	Beryllium	0.69	mg/kg	0.55		
478CS140.5	5/4/2003	SOIL	HASL300	Bi-214	1.7	pCi/g	0.76		0.66
478CS140.5	5/4/2003	SOIL	EPA6010	Chromium	2.9	mg/kg	1.1		
478CS140.5	5/4/2003	SOIL	HASL300	Cs-137	50.5	pCi/g	0.49		8.5
478CS140.5	5/4/2003	SOIL	EPA8015	Diesel-Range Organics	7.2	mg/kg	5.5	Н	
478CS140.5	5/4/2003	SOIL	HASL300	K-40	30.5	pCi/g	3.4		7.6
478CS140.5	5/4/2003	SOIL	EPA6010	Lead	12	mg/kg	0.33		-
478CS140.5	5/4/2003	SOIL	HASL300	Pb-212	2.08	pCi/g	0.77		0.65
478CS140.5	5/4/2003	SOIL	HASL300	Pb-214	1.41	pCi/g	1.1		0.60
478CS140.5	5/4/2003	SOIL	UGTAISOPU	Pu-238	1.1	pCi/g	0.027		0.21
478CS140.5	5/4/2003	SOIL	UGTAISOPU	Pu-239	11.4	pCi/g	0.023		1.7
478CS140.5	5/4/2003	SOIL	SR7500	Sr-90	1.34	pCi/g	0.36		0.39
478CS140.5	5/4/2003	SOIL	HASL300	TI-208	0.93	pCi/g	0.36		0.33
478CS1501	5/4/2003	SOIL	HASL300	Ac-228	2.5	pCi/g	1.3		1.1
478CS1501	5/4/2003	SOIL	HASL300	Am-241	3.41	pCi/g	0.47		0.75
478CS1501	5/4/2003	SOIL	EPA6010	Arsenic	3	mg/kg	1.2		
478CS1501	5/4/2003	SOIL	EPA6010	Barium	980	mg/kg	12		
478CS1501	5/4/2003	SOIL	EPA6010	Beryllium	0.65	mg/kg	0.58		
478CS1501	5/4/2003	SOIL	HASL300	Bi-214	0.86	pCi/g	0.68		0.52
478CS1501	5/4/2003	SOIL	EPA6010	Chromium	2.7	mg/kg	1.2		
478CS1501	5/4/2003	SOIL	HASL300	Cs-137	30	pCi/g	0.37		5.2
478CS1501	5/4/2003	SOIL	EPA8015	Diesel-Range Organics	12	mg/kg	5.8	Н	
478CS1501	5/4/2003	SOIL	HASL300	K-40	29.5	pCi/g	4.5		8.5
478CS1501	5/4/2003	SOIL	EPA6010	Lead	11	mg/kg	0.35		
478CS1501	5/4/2003	SOIL	HASL300	Pb-212	2.18	pCi/g	0.65		0.64
478CS1501	5/4/2003	SOIL	HASL300	Pb-214	1.07	pCi/g	0.83		0.49
478CS1501	5/4/2003	SOIL	UGTAISOPU	Pu-238	1.03	pCi/g	0.022		0.19
478CS1501	5/4/2003	SOIL	UGTAISOPU	Pu-239	10.1	pCi/g	0.012		1.5
478CS1501	5/4/2003	SOIL	HASL300	Sb-125	1.11	pCi/g	1.1	TI	0.76
478CS1501	5/4/2003	SOIL	SR7500	Sr-90	2.72	pCi/g	0.37		0.71
478CS1501	5/4/2003	SOIL	HASL300	TI-208	0.83	pCi/g	0.46		0.38
478CS160.5	5/3/2003	SOIL	HASL300	Ac-228	2.41	pCi/g	1.1		0.75
478CS160.5	5/3/2003	SOIL	HASL300	Am-241	2.2	pCi/g	1.9	TI	1.3
478CS160.5	5/3/2003	SOIL	EPA6010	Arsenic	2.5	mg/kg	1.1		
478CS160.5	5/3/2003	SOIL	EPA6010	Barium	110	mg/kg	11		
478CS160.5	5/3/2003	SOIL	EPA6010	Beryllium	0.64	mg/kg	0.56		
478CS160.5	5/3/2003	SOIL	HASL300	Bi-214	0.86	pCi/g	0.62		0.46
478CS160.5	5/3/2003	SOIL	EPA6010	Chromium	2.5	mg/kg	1.1		
478CS160.5	5/3/2003	SOIL	HASL300	Cs-137	12.2	pCi/g	0.31		2.2

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478CS160.5	5/3/2003	SOIL	HASL300	K-40	27.7	pCi/g	3.2		6.7
478CS160.5	5/3/2003	SOIL	EPA6010	Lead	9.2	mg/kg	0.34		-
478CS160.5	5/3/2003	SOIL	EPA8260	Methylene Chloride	22	μg/kg	5.6		
478CS160.5	5/3/2003	SOIL	HASL300	Pb-212	2.35	pCi/g	0.44		0.56
478CS160.5	5/3/2003	SOIL	HASL300	Pb-214	1.44	pCi/g	0.61		0.46
478CS160.5	5/3/2003	SOIL	UGTAISOPU	Pu-238	0.48	pCi/g	0.028		0.12
478CS160.5	5/3/2003	SOIL	UGTAISOPU	Pu-239	6.23	pCi/g	0.014		0.98
478CS160.5	5/3/2003	SOIL	SR7500	SR-90	1.63	pCi/g	0.33		0.45
478CS160.5	5/3/2003	SOIL	HASL300	TI-208	0.67	pCi/g	0.27		0.25
478CS1602	5/3/2003	SOIL	HASL300	Ac-228	2.32	pCi/g	1.1		0.71
478CS1602	5/3/2003	SOIL	EPA6010	Arsenic	1.9	mg/kg	1		-
478CS1602	5/3/2003	SOIL	EPA6010	Barium	34	mg/kg	10		
478CS1602	5/3/2003	SOIL	HASL300	Bi-212	3.9	pCi/g	3.9		2.7
478CS1602	5/3/2003	SOIL	HASL300	Bi-214	1.12	pCi/g	0.46		0.41
478CS1602	5/3/2003	SOIL	EPA6010	Chromium	1.6	mg/kg	1		• • • • • • • • • • • • • • • • • • • •
478CS1602	5/3/2003	SOIL	HASL300	K-40	31	pCi/g	3.5		7.0
478CS1602	5/3/2003	SOIL	EPA6010	Lead	3.9	mg/kg	0.31		
478CS1602	5/3/2003	SOIL	EPA8260	Methylene Chloride	19	μg/kg	5.2		
478CS1602	5/3/2003	SOIL	HASL300	Pb-212	3.05	pCi/g	0.32		0.62
478CS1602	5/3/2003	SOIL	HASL300	Pb-214	1.33	pCi/g	0.47		0.38
478CS1602	5/3/2003	SOIL	HASL300	Th-234	2.9	pCi/g	2.9		1.8
478CS1602	5/3/2003	SOIL	HASL300	TI-208	0.71	pCi/g	0.35		0.27
478CS170.5	5/3/2003	SOIL	HASL300	Ac-228	2.51	pCi/g	1		0.85
478CS170.5	5/3/2003	SOIL	HASL300	Am-241	7.5	pCi/g	3.1		2.5
478CS170.5	5/3/2003	SOIL	EPA6010	Arsenic	2.5	mg/kg	1.1		
478CS170.5	5/3/2003	SOIL	EPA6010	Barium	510	mg/kg	11		
478CS170.5	5/3/2003	SOIL	EPA6010	Beryllium	0.6	mg/kg	0.56		
478CS170.5	5/3/2003	SOIL	EPA6010	Chromium	3.5	mg/kg	1.1		
478CS170.5	5/3/2003	SOIL	HASL300	Cs-137	65	pCi/g	0.38		11
478CS170.5	5/3/2003	SOIL	EPA8015	Diesel-Range Organics	17	mg/kg	5.6	Н	
478CS170.5	5/3/2003	SOIL	HASL300	K-40	29.2	pCi/g	3.5		7.0
478CS170.5	5/3/2003	SOIL	EPA6010	Lead	14	mg/kg	0.34		7.0
478CS170.5	5/3/2003	SOIL	HASL300	Pb-212	2.55	pCi/g	0.63		0.65
478CS170.5	5/3/2003	SOIL	HASL300	Pb-214	1.39	pCi/g	0.83		0.52
478CS170.5	5/3/2003	SOIL	UGTAISOPU	Pu-238	2	pCi/g	0.041		0.37
478CS170.5	5/3/2003	SOIL	UGTAISOPU	Pu-239	21.9	pCi/g	0.017		3.4
478CS170.5	5/3/2003	SOIL	SR7500	SR-90	5.1	pCi/g	0.4		1.3
478CS170.5	5/3/2003	SOIL	HASL300	TI-208	1.07	pCi/g	0.38		0.34
478CS1703	5/3/2003	SOIL	HASL300	Ac-228	2.34	pCi/g	1.1		0.73
478CS1703	5/3/2003	SOIL	EPA6010	Arsenic	3	mg/kg	1.1		0.70
478CS1703	5/3/2003	SOIL	EPA6010	Barium	170	mg/kg	11		
478CS1703	5/3/2003	SOIL	EPA6010	Beryllium	1.8	mg/kg	0.56		

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478CS1703	5/3/2003	SOIL	HASL300	Bi-214	0.6	pCi/g	0.58	40712111211	0.40
478CS1703	5/3/2003	SOIL	EPA8270	Bis(2-Ethylhexyl)Phthalathe	370	μg/kg	370	J	00
478CS1703	5/3/2003	SOIL	HASL300	Cs-137	0.5	pCi/g	0.21		0.21
478CS1703	5/3/2003	SOIL	HASL300	K-40	22.4	pCi/g	3.8		5.9
478CS1703	5/3/2003	SOIL	EPA6010	Lead	13	mg/kg	0.34		
478CS1703	5/3/2003	SOIL	HASL300	Pb-212	2.01	pCi/g	0.4		0.50
478CS1703	5/3/2003	SOIL	HASL300	Pb-214	0.67	pCi/g	0.5		0.30
478CS1703	5/3/2003	SOIL	HASL300	TI-208	0.69	pCi/g	0.24		0.25
478CS180.5	5/3/2003	SOIL	HASL300	Ac-228	2.05	pCi/g	1.2		0.75
478CS180.5	5/3/2003	SOIL	HASL300	Am-241	5.3	pCi/g	1.3		1.4
478CS180.5	5/3/2003	SOIL	EPA6010	Arsenic	2.2	mg/kg	1.1		
478CS180.5	5/3/2003	SOIL	EPA6010	Barium	170	mg/kg	11		
478CS180.5	5/3/2003	SOIL	EPA6010	Beryllium	0.6	mg/kg	0.56		
478CS180.5	5/3/2003	SOIL	HASL300	Bi-214	1.12	pCi/g	0.68		0.52
478CS180.5	5/3/2003	SOIL	EPA6010	Chromium	2.6	mg/kg	1.1		0.02
478CS180.5	5/3/2003	SOIL	HASL300	Cs-137	31.5	pCi/g	0.34		5.3
478CS180.5	5/3/2003	SOIL	EPA8015	Diesel-Range Organics	10	mg/kg	5.6	Н	
478CS180.5	5/3/2003	SOIL	HASL300	K-40	29	pCi/g	2.5		6.8
478CS180.5	5/3/2003	SOIL	EPA6010	Lead	13	mg/kg	0.34		
478CS180.5	5/3/2003	SOIL	HASL300	Pb-212	2.54	pCi/g	0.55		0.62
478CS180.5	5/3/2003	SOIL	HASL300	Pb-214	1.16	pCi/g	0.77		0.45
478CS180.5	5/3/2003	SOIL	UGTAISOPU	Pu-238	1.28	pCi/g	0.013		0.23
478CS180.5	5/3/2003	SOIL	UGTAISOPU	Pu-239	14.7	pCi/g	0.025		2.2
478CS180.5	5/3/2003	SOIL	SR7500	SR-90	2.02	pCi/g	0.32		0.53
478CS180.5	5/3/2003	SOIL	HASL300	TI-208	0.87	pCi/g	0.34		0.31
478CS1803	5/3/2003	SOIL	HASL300	Ac-228	1.92	pCi/g	1.6	TI	0.79
478CS1803	5/3/2003	SOIL	EPA8260	Acetone	12	μg/kg	23	J	
478CS1803	5/3/2003	SOIL	EPA6010	Arsenic	3.3	mg/kg	1.1		
478CS1803	5/3/2003	SOIL	EPA6010	Barium	120	mg/kg	11		
478CS1803	5/3/2003	SOIL	EPA6010	Beryllium	1.5	mg/kg	0.57		
478CS1803	5/3/2003	SOIL	HASL300	Bi-214	0.91	pCi/g	0.65		0.50
478CS1803	5/3/2003	SOIL	EPA6010	Chromium	1.2	mg/kg	1.1		
478CS1803	5/3/2003	SOIL	HASL300	Cs-137	0.93	pCi/g	0.34		0.35
478CS1803	5/3/2003	SOIL	HASL300	K-40	22	pCi/g	4.6		6.7
478CS1803	5/3/2003	SOIL	EPA6010	Lead	14	mg/kg	0.34		
478CS1803	5/3/2003	SOIL	HASL300	Pb-212	2.07	pCi/g	0.48		0.55
478CS1803	5/3/2003	SOIL	HASL300	Pb-214	0.79	pCi/g	0.52		0.35
478CS1803	5/3/2003	SOIL	HASL300	TI-208	0.76	pCi/g	0.32		0.30
478CS190.5	5/3/2003	SOIL	HASL300	Ac-228	2.01	pCi/g	1.1		0.88
478CS190.5	5/3/2003	SOIL	HASL300	Am-241	11	pCi/g	0.63		2.0
478CS190.5	5/3/2003	SOIL	EPA6010	Arsenic	2.6	mg/kg	1.1		
478CS190.5	5/3/2003	SOIL	EPA6010	Barium	150	mg/kg	11		

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478CS190.5	5/3/2003	SOIL	EPA6010	Beryllium	0.58	mg/kg	0.56	40112111211	
478CS190.5	5/3/2003	SOIL	HASL300	Bi-214	1.05	pCi/g	0.87		0.61
478CS190.5	5/3/2003	SOIL	EPA6010	Chromium	3	mg/kg	1.1		
478CS190.5	5/3/2003	SOIL	HASL300	Co-60	0.3	pCi/g	0.3	TI	0.23
478CS190.5	5/3/2003	SOIL	HASL300	Cs-137	45.2	pCi/g	0.38		7.7
478CS190.5	5/3/2003	SOIL	EPA8015	Diesel-Range Organics	13	mg/kg	5.6	Н	
478CS190.5	5/3/2003	SOIL	HASL300	K-40	26.5	pCi/g	4.8		7.1
478CS190.5	5/3/2003	SOIL	EPA6010	Lead	13	mg/kg	0.34		
478CS190.5	5/3/2003	SOIL	HASL300	Pb-212	3.02	pCi/g	0.64		0.74
478CS190.5	5/3/2003	SOIL	HASL300	Pb-214	1.27	pCi/g	1.1		0.66
478CS190.5	5/3/2003	SOIL	UGTAISOPU	Pu-238	2.07	pCi/g	0.029		0.37
478CS190.5	5/3/2003	SOIL	UGTAISOPU	Pu-239	21.8	pCi/g	0.029		3.3
478CS190.5	5/3/2003	SOIL	SR7500	SR-90	5.2	pCi/g	0.3		1.3
478CS190.5	5/3/2003	SOIL	HASL300	TI-208	0.83	pCi/g	0.36		0.32
478CS1903	5/3/2003	SOIL	HASL300	Ac-228	2.2	pCi/g	1.7	TI	1.3
478CS1903	5/3/2003	SOIL	EPA6010	Arsenic	2.9	mg/kg	1.1		
478CS1903	5/3/2003	SOIL	EPA6010	Barium	160	mg/kg	11		
478CS1903	5/3/2003	SOIL	EPA6010	Beryllium	1.7	mg/kg	0.56		
478CS1903	5/3/2003	SOIL	HASL300	Bi-214	0.71	pCi/g	0.71		0.49
478CS1903	5/3/2003	SOIL	HASL300	Eu-152	0.9	pCi/g	0.41	TI	0.75
478CS1903	5/3/2003	SOIL	HASL300	K-40	26.6	pCi/g	6.6		8.0
478CS1903	5/3/2003	SOIL	EPA6010	Lead	13	mg/kg	0.34		
478CS1903	5/3/2003	SOIL	HASL300	Pb-212	1.96	pCi/g	0.49		0.54
478CS1903	5/3/2003	SOIL	HASL300	TI-208	0.81	pCi/g	0.33		0.32
478CS200.5	5/6/2003	SOIL	HASL300	Ac-228	1.97	pCi/g	1.1		0.67
478CS200.5	5/6/2003	SOIL	HASL300	Am-241	1.58	pCi/g	0.33		0.39
478CS200.5	5/6/2003	SOIL	EPA6010	Arsenic	2.2	mg/kg	1.1		
478CS200.5	5/6/2003	SOIL	EPA6010	Barium	190	mg/kg	11		
478CS200.5	5/6/2003	SOIL	EPA6010	Beryllium	0.7	mg/kg	0.54		
478CS200.5	5/6/2003	SOIL	HASL300	Bi-214	1.21	pCi/g	0.45		0.44
478CS200.5	5/6/2003	SOIL	EPA6010	Chromium	2.2	mg/kg	1.1		
478CS200.5	5/6/2003	SOIL	HASL300	Cs-137	5.9	pCi/g	0.26		1.1
478CS200.5	5/6/2003	SOIL	HASL300	K-40	31	pCi/g	2.9		7.2
478CS200.5	5/6/2003	SOIL	EPA6010	Lead	11	mg/kg	0.32		
478CS200.5	5/6/2003	SOIL	EPA8260	Methylene Chloride	11	μg/kg	5.4		
478CS200.5	5/6/2003	SOIL	HASL300	Pb-212	2.48	pCi/g	0.46		0.58
478CS200.5	5/6/2003	SOIL	HASL300	Pb-214	1.39	pCi/g	0.54		0.41
478CS200.5	5/6/2003	SOIL	HASL300	TI-208	0.67	pCi/g	0.22		0.23
478CS2001.5	5/6/2003	SOIL	HASL300	Ac-228	2.24	pCi/g	1.5		0.77
478CS2001.5	5/6/2003	SOIL	EPA6010	Arsenic	1.5	mg/kg	1.1		
478CS2001.5	5/6/2003	SOIL	EPA6010	Barium	42	mg/kg	11		
478CS2001.5	5/6/2003	SOIL	HASL300	Bi-214	0.61	pCi/g	0.53		0.38

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478CS2001.5	5/6/2003	SOIL	EPA6010	Chromium	1.9	mg/kg	1.1		
478CS2001.5	5/6/2003	SOIL	HASL300	Cs-137	0.69	pCi/g	0.26		0.26
478CS2001.5	5/6/2003	SOIL	HASL300	K-40	26.4	pCi/g	4.2		6.9
478CS2001.5	5/6/2003	SOIL	EPA6010	Lead	5.2	mg/kg	0.32		
478CS2001.5	5/6/2003	SOIL	EPA8260	Methylene Chloride	13	μg/kg	5.3		
478CS2001.5	5/6/2003	SOIL	HASL300	Pb-212	2.8	pCi/g	0.42		0.62
478CS2001.5	5/6/2003	SOIL	HASL300	Pb-214	1.01	pCi/g	0.6		0.37
478CS2001.5	5/6/2003	SOIL	HASL300	TI-208	0.68	pCi/g	0.31		0.27
478CS210.5	5/6/2003	SOIL	HASL300	Ac-228	2.18	pCi/g	0.83		0.74
478CS210.5	5/6/2003	SOIL	HASL300	Am-241	1.9	pCi/g	1.7		1.2
478CS210.5	5/6/2003	SOIL	EPA6010	Arsenic	2.4	mg/kg	1.1		
478CS210.5	5/6/2003	SOIL	EPA6010	Barium	540	mg/kg	11		
478CS210.5	5/6/2003	SOIL	EPA8270	Benzoic Acid	930	μg/kg	3600	J	
478CS210.5	5/6/2003	SOIL	EPA6010	Beryllium	0.83	mg/kg	0.54	-	
478CS210.5	5/6/2003	SOIL	HASL300	Bi-212	3.3	pCi/g	2.8		2.1
478CS210.5	5/6/2003	SOIL	HASL300	Bi-214	0.98	pCi/g	0.62		0.47
478CS210.5	5/6/2003	SOIL	EPA6010	Chromium	2.9	mg/kg	1.1		-
478CS210.5	5/6/2003	SOIL	HASL300	Cs-137	27.6	pCi/g	0.3		4.7
478CS210.5	5/6/2003	SOIL	EPA8015	Diesel-Range Organics	10	mg/kg	5.4	Н	
478CS210.5	5/6/2003	SOIL	HASL300	K-40	27.6	pCi/g	2.8		6.6
478CS210.5	5/6/2003	SOIL	EPA6010	Lead	12	mg/kg	0.33		
478CS210.5	5/6/2003	SOIL	HASL300	Pb-212	2.44	pCi/g	0.5		0.59
478CS210.5	5/6/2003	SOIL	HASL300	Pb-214	1.17	pCi/g	0.8		0.47
478CS210.5	5/6/2003	SOIL	UGTAISOPU	Pu-238	0.85	pCi/g	0.014		0.18
478CS210.5	5/6/2003	SOIL	UGTAISOPU	Pu-239	9.6	pCi/g	0.014		1.5
478CS210.5	5/6/2003	SOIL	SR7500	SR-90	0.91	pCi/g	0.34		0.29
478CS210.5	5/6/2003	SOIL	HASL300	TI-208	0.75	pCi/g	0.29		0.27
478CS2201	5/5/2003	SOIL	HASL300	Ac-228	1.68	pCi/g	1.3		0.71
478CS2201	5/5/2003	SOIL	HASL300	Am-241	1.8	pCi/g	0.37		0.45
478CS2201	5/5/2003	SOIL	EPA6010	Arsenic	2	mg/kg	1.1		
478CS2201	5/5/2003	SOIL	EPA6010	Barium	98	mg/kg	11		
478CS2201	5/5/2003	SOIL	EPA6010	Beryllium	0.62	mg/kg	0.53		
478CS2201	5/5/2003	SOIL	HASL300	Bi-214	1.24	pCi/g	0.7		0.56
478CS2201	5/5/2003	SOIL	EPA6010	Chromium	2.3	mg/kg	1.1		
478CS2201	5/5/2003	SOIL	HASL300	Cs-137	15.8	pCi/g	0.36		2.8
478CS2201	5/5/2003	SOIL	EPA8015	Diesel-Range Organics	6.2	mg/kg	5.3	H,Z	
478CS2201	5/5/2003	SOIL	HASL300	K-40	30.1	pCi/g	3.2	,	7.6
478CS2201	5/5/2003	SOIL	EPA6010	Lead	12	mg/kg	0.32		
478CS2201	5/5/2003	SOIL	EPA8260	Methylene Chloride	9.6	μg/kg	5.3		
478CS2201	5/5/2003	SOIL	HASL300	Pb-212	2.63	pCi/g	0.49		0.63
478CS2201	5/5/2003	SOIL	HASL300	Pb-214	1.45	pCi/g	0.62		0.46
478CS2201	5/5/2003	SOIL	HASL300	TI-208	0.9	pCi/g	0.34		0.32

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478CS230.5	5/5/2003	SOIL	HASL300	Ac-228	2.28	pCi/g	1.3	401121111	0.93
478CS230.5	5/5/2003	SOIL	HASL300	Am-241	1.87	pCi/g	0.35		0.45
478CS230.5	5/5/2003	SOIL	EPA6010	Arsenic	2.2	mg/kg	1.1		
478CS230.5	5/5/2003	SOIL	EPA6010	Barium	310	mg/kg	11		
478CS230.5	5/5/2003	SOIL	EPA6010	Beryllium	0.65	mg/kg	0.55		
478CS230.5	5/5/2003	SOIL	HASL300	Bi-214	1.4	pCi/g	0.52		0.53
478CS230.5	5/5/2003	SOIL	EPA6010	Chromium	1.9	mg/kg	1.1		
478CS230.5	5/5/2003	SOIL	HASL300	Cs-137	4.55	pCi/g	0.33		0.94
478CS230.5	5/5/2003	SOIL	EPA8015	Diesel-Range Organics	7.1	mg/kg	5.5	Н	
478CS230.5	5/5/2003	SOIL	HASL300	K-40	30.8	pCi/g	3.9		7.9
478CS230.5	5/5/2003	SOIL	EPA6010	Lead	8.6	mg/kg	0.33		
478CS230.5	5/5/2003	SOIL	EPA8260	Methylene Chloride	8	μg/kg	5.5		
478CS230.5	5/5/2003	SOIL	HASL300	Pb-212	2.23	pCi/g	0.47		0.56
478CS230.5	5/5/2003	SOIL	HASL300	Pb-214	1.4	pCi/g	0.48		0.43
478CS230.5	5/5/2003	SOIL	HASL300	TI-208	0.63	pCi/g	0.27		0.25
478CS2301.5	5/5/2003	SOIL	HASL300	Ac-228	2.01	pCi/g	1.3		0.77
478CS2301.5	5/5/2003	SOIL	EPA6010	Arsenic	2.8	mg/kg	1.1		
478CS2301.5	5/5/2003	SOIL	EPA6010	Barium	58	mg/kg	11		
478CS2301.5	5/5/2003	SOIL	EPA6010	Chromium	1.8	mg/kg	1.1		
478CS2301.5	5/5/2003	SOIL	HASL300	Cs-137	4.33	pCi/g	0.36		0.87
478CS2301.5	5/5/2003	SOIL	EPA8015	Diesel-Range Organics	4.1	mg/kg	5.4	J	
478CS2301.5	5/5/2003	SOIL	HASL300	K-40	30.8	pCi/g	5.3		7.5
478CS2301.5	5/5/2003	SOIL	EPA6010	Lead	7.7	mg/kg	0.32		
478CS2301.5	5/5/2003	SOIL	EPA8260	Methylene Chloride	31	μg/kg	5.4		
478CS2301.5	5/5/2003	SOIL	HASL300	Pb-212	2.08	pCi/g	0.46		0.51
478CS2301.5	5/5/2003	SOIL	HASL300	Pb-214	1.19	pCi/g	0.53		0.39
478CS2301.5	5/5/2003	SOIL	HASL300	TI-208	0.64	pCi/g	0.37		0.28
478CS240.5	5/5/2003	SOIL	HASL300	Ac-228	2.59	pCi/g	1.4		0.95
478CS240.5	5/5/2003	SOIL	EPA6010	Arsenic	2.2	mg/kg	1.1		
478CS240.5	5/5/2003	SOIL	EPA6010	Barium	120	mg/kg	11		
478CS240.5	5/5/2003	SOIL	EPA6010	Beryllium	0.65	mg/kg	0.56		
478CS240.5	5/5/2003	SOIL	HASL300	Bi-214	1.3	pCi/g	1		0.71
478CS240.5	5/5/2003	SOIL	EPA6010	Chromium	2.8	mg/kg	1.1		
478CS240.5	5/5/2003	SOIL	HASL300	Cs-137	44.6	pCi/g	0.56		7.5
478CS240.5	5/5/2003	SOIL	EPA8015	Diesel-Range Organics	2.4	mg/kg	5.6	J	
478CS240.5	5/5/2003	SOIL	HASL300	K-40	33.8	pCi/g	4.5		8.1
478CS240.5	5/5/2003	SOIL	EPA6010	Lead	12	mg/kg	0.33		
478CS240.5	5/5/2003	SOIL	HASL300	Pb-212	2.16	pCi/g	0.74		0.64
478CS240.5	5/5/2003	SOIL	HASL300	Pb-214	1.12	pCi/g	1		0.59
478CS240.5	5/5/2003	SOIL	HASL300	TI-208	0.88	pCi/g	0.47		0.37
478CS2403	5/5/2003	SOIL	HASL300	Ac-228	2.91	pCi/g	0.91		0.77
478CS2403	5/5/2003	SOIL	EPA6010	Arsenic	1.3	mg/kg	1		

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478CS2403	5/5/2003	SOIL	EPA6010	Barium	100	mg/kg	10		-
478CS2403	5/5/2003	SOIL	HASL300	Bi-214	1.03	pCi/g	0.54		0.44
478CS2403	5/5/2003	SOIL	EPA6010	Chromium	1.2	mg/kg	1		
478CS2403	5/5/2003	SOIL	HASL300	K-40	33	pCi/g	2.2		7.3
478CS2403	5/5/2003	SOIL	EPA6010	Lead	1.8	mg/kg	0.3		
478CS2403	5/5/2003	SOIL	HASL300	Pb-212	3.17	pCi/g	0.32		0.65
478CS2403	5/5/2003	SOIL	HASL300	Pb-214	1.07	pCi/g	0.38		0.32
478CS2403	5/5/2003	SOIL	HASL300	TI-208	0.99	pCi/g	0.2		0.28
478CS250.5	5/6/2003	SOIL	HASL300	Ac-228	2.22	pCi/g	0.93		0.71
478CS250.5	5/6/2003	SOIL	EPA6010	Arsenic	3.4	mg/kg	1.1		-
478CS250.5	5/6/2003	SOIL	EPA6010	Barium	63	mg/kg	11		
478CS250.5	5/6/2003	SOIL	EPA6010	Beryllium	0.79	mg/kg	0.56		
478CS250.5	5/6/2003	SOIL	HASL300	Bi-214	0.96	pCi/g	0.5		0.44
478CS250.5	5/6/2003	SOIL	EPA6010	Chromium	4.2	mg/kg	1.1		
478CS250.5	5/6/2003	SOIL	HASL300	K-40	25.2	pCi/g	3.6		6.8
478CS250.5	5/6/2003	SOIL	EPA6010	Lead	7.8	mg/kg	0.33		
478CS250.5	5/6/2003	SOIL	HASL300	Pb-212	2.38	pCi/g	0.42		0.57
478CS250.5	5/6/2003	SOIL	HASL300	Pb-214	1.19	pCi/g	0.56		0.39
478CS250.5	5/6/2003	SOIL	HASL300	TI-208	0.82	pCi/g	0.28		0.29
478CS260.5	5/6/2003	SOIL	HASL300	Ac-228	1.63	pCi/g	0.92		0.60
478CS260.5	5/6/2003	SOIL	HASL300	Am-241	1.98	pCi/g	0.35		0.46
478CS260.5	5/6/2003	SOIL	EPA6010	Arsenic	1.6	mg/kg	1.1		
478CS260.5	5/6/2003	SOIL	EPA6010	Barium	450	mg/kg	11		
478CS260.5	5/6/2003	SOIL	HASL300	Bi-214	1.54	pCi/g	0.47		0.51
478CS260.5	5/6/2003	SOIL	EPA6010	Chromium	1.8	mg/kg	1.1		
478CS260.5	5/6/2003	SOIL	HASL300	Cs-137	5.7	pCi/g	0.28		1.1
478CS260.5	5/6/2003	SOIL	HASL300	K-40	32.2	pCi/g	3.5		7.6
478CS260.5	5/6/2003	SOIL	EPA6010	Lead	7.2	mg/kg	0.33		
478CS260.5	5/6/2003	SOIL	HASL300	Pb-212	2.68	pCi/g	0.39		0.60
478CS260.5	5/6/2003	SOIL	HASL300	Pb-214	1.46	pCi/g	0.61		0.45
478CS260.5	5/6/2003	SOIL	UGTAISOPU	Pu-238	7.06	pCi/g	0.019		0.99
478CS260.5	5/6/2003	SOIL	UGTAISOPU	Pu-239	79	pCi/g	0.0078		11
478CS260.5	5/6/2003	SOIL	SR7500	SR-90	0.52	pCi/g	0.33		0.22
478CS260.5	5/6/2003	SOIL	HASL300	TI-208	0.89	pCi/g	0.29		0.30
478CS270.5	5/6/2003	SOIL	HASL300	Ac-228	3.1	pCi/g	1.9		1.2
478CS270.5	5/6/2003	SOIL	EPA6010	Arsenic	1.8	mg/kg	1.1		
478CS270.5	5/6/2003	SOIL	EPA6010	Barium	150	mg/kg	11		
478CS270.5	5/6/2003	SOIL	EPA6010	Beryllium	0.65	mg/kg	0.55		
478CS270.5	5/6/2003	SOIL	HASL300	Bi-214	1.09	pCi/g	0.84		0.60
478CS270.5	5/6/2003	SOIL	EPA8270	Bis(2-Ethylhexyl)Phthalathe	220	μg/kg	360	J	0.00
478CS270.5	5/6/2003	SOIL	EPA6010	Chromium	2.5	mg/kg	1.1		
478CS270.5	5/6/2003	SOIL	HASL300	Cs-137	9.4	pCi/g	0.49		1.7

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478CS270.5	5/6/2003	SOIL	EPA8015	Diesel-Range Organics	8.9	mg/kg	5.5	Н	-
478CS270.5	5/6/2003	SOIL	HASL300	K-40	25.3	pCi/g	6.2		7.3
478CS270.5	5/6/2003	SOIL	EPA6010	Lead	9.7	mg/kg	0.33		-
478CS270.5	5/6/2003	SOIL	HASL300	Pb-212	2.22	pCi/g	0.56		0.58
478CS270.5	5/6/2003	SOIL	HASL300	Pb-214	0.94	pCi/g	0.64		0.42
478CS270.5	5/6/2003	SOIL	HASL300	TI-208	0.56	pCi/g	0.38		0.29
478CSB0102	5/4/2003	SOIL	HASL300	Ac-228	1.7	pCi/g	0.94		0.76
478CSB0102	5/4/2003	SOIL	HASL300	Am-241	0.63	pCi/g	0.36		0.27
478CSB0102	5/4/2003	SOIL	EPA6010	Arsenic	1.2	mg/kg	1.1		
478CSB0102	5/4/2003	SOIL	EPA6010	Barium	66	mg/kg	11		
478CSB0102	5/4/2003	SOIL	EPA6010	Beryllium	0.55	mg/kg	0.53		
478CSB0102	5/4/2003	SOIL	HASL300	Bi-214	1.27	pCi/g	0.78		0.60
478CSB0102	5/4/2003	SOIL	EPA6010	Chromium	1.4	mg/kg	1.1		
478CSB0102	5/4/2003	SOIL	HASL300	Cs-137	24.5	pCi/g	0.37		4.2
478CSB0102	5/4/2003	SOIL	HASL300	K-40	29.9	pCi/g	3.9		7.7
478CSB0102	5/4/2003	SOIL	EPA6010	Lead	6.3	mg/kg	0.32		
478CSB0102	5/4/2003	SOIL	EPA8260	Methylene Chloride	4.5	μg/kg	5.3	J	
478CSB0102	5/4/2003	SOIL	HASL300	Pb-212	2.1	pCi/g	0.52		0.56
478CSB0102	5/4/2003	SOIL	HASL300	Pb-214	1.28	pCi/g	0.73		0.49
478CSB0102	5/4/2003	SOIL	HASL300	Th-234	3.6	pCi/g	3.1		1.8
478CSB0102	5/4/2003	SOIL	HASL300	TI-208	0.8	pCi/g	0.31		0.30
478CSB0204.5	5/6/2003	SOIL	EPA8260	2-Hexanone	25	μg/kg	21		
478CSB0204.5	5/6/2003	SOIL	HASL300	Ac-228	2.45	pCi/g	0.88		0.70
478CSB0204.5	5/6/2003	SOIL	EPA6010	Arsenic	1.3	mg/kg	1		
478CSB0204.5	5/6/2003	SOIL	EPA6010	Barium	42	mg/kg	10		
478CSB0204.5	5/6/2003	SOIL	HASL300	Bi-214	1.1	pCi/g	0.46		0.41
478CSB0204.5	5/6/2003	SOIL	EPA8270	Bis(2-Ethylhexyl)Phthalathe	170	μg/kg	350	J	
478CSB0204.5	5/6/2003	SOIL	EPA6010	Chromium	1.3	mg/kg	1		
478CSB0204.5	5/6/2003	SOIL	HASL300	K-40	32.5	pCi/g	2.7		7.1
478CSB0204.5	5/6/2003	SOIL	EPA6010	Lead	4.5	mg/kg	0.31		
478CSB0204.5	5/6/2003	SOIL	HASL300	Pb-212	2.22	pCi/g	0.38		0.51
478CSB0204.5	5/6/2003	SOIL	HASL300	Pb-214	1.31	pCi/g	0.37		0.35
478CSB0204.5	5/6/2003	SOIL	HASL300	TI-208	0.8	pCi/g	0.23		0.25
478CSB0205.5	5/6/2003	SOIL	HASL300	Ac-228	2.06	pCi/g	0.9		0.64
478CSB0205.5	5/6/2003	SOIL	EPA6010	Arsenic	2.2	mg/kg	1		
478CSB0205.5	5/6/2003	SOIL	EPA6010	Barium	38	mg/kg	10		
478CSB0205.5	5/6/2003	SOIL	HASL300	Bi-212	3.1	pCi/g	2.8	TI	2.1
478CSB0205.5	5/6/2003	SOIL	HASL300	Bi-214	1.29	pCi/g	0.44		0.44
478CSB0205.5	5/6/2003	SOIL	EPA6010	Chromium	1.8	mg/kg	1		
478CSB0205.5	5/6/2003	SOIL	HASL300	K-40	31.3	pCi/g	2.8		7.0
478CSB0205.5	5/6/2003	SOIL	EPA6010	Lead	4.2	mg/kg	0.31		
478CSB0205.5	5/6/2003	SOIL	EPA8260	Methylene Chloride	12	∞γ/κγ	5.2		

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478CSB0205.5	5/6/2003	SOIL	HASL300	Pb-212	2.94	pCi/g	0.3		0.60
478CSB0205.5	5/6/2003	SOIL	HASL300	Pb-214	1.61	pCi/g	0.31		0.39
478CSB0205.5	5/6/2003	SOIL	HASL300	Th-234	3.5	pCi/g	2.3	TI	1.6
478CSB0205.5	5/6/2003	SOIL	HASL300	TI-208	0.99	pCi/g	0.19		0.27
478CSB0303	5/6/2003	SOIL	EPA8260	2-Hexanone	44	∞γ/κγ	22		
478CSB0303	5/6/2003	SOIL	HASL300	Ac-228	1.92	pCi/g	0.79		0.69
478CSB0303	5/6/2003	SOIL	EPA6010	Arsenic	2.6	mg/kg	1.1		
478CSB0303	5/6/2003	SOIL	EPA6010	Barium	300	mg/kg	11		
478CSB0303	5/6/2003	SOIL	EPA6010	Beryllium	0.76	mg/kg	0.54		
478CSB0303	5/6/2003	SOIL	HASL300	Bi-212	3.1	pCi/g	3	TI	2.1
478CSB0303	5/6/2003	SOIL	HASL300	Bi-214	0.78	pCi/g	0.5		0.38
478CSB0303	5/6/2003	SOIL	EPA6010	Chromium	2.4	mg/kg	1.1		
478CSB0303	5/6/2003	SOIL	HASL300	Cs-137	29.5	pCi/g	0.27		5.0
478CSB0303	5/6/2003	SOIL	EPA8015	Diesel-Range Organics	12	mg/kg	5.4	Н	
478CSB0303	5/6/2003	SOIL	HASL300	K-40	26.9	pCi/g	1.9		6.1
478CSB0303	5/6/2003	SOIL	EPA6010	Lead	8.8	mg/kg	0.32		
478CSB0303	5/6/2003	SOIL	HASL300	Pb-212	2.09	pCi/g	0.45		0.51
478CSB0303	5/6/2003	SOIL	HASL300	Pb-214	0.96	pCi/g	0.68		0.41
478CSB0303	5/6/2003	SOIL	HASL300	TI-208	0.72	pCi/g	0.3		0.26
478CSB0305.5	5/6/2003	SOIL	HASL300	Ac-228	1.68	pCi/g	1.1		0.74
478CSB0305.5	5/6/2003	SOIL	EPA6010	Arsenic	1.9	mg/kg	1		
478CSB0305.5	5/6/2003	SOIL	EPA6010	Barium	53	mg/kg	10		
478CSB0305.5	5/6/2003	SOIL	HASL300	Bi-214	1.31	pCi/g	0.72		0.56
478CSB0305.5	5/6/2003	SOIL	EPA6010	Chromium	2	mg/kg	1		
478CSB0305.5	5/6/2003	SOIL	HASL300	Cs-137	0.45	pCi/g	0.37		0.26
478CSB0305.5	5/6/2003	SOIL	HASL300	K-40	30	pCi/g	4.4		7.3
478CSB0305.5	5/6/2003	SOIL	EPA6010	Lead	4.3	mg/kg	0.31		
478CSB0305.5	5/6/2003	SOIL	EPA8260	Methylene Chloride	12	μg/kg	5.2		
478CSB0305.5	5/6/2003	SOIL	HASL300	Pb-212	1.93	pCi/g	0.44		0.49
478CSB0305.5	5/6/2003	SOIL	HASL300	Pb-214	1.31	pCi/g	0.53		0.40
478CSB0305.5	5/6/2003	SOIL	HASL300	TI-208	0.7	pCi/g	0.34		0.28
478CSB040.5	5/6/2003	SOIL	HASL300	Ac-228	1.76	pCi/g	1.7	TI	0.87
478CSB040.5	5/6/2003	SOIL	EPA6010	Arsenic	3.1	mg/kg	1.2		
478CSB040.5	5/6/2003	SOIL	EPA6010	Barium	780	mg/kg	12		
478CSB040.5	5/6/2003	SOIL	EPA6010	Beryllium	1.2	mg/kg	0.61		
478CSB040.5	5/6/2003	SOIL	HASL300	Bi-214	1.03	pCi/g	0.9		0.63
478CSB040.5	5/6/2003	SOIL	EPA6010	Chromium	1.6	mg/kg	1.2		
478CSB040.5	5/6/2003	SOIL	HASL300	Cs-137	12.3	pCi/g	0.52		2.2
478CSB040.5	5/6/2003	SOIL	HASL300	K-40	28.4	pCi/g	7.5		8.3
478CSB040.5	5/6/2003	SOIL	EPA6010	Lead	12	mg/kg	0.36		
478CSB040.5	5/6/2003	SOIL	HASL300	Pb-212	1.91	pCi/g	0.6		0.56
478CSB040.5	5/6/2003	SOIL	HASL300	Pb-214	0.73	pCi/g	0.62		0.44

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478CSB040.5	5/6/2003	SOIL	HASL300	TI-208	0.73	pCi/g	0.43		0.34
478CSX040.5	4/30/2003	SOIL	HASL300	Ac-228	2.03	pCi/g	1.7		0.94
478CSX040.5	4/30/2003	SOIL	EPA6010	Arsenic	2.7	mg/kg	1.1		
478CSX040.5	4/30/2003	SOIL	EPA6010	Barium	390	mg/kg	11		
478CSX040.5	4/30/2003	SOIL	EPA6010	Beryllium	0.9	mg/kg	0.55		
478CSX040.5	4/30/2003	SOIL	HASL300	Bi-212	6.2	pCi/g	4.2	TI	3.3
478CSX040.5	4/30/2003	SOIL	HASL300	Bi-214	0.79	pCi/g	0.73		0.51
478CSX040.5	4/30/2003	SOIL	EPA6010	Chromium	3.7	mg/kg	1.1		
478CSX040.5	4/30/2003	SOIL	HASL300	Cs-137	6.5	pCi/g	0.4		1.3
478CSX040.5	4/30/2003	SOIL	EPA8015	Diesel-Range Organics	8	mg/kg	5.5	Н	
478CSX040.5	4/30/2003	SOIL	HASL300	K-40	24.6	pCi/g	6.3		7.2
478CSX040.5	4/30/2003	SOIL	EPA6010	Lead	8.8	mg/kg	0.33		
478CSX040.5	4/30/2003	SOIL	HASL300	Pb-212	2.48	pCi/g	0.54		0.61
478CSX040.5	4/30/2003	SOIL	HASL300	Pb-214	1.36	pCi/g	0.71		0.47
478CSX040.5	4/30/2003	SOIL	HASL300	TI-208	0.87	pCi/g	0.29		0.30
478CSX160.5	5/3/2003	SOIL	HASL300	Ac-228	2.75	pCi/g	1.1		0.94
478CSX160.5	5/3/2003	SOIL	EPA6010	Arsenic	2	mg/kg	1.1		
478CSX160.5	5/3/2003	SOIL	EPA6010	Barium	120	mg/kg	11		
478CSX160.5	5/3/2003	SOIL	HASL300	Bi-214	0.83	pCi/g	0.62		0.46
478CSX160.5	5/3/2003	SOIL	EPA6010	Chromium	2	mg/kg	1.1		
478CSX160.5	5/3/2003	SOIL	HASL300	Cs-137	12.6	pCi/g	0.38		2.3
478CSX160.5	5/3/2003	SOIL	HASL300	K-40	32.7	pCi/g	3.9		7.9
478CSX160.5	5/3/2003	SOIL	EPA6010	Lead	6.7	mg/kg	0.34		
478CSX160.5	5/3/2003	SOIL	EPA8260	Methylene Chloride	24	μg/kg	5.6		
478CSX160.5	5/3/2003	SOIL	HASL300	Pb-212	3.03	pCi/g	0.57		0.71
478CSX160.5	5/3/2003	SOIL	HASL300	Pb-214	1.3	pCi/g	0.71		0.49
478CSX160.5	5/3/2003	SOIL	HASL300	TI-208	0.86	pCi/g	0.31		0.30
478CSX230.5	5/5/2003	SOIL	EPA6010	Arsenic	2.2	mg/kg	1.1		
478CSX230.5	5/5/2003	SOIL	EPA6010	Barium	310	mg/kg	11		
478CSX230.5	5/5/2003	SOIL	EPA6010	Beryllium	0.72	mg/kg	0.55		
478CSX230.5	5/5/2003	SOIL	HASL300	Bi-214	1.25	pCi/g	0.84		0.62
478CSX230.5	5/5/2003	SOIL	EPA6010	Chromium	1.8	mg/kg	1.1		
478CSX230.5	5/5/2003	SOIL	HASL300	Cs-137	4.17	pCi/g	0.43		0.88
478CSX230.5	5/5/2003	SOIL	EPA8015	Diesel-Range Organics	12	mg/kg	5.5	H,Z	
478CSX230.5	5/5/2003	SOIL	HASL300	Eu-152	1.12	pCi/g	0.34	TI	0.77
478CSX230.5	5/5/2003	SOIL	HASL300	K-40	29.8	pCi/g	6		8.0
478CSX230.5	5/5/2003	SOIL	EPA6010	Lead	11	mg/kg	0.33		
478CSX230.5	5/5/2003	SOIL	EPA8260	Methylene Chloride	7.6	μg/kg	5.5		
478CSX230.5	5/5/2003	SOIL	HASL300	Pb-212	2.34	pCi/g	0.51		0.58
478CSX230.5	5/5/2003	SOIL	HASL300	Pb-214	1.16	pCi/g	0.57		0.42
478CSX230.5	5/5/2003	SOIL	HASL300	TI-208	0.5	pCi/g	0.37		0.27
478PS010.5	5/1/2003	SOIL	HASL300	Ac-228	1.69	pCi/g	0.84		0.61

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478PS010.5	5/1/2003	SOIL	HASL300	Al-26	0.15	pCi/g	0.08	TI	0.14
478PS010.5	5/1/2003	SOIL	EPA6010	Arsenic	2.8	mg/kg	1.1		
478PS010.5	5/1/2003	SOIL	EPA6010	Barium	510	mg/kg	11		
478PS010.5	5/1/2003	SOIL	EPA6010	Beryllium	0.62	mg/kg	0.56		
478PS010.5	5/1/2003	SOIL	HASL300	Bi-214	0.98	pCi/g	0.59		0.47
478PS010.5	5/1/2003	SOIL	EPA6010	Chromium	5	mg/kg	1.1		
478PS010.5	5/1/2003	SOIL	HASL300	Cs-137	0.97	pCi/g	0.28		0.32
478PS010.5	5/1/2003	SOIL	EPA8015	Diesel-Range Organics	2.5	mg/kg	5.6	J	
478PS010.5	5/1/2003	SOIL	HASL300	K-40	22.9	pCi/g	3.5		6.1
478PS010.5	5/1/2003	SOIL	EPA6010	Lead	8.9	mg/kg	0.34		
478PS010.5	5/1/2003	SOIL	HASL300	Pb-212	1.72	pCi/g	0.47		0.48
478PS010.5	5/1/2003	SOIL	HASL300	Pb-214	1.15	pCi/g	0.59		0.40
478PS010.5	5/1/2003	SOIL	HASL300	TI-208	0.63	pCi/g	0.27		0.25
478PS0105.5	5/1/2003	SOIL	HASL300	Ac-228	2.3	pCi/g	1.7	TI	1.4
478PS0105.5	5/1/2003	SOIL	EPA6010	Arsenic	7.6	mg/kg	1.9		
478PS0105.5	5/1/2003	SOIL	EPA6010	Barium	1000	mg/kg	19		
478PS0105.5	5/1/2003	SOIL	EPA6010	Beryllium	1.7	mg/kg	0.96		
478PS0105.5	5/1/2003	SOIL	HASL300	Bi-212	5.4	pCi/g	5.1	TI	3.8
478PS0105.5	5/1/2003	SOIL	EPA8270	Bis(2-Ethylhexyl)Phthalathe	780	μg/kg	640		
478PS0105.5	5/1/2003	SOIL	EPA6010	Chromium	7.2	mg/kg	1.9		
478PS0105.5	5/1/2003	SOIL	HASL300	Cs-137	202	pCi/g	1		34
478PS0105.5	5/1/2003	SOIL	EPA8015	Diesel-Range Organics	220	mg/kg	9.6	Н	
478PS0105.5	5/1/2003	SOIL	HASL300	K-40	21.1	pCi/g	5.5		7.2
478PS0105.5	5/1/2003	SOIL	EPA6010	Lead	18	mg/kg	0.58		
478PS0105.5	5/1/2003	SOIL	HASL300	Pb-212	1.67	pCi/g	1.3		0.88
478PS0105.5	5/1/2003	SOIL	UGTAISOPU	Pu-238	0.096	pCi/g	0.016		0.047
478PS0105.5	5/1/2003	SOIL	UGTAISOPU	Pu-239	1.24	pCi/g	0.016		0.25
478PS0105.5	5/1/2003	SOIL	SR7500	SR-90	4.4	pCi/g	0.3		1.1
478PS0112	5/1/2003	SOIL	HASL300	Ac-228	2.46	pCi/g	1		0.74
478PS0112	5/1/2003	SOIL	EPA8260	Acetone	39	μg/kg	27		
478PS0112	5/1/2003	SOIL	EPA6010	Arsenic	3.3	mg/kg	1.4		
478PS0112	5/1/2003	SOIL	EPA6010	Barium	620	mg/kg	14		
478PS0112	5/1/2003	SOIL	EPA6010	Beryllium	1	mg/kg	0.68		
478PS0112	5/1/2003	SOIL	HASL300	Bi-214	1.2	pCi/g	0.58		0.50
478PS0112	5/1/2003	SOIL	EPA8270	Bis(2-Ethylhexyl)Phthalathe	230	μg/kg	450	J	
478PS0112	5/1/2003	SOIL	EPA6010	Chromium	4.6	mg/kg	1.4		
478PS0112	5/1/2003	SOIL	HASL300	Cs-137	0.76	pCi/g	0.26		0.27
478PS0112	5/1/2003	SOIL	EPA8015	Diesel-Range Organics	150	mg/kg	6.8	Н	
478PS0112	5/1/2003	SOIL	HASL300	K-40	24.5	pCi/g	2.9		6.2
478PS0112	5/1/2003	SOIL	EPA6010	Lead	19	mg/kg	0.41		
478PS0112	5/1/2003	SOIL	HASL300	Pb-212	2.71	pCi/g	0.47		0.63
478PS0112	5/1/2003	SOIL	HASL300	Pb-214	1.61	pCi/g	0.43		0.44

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478PS0112	5/1/2003	SOIL	HASL300	TI-208	0.6	pCi/g	0.27	40112111211	0.24
478PS020.5	5/2/2003	SOIL	HASL300	Ac-228	2.31	pCi/g	0.8		0.68
478PS020.5	5/2/2003	SOIL	EPA6010	Arsenic	3.1	mg/kg	1.1		
478PS020.5	5/2/2003	SOIL	EPA6010	Barium	810	mg/kg	11		
478PS020.5	5/2/2003	SOIL	EPA6010	Beryllium	1.1	mg/kg	0.57		
478PS020.5	5/2/2003	SOIL	HASL300	Bi-214	1.11	pCi/g	0.7		0.48
478PS020.5	5/2/2003	SOIL	EPA6010	Chromium	3.5	mg/kg	1.1		
478PS020.5	5/2/2003	SOIL	HASL300	Cs-137	2.24	pCi/g	0.26		0.52
478PS020.5	5/2/2003	SOIL	EPA8015	Diesel-Range Organics	6.2	mg/kg	5.7	Н	
478PS020.5	5/2/2003	SOIL	HASL300	K-40	27	pCi/g	2.6		6.4
478PS020.5	5/2/2003	SOIL	EPA6010	Lead	13	mg/kg	0.34		
478PS020.5	5/2/2003	SOIL	EPA8260	Methylene Chloride	6.2	μg/kg	5.7		
478PS020.5	5/2/2003	SOIL	HASL300	Pb-212	2.25	pCi/g	0.31		0.51
478PS020.5	5/2/2003	SOIL	HASL300	Pb-214	1.39	pCi/g	0.5		0.40
478PS020.5	5/2/2003	SOIL	HASL300	TI-208	0.68	pCi/g	0.25		0.25
478PS0202	5/2/2003	SOIL	EPA8260	Acetone	14	μg/kg	25	J	
478PS0202	5/2/2003	SOIL	EPA6010	Arsenic	5.9	mg/kg	1.2		
478PS0202	5/2/2003	SOIL	EPA6010	Barium	1900	mg/kg	62		
478PS0202	5/2/2003	SOIL	EPA6010	Beryllium	1.5	mg/kg	0.62		
478PS0202	5/2/2003	SOIL	EPA6010	Chromium	8.2	mg/kg	1.2		
478PS0202	5/2/2003	SOIL	HASL300	Co-60	0.41	pCi/g	0.26	TI	0.25
478PS0202	5/2/2003	SOIL	HASL300	Cs-137	165	pCi/g	0.76		27
478PS0202	5/2/2003	SOIL	EPA8015	Diesel-Range Organics	40	mg/kg	6.2	H,Z	
478PS0202	5/2/2003	SOIL	HASL300	K-40	24	pCi/g	4.7		6.9
478PS0202	5/2/2003	SOIL	EPA6010	Lead	21	mg/kg	0.37		
478PS0202	5/2/2003	SOIL	EPA8260	Methylene Chloride	6.6	μg/kg	6.2		
478PS0202	5/2/2003	SOIL	HASL300	Pb-212	2.13	pCi/g	1.2		0.85
478PS0202	5/2/2003	SOIL	UGTAISOPU	Pu-238	0.76	pCi/g	0.044		0.17
478PS0202	5/2/2003	SOIL	UGTAISOPU	Pu-239	2.58	pCi/g	0.016		0.45
478PS0202	5/2/2003	SOIL	SR7500	SR-90	9.4	pCi/g	0.3		2.3
478PS0209.5	5/2/2003	SOIL	HASL300	Ac-228	2.54	pCi/g	1.3		0.87
478PS0209.5	5/2/2003	SOIL	EPA6010	Arsenic	2.3	mg/kg	1.1		
478PS0209.5	5/2/2003	SOIL	EPA6010	Barium	49	mg/kg	11		
478PS0209.5	5/2/2003	SOIL	HASL300	Bi-212	3.9	pCi/g	3.7	TI	2.6
478PS0209.5	5/2/2003	SOIL	HASL300	Bi-214	1.25	pCi/g	0.69		0.55
478PS0209.5	5/2/2003	SOIL	EPA6010	Chromium	1.7	mg/kg	1.1		
478PS0209.5	5/2/2003	SOIL	HASL300	Cs-137	0.47	pCi/g	0.24		0.21
478PS0209.5	5/2/2003	SOIL	HASL300	K-40	27.3	pCi/g	5		7.0
478PS0209.5	5/2/2003	SOIL	EPA6010	Lead	4.6	mg/kg	0.32		
478PS0209.5	5/2/2003	SOIL	EPA8260	Methylene Chloride	4.9	μg/kg	5.3	J	
478PS0209.5	5/2/2003	SOIL	HASL300	Pb-212	2.39	pCi/g	0.39		0.54
478PS0209.5	5/2/2003	SOIL	HASL300	Pb-214	1.17	pCi/g	0.62		0.42

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478PS0209.5	5/2/2003	SOIL	HASL300	TI-208	0.66	pCi/g	0.31	40112111211	0.26
478PS030.5	5/7/2003	SOIL	HASL300	Ac-228	2.7	pCi/g	1.3	TI	1.1
478PS030.5	5/7/2003	SOIL	EPA6010	Arsenic	6	mg/kg	1.1		
478PS030.5	5/7/2003	SOIL	EPA6010	Barium	300	mg/kg	11		
478PS030.5	5/7/2003	SOIL	EPA6010	Beryllium	0.87	mg/kg	0.55		
478PS030.5	5/7/2003	SOIL	EPA6010	Chromium	8.5	mg/kg	1.1		
478PS030.5	5/7/2003	SOIL	HASL300	Cs-137	312	pCi/g	0.93		52
478PS030.5	5/7/2003	SOIL	EPA8015	Diesel-Range Organics	40	mg/kg	5.5	Н	
478PS030.5	5/7/2003	SOIL	HASL300	K-40	30.6	pCi/g	5		7.5
478PS030.5	5/7/2003	SOIL	EPA6010	Lead	13	mg/kg	0.33		
478PS030.5	5/7/2003	SOIL	EPA8260	Methylene Chloride	19	μg/kg	5.5		
478PS030.5	5/7/2003	SOIL	HASL300	Pb-212	1.86	pCi/g	1.1		0.75
478PS030.5	5/7/2003	SOIL	UGTAISOPU	Pu-238	1.26	pCi/g	0.036		0.25
478PS030.5	5/7/2003	SOIL	UGTAISOPU	Pu-239	10.7	pCi/g	0.03		1.7
478PS030.5	5/7/2003	SOIL	HASL300	Sb-125	4.5	pCi/g	3.2		1.6
478PS030.5	5/7/2003	SOIL	SR7500	SR-90	16.7	pCi/g	0.3		4
478PS030.5	5/7/2003	SOIL	HASL300	TI-208	0.94	pCi/g	0.75	TI	0.50
478PS0312	5/7/2003	SOIL	HASL300	Ac-228	2.1	pCi/g	0.75		0.59
478PS0312	5/7/2003	SOIL	EPA6010	Arsenic	2.8	mg/kg	1.1		
478PS0312	5/7/2003	SOIL	EPA6010	Barium	66	mg/kg	11		
478PS0312	5/7/2003	SOIL	EPA6010	Beryllium	0.82	mg/kg	0.53		
478PS0312	5/7/2003	SOIL	HASL300	Bi-214	1.4	pCi/g	0.43		0.43
478PS0312	5/7/2003	SOIL	EPA6010	Chromium	3	mg/kg	1.1		
478PS0312	5/7/2003	SOIL	HASL300	K-40	29.3	pCi/g	2.5		6.4
478PS0312	5/7/2003	SOIL	EPA6010	Lead	6	mg/kg	0.32		
478PS0312	5/7/2003	SOIL	EPA8260	Methylene Chloride	18	μg/kg	5.3		
478PS0312	5/7/2003	SOIL	HASL300	Pb-212	2.16	pCi/g	0.34		0.48
478PS0312	5/7/2003	SOIL	HASL300	Pb-214	1.4	pCi/g	0.36		0.35
478PS0312	5/7/2003	SOIL	HASL300	Sb-125	0.55	pCi/g	0.44	TI	0.30
478PS0312	5/7/2003	SOIL	HASL300	Th-234	3.8	pCi/g	3.2	TI	2.2
478PS0312	5/7/2003	SOIL	HASL300	TI-208	0.8	pCi/g	0.19		0.23
478PS040.5	5/7/2003	SOIL	HASL300	Ac-228	2.2	pCi/g	1.5		1.1
478PS040.5	5/7/2003	SOIL	EPA6010	Arsenic	7	mg/kg	1.4		
478PS040.5	5/7/2003	SOIL	EPA6010	Barium	930	mg/kg	14		
478PS040.5	5/7/2003	SOIL	EPA6010	Beryllium	1.6	mg/kg	0.69		
478PS040.5	5/7/2003	SOIL	EPA8270	Bis(2-Ethylhexyl)Phthalathe	2100	μg/kg	460		
478PS040.5	5/7/2003	SOIL	EPA6010	Chromium	7.8	mg/kg	1.4		
478PS040.5	5/7/2003	SOIL	HASL300	Cs-137	239	pCi/g	0.71		40
478PS040.5	5/7/2003	SOIL	EPA8015	Diesel-Range Organics	38	mg/kg	6.9	Н	
478PS040.5	5/7/2003	SOIL	HASL300	K-40	24.7	pCi/g	4.7		7.0
478PS040.5	5/7/2003	SOIL	EPA6010	Lead	37	mg/kg	0.42		
478PS040.5	5/7/2003	SOIL	EPA8260	Methylene Chloride	15	μg/kg	6.9		

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478PS040.5	5/7/2003	SOIL	HASL300	Pb-212	2.01	pCi/g	1.1		0.82
478PS040.5	5/7/2003	SOIL	UGTAISOPU	Pu-238	0.7	pCi/g	0.015		0.16
478PS040.5	5/7/2003	SOIL	UGTAISOPU	Pu-239	1.99	pCi/g	0.028		0.36
478PS040.5	5/7/2003	SOIL	SR7500	SR-90	12.9	pCi/g	0.3		3.1
478PS040.5	5/7/2003	SOIL	HASL300	TI-208	0.68	pCi/g	0.64		0.44
478PS0404	5/7/2003	SOIL	HASL300	Ac-228	2.29	pCi/g	1		0.79
478PS0404	5/7/2003	SOIL	EPA8260	Acetone	20	μg/kg	23	J	
478PS0404	5/7/2003	SOIL	EPA6010	Arsenic	4.1	mg/kg	1.2		
478PS0404	5/7/2003	SOIL	EPA6010	Barium	4700	mg/kg	58		
478PS0404	5/7/2003	SOIL	EPA6010	Beryllium	1	mg/kg	0.58		
478PS0404	5/7/2003	SOIL	HASL300	Bi-214	0.79	pCi/g	0.55		0.41
478PS0404	5/7/2003	SOIL	EPA6010	Chromium	5.7	mg/kg	1.2		
478PS0404	5/7/2003	SOIL	HASL300	Cs-137	17.7	pCi/g	0.18		3.1
478PS0404	5/7/2003	SOIL	EPA8015	Diesel-Range Organics	160	mg/kg	5.8	Н	-
478PS0404	5/7/2003	SOIL	HASL300	K-40	28.2	pCi/g	3.1		6.7
478PS0404	5/7/2003	SOIL	EPA6010	Lead	16	mg/kg	0.35		-
478PS0404	5/7/2003	SOIL	EPA8260	Methylene Chloride	15	μg/kg	5.8		
478PS0404	5/7/2003	SOIL	EPA8260	O-Xylene	0.77	μg/kg	5.8	J	
478PS0404	5/7/2003	SOIL	HASL300	Pb-212	1.94	pCi/g	0.45		0.50
478PS0404	5/7/2003	SOIL	HASL300	Pb-214	1.08	pCi/g	0.59		0.40
478PS0404	5/7/2003	SOIL	EPA8260	P-Isopropyltoluene	1.4	μg/kg	5.8	J	
478PS0404	5/7/2003	SOIL	HASL300	TI-208	0.61	pCi/g	0.25		0.23
478PS0409	5/7/2003	SOIL	HASL300	Ac-228	2.15	pCi/g	1.2		0.83
478PS0409	5/7/2003	SOIL	EPA6010	Arsenic	4	mg/kg	1.1		
478PS0409	5/7/2003	SOIL	EPA6010	Barium	93	mg/kg	11		
478PS0409	5/7/2003	SOIL	EPA6010	Beryllium	1.2	mg/kg	0.57		
478PS0409	5/7/2003	SOIL	HASL300	Bi-214	1.36	pCi/g	0.72		0.56
478PS0409	5/7/2003	SOIL	EPA6010	Chromium	6	mg/kg	1.1		0.00
478PS0409	5/7/2003	SOIL	HASL300	K-40	26.3	pCi/g	4.5		7.1
478PS0409	5/7/2003	SOIL	EPA6010	Lead	9.2	mg/kg	0.34		
478PS0409	5/7/2003	SOIL	EPA8260	Methylene Chloride	24	μg/kg	5.7		
478PS0409	5/7/2003	SOIL	HASL300	Pb-212	2.06	pCi/g	0.51		0.55
478PS0409	5/7/2003	SOIL	HASL300	Pb-214	1.83	pCi/g	0.48		0.49
478PS0409	5/7/2003	SOIL	HASL300	TI-208	0.63	pCi/g	0.34		0.28
478PS050.5	5/2/2003	SOIL	HASL300	Ac-228	3.4	pCi/g	1.3		1.4
478PS050.5	5/2/2003	SOIL	EPA6010	Arsenic	6.1	mg/kg	1.3		
478PS050.5	5/2/2003	SOIL	EPA6010	Barium	2300	mg/kg	130		
478PS050.5	5/2/2003	SOIL	EPA6010	Beryllium	1.4	mg/kg	0.64		
478PS050.5	5/2/2003	SOIL	HASL300	Bi-214	1.49	pCi/g	1.4	TI	0.95
478PS050.5	5/2/2003	SOIL	EPA6010	Chromium	6.1	mg/kg	1.3		2.00
478PS050.5	5/2/2003	SOIL	HASL300	Cs-137	91	pCi/g	1.3		15
478PS050.5	5/2/2003	SOIL	EPA8015	Diesel-Range Organics	40	mg/kg	6.4	Н	

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478PS050.5	5/2/2003	SOIL	HASL300	K-40	26.4	pCi/g	8.1		8.8
478PS050.5	5/2/2003	SOIL	EPA6010	Lead	16	mg/kg	0.38		
478PS050.5	5/2/2003	SOIL	HASL300	Pb-212	2.79	pCi/g	1.2		0.93
478PS050.5	5/2/2003	SOIL	HASL300	TI-208	1	pCi/g	0.58		0.46
478PS0506.5	5/2/2003	SOIL	HASL300	Ac-228	2.65	pCi/g	1.3		0.89
478PS0506.5	5/2/2003	SOIL	EPA8260	Acetone	11	μg/kg	22	J	
478PS0506.5	5/2/2003	SOIL	EPA6010	Arsenic	2.5	mg/kg	1.1	-	
478PS0506.5	5/2/2003	SOIL	EPA6010	Barium	32	mg/kg	11		
478PS0506.5	5/2/2003	SOIL	EPA6010	Beryllium	0.92	mg/kg	0.54		
478PS0506.5	5/2/2003	SOIL	HASL300	Bi-214	1.42	pCi/g	0.5		0.53
478PS0506.5	5/2/2003	SOIL	EPA6010	Chromium	3.6	mg/kg	1.1		
478PS0506.5	5/2/2003	SOIL	HASL300	K-40	24.5	pCi/g	4.7		7.1
478PS0506.5	5/2/2003	SOIL	EPA6010	Lead	6.7	mg/kg	0.33		
478PS0506.5	5/2/2003	SOIL	HASL300	Pb-212	2.51	pCi/g	0.43		0.60
478PS0506.5	5/2/2003	SOIL	HASL300	Pb-214	1.35	pCi/g	0.51		0.42
478PS0506.5	5/2/2003	SOIL	HASL300	Th-234	2.5	pCi/g	2.5	TI	1.7
478PS0506.5	5/2/2003	SOIL	HASL300	TI-208	0.69	pCi/g	0.43		0.33
478PS0602	5/2/2003	SOIL	HASL300	Ac-228	2.4	pCi/g	1.6		1.2
478PS0602	5/2/2003	SOIL	HASL300	Am-241	1.3	pCi/g	0.81		0.58
478PS0602	5/2/2003	SOIL	EPA6010	Arsenic	7.7	mg/kg	1.3		
478PS0602	5/2/2003	SOIL	EPA6010	Barium	6400	mg/kg	130		
478PS0602	5/2/2003	SOIL	EPA6010	Beryllium	1.4	mg/kg	0.64		
478PS0602	5/2/2003	SOIL	EPA6010	Chromium	6.4	mg/kg	1.3		
478PS0602	5/2/2003	SOIL	HASL300	Cs-137	93	pCi/g	0.51		16
478PS0602	5/2/2003	SOIL	EPA8015	Diesel-Range Organics	81	mg/kg	6.4	Н	
478PS0602	5/2/2003	SOIL	HASL300	K-40	22.6	pCi/g	4.8		7.3
478PS0602	5/2/2003	SOIL	EPA6010	Lead	16	mg/kg	0.38		
478PS0602	5/2/2003	SOIL	HASL300	Pb-212	2.49	pCi/g	0.9		0.78
478PS0602	5/2/2003	SOIL	HASL300	Pb-214	1.18	pCi/g	1		0.72
478PS0602	5/2/2003	SOIL	UGTAISOPU	Pu-238	0.349	pCi/g	0.034		0.098
478PS0602	5/2/2003	SOIL	UGTAISOPU	Pu-239	3.38	pCi/g	0.015		0.56
478PS0602	5/2/2003	SOIL	SR7500	SR-90	6.7	pCi/g	0.3		1.6
478PS0602	5/2/2003	SOIL	HASL300	TI-208	0.78	pCi/g	0.59		0.43
478PS0607.5	5/2/2003	SOIL	HASL300	Ac-228	2.57	pCi/g	1.3		0.83
478PS0607.5	5/2/2003	SOIL	EPA6010	Arsenic	3	mg/kg	1.1		
478PS0607.5	5/2/2003	SOIL	EPA6010	Barium	2400	mg/kg	110		
478PS0607.5	5/2/2003	SOIL	HASL300	Bi-214	1.23	pCi/g	0.62		0.52
478PS0607.5	5/2/2003	SOIL	EPA6010	Chromium	9.7	mg/kg	1.1		
478PS0607.5	5/2/2003	SOIL	HASL300	Co-60	0.28	pCi/g	0.2	TI	0.19
478PS0607.5	5/2/2003	SOIL	HASL300	Cs-137	5.3	pCi/g	0.34		1.0
478PS0607.5	5/2/2003	SOIL	EPA8015	Diesel-Range Organics	13	mg/kg	5.5	Н	
478PS0607.5	5/2/2003	SOIL	HASL300	K-40	31.4	pCi/g	3.3		7.5

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478PS0607.5	5/2/2003	SOIL	EPA6010	Lead	5	mg/kg	0.33		
478PS0607.5	5/2/2003	SOIL	HASL300	Pb-212	2.81	pCi/g	0.44		0.64
478PS0607.5	5/2/2003	SOIL	HASL300	Pb-214	1.56	pCi/g	0.49		0.44
478PS0607.5	5/2/2003	SOIL	UGTAISOPU	Pu-238	0.046	pCi/g	0.036	LT	0.033
478PS0607.5	5/2/2003	SOIL	UGTAISOPU	Pu-239	0.47	pCi/g	0.03		0.12
478PS0607.5	5/2/2003	SOIL	SR7500	SR-90	0.52	pCi/g	0.33		0.22
478PS0607.5	5/2/2003	SOIL	HASL300	TI-208	0.85	pCi/g	0.3		0.30
478PS0701	5/3/2003	SOIL	HASL300	Ac-228	2.14	pCi/g	0.93		0.70
478PS0701	5/3/2003	SOIL	HASL300	Am-241	2.3	pCi/g	2.3	TI	1.5
478PS0701	5/3/2003	SOIL	EPA6010	Arsenic	6.7	mg/kg	1.2		
478PS0701	5/3/2003	SOIL	EPA6010	Barium	3300	mg/kg	59		
478PS0701	5/3/2003	SOIL	EPA6010	Beryllium	1.4	mg/kg	0.59		
478PS0701	5/3/2003	SOIL	HASL300	Bi-214	1.24	pCi/g	0.53		0.49
478PS0701	5/3/2003	SOIL	EPA6010	Chromium	6.6	mg/kg	1.2		
478PS0701	5/3/2003	SOIL	HASL300	Cs-137	29.3	pCi/g	0.29		5.0
478PS0701	5/3/2003	SOIL	EPA8015	Diesel-Range Organics	38	mg/kg	5.9	Н	
478PS0701	5/3/2003	SOIL	HASL300	K-40	29.2	pCi/g	3.3		7.0
478PS0701	5/3/2003	SOIL	EPA6010	Lead	16	mg/kg	0.36		
478PS0701	5/3/2003	SOIL	EPA8260	Methylene Chloride	33	μg/kg	5.9		
478PS0701	5/3/2003	SOIL	HASL300	Pb-212	2.29	pCi/g	0.56		0.59
478PS0701	5/3/2003	SOIL	HASL300	Pb-214	1.18	pCi/g	0.7		0.47
478PS0701	5/3/2003	SOIL	UGTAISOPU	Pu-238	0.213	pCi/g	0.034		0.071
478PS0701	5/3/2003	SOIL	UGTAISOPU	Pu-239	2.38	pCi/g	0.015		0.41
478PS0701	5/3/2003	SOIL	SR7500	SR-90	3.06	pCi/g	0.32		0.77
478PS0701	5/3/2003	SOIL	HASL300	TI-208	1.09	pCi/g	0.34		0.34
478PS0707	5/3/2003	SOIL	HASL300	Ac-228	2.05	pCi/g	1.4		0.88
478PS0707	5/3/2003	SOIL	EPA8260	Acetone	17	μg/kg	21	J	
478PS0707	5/3/2003	SOIL	EPA6010	Arsenic	2.7	mg/kg	1.1	-	
478PS0707	5/3/2003	SOIL	EPA6010	Barium	32	mg/kg	11		
478PS0707	5/3/2003	SOIL	EPA6010	Beryllium	0.54	mg/kg	0.53		
478PS0707	5/3/2003	SOIL	HASL300	Bi-214	1.25	pCi/g	0.74		0.57
478PS0707	5/3/2003	SOIL	EPA6010	Chromium	9.3	mg/kg	1.1		
478PS0707	5/3/2003	SOIL	HASL300	K-40	27.5	pCi/g	6.2		7.5
478PS0707	5/3/2003	SOIL	EPA6010	Lead	4.3	mg/kg	0.32		
478PS0707	5/3/2003	SOIL	EPA8260	Methylene Chloride	24	μg/kg	5.3		
478PS0707	5/3/2003	SOIL	HASL300	Pb-212	2.89	pCi/g	0.4		0.63
478PS0707	5/3/2003	SOIL	HASL300	Pb-214	1.33	pCi/g	0.54		0.41
478PS0707	5/3/2003	SOIL	HASL300	TI-208	0.84	pCi/g	0.33		0.30
478PS080.5	5/3/2003	SOIL	HASL300	Ac-228	3.12	pCi/g	0.95		0.84
478PS080.5	5/3/2003	SOIL	EPA6010	Arsenic	1.8	mg/kg	1.1		
478PS080.5	5/3/2003	SOIL	EPA6010	Barium	47	mg/kg	11		
478PS080.5	5/3/2003	SOIL	HASL300	Bi-214	1.23	pCi/g	0.6		0.50

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478PS080.5	5/3/2003	SOIL	EPA6010	Chromium	1.5	mg/kg	1.1		
478PS080.5	5/3/2003	SOIL	HASL300	Cs-137	6.9	pCi/g	0.29		1.3
478PS080.5	5/3/2003	SOIL	EPA8015	Diesel-Range Organics	4.2	mg/kg	5.3	J	-
478PS080.5	5/3/2003	SOIL	HASL300	K-40	34.6	pCi/g	4.1		7.9
478PS080.5	5/3/2003	SOIL	EPA6010	Lead	4	mg/kg	0.32		
478PS080.5	5/3/2003	SOIL	HASL300	Pb-212	2.54	pCi/g	0.48		0.59
478PS080.5	5/3/2003	SOIL	HASL300	Pb-214	1.38	pCi/g	0.51		0.43
478PS080.5	5/3/2003	SOIL	HASL300	TI-208	0.85	pCi/g	0.28		0.28
478PS0805	5/3/2003	SOIL	HASL300	Ac-228	2.67	pCi/g	0.95		0.71
478PS0805	5/3/2003	SOIL	EPA6010	Arsenic	1.6	mg/kg	1.1		
478PS0805	5/3/2003	SOIL	EPA6010	Barium	33	mg/kg	11		
478PS0805	5/3/2003	SOIL	HASL300	Bi-214	1.31	pCi/g	0.42		0.40
478PS0805	5/3/2003	SOIL	EPA6010	Chromium	1.4	mg/kg	1.1		
478PS0805	5/3/2003	SOIL	HASL300	Cs-137	0.72	pCi/g	0.22		0.24
478PS0805	5/3/2003	SOIL	HASL300	K-40	36.7	pCi/g	2.6		7.7
478PS0805	5/3/2003	SOIL	EPA6010	Lead	2.7	mg/kg	0.32		
478PS0805	5/3/2003	SOIL	HASL300	Pb-212	3.03	pCi/g	0.29		0.61
478PS0805	5/3/2003	SOIL	HASL300	Pb-214	1.6	pCi/g	0.33		0.39
478PS0805	5/3/2003	SOIL	HASL300	TI-208	0.73	pCi/g	0.19		0.22
478PS090.5	5/3/2003	SOIL	HASL300	Ac-228	2.34	pCi/g	1.4	TI	0.99
478PS090.5	5/3/2003	SOIL	EPA6010	Arsenic	2.7	mg/kg	1.1		
478PS090.5	5/3/2003	SOIL	EPA6010	Barium	230	mg/kg	11		
478PS090.5	5/3/2003	SOIL	EPA6010	Beryllium	0.63	mg/kg	0.55		
478PS090.5	5/3/2003	SOIL	HASL300	Bi-214	1.46	pCi/g	0.99		0.72
478PS090.5	5/3/2003	SOIL	EPA6010	Chromium	3	mg/kg	1.1		
478PS090.5	5/3/2003	SOIL	HASL300	Cs-137	52.6	pCi/g	0.61		8.8
478PS090.5	5/3/2003	SOIL	EPA8015	Diesel-Range Organics	33	mg/kg	5.5	Н	
478PS090.5	5/3/2003	SOIL	HASL300	K-40	29	pCi/g	5.4		7.5
478PS090.5	5/3/2003	SOIL	EPA6010	Lead	8.3	mg/kg	0.33		
478PS090.5	5/3/2003	SOIL	HASL300	Pb-212	2.23	pCi/g	0.74		0.65
478PS090.5	5/3/2003	SOIL	HASL300	Sb-125	3.6	pCi/g	1.5		1.0
478PS090.5	5/3/2003	SOIL	HASL300	TI-208	0.55	pCi/g	0.49		0.34
478PS0906.5	5/3/2003	SOIL	HASL300	Ac-228	2.34	pCi/g	1.6		0.79
478PS0906.5	5/3/2003	SOIL	EPA6010	Arsenic	6.6	mg/kg	1.3		
478PS0906.5	5/3/2003	SOIL	EPA6010	Barium	54	mg/kg	13		
478PS0906.5	5/3/2003	SOIL	EPA6010	Beryllium	2.4	mg/kg	0.65		
478PS0906.5	5/3/2003	SOIL	HASL300	Bi-212	3.9	pCi/g	3.6		2.7
478PS0906.5	5/3/2003	SOIL	HASL300	Bi-214	0.93	pCi/g	0.69		0.51
478PS0906.5	5/3/2003	SOIL	EPA6010	Chromium	2.8	mg/kg	1.3		
478PS0906.5	5/3/2003	SOIL	HASL300	Cs-137	0.82	pCi/g	0.21		0.28
478PS0906.5	5/3/2003	SOIL	HASL300	K-40	12	pCi/g	4		4.4
478PS0906.5	5/3/2003	SOIL	EPA6010	Lead	25	mg/kg	1.2		

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478PS0906.5	5/3/2003	SOIL	HASL300	Pb-212	2.57	pCi/g	0.51		0.63
478PS0906.5	5/3/2003	SOIL	HASL300	Pb-214	1.05	pCi/g	0.48		0.38
478PS0906.5	5/3/2003	SOIL	EPA6010	Selenium	0.84	mg/kg	0.65		
478PS0906.5	5/3/2003	SOIL	HASL300	TI-208	1.28	pCi/g	0.32		0.38
478PS100.5	5/4/2003	SOIL	HASL300	Ac-228	2.5	pCi/g	1.1	TI	1.1
478PS100.5	5/4/2003	SOIL	EPA6010	Arsenic	1.9	mg/kg	1.1		
478PS100.5	5/4/2003	SOIL	EPA6010	Barium	630	mg/kg	11		
478PS100.5	5/4/2003	SOIL	EPA6010	Beryllium	0.62	mg/kg	0.55		
478PS100.5	5/4/2003	SOIL	HASL300	Bi-214	1.28	pCi/g	0.79		0.61
478PS100.5	5/4/2003	SOIL	EPA6010	Chromium	3.2	mg/kg	1.1		
478PS100.5	5/4/2003	SOIL	HASL300	Cs-137	52.6	pCi/g	0.91		8.9
478PS100.5	5/4/2003	SOIL	EPA8015	Diesel-Range Organics	2.4	mg/kg	5.5	J	
478PS100.5	5/4/2003	SOIL	HASL300	K-40	29.7	pCi/g	6.9		8.4
478PS100.5	5/4/2003	SOIL	EPA6010	Lead	11	mg/kg	0.33		
478PS100.5	5/4/2003	SOIL	EPA8260	Methylene Chloride	4.9	μg/kg	5.5	J	
478PS100.5	5/4/2003	SOIL	HASL300	Pb-212	3.17	pCi/g	0.85		0.82
478PS100.5	5/4/2003	SOIL	HASL300	Pb-214	1.99	pCi/g	1.4		0.95
478PS100.5	5/4/2003	SOIL	HASL300	TI-208	0.77	pCi/g	0.54		0.39
478PS1003	5/4/2003	SOIL	HASL300	Ac-228	2.03	pCi/g	1.1		0.66
478PS1003	5/4/2003	SOIL	EPA6010	Arsenic	2.5	mg/kg	1		
478PS1003	5/4/2003	SOIL	EPA6010	Barium	56	mg/kg	10		
478PS1003	5/4/2003	SOIL	EPA6010	Beryllium	0.56	mg/kg	0.52		
478PS1003	5/4/2003	SOIL	HASL300	Bi-212	3.4	pCi/g	3.3		2.3
478PS1003	5/4/2003	SOIL	HASL300	Bi-214	1.07	pCi/g	0.43		0.40
478PS1003	5/4/2003	SOIL	EPA6010	Chromium	2.5	mg/kg	1		
478PS1003	5/4/2003	SOIL	HASL300	Cs-137	7.6	pCi/g	0.31		1.4
478PS1003	5/4/2003	SOIL	HASL300	K-40	31.3	pCi/g	3.9		7.1
478PS1003	5/4/2003	SOIL	EPA6010	Lead	6.2	mg/kg	0.31		
478PS1003	5/4/2003	SOIL	EPA8260	Methylene Chloride	5.1	μg/kg	5.2	J	
478PS1003	5/4/2003	SOIL	HASL300	Pb-212	1.77	pCi/g	0.41		0.44
478PS1003	5/4/2003	SOIL	HASL300	Pb-214	1.06	pCi/g	0.51		0.36
478PS1003	5/4/2003	SOIL	HASL300	TI-208	0.8	pCi/g	0.3		0.27
478PS1006.5	5/4/2003	SOIL	HASL300	Ac-228	2.15	pCi/g	0.97		0.67
478PS1006.5	5/4/2003	SOIL	EPA6010	Arsenic	2.1	mg/kg	1.1		
478PS1006.5	5/4/2003	SOIL	EPA6010	Barium	44	mg/kg	11		
478PS1006.5	5/4/2003	SOIL	EPA6010	Beryllium	0.55	mg/kg	0.53		
478PS1006.5	5/4/2003	SOIL	HASL300	Bi-214	0.78	pCi/g	0.55		0.41
478PS1006.5	5/4/2003	SOIL	EPA6010	Chromium	2	mg/kg	1.1		
478PS1006.5	5/4/2003	SOIL	HASL300	Cs-137	2.47	pCi/g	0.29		0.54
478PS1006.5	5/4/2003	SOIL	HASL300	K-40	31.4	pCi/g	3.1		7.0
478PS1006.5	5/4/2003	SOIL	EPA6010	Lead	6.4	mg/kg	0.32		
478PS1006.5	5/4/2003	SOIL	EPA8260	Methylene Chloride	7	μg/kg	5.3		

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478PS1006.5	5/4/2003	SOIL	HASL300	Pb-212	3.15	pCi/g	0.38	4000	0.66
478PS1006.5	5/4/2003	SOIL	HASL300	Pb-214	1.49	pCi/g	0.46		0.41
478PS1006.5	5/4/2003	SOIL	HASL300	TI-208	0.98	pCi/g	0.25		0.29
478PS110.5	5/4/2003	SOIL	HASL300	Ac-228	2.44	pCi/g	1.2		0.98
478PS110.5	5/4/2003	SOIL	EPA6010	Arsenic	3.6	mg/kg	1.1		
478PS110.5	5/4/2003	SOIL	EPA6010	Barium	120	mg/kg	11		
478PS110.5	5/4/2003	SOIL	EPA6010	Beryllium	1.1	mg/kg	0.55		
478PS110.5	5/4/2003	SOIL	EPA6010	Chromium	3.4	mg/kg	1.1		
478PS110.5	5/4/2003	SOIL	HASL300	Cs-137	197	pCi/g	0.51		33
478PS110.5	5/4/2003	SOIL	EPA8015	Diesel-Range Organics	8.5	mg/kg	5.5	Н	
478PS110.5	5/4/2003	SOIL	HASL300	K-40	27.5	pCi/g	2.9		6.5
478PS110.5	5/4/2003	SOIL	EPA6010	Lead	12	mg/kg	0.33		
478PS110.5	5/4/2003	SOIL	EPA8260	Methylene Chloride	4.4	μg/kg	5.5	J	
478PS110.5	5/4/2003	SOIL	HASL300	Pb-212	2.22	pCi/g	1		0.76
478PS110.5	5/4/2003	SOIL	HASL300	TI-208	0.76	pCi/g	0.46		0.34
478PS1106.5	5/4/2003	SOIL	HASL300	Ac-228	3.36	pCi/g	1		0.84
478PS1106.5	5/4/2003	SOIL	EPA6010	Arsenic	1.9	mg/kg	1.1		
478PS1106.5	5/4/2003	SOIL	EPA6010	Barium	40	mg/kg	11		
478PS1106.5	5/4/2003	SOIL	EPA6010	Beryllium	0.55	mg/kg	0.53		
478PS1106.5	5/4/2003	SOIL	HASL300	Bi-212	4.1	pCi/g	3.9		2.7
478PS1106.5	5/4/2003	SOIL	HASL300	Bi-214	1.41	pCi/g	0.49		0.48
478PS1106.5	5/4/2003	SOIL	EPA6010	Chromium	2.3	mg/kg	1.1		
478PS1106.5	5/4/2003	SOIL	HASL300	Cs-137	1.26	pCi/g	0.28		0.35
478PS1106.5	5/4/2003	SOIL	HASL300	K-40	30.7	pCi/g	2.6		6.9
478PS1106.5	5/4/2003	SOIL	EPA6010	Lead	5.5	mg/kg	0.32		
478PS1106.5	5/4/2003	SOIL	EPA8260	Methylene Chloride	5.7	μg/kg	5.3		
478PS1106.5	5/4/2003	SOIL	HASL300	Pb-212	3.3	pCi/g	0.35		0.67
478PS1106.5	5/4/2003	SOIL	HASL300	Pb-214	1.27	pCi/g	0.44		0.36
478PS1106.5	5/4/2003	SOIL	HASL300	Sb-125	0.51	pCi/g	0.51	TI	0.33
478PS1106.5	5/4/2003	SOIL	HASL300	Th-234	3.8	pCi/g	2.6	TI	1.8
478PS1106.5	5/4/2003	SOIL	HASL300	TI-208	0.87	pCi/g	0.26		0.27
478PS120.5	5/5/2003	SOIL	HASL300	Ac-228	1.87	pCi/g	1.4		0.80
478PS120.5	5/5/2003	SOIL	EPA6010	Arsenic	2.2	mg/kg	1.1		
478PS120.5	5/5/2003	SOIL	EPA6010	Barium	85	mg/kg	11		
478PS120.5	5/5/2003	SOIL	EPA6010	Beryllium	0.7	mg/kg	0.55		
478PS120.5	5/5/2003	SOIL	HASL300	Bi-212	5.6	pCi/g	5.4		3.8
478PS120.5	5/5/2003	SOIL	EPA6010	Chromium	2.8	mg/kg	1.1		
478PS120.5	5/5/2003	SOIL	HASL300	Cs-137	11.5	pCi/g	0.41		2.1
478PS120.5	5/5/2003	SOIL	EPA8015	Diesel-Range Organics	7.6	mg/kg	5.5	Н	
478PS120.5	5/5/2003	SOIL	HASL300	K-40	26.4	pCi/g	5		7.0
478PS120.5	5/5/2003	SOIL	EPA6010	Lead	11	mg/kg	0.33		
478PS120.5	5/5/2003	SOIL	HASL300	Pb-212	2.49	pCi/g	0.52		0.60

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478PS120.5	5/5/2003	SOIL	HASL300	Pb-214	1.65	pCi/g	0.75		0.61
478PS120.5	5/5/2003	SOIL	HASL300	TI-208	0.62	pCi/g	0.36		0.28
478PS1204.5	5/5/2003	SOIL	HASL300	Ac-228	2.74	pCi/g	0.8		0.71
478PS1204.5	5/5/2003	SOIL	EPA6010	Arsenic	3.6	mg/kg	1.1		
478PS1204.5	5/5/2003	SOIL	EPA6010	Barium	62	mg/kg	11		
478PS1204.5	5/5/2003	SOIL	EPA6010	Beryllium	0.73	mg/kg	0.54		
478PS1204.5	5/5/2003	SOIL	HASL300	Bi-214	1.32	pCi/g	0.36		0.42
478PS1204.5	5/5/2003	SOIL	EPA6010	Chromium	4.7	mg/kg	1.1		
478PS1204.5	5/5/2003	SOIL	HASL300	K-40	31.5	pCi/g	2.8		7.0
478PS1204.5	5/5/2003	SOIL	EPA6010	Lead	7.1	mg/kg	0.32		
478PS1204.5	5/5/2003	SOIL	HASL300	Pb-212	2.35	pCi/g	0.35		0.52
478PS1204.5	5/5/2003	SOIL	HASL300	Pb-214	1.38	pCi/g	0.38		0.36
478PS1204.5	5/5/2003	SOIL	HASL300	TI-208	0.75	pCi/g	0.21		0.24
478PS130.5	5/7/2003	SOIL	EPA8260	2-Hexanone	330	μg/kg	22		-
478PS130.5	5/7/2003	SOIL	HASL300	Ac-228	2.96	pCi/g	1.1		0.92
478PS130.5	5/7/2003	SOIL	EPA8260	Acetone	20	μg/kg	22	J	
478PS130.5	5/7/2003	SOIL	EPA6010	Arsenic	1.9	mg/kg	1.1		
478PS130.5	5/7/2003	SOIL	EPA6010	Barium	47	mg/kg	11		
478PS130.5	5/7/2003	SOIL	EPA6010	Beryllium	0.71	mg/kg	0.54		
478PS130.5	5/7/2003	SOIL	HASL300	Bi-214	1.54	pCi/g	0.69		0.58
478PS130.5	5/7/2003	SOIL	EPA6010	Chromium	2.4	mg/kg	1.1		
478PS130.5	5/7/2003	SOIL	HASL300	Cs-137	3.95	pCi/g	0.35		0.81
478PS130.5	5/7/2003	SOIL	HASL300	K-40	26.4	pCi/g	4.5		6.7
478PS130.5	5/7/2003	SOIL	EPA6010	Lead	5.8	mg/kg	0.32		
478PS130.5	5/7/2003	SOIL	EPA8260	Methylene Chloride	22	μg/kg	5.4		
478PS130.5	5/7/2003	SOIL	HASL300	Pb-212	2.51	pCi/g	0.44		0.57
478PS130.5	5/7/2003	SOIL	HASL300	Pb-214	1.52	pCi/g	0.55		0.46
478PS130.5	5/7/2003	SOIL	HASL300	TI-208	0.84	pCi/g	0.32		0.29
478PS1304.5	5/5/2003	SOIL	HASL300	Ac-228	1.95	pCi/g	0.88		0.64
478PS1304.5	5/5/2003	SOIL	EPA8260	Acetone	16	μg/kg	20	J	
478PS1304.5	5/5/2003	SOIL	EPA6010	Arsenic	2.5	mg/kg	1		
478PS1304.5	5/5/2003	SOIL	EPA6010	Barium	43	mg/kg	10		
478PS1304.5	5/5/2003	SOIL	HASL300	Bi-214	1.54	pCi/g	0.45		0.50
478PS1304.5	5/5/2003	SOIL	EPA6010	Chromium	9.3	mg/kg	1		
478PS1304.5	5/5/2003	SOIL	HASL300	Cs-137	4.29	pCi/g	0.26		0.85
478PS1304.5	5/5/2003	SOIL	HASL300	Eu-155	0.44	pCi/g	0.42	TI	0.29
478PS1304.5	5/5/2003	SOIL	HASL300	K-40	30.2	pCi/g	2.8		7.0
478PS1304.5	5/5/2003	SOIL	EPA6010	Lead	4.1	mg/kg	0.31		
478PS1304.5	5/5/2003	SOIL	EPA8260	Methylene Chloride	22	μg/kg	5.1		
478PS1304.5	5/5/2003	SOIL	HASL300	Pb-212	2.49	pCi/g	0.36		0.55
478PS1304.5	5/5/2003	SOIL	HASL300	Pb-214	1.51	pCi/g	0.47		0.41
478PS1304.5	5/5/2003	SOIL	HASL300	Th-234	2.9	pCi/g	2.4	TI	1.6

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478PS1304.5	5/5/2003	SOIL	HASL300	TI-208	0.75	pCi/g	0.28		0.26
478PS140.5	5/5/2003	SOIL	HASL300	Ac-228	2.69	pCi/g	0.65		0.76
478PS140.5	5/5/2003	SOIL	EPA6010	Arsenic	1.9	mg/kg	1.1		
478PS140.5	5/5/2003	SOIL	EPA6010	Barium	42	mg/kg	11		
478PS140.5	5/5/2003	SOIL	HASL300	Bi-214	1.2	pCi/g	0.46		0.43
478PS140.5	5/5/2003	SOIL	EPA6010	Chromium	2.1	mg/kg	1.1		
478PS140.5	5/5/2003	SOIL	HASL300	Cs-137	2.12	pCi/g	0.22		0.47
478PS140.5	5/5/2003	SOIL	HASL300	K-40	27.4	pCi/g	2.6		6.3
478PS140.5	5/5/2003	SOIL	EPA6010	Lead	4.2	mg/kg	0.33		
478PS140.5	5/5/2003	SOIL	EPA8260	Methylene Chloride	25	μg/kg	5.4		
478PS140.5	5/5/2003	SOIL	HASL300	Pb-212	2.18	pCi/g	0.38		0.51
478PS140.5	5/5/2003	SOIL	HASL300	Pb-214	1.14	pCi/g	0.4		0.33
478PS140.5	5/5/2003	SOIL	HASL300	TI-208	0.61	pCi/g	0.23		0.22
478PS1404.5	5/5/2003	SOIL	HASL300	Ac-228	2.7	pCi/g	1.1		0.84
478PS1404.5	5/5/2003	SOIL	EPA6010	Arsenic	2.7	mg/kg	1		
478PS1404.5	5/5/2003	SOIL	EPA6010	Barium	76	mg/kg	10		
478PS1404.5	5/5/2003	SOIL	EPA6010	Beryllium	0.59	mg/kg	0.52		
478PS1404.5	5/5/2003	SOIL	HASL300	Bi-214	1.36	pCi/g	0.71		0.57
478PS1404.5	5/5/2003	SOIL	EPA6010	Chromium	5.6	mg/kg	1		
478PS1404.5	5/5/2003	SOIL	HASL300	K-40	28.8	pCi/g	4.5		7.2
478PS1404.5	5/5/2003	SOIL	EPA6010	Lead	5.4	mg/kg	0.31		
478PS1404.5	5/5/2003	SOIL	EPA8260	Methylene Chloride	25	μg/kg	5.2		
478PS1404.5	5/5/2003	SOIL	HASL300	Pb-212	2.71	pCi/g	0.36		0.59
478PS1404.5	5/5/2003	SOIL	HASL300	Pb-214	1.39	pCi/g	0.58		0.44
478PS1404.5	5/5/2003	SOIL	HASL300	TI-208	0.79	pCi/g	0.3		0.28
478PS150.5	5/5/2003	SOIL	HASL300	Ac-228	2.1	pCi/g	2.1		1.1
478PS150.5	5/5/2003	SOIL	HASL300	Am-241	3.4	pCi/g	1.5		1.3
478PS150.5	5/5/2003	SOIL	EPA6010	Arsenic	4.3	mg/kg	1.2		
478PS150.5	5/5/2003	SOIL	EPA6010	Barium	160	mg/kg	12		
478PS150.5	5/5/2003	SOIL	EPA6010	Beryllium	1.7	mg/kg	0.6		
478PS150.5	5/5/2003	SOIL	HASL300	Bi-214	1	pCi/g	0.81		0.58
478PS150.5	5/5/2003	SOIL	EPA6010	Chromium	6.8	mg/kg	1.2		
478PS150.5	5/5/2003	SOIL	HASL300	Cs-137	30.4	pCi/g	0.58		5.2
478PS150.5	5/5/2003	SOIL	EPA8015	Diesel-Range Organics	19	mg/kg	6	Н	
478PS150.5	5/5/2003	SOIL	HASL300	K-40	24	pCi/g	8.2		7.9
478PS150.5	5/5/2003	SOIL	EPA6010	Lead	25	mg/kg	0.36		
478PS150.5	5/5/2003	SOIL	EPA8260	Methylene Chloride	6.6	μg/kg	6		
478PS150.5	5/5/2003	SOIL	HASL300	Pb-212	2.36	pCi/g	0.71		0.67
478PS150.5	5/5/2003	SOIL	HASL300	Pb-214	1	pCi/g	1		0.60
478PS150.5	5/5/2003	SOIL	UGTAISOPU	Pu-238	0.99	pCi/g	0.03		0.21
478PS150.5	5/5/2003	SOIL	UGTAISOPU	Pu-239	12.2	pCi/g	0.016		1.9
478PS150.5	5/5/2003	SOIL	SR7500	SR-90	1.42	pCi/g	0.32		0.4

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478PS150.5	5/5/2003	SOIL	HASL300	TI-208	0.83	pCi/g	0.51		0.39
478PS1505.5	5/5/2003	SOIL	HASL300	Ac-228	2.74	pCi/g	0.81		0.71
478PS1505.5	5/5/2003	SOIL	EPA6010	Arsenic	1.8	mg/kg	1.1		
478PS1505.5	5/5/2003	SOIL	EPA6010	Barium	42	mg/kg	11		
478PS1505.5	5/5/2003	SOIL	HASL300	Bi-214	1.29	pCi/g	0.46		0.45
478PS1505.5	5/5/2003	SOIL	EPA6010	Chromium	1.8	mg/kg	1.1		
478PS1505.5	5/5/2003	SOIL	HASL300	K-40	29.8	pCi/g	2.5		6.6
478PS1505.5	5/5/2003	SOIL	EPA6010	Lead	3.9	mg/kg	0.32		
478PS1505.5	5/5/2003	SOIL	EPA8260	Methylene Chloride	35	μg/kg	5.4		
478PS1505.5	5/5/2003	SOIL	HASL300	Pb-212	2.34	pCi/g	0.35		0.52
478PS1505.5	5/5/2003	SOIL	HASL300	Pb-214	1.28	pCi/g	0.47		0.36
478PS1505.5	5/5/2003	SOIL	HASL300	Th-234	4.7	pCi/g	3.6	TI	2.5
478PS1505.5	5/5/2003	SOIL	HASL300	TI-208	0.94	pCi/g	0.2		0.27
478PSB0101.5	5/2/2003	SOIL	HASL300	Ac-228	2.7	pCi/g	1.6	TI	1.3
478PSB0101.5	5/2/2003	SOIL	EPA6010	Arsenic	4.7	mg/kg	1.2		
478PSB0101.5	5/2/2003	SOIL	EPA6010	Barium	1000	mg/kg	12		
478PSB0101.5	5/2/2003	SOIL	EPA6010	Beryllium	1.4	mg/kg	0.58		
478PSB0101.5	5/2/2003	SOIL	EPA8270	Bis(2-Ethylhexyl)Phthalathe	160	μg/kg	380	J	
478PSB0101.5	5/2/2003	SOIL	EPA6010	Chromium	7	mg/kg	1.2		
478PSB0101.5	5/2/2003	SOIL	HASL300	Co-60	0.51	pCi/g	0.41	TI	0.33
478PSB0101.5	5/2/2003	SOIL	HASL300	Cs-137	227	pCi/g	1.6		38
478PSB0101.5	5/2/2003	SOIL	EPA8015	Diesel-Range Organics	48	mg/kg	5.8	Н	
478PSB0101.5	5/2/2003	SOIL	HASL300	K-40	26.7	pCi/g	5.6		7.6
478PSB0101.5	5/2/2003	SOIL	EPA6010	Lead	18	mg/kg	0.35		
478PSB0101.5	5/2/2003	SOIL	EPA8260	Methylene Chloride	8	μg/kg	5.8		
478PSB0101.5	5/2/2003	SOIL	HASL300	Pb-212	2.4	pCi/g	2.2		1.4
478PSB0101.5	5/2/2003	SOIL	UGTAISOPU	Pu-238	0.89	pCi/g	0.037		0.19
478PSB0101.5	5/2/2003	SOIL	UGTAISOPU	Pu-239	5.35	pCi/g	0.017		0.88
478PSB0101.5	5/2/2003	SOIL	SR7500	Sr-90	12.1	pCi/g	0.3		2.9
478PSB0109.5	5/2/2003	SOIL	EPA8260	2-Hexanone	13	μg/kg	22	J	
478PSB0109.5	5/2/2003	SOIL	HASL300	Ac-228	1.8	pCi/g	0.81		0.57
478PSB0109.5	5/2/2003	SOIL	EPA8260	Acetone	9.3	μg/kg	22	J	
478PSB0109.5	5/2/2003	SOIL	EPA6010	Arsenic	6.1	mg/kg	1.1	-	
478PSB0109.5	5/2/2003	SOIL	EPA6010	Barium	88	mg/kg	11		
478PSB0109.5	5/2/2003	SOIL	EPA6010	Beryllium	1.1	mg/kg	0.54		
478PSB0109.5	5/2/2003	SOIL	HASL300	Bi-214	2.1	pCi/g	0.53		0.60
478PSB0109.5	5/2/2003	SOIL	EPA6010	Chromium	4	mg/kg	1.1		
478PSB0109.5	5/2/2003	SOIL	HASL300	K-40	25.2	pCi/g	2.3		5.9
478PSB0109.5	5/2/2003	SOIL	EPA6010	Lead	10	mg/kg	0.33		
478PSB0109.5	5/2/2003	SOIL	EPA8260	Methylene Chloride	5.8	μg/kg	5.4		
478PSB0109.5	5/2/2003	SOIL	HASL300	Pb-212	2.31	pCi/g	0.38		0.52
478PSB0109.5	5/2/2003	SOIL	HASL300	Pb-214	1.53	pCi/g	0.44		0.40

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478PSB0109.5	5/2/2003	SOIL	HASL300	TI-208	0.69	pCi/g	0.26		0.24
478PSB020.5	5/7/2003	SOIL	HASL300	Ac-228	3.1	pCi/g	1.9	TI	1.6
478PSB020.5	5/7/2003	SOIL	EPA6010	Arsenic	7.6	mg/kg	1.4		
478PSB020.5	5/7/2003	SOIL	EPA6010	Barium	1000	mg/kg	14		
478PSB020.5	5/7/2003	SOIL	EPA6010	Beryllium	1.7	mg/kg	0.69		
478PSB020.5	5/7/2003	SOIL	EPA8270	Bis(2-Ethylhexyl)Phthalathe	380	μg/kg	460	J	
478PSB020.5	5/7/2003	SOIL	EPA6010	Chromium	8.5	mg/kg	1.4		
478PSB020.5	5/7/2003	SOIL	HASL300	Co-60	0.64	pCi/g	0.49	TI	0.30
478PSB020.5	5/7/2003	SOIL	HASL300	Cs-137	366	pCi/g	0.86		61
478PSB020.5	5/7/2003	SOIL	EPA8015	Diesel-Range Organics	29	mg/kg	6.9	Н	
478PSB020.5	5/7/2003	SOIL	HASL300	K-40	28.2	pCi/g	6		8.5
478PSB020.5	5/7/2003	SOIL	EPA6010	Lead	42	mg/kg	0.41		
478PSB020.5	5/7/2003	SOIL	EPA8260	Methylene Chloride	16	μg/kg	6.9		
478PSB020.5	5/7/2003	SOIL	HASL300	Pb-212	3.3	pCi/g	1.6		1.2
478PSB020.5	5/7/2003	SOIL	UGTAISOPU	Pu-238	0.83	pCi/g	0.026		0.17
478PSB020.5	5/7/2003	SOIL	UGTAISOPU	Pu-239	2.89	pCi/g	0.031		0.48
478PSB020.5	5/7/2003	SOIL	HASL300	Sb-125	3.9	pCi/g	2.8	TI	1.7
478PSB020.5	5/7/2003	SOIL	SR7500	Sr-90	22.8	pCi/g	0.4		5.4
478PSB0209.5	5/7/2003	SOIL	HASL300	Ac-228	2.23	pCi/g	1.2		0.77
478PSB0209.5	5/7/2003	SOIL	EPA6010	Arsenic	3.8	mg/kg	1		
478PSB0209.5	5/7/2003	SOIL	EPA6010	Barium	43	mg/kg	10		
478PSB0209.5	5/7/2003	SOIL	EPA6010	Beryllium	0.63	mg/kg	0.52		
478PSB0209.5	5/7/2003	SOIL	HASL300	Bi-214	1.45	pCi/g	0.67		0.56
478PSB0209.5	5/7/2003	SOIL	EPA6010	Chromium	2.7	mg/kg	1		
478PSB0209.5	5/7/2003	SOIL	HASL300	K-40	29.7	pCi/g	4.6		7.2
478PSB0209.5	5/7/2003	SOIL	EPA6010	Lead	4.4	mg/kg	0.31		
478PSB0209.5	5/7/2003	SOIL	EPA8260	Methylene Chloride	10	μg/kg	5.2		
478PSB0209.5	5/7/2003	SOIL	HASL300	Pb-212	2.31	pCi/g	0.46		0.54
478PSB0209.5	5/7/2003	SOIL	HASL300	Pb-214	1.87	pCi/g	0.55		0.48
478PSB0209.5	5/7/2003	SOIL	HASL300	TI-208	0.81	pCi/g	0.32		0.29
478PSB030.5	5/4/2003	SOIL	HASL300	Ac-228	2.47	pCi/g	1		0.82
478PSB030.5	5/4/2003	SOIL	HASL300	Am-241	2	pCi/g	0.43		0.49
478PSB030.5	5/4/2003	SOIL	EPA6010	Arsenic	3.9	mg/kg	1.1		
478PSB030.5	5/4/2003	SOIL	EPA6010	Barium	420	mg/kg	11		
478PSB030.5	5/4/2003	SOIL	EPA6010	Beryllium	0.92	mg/kg	0.53		
478PSB030.5	5/4/2003	SOIL	HASL300	Bi-214	1.18	pCi/g	0.64		0.52
478PSB030.5	5/4/2003	SOIL	EPA6010	Chromium	4.7	mg/kg	1.1		
478PSB030.5	5/4/2003	SOIL	HASL300	Cs-137	65	pCi/g	0.34		11
478PSB030.5	5/4/2003	SOIL	EPA8015	Diesel-Range Organics	18	mg/kg	5.3	Н	
478PSB030.5	5/4/2003	SOIL	HASL300	K-40	26.9	pCi/g	3.9		7.0
478PSB030.5	5/4/2003	SOIL	EPA6010	Lead	15	mg/kg	0.32		
478PSB030.5	5/4/2003	SOIL	EPA8260	Methylene Chloride	3.2	μg/kg	5.3	J	

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478PSB030.5	5/4/2003	SOIL	HASL300	Pb-212	2.25	pCi/g	0.61		0.60
478PSB030.5	5/4/2003	SOIL	HASL300	Pb-214	1.13	pCi/g	0.84		0.49
478PSB030.5	5/4/2003	SOIL	UGTAISOPU	Pu-238	0.96	pCi/g	0.029		0.20
478PSB030.5	5/4/2003	SOIL	UGTAISOPU	Pu-239	8.1	pCi/g	0.016		1.3
478PSB030.5	5/4/2003	SOIL	HASL300	Sb-125	1.6	pCi/g	1.5	TI	1.0
478PSB030.5	5/4/2003	SOIL	SR7500	Sr-90	3.88	pCi/g	0.35		0.97
478PSB030.5	5/4/2003	SOIL	HASL300	TI-208	0.72	pCi/g	0.39		0.31
478PSB0306.5	5/4/2003	SOIL	EPA8260	2-Hexanone	5.5	μg/kg	21	J	
478PSB0306.5	5/4/2003	SOIL	HASL300	Ac-228	2.45	pCi/g	1.4		0.83
478PSB0306.5	5/4/2003	SOIL	EPA6010	Arsenic	1.5	mg/kg	1		
478PSB0306.5	5/4/2003	SOIL	EPA6010	Barium	40	mg/kg	10		
478PSB0306.5	5/4/2003	SOIL	HASL300	Bi-214	1.18	pCi/g	0.49		0.44
478PSB0306.5	5/4/2003	SOIL	EPA6010	Chromium	2.1	mg/kg	1		
478PSB0306.5	5/4/2003	SOIL	HASL300	Cs-137	0.85	pCi/g	0.33		0.30
478PSB0306.5	5/4/2003	SOIL	HASL300	Eu-152	0.79	pCi/g	0.72	TI	0.61
478PSB0306.5	5/4/2003	SOIL	HASL300	K-40	32.3	pCi/g	3.4		7.2
478PSB0306.5	5/4/2003	SOIL	EPA6010	Lead	4.6	mg/kg	0.31		
478PSB0306.5	5/4/2003	SOIL	EPA8260	Methylene Chloride	3.2	μg/kg	5.2	J	
478PSB0306.5	5/4/2003	SOIL	HASL300	Pb-212	2.09	pCi/g	0.39		0.49
478PSB0306.5	5/4/2003	SOIL	HASL300	Pb-214	1.53	pCi/g	0.4		0.39
478PSB0306.5	5/4/2003	SOIL	HASL300	Th-234	2.3	pCi/g	1.9	TI	1.4
478PSB0306.5	5/4/2003	SOIL	HASL300	TI-208	0.59	pCi/g	0.28		0.24
478PSB040.5	5/4/2003	SOIL	HASL300	Ac-228	1.7	pCi/g	1.4		0.77
478PSB040.5	5/4/2003	SOIL	HASL300	Al-26	0.17	pCi/g	0.078	TI	0.14
478PSB040.5	5/4/2003	SOIL	HASL300	Am-241	4.5	pCi/g	3.6		2.5
478PSB040.5	5/4/2003	SOIL	EPA6010	Arsenic	4	mg/kg	1.2		
478PSB040.5	5/4/2003	SOIL	EPA6010	Barium	1100	mg/kg	12		
478PSB040.5	5/4/2003	SOIL	EPA6010	Beryllium	1	mg/kg	0.6		
478PSB040.5	5/4/2003	SOIL	EPA8270	Bis(2-Ethylhexyl)Phthalathe	270	μg/kg	400	J	
478PSB040.5	5/4/2003	SOIL	EPA6010	Chromium	5.4	mg/kg	1.2		
478PSB040.5	5/4/2003	SOIL	HASL300	Cs-137	142	pCi/g	0.47		24
478PSB040.5	5/4/2003	SOIL	EPA8015	Diesel-Range Organics	86	mg/kg	6	Н	
478PSB040.5	5/4/2003	SOIL	HASL300	K-40	26.7	pCi/g	3.6		6.8
478PSB040.5	5/4/2003	SOIL	EPA6010	Lead	16	mg/kg	0.36		
478PSB040.5	5/4/2003	SOIL	EPA8260	Methylene Chloride	9.5	μg/kg	6		
478PSB040.5	5/4/2003	SOIL	HASL300	Pb-212	2.68	pCi/g	0.85		0.76
478PSB040.5	5/4/2003	SOIL	HASL300	Pb-214	1.53	pCi/g	1.3		0.79
478PSB040.5	5/4/2003	SOIL	UGTAISOPU	Pu-238	1.53	pCi/g	0.038		0.29
478PSB040.5	5/4/2003	SOIL	UGTAISOPU	Pu-239	15.3	pCi/g	0.033		2.3
478PSB040.5	5/4/2003	SOIL	HASL300	Sb-125	8.3	pCi/g	2.1		1.8
478PSB040.5	5/4/2003	SOIL	SR7500	Sr-90	7	pCi/g	0.3		1.7
478PSB040.5	5/4/2003	SOIL	HASL300	TI-208	0.56	pCi/g	0.47		0.33

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478PSB0405.5	5/4/2003	SOIL	HASL300	Ac-228	3.3	pCi/g	1.4		1.1
478PSB0405.5	5/4/2003	SOIL	EPA6010	Arsenic	1.6	mg/kg	1.1		
478PSB0405.5	5/4/2003	SOIL	EPA6010	Barium	41	mg/kg	11		
478PSB0405.5	5/4/2003	SOIL	HASL300	Bi-212	4.1	pCi/g	4.1	TI	2.9
478PSB0405.5	5/4/2003	SOIL	HASL300	Bi-214	1.4	pCi/g	0.77		0.60
478PSB0405.5	5/4/2003	SOIL	EPA6010	Chromium	2.4	mg/kg	1.1		
478PSB0405.5	5/4/2003	SOIL	HASL300	Cs-137	2.91	pCi/g	0.4		0.66
478PSB0405.5	5/4/2003	SOIL	HASL300	K-40	28.8	pCi/g	6.3		7.7
478PSB0405.5	5/4/2003	SOIL	EPA6010	Lead	3.7	mg/kg	0.33		
478PSB0405.5	5/4/2003	SOIL	EPA8260	Methylene Chloride	12	μg/kg	5.4		
478PSB0405.5	5/4/2003	SOIL	HASL300	Pb-212	3.03	pCi/g	0.46		0.66
478PSB0405.5	5/4/2003	SOIL	HASL300	Pb-214	1.52	pCi/g	0.7		0.48
478PSB0405.5	5/4/2003	SOIL	HASL300	TI-208	0.81	pCi/g	0.37		0.31
478PSBX020.5	5/7/2003	SOIL	HASL300	Ac-228	3.3	pCi/g	2.4	TI	1.8
478PSBX020.5	5/7/2003	SOIL	EPA6010	Arsenic	7.7	mg/kg	1.4		
478PSBX020.5	5/7/2003	SOIL	EPA6010	Barium	930	mg/kg	14		
478PSBX020.5	5/7/2003	SOIL	EPA6010	Beryllium	1.7	mg/kg	0.69		
478PSBX020.5	5/7/2003	SOIL	EPA8270	Bis(2-Ethylhexyl)Phthalathe	450	μg/kg	460	J	
478PSBX020.5	5/7/2003	SOIL	EPA6010	Chromium	8.5	mg/kg	1.4		
478PSBX020.5	5/7/2003	SOIL	HASL300	Co-60	0.77	pCi/g	0.46	TI	0.31
478PSBX020.5	5/7/2003	SOIL	HASL300	Cs-137	354	pCi/g	0.86		59
478PSBX020.5	5/7/2003	SOIL	EPA8015	Diesel-Range Organics	28	mg/kg	6.9	Н	
478PSBX020.5	5/7/2003	SOIL	HASL300	Eu-152	1.3	pCi/g	0.51	TI	1.0
478PSBX020.5	5/7/2003	SOIL	HASL300	K-40	21.8	pCi/g	6.7		7.5
478PSBX020.5	5/7/2003	SOIL	EPA6010	Lead	43	mg/kg	0.41		
478PSBX020.5	5/7/2003	SOIL	EPA8260	Methylene Chloride	20	μg/kg	6.9		
478PSBX020.5	5/7/2003	SOIL	HASL300	Pb-212	1.9	pCi/g	1.7		1.1
478PSBX020.5	5/7/2003	SOIL	HASL300	Sb-125	4.2	pCi/g	3.6		1.9
478PSBX030.5	5/4/2003	SOIL	HASL300	Ac-228	2.2	pCi/g	0.78		0.69
478PSBX030.5	5/4/2003	SOIL	EPA6010	Arsenic	4	mg/kg	1.1		
478PSBX030.5	5/4/2003	SOIL	EPA6010	Barium	410	mg/kg	11		
478PSBX030.5	5/4/2003	SOIL	EPA6010	Beryllium	0.83	mg/kg	0.53		
478PSBX030.5	5/4/2003	SOIL	HASL300	Bi-212	4.2	pCi/g	2.8		2.3
478PSBX030.5	5/4/2003	SOIL	HASL300	Bi-214	0.77	pCi/g	0.68		0.47
478PSBX030.5	5/4/2003	SOIL	EPA6010	Chromium	4.3	mg/kg	1.1		
478PSBX030.5	5/4/2003	SOIL	HASL300	Cs-137	64	pCi/g	0.27		11
478PSBX030.5	5/4/2003	SOIL	EPA8015	Diesel-Range Organics	11	mg/kg	5.3	Н	
478PSBX030.5	5/4/2003	SOIL	HASL300	K-40	31.9	pCi/g	2		7.0
478PSBX030.5	5/4/2003	SOIL	EPA6010	Lead	13	mg/kg	0.32		
478PSBX030.5	5/4/2003	SOIL	HASL300	Pb-212	2.43	pCi/g	0.61		0.61
478PSBX030.5	5/4/2003	SOIL	HASL300	Pb-214	1.14	pCi/g	0.97		0.53
478PSBX030.5	5/4/2003	SOIL	EPA6010	Selenium	0.59	mg/kg	0.53		

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
478PSBX030.5	5/4/2003	SOIL	HASL300	TI-208	0.51	pCi/g	0.28		0.22
478TR08	5/2/2003	WATER	EPA8260	Methylene Chloride	2.6	μg/L	5	J	
478TR15	5/4/2003	WATER	EPA8260	Methylene Chloride	2.8	μg/L	5	J	
478TR16	5/4/2003	WATER	EPA8260	Methylene Chloride	2.1	μg/L	5	J	
478TR17	5/1/2003	WATER	EPA8260	Methylene Chloride	2.3	μg/L	5	J	
478TR20	5/5/2003	WATER	EPA8260	Methylene Chloride	1.6	μg/L	5	J	
478TR22	5/5/2003	WATER	EPA8260	Methylene Chloride	1.5	μg/L	5	J	
478TR24	5/6/2003	WATER	EPA8260	Methylene Chloride	1.9	μg/L	5	J	
478TR26	5/6/2003	WATER	EPA8260	Methylene Chloride	1.8	μg/L	5	J	
478TR28	5/7/2003	WATER	EPA8260	Methylene Chloride	1.9	μg/L	5	J	
478TR29	5/7/2003	WATER	EPA8260	Methylene Chloride	1.5	μg/L	5	J	
478TR30	5/7/2003	WATER	EPA8260	Methylene Chloride	1.6	μg/L	5	J	
478TR31	5/7/2003	WATER	EPA8260	Methylene Chloride	4	μg/L	5	J	
478W01	5/1/2003	WATER	EPA8260	Acetone	8.3	μg/L	20	J	
478W02	5/1/2003	WATER	EPA8260	Acetone	10	μg/L	20	J	
478W04	5/3/2003	WATER	HASL300	Ac-228	30	pCi/L	28	TI	19
478W07	5/6/2003	WATER	EPA8260	Acetone	29	μg/L	20		
478W07	5/6/2003	WATER	EPA8260	Chloroform	1.2	μg/L	5	J	
478W07	5/6/2003	WATER	EPA8260	Methylene Chloride	8.6	μg/L	5		
478W08	5/6/2003	WATER	EPA8260	Acetone	9.6	μg/L	20	J	
478W09	5/6/2003	WATER	EPA8260	Acetone	9.8	μg/L	20	J	
478W09	5/6/2003	WATER	HASL300	Eu-155	17	pCi/L	17	TI	11
			The Foll	owing Informatiom is from the C	AU 476 Backgro	und Samples		'	
TS-B1-01	5/1/2000	SOIL	N/A	AC-228	2.11	pCi/g	0.74		0.8
TS-B1-01	5/1/2000	SOIL	N/A	AL-26	0	pCi/g	0.055	SQ	0
TS-B1-01	5/1/2000	SOIL	N/A	Arsenic	2	mg/kg	1.1		
TS-B1-01	5/1/2000	SOIL	N/A	Barium	81	mg/kg	11		
TS-B1-01	5/1/2000	SOIL	N/A	BI-212	3.6	pCi/g	2		2.2
TS-B1-01	5/1/2000	SOIL	N/A	BI-214	1.6	pCi/g	0.46		0.52
TS-B1-01	5/1/2000	SOIL	N/A	Chromium	3.6	mg/kg	1.1		
TS-B1-01	5/1/2000	SOIL	N/A	CS-137	1.14	pCi/g	0.24		0.35
TS-B1-01	5/1/2000	SOIL	N/A	K-40	30.9	pCi/g	2.3		6.7
TS-B1-01	5/1/2000	SOIL	N/A	Lead	9.1	mg/kg	0.32		
TS-B1-01	5/1/2000	SOIL	N/A	Na-22	0	pCi/g	0.25	SQ	0
TS-B1-01	5/1/2000	SOIL	N/A	Pb-212	2.24	pCi/g	0.29		0.48
TS-B1-01	5/1/2000	SOIL	N/A	Pb-214	1.59	pCi/g	0.58		0.65
TS-B1-01	5/1/2000	SOIL	N/A	Pu-238	0.307	pCi/g	0.047		0.084
TS-B1-01	5/1/2000	SOIL	N/A	Pu-239	1.18	pCi/g	0.029		0.21
TS-B1-01	5/1/2000	SOIL	N/A	Sr-90	0.28	pCi/g	0.28		0.18
TS-B1-01	5/1/2000	SOIL	N/A	TI-208	0.88	pCi/g	0.22		0.26
TS-B2-01	5/1/2000	SOIL	N/A	Ac-228	3.2	pCi/g	0.62		1
TS-B2-01	5/1/2000	SOIL	N/A	Al-26	0	pCi/g	0.42	SQ	0

	SAMPLE	SAMPLE	USER TEST						
SAMPLE NO	DATE	MATRIX	PANEL	PARAMETER	RESULT	UNITS	DETECT LIMIT	QUALIFIER	ERROR
TS-B2-01	5/1/2000	SOIL	N/A	Am-241	2.8	pCi/g	0.94		1.6
TS-B2-01	5/1/2000	SOIL	N/A	Arsenic	2.1	mg/kg	1.1		
TS-B2-01	5/1/2000	SOIL	N/A	Barium	78	mg/kg	11		
TS-B2-01	5/1/2000	SOIL	N/A	Bi-214	2.4	pCi/g	0.85		1
TS-B2-01	5/1/2000	SOIL	N/A	Chromium	3.5	mg/kg	1.1		
TS-B2-01	5/1/2000	SOIL	N/A	Cs-137	13.5	pCi/g	0.33		2.4
TS-B2-01	5/1/2000	SOIL	N/A	K-40	32.2	pCi/g	3.7		7.8
TS-B2-01	5/1/2000	SOIL	N/A	Lead	12	mg/kg	0.32		
TS-B2-01	5/1/2000	SOIL	N/A	Pb-212	2.12	pCi/g	0.4		0.52
TS-B2-01	5/1/2000	SOIL	N/A	Pb-214	1.27	pCi/g	0.65		0.5
TS-B2-01	5/1/2000	SOIL	N/A	Pu-238	1.03	pCi/g	0.072		0.24
TS-B2-01	5/1/2000	SOIL	N/A	Pu-239	9.6	pCi/g	0.052		1.4
TS-B2-01	5/1/2000	SOIL	N/A	Sr-90	1.13	pCi/g	0.27		0.29
TS-B2-01	5/1/2000	SOIL	N/A	TI-208	0.75	pCi/g	0.34		0.32
TS-B3-01	5/1/2000	SOIL	N/A	Ac-228	2.12	pCi/g	0.69		0.74
TS-B3-01	5/1/2000	SOIL	N/A	Al-26	0	pCi/g	0.023	SQ	0
TS-B3-01	5/1/2000	SOIL	N/A	Arsenic	3.8	mg/kg	1.1		
TS-B3-01	5/1/2000	SOIL	N/A	Barium	110	mg/kg	11		
TS-B3-01	5/1/2000	SOIL	N/A	Bi-212	1.3	pCi/g	1.3		1
TS-B3-01	5/1/2000	SOIL	N/A	Bi-214	1.16	pCi/g	0.4		0.37
TS-B3-01	5/1/2000	SOIL	N/A	Chromium	6	mg/kg	1.1		
TS-B3-01	5/1/2000	SOIL	N/A	K-40	30.1	pCi/g	2.5		5.8
TS-B3-01	5/1/2000	SOIL	N/A	Lead	9.6	mg/kg	0.32		
TS-B3-01	5/1/2000	SOIL	N/A	Pb-212	2.76	pCi/g	0.38		0.61
TS-B3-01	5/1/2000	SOIL	N/A	Pb-214	1.52	pCi/g	0.43		0.47
TS-B3-01	5/1/2000	SOIL	N/A	Pu-239	0.095	pCi/g	0.011		0.041
TS-B3-01	5/1/2000	SOIL	N/A	TI-208	0.7	pCi/g	0.22		0.25

Appendix B

Data Quality Objective Process for Corrective Action Unit 478, Area 12 T-Tunnel Ponds

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B.1.0 Data Quality Objective Process for Corrective Action Unit 478, Area 12 T-Tunnel Ponds

The DQO process is a planning approach based on the scientific method that is used to ensure that data collected during site characterization will provide sufficient and reliable information to identify, evaluate, and technically defend potentially viable corrective actions (i.e., no further action, closure in place, or clean closure). The existing information about the nature and extent of contamination at the CAS in CAU 478 is insufficient to evaluate and select preferred corrective actions. The CAU 478 investigation will be based on DQOs agreed to by NDEP and DTRA representatives.

One CAS comprises CAU 478:

• CAS 12-23-01, Ponds (5), RAD Area

B.1.1 Step 1 - State the Problem

This step identifies the DQO planning team members, states the problem that has initiated the CAU 478 investigation, and develops the CSM.

B.1.1.1 Planning Team Members

The DQO planning team consists of representatives from NDEP, DTRA, and IT Corporation. The primary decision-makers include NDEP and DTRA representatives. The DQO meeting to present and discuss the DQOs for CAU 478 was held on November 21, 2002.

B.1.1.2 State the Problem

It is unknown whether COPCs exceeding PALs are present in or have migrated from the T-Tunnel Ponds. If contaminants are present in concentrations that exceed the PALs, they may present a risk to human health and/or the environment and have the potential for migrating off site. If contaminants are present, their nature and extent need to be determined, and their risk to human health and/or the environment evaluated.

B.1.1.3 Conceptual Site Model

A CSM has been developed to describe potential exposure pathways from possible contaminant sources in the T-Tunnel Ponds. If the CSM is proven incorrect by the results of the environmental sampling, NDEP will be notified, and the corrective action investigation rescoped.

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The following statements are assumptions and/or facts that were considered in developing the model:

- The ponds were placed on a thin veneer of alluvium overlying the tuffs of the Calico Hills and Grouse Canyon Formations.
- The T-Tunnel Ponds were used as settling ponds for water removed from the workings during tunnel re-entry following testing.
- The T-Tunnel Ponds consist of six ponds, ranging from 80 to 160 ft long and 50 to 170 ft wide. The ponds stretch in an easterly direction from CAU 476 (Area 12 T-Tunnel Muckpile), with the first pond partly covered by the muckpile and the last earthen berm being approximately 1,240 ft east of the muckpile. The ponds are located next to each other in a southeasterly trend, with an earthen berm separating each pond from the one below it. The ponds contain approximately 4,578 cubic yards of sediments.
- The material in the ponds consists of fine-grained sediments that settled out of water pumped from the T-Tunnel workings.
- The thickness of the material in the ponds is unknown.
- Areas of potential underground radiological contamination have been posted at the ponds.
- The most likely pathway for migration of contaminants away from the ponds is in stormwater runoff. Migration might also result when precipitation infiltrates into the thin, peripheral portions of the ponds and enters the native material and/or drains downgradient along the contact between the fill and the underlying native alluvium or bedrock
- Arsenic is found in the native soils and may also be found in the ponds (NBMG, 1998). In addition, the ponds may also contain very small volumes of RCRA-regulated hazardous constituents and beryllium. The possible distribution of these COPCs is not known.
- The ponds are not lined. Although specific permeability data are lacking, low precipitation and high evaporation rates in this region would tend to limit downward migration of contaminants from the ponds.

The CSM was developed using these assumptions. It was postulated that the majority of the ponds do not contain COPCs, and if any COPCs are present, they are probably isolated. The location of buried COPCs cannot be predicted; however, surface radiological surveys can be used to increase the probability of finding impacted areas of the ponds. The areas most likely to be affected are the ponds that are furthest upgradient. It is also possible, but unlikely, that the

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native soil beneath the ponds has been impacted by downward migration of COPCs. Figure B.1-1 is a generalized drawing of the CSM.

B.1.2 Step 2 - Identify the Decision

This step develops the decision statement.

B.1.2.1 Develop the Decision Statement

Are there concentrations of COPCs present in the ponds that exceed the PALs and, if so, do they pose a threat to human health and/or the environment?

B.1.3 Step 3 - Identify Inputs to the Decision

This step identifies the information needed, determines sources for information, determines the basis for establishing the action levels, and identifies sampling and analysis methods that can meet the data requirements.

B.1.3.1 Information Needs and Information Sources

Inputs to the decision are centered on the sampling approach, which depends foremost on a reasonable CSM. The model provides a basis for development of the approach and ultimately the course of action that will be taken for the site. In turn, the CSM is tested and confirmed by the results of the sampling. Radiological walkover surveys will be conducted to guide the placement of biased samples. Sampling will consist of collecting random and biased environmental samples from the ponds and the native materials beneath the ponds.

Table B.1-1 lists the information needs, the source of information for each need, the methods proposed to collect the data, and the quality assurance (QA)/quality control (QC) data type. The data type is determined by the intended use of the data in decision making. Data types are discussed in the following text.

B.1.3.1.1 Quantitative Data

Quantitative data directly measure the quantity or amount of a characteristic or component within the population of interest. These data require the highest level of QA/QC in collection and measurement systems because the intended use of the data is to resolve primary decisions (i.e., rejecting or accepting the null hypothesis) and/or verifying that closure standards have been met. Laboratory analytical data are generally considered quantitative.

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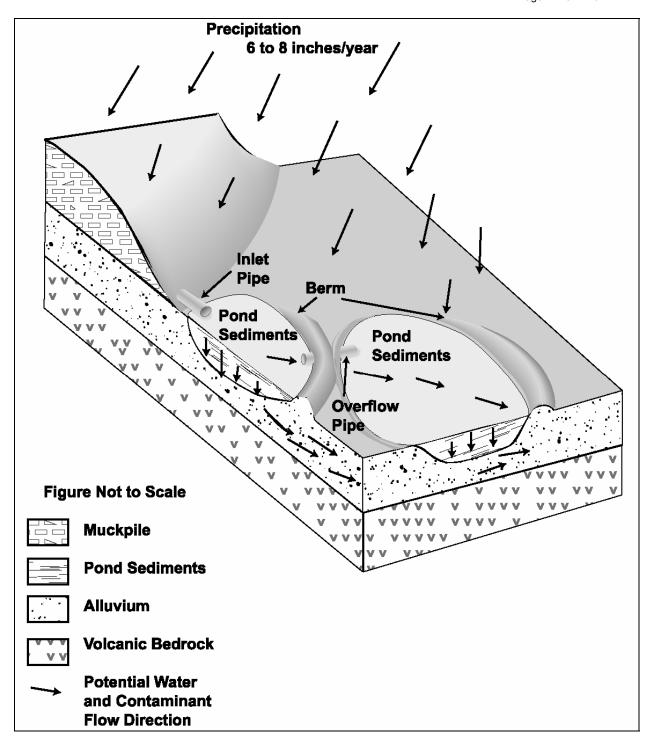


Figure B.1-1 CAU 478 Conceptual Site Model

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Table B.1-1 Information Needs To Resolve the Decision

(Page 1 of 2)

Information Need	Information Source	Collection Method	Data Type
Identify the COPCs.	Results of historical data review Results of the walkover radiological survey	 Review the source terms for all tests that could have contributed contaminants to the ponds. Review historical data for chemicals that may have been used on site. Review historical data for potential release information. 	Qualitative
Are any COPCs present in the ponds?	Analytical results of soil samples	 Collect soil samples at random locations and at random depths in the ponds using a rotosonic drill rig or hand tools. Collect shallow, biased soil samples from the ponds using the rotosonic drill rig or hand tools. Send samples to an offsite laboratory to be analyzed for chemical and radiological constituents. 	Quantitative
Are any COPCs present in the native material beneath the ponds?	Analytical results of soil samples	 Collect samples of native material at random locations immediately beneath the ponds using a rotosonic drill rig. Send samples to an offsite laboratory to be analyzed for chemical and radiological constituents. 	Quantitative
If COPCs are present in or beneath the ponds, are the concentrations high enough to exceed PALs?	 Analytical results of soil samples Region 9 PRGs (EPA, 2002), Nevada Administrative Code 445.2272 (NAC, 2002) Individual isotope and metals concentrations in background soil samples Individual isotope and metals concentrations from published sources 	 Compare the analytical results from the offsite laboratory for the chemical and radiological data to the PALs taking into account that the site is an industrial facility in a nuclear and high explosives test zone. 	Quantitative

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Table B.1-1 **Information Needs To Resolve the Decision**

(Page 2 of 2)

Information Need	Information Source	Collection Method	Data Type
If COPCs are present in concentrations that exceed PALs, what is their extent?	 Analytical results of soil samples Results of the walkover radiological survey Field-screening results collected with the Electra and PID 	 The walkover survey will be used to determine lateral extent of any contamination. Boreholes will be continued into the native material until field-screening levels as determined from Electra and PID results are not exceeded (unless refusal is encountered) to define the vertical extent. 	Quantitative
If COPCs are present in concentrations that exceed PALs, is there a potential for migration?	 Analytical results of soil samples Results of the walkover radiological survey Stability and drainage surveys 	 Assess existing data for usability and collect geotechnical samples if needed. Evaluate the results of the surveys to determine the stability of the ponds. 	Semiquantitative

COPC = Contaminant of potential concern

PAL = Preliminary action level PID = Photoionization detector

B.1.3.1.2 Semiquantitative Data

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

B.1.3.1.3 Qualitative Data

Qualitative data identify or describe the characteristics or components of the population of interest. The QA/QC requirements are the least rigorous on data collection methods and measurement systems. The intended use of the data is for information purposes, to refine CSMs, and to guide investigations rather than resolve primary decisions. This measurement of quality is typically assigned to historical information and data where QA/QC may be highly variable or not known. Professional judgment is often used to generate qualitative data.

B.1.3.1.4 Determine the Basis for the Preliminary Action Levels

Laboratory analytical results for soils will be compared to the following PALs to evaluate whether COPCs are present at levels that could pose an unacceptable risk to human health and/or the environment:

- 100 mg/kg TPH in soil, per NAC 445A.2272, "Contamination of Soils: Establishment of Action Levels" (NAC, 2002)
- Background concentrations for metals when natural background exceeds the PRG, as is
 often the case with arsenic. Background is considered to be the highest measurement
 from soil samples taken as local background or from soil samples collected near the CAU
 by the Nevada Bureau of Mines and Geology's sampling of the Nellis Air Force Range
 (NBMG, 1998; Moore, 1999).
- U.S. Environmental Protection Agency (EPA) Region 9 PRGs (EPA, 2002) for industrial soils, as based on future use of the site in a Nuclear and High Explosive Test Zone (DOE/NV, 1996a and b and 1998).

• The PALs for radionuclides are isotope-specific and defined as the higher of the maximum concentration for that isotope found in samples from undisturbed background locations in the vicinity of the NTS (McArthur and Miller, 1989; US Ecology and Atlan-Tech, 1991) or from any of the three background samples that will be collected during the investigation.

B.1.3.1.5 Potential Sampling Techniques and Appropriate Analytical Methods

B.1.3.1.5.1 Radiological Surveys

Radiological surveys will be used to help determine the presence and lateral extent of surface radiological contamination. Radiological surveys will follow standard procedures. Further information is provided in Section B.1.7.1.

B.1.3.1.5.2 Soil Sampling

Rotosonic drilling and hand tools will be used to collect soil samples. Soil sample collection and handling activities will follow standard procedures. Section 6.0 of the CAIP lists analytical methods and laboratory requirements (e.g., detection limits, precision, and accuracy) for the investigation. Sample volumes are laboratory and method-specific and will be determined in accordance with laboratory requirements. Specific analyses required for the disposal of investigation-derived waste are identified in Section 5.0 of this CAIP. To ensure that laboratory analyses can detect contamination in soil samples at concentrations exceeding the minimum reporting limit, chemical and/or radiological parameters of interest have been selected for the CAU. The chemical and radiological parameters are listed in Table B.1-2.

The VOCs and SVOCs to be analyzed for in the investigation are listed in Tables B.1-3 and B.1-4, respectively.

Table B.1-2
Analyses To Be Performed

	Sample Type							
Analyses		Duplicate	Background	Full Lab QC	Source Blanks	Field Blanks	Equipment Rinsate Blanks	Trip Blanks
Organics			_	_	_			
Volatile organic compounds	Х	Х		Χ	Х	Х	X	Х
Semivolatile organic compounds	Х	Х		Х	Х	Х	X	
Total petroleum hydrocarbons-diesel-range organics	Х	Х		Х	Х	Х	X	
Metals								
Total RCRA Metals	Х	Х	Х	Х	Х	Х	Х	
Beryllium		Х	Х	Х	Х	Х	Х	
Radionuclides								
Gamma Spectrometry	Х	Х	Х		Х	Х	Х	
Isotopic Plutonium (at least 25% of samples for waste management)	Х	Х		Х				
Total Strontium (at least 25% of samples for waste management) a	Х	Х		Х				

^a Total strontium uses a stable strontium carrier as opposed to a matrix spike.

Table B.1-3
Volatile Organic Compounds Proposed for Analysis

Volatile Organic Compounds i roposed for Analysis				
1,1,1-Trichloroethane	4-Methyl-2-pentanone	Dibromochloromethane		
1,1,2,2-Tetrachloroethane	Acetone	Ethylbenzene		
1,1,2-Trichloroethane	Benzene	Methyl tertiary butyl ether		
1,1-Dichloroethane	Bromochloromethane	Methylene chloride		
1,1-Dichloroethene	Bromodichloromethane	Styrene		
cis-1,2-Dichloroethene	Bromoform	Tetrachloroethene		
trans-1,2-Dichloroethene	Bromomethane	Toluene		
1,2-Dichloroethane	Carbon disulfide	Trichloroethene		
1,2-Dichloropropane	Carbon tetrachloride	Vinyl acetate		
cis-1,3-Dichloropropene	Chlorobenzene	Vinyl chloride		
trans-1,3-Dichloropropene	Chloroethane	Xylene		
2-Butanone	Chloroform			
2-Hexanone	Chloromethane			

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Table B.1-4
Semivolatile Organic Compounds Proposed for Analysis

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

^a May be reported with volatile organic compounds

B.1.4 Step 4 - Define the Boundaries of the Study

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

B.1.4.1 Define the Target Population

The target populations for the characterization are:

- a. The material in the ponds
- b. The native material underlying the ponds to a depth of no more than 5 ft

B.1.4.2 Identify the Spatial and Temporal Boundaries

The horizontal boundaries of the study area are the edges of the ponds to the extent that elevated radiological readings are identified by the walkover survey. The vertical boundary is 2 to 5 ft beneath the bottom of the ponds or until drill refusal (defined as requiring more than 15 minutes

to drill 1 ft). The study area also includes undisturbed background sample locations outside, but adjacent to, the pond boundaries. There are no temporal constraints on the characterization.

B.1.4.3 Identify Practical Constraints on the Characterization

The practical constraints on the investigation are the capability of the drill to penetrate the ponds and native material, the ability to get the drill onto the sample locations, and the weather, all of which can impact the fieldwork.

B.1.4.4 Define the Scale of the Decision Making

The scale of decision making is defined as the six ponds, consisting of one CAS as one unit.

B.1.5 Step 5 - Develop a Decision Rule

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

B.1.5.1 Specify the Population Parameter

The population parameter is the maximum observed concentration of each COPC within the target population. For radiological surveys, the maximum observed concentration of each COPC will be the population parameter. If sampling is performed to support the radiological survey results, the maximum observed concentration of each COPC identified in the sample will be the population parameter. Radiological sampling results will supersede radiological survey results.

B.1.5.2 Choose an Action Level

Action levels are defined in Section B.1.3.1.4.

B.1.5.3 Measurement and Analysis Methods

Radiological surveys and soil sampling and analyses, identified in Section B.1.7.1, will be used to identify the presence and location of COPCs.

The measurement and analysis methods referenced in the Industrial Sites QAPP (NNSA/NV, 2002) are capable of achieving the expected range of values to resolve the Primary Decision. The detection limit of the measurement method to be used is less than the action level for each COPC unless otherwise specified in the CAIP.

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B.1.5.4 Decision Rule

The following decision rules are applicable to the CAU 478 investigation and will be used to guide the investigation and data evaluation:

- If laboratory results for the soil samples indicate the presence of COPCs above the PALs, then a CADD will be prepared.
- If the laboratory results for the soil samples do not indicate the presence of COPCs above the PALs, then a CADD or CADD/CR will be prepared.

The PALs are defined in Section B.1.3.1.4.

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

Only validated analytical results (quantitative data) will be used to determine whether COPCs are present, unless otherwise stated. The baseline condition, or null hypothesis, assumed for this site is that COPCs above the action levels are present in the ponds. The alternate hypothesis is that COPCs above the action levels are not present in the ponds. Based on these hypotheses, two types of decision errors are possible, false positive and false negative. This CAIP has been designed to minimize both types of errors.

B.1.6.1 False Positive Decision Error

The consequences of a false positive are: (1) the corrective action could be needlessly expanded to encompass a greater quantity of media than is necessary, and (2) media incorrectly judged to be contaminated could be treated as regulated waste rather than unregulated waste. Both of these consequences could lead to increased corrective action and waste disposal costs.

B.1.6.2 False Negative Decision Error

The consequences of a false negative are: (1) regulated contaminants might not be appropriately addressed by corrective action or treatment activities, (2) contamination could remain in place, and (3) contaminated media might be disposed of improperly. These consequences could result in unacceptable risks to human health and the environment and potential fines from regulatory agencies.

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B.1.6.3 Statistical Model

Statistical modeling was performed to determine how many samples are sufficient to ensure a 90 percent confidence level in the mean COPC concentration when compared with the regulatory threshold.

The EPA has defined regulatory thresholds (RTs) for many chemicals and metals in soil. However, cleanup levels for radionuclides in soil have not been promulgated for sites such as CAU 478, nor have they been defined for the radionuclide COPCs likely to be found at a DTRA site. Therefore, RTs for radionuclides are assumed to be the background concentration for the radionuclide or the "rad added" screening levels of the *Nevada Test Site Performance Objective for Certification of Nonradioactive Hazardous Waste* (POC) (BN, 1995), whichever is greater.

If chemical COPCs are found at the site, the RT values used to calculate whether sufficient samples have been taken will be the PALs as defined in Section 3.3 of the CAIP. For TPH, the PAL is 100 mg/kg in soil, and for RCRA-regulated contaminants, the EPA Region 9 PRGs for Industrial Soils are the PALs.

Analytical results for Cs-137 will be used to determine the number of samples required to characterize the T-Tunnel Ponds. Cesium-137 was selected because it is found in more of the tunnel samples than any other contaminant. The number of samples required to ensure a 90 percent confidence level was calculated using only the data for samples with Cs-137 concentrations exceeding the minimum detectable concentration.

Testing for the Number of Required Samples

Because no soil sampling data are available for the T-Tunnel Ponds, the Cs-137 results from characterization of the ponds at CAUs 477 and 482 were used to calculate the number of samples required to characterize the T-Tunnel Ponds. After the characterization is completed the procedure will be repeated using CAU 478 data for radiological and chemical contaminants to confirm that sufficient samples were collected to characterize the site at the 90 percent confidence level (EPA, 1998).

Calculation of the Number of Samples

Determine the number of samples required to obtain a 90 percent confidence interval (EPA, 2000) for the ponds using the Cs-137 data from the pond characterizations at CAUs 477 and 482.

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Required number of samples for the ponds using Cs-137 data:

$$n = (t_{20})^2 \times s^2 / (RT - \bar{x})^2$$

where:

n = minimum number of samples to ensure a 90 percent confidence level in the calculated mean concentration in the COPC

 $(t_{.20})^2$ = 1.643, the square of 1.282, the $t_{.20}$ value for infinite degrees of freedom, 90 percent confidence level, Table 9-2, SW-846 (EPA, 1998)

s² = variance of the Cs-137 concentration in the positive samples from the ponds at CAUs 477 and 482: 73,798 picocuries per gram (pCi/g)

RT = 7 pCi/g

 \overline{x} = mean Cs-137 concentration in the positive samples from the ponds at CAUs 477 and 482: 109 pCi/g

n =
$$(t_{.20})^2 \times s^2/(RT - \bar{x})^2 = (1.643 \times 73,798)/(7 - 109)^2 = 11.7 \text{ samples}$$

In addition to calculating the required number of samples, a decision performance curve graph was prepared using the same data from the characterization of the ponds at CAUs 477 and 482. The number of samples was estimated using a stratified random sampling strategy. The action level (the lower limit on the graph) was set at the POC or background, whichever was greater. The upper bound of the gray area was set at the action level plus one standard deviation of the ponds data from CAUs 477 and 482. The graph is presented in Figure B.1-2.

The number of samples required to characterize the ponds was multiplied by a factor of safety of 1.25 to provide additional assurance that the 90 percent confidence level would be reached.

$$n+$$
 (ponds) = 11.7 samples x 1.25 = 14.7 samples (round up) = 15 samples $n+$ (channels) = 21.0 samples x 1.25 = 26.3 samples (round up) = 27 samples

Therefore, 15 samples need to be collected from the ponds, and 27 samples need to be collected from the channels. The decision performance curve indicates that 10 samples need to be collected from the ponds, and 9 samples need to be collected from the channels. The number of samples proposed for the stratified random sampling of the T-Tunnel Ponds and for the channels exceeds the numbers indicated by the decision performance curves.

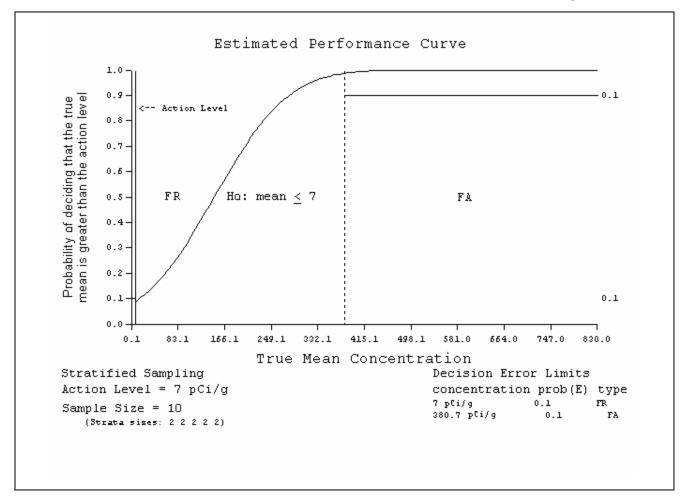


Figure B.1-2 CAU 478 Confidence Interval Graph for Cs-137

The sampling program for T-Tunnel Ponds and channels was designed to provide sufficient data to allow a statistical determination of whether enough samples were collected to adequately characterize the site. This determination will be made using the procedures described in Chapter 9 of SW-846 (EPA, 1998). The mean concentration (or activity) and standard deviation of each targeted analyte in the ponds and channel soils will be used to calculate the number of samples necessary to make the determination with a 90 percent confidence level.

B.1.6.4 Quality Assurance/Quality Control

Radiological survey instruments will be calibrated in accordance with the manufacturer's instructions, and periodic response checks will be performed in accordance with approved procedures.

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

- Trip blanks (1 per sample cooler containing VOC investigation samples)
- Equipment rinsate blanks (1 per sampling event for each type of decontamination procedure performed) to include all sampling equipment that comes into contact with the sample
- Source blanks (1 per source of water for decontamination and 1 from the water tank the first time it is filled); one sample could fill both requirements
- Field duplicates (a minimum 1 per 20 environmental samples)
- Field blanks (minimum of 1 per 20 environmental samples; more may be collected at the discretion of the Site Supervisor)
- Matrix spike (MS)/matrix spike duplicate (MSD) or a laboratory duplicate as required by the method (a minimum of 1 per 20 environmental samples)

Additional QC samples may be submitted based on site conditions.

The DQIs of precision, accuracy, comparability, completeness, and representativeness are defined in the Industrial Sites QAPP (NNSA/NV, 2002). Site-specific DQIs are discussed in more detail in Section 6.0 of the CAIP

B.1.7 Step 7 - Optimize the Design

The site characterization will consist of collecting both random and biased soil samples from the ponds and channels. The sampling program has been optimized by determining the location and number of samples to collect and by determining which analyses will be performed. A walkover radiological survey as well as visual observations will help guide the biased sampling. The COPCs for CAU 478 are TPH-DRO, VOCs, SVOCs, RCRA metals, beryllium, and radionuclides. All of the environmental samples collected from boreholes will be analyzed for all of the COPCs. The samples that are collected by hand sampling will be analyzed for RCRA metals, beryllium, and radionuclides only unless there is evidence of contamination with organic constituents. Background samples will be analyzed for radionuclides, RCRA metals, and beryllium only.

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B.1.7.1 Radiological Survey Methodologies and Instruments

A radiological survey will be conducted at CAU 478 to define the presence and lateral extent of surface radiological contaminants. Walkover surveys will be performed using hand-held radiological survey instruments such as the NE Technology Electra, Eberline E-600, TSA-PRM-470B, and Bicron mRem, or equivalent.

Additional equipment and software used in the radiological data collection and processing include a global positioning system receiver, such as Trimble or Motorola, and associated laptop computers used to log and process the radiological survey data. Mapping programs such as Surfer[®] and EarthVision[®] are used to plot data on site maps or aerial photographs.

B.1.7.2 Intrusive Investigation

Intrusive investigations will be conducted at CAU 478 to determine whether COPCs are present. Samples will be collected from predetermined random and biased locations. Selection of biased locations will be based on the results of the radiological surveys, a review of the operational history, and visual inspection of the CAU.

Borehole locations at CAU 478 (Figures B.1-3 through B.1-9) have been identified using a stratified random sampling strategy as defined in Gilbert (1987). Additional locations were identified to be used in the event that not all of the identified locations can be used. Table B.1-5 shows the intrusive investigation locations and alternate pond locations. Table B.1-6 shows the intrusive investigation locations for the channels. If a channel location cannot be used, the hole will be moved within a 10-ft radius from the randomly identified location. Each pond is considered as a stratum and weighted by area for the purpose of deciding how many samples should be collected from each pond. There are three sections of channel. Each channel was weighted by length for purposes of deciding how many samples need to be collected.

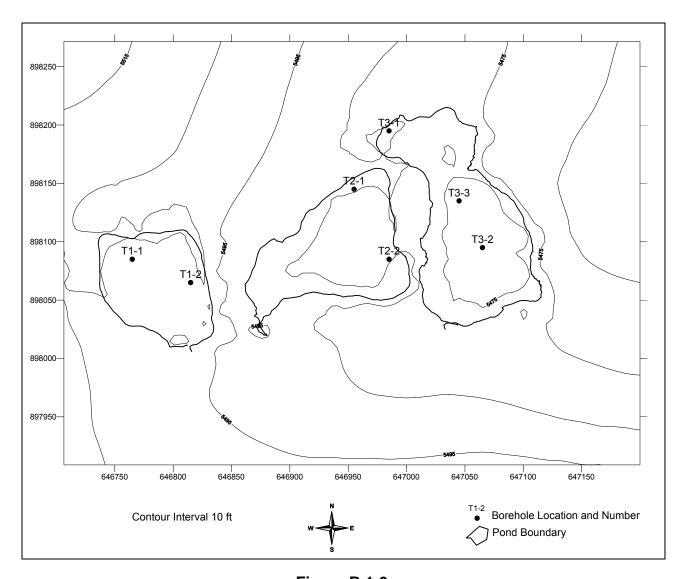


Figure B.1-3 CAU 478 Proposed Random Boreholes for Ponds 1, 2, and 3

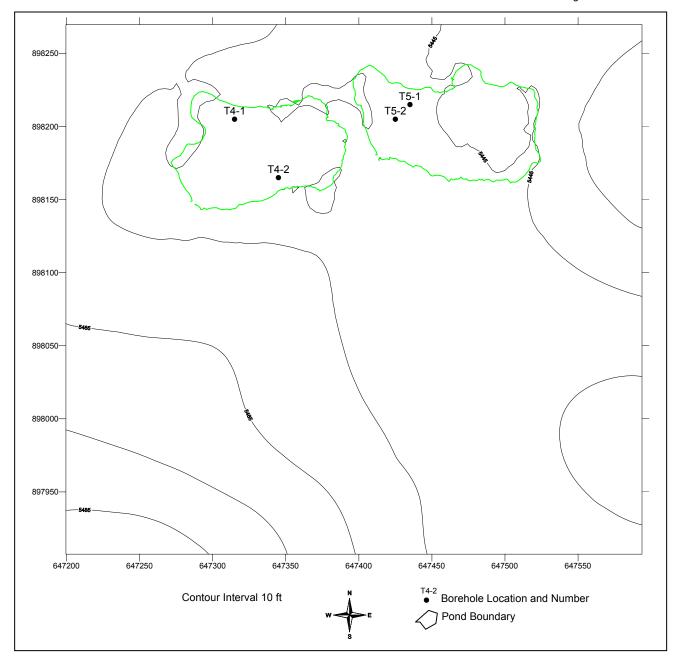


Figure B.1-4
CAU 478 Proposed Random Boreholes for Ponds 4 and 5

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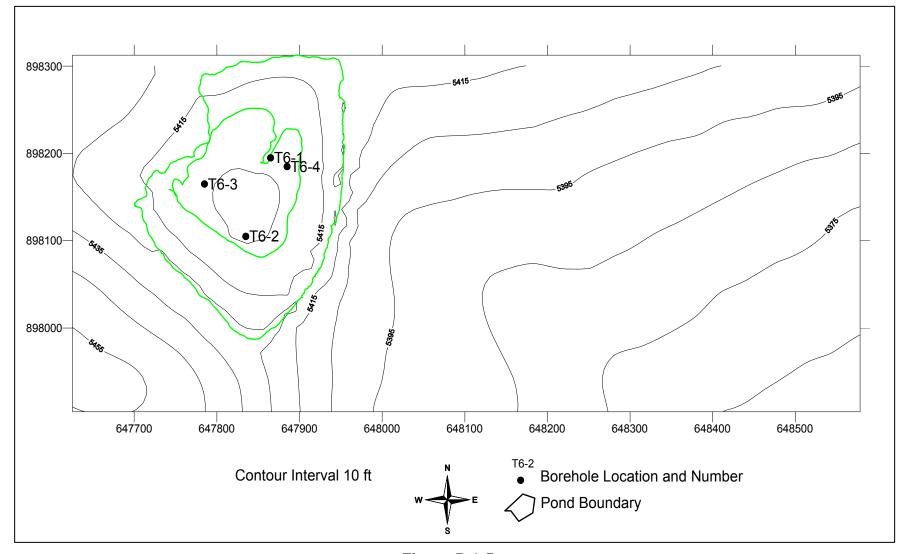


Figure B.1-5
CAU 478 Proposed Random Boreholes for Pond 6

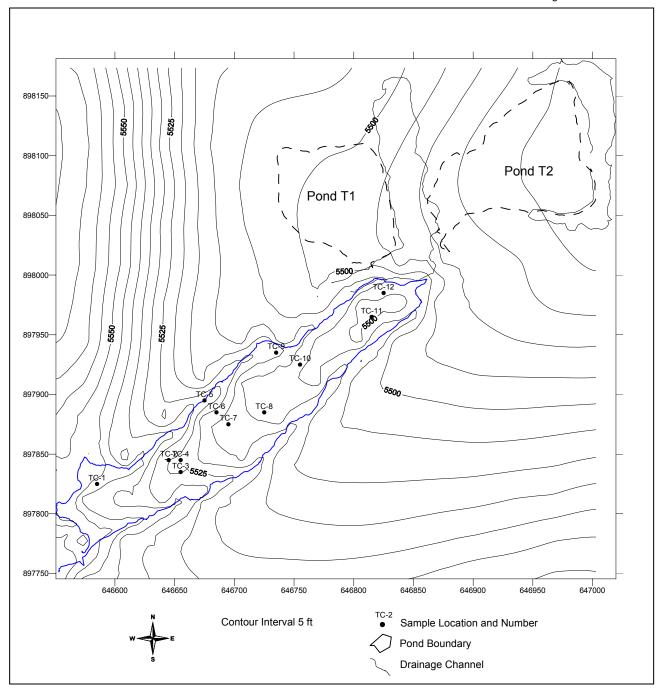


Figure B.1-6
CAU 478 Proposed Random Boreholes for the Channel between the Muckpile and Pond 1

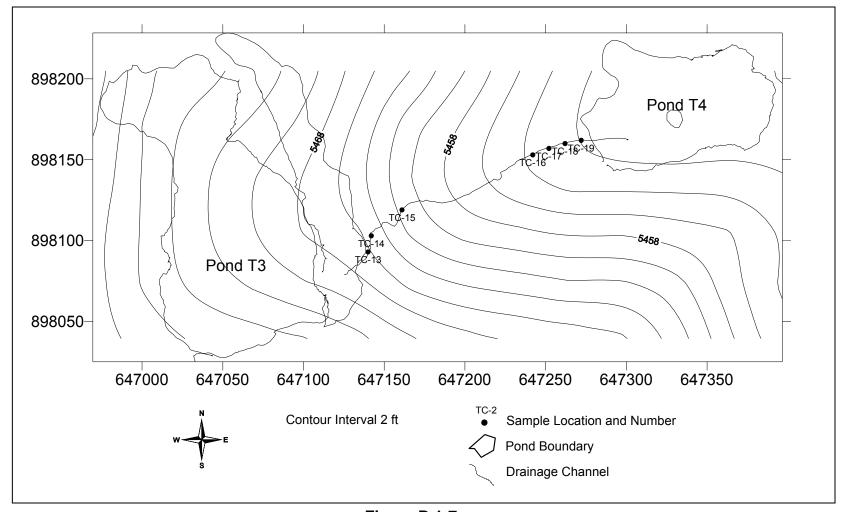


Figure B.1-7
CAU 478 Proposed Random Boreholes for the Channel between Pond 3 and Pond 4

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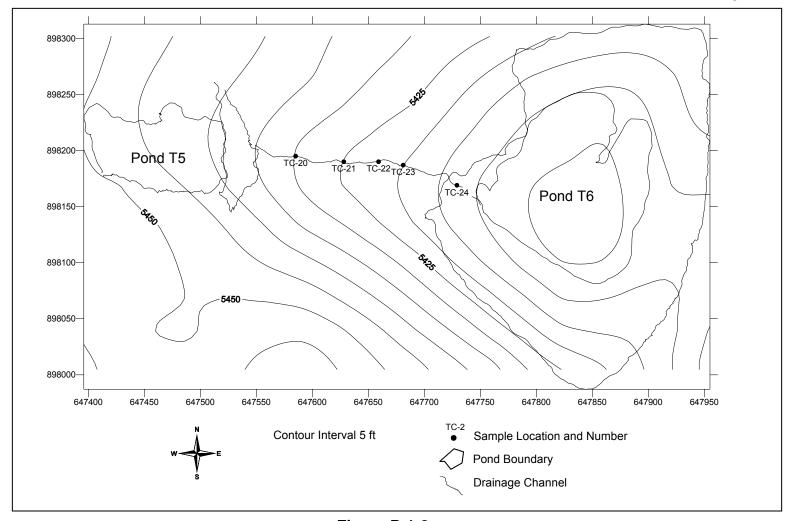


Figure B.1-8
CAU 478 Proposed Random Boreholes for the Channel between Pond 5 and Pond 6

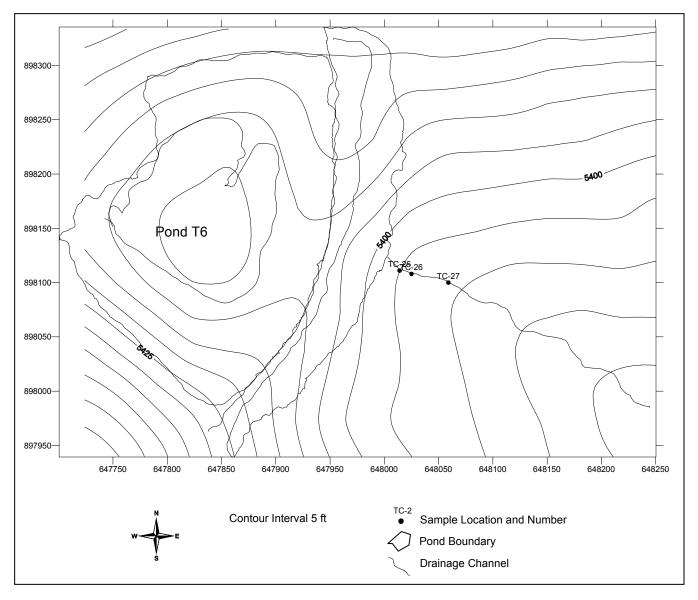


Figure B.1-9
CAU 478 Proposed Random Boreholes for the Channel below Pond 6

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Table B.1-5
Primary and Alternate Sample Locations for the Intrusive Investigation

	Ponds						
	Primary			Alternate			
Easting	Northing	Hole ID	Easting	Northing	Hole ID		
		Poi	nd 1				
646765	898085	T1-1	646815	898035	T1-A		
646815	898065	T1-2	646795	898095	T1-B		
		Poi	nd 2				
646955	898145	T2-1	646955	898105	T2-A		
646985	898085	T2-2	646875	898045	T2-B		
		Poi	nd 3				
646985	898195	T3-1	647045	898035	T3-A		
647065	898095	T3-2	647035	898155	Т3-В		
647045	898135	T3-3	647025	898195	T3-C		
		Poi	nd 4				
647315	898205	T4-1	647305	898175	T4-A		
647345	898165	T4-2	647365	898185	T4-B		
		Poi	nd 5				
647435	898215	T5-1	647500	898175	T5-A		
647425	898205	T5-2	647495	898165	T5-B		
	Pond 6						
647865	898195	T6-1	647795	898175	T6-A		
647835	898105	T6-2	647775	898175	Т6-В		
647785	898165	T6-3	647805	898205	T6-C		
647885	898185	T6-4	647815	898185	T6-D		

Table B.1-6
Sample Locations for the Channels for the Intrusive Investigation

	Channels	
Northing	Easting	Hole ID
	Channel 1	
646585	897825	TC-1
646645	897845	TC-2
646655	897835	TC-3
646655	897845	TC-4
646675	897895	TC-5
646685	897885	TC-6
646695	897875	TC-7
646725	897885	TC-8
646735	897935	TC-9
646755	897925	TC-10
646815	897965	TC-11
646825	897985	TC-12
	Channel 2	
647140	898093	TC-13
647142	898103	TC-14
647161	898119	TC-15
647242	898153	TC-16
647252	898157	TC-17
647262	898160	TC-18
647272	898162	TC-19
	Channel 3	
647585	898195	TC-20
647628	898190	TC-21
647659	898190	TC-22
647681	898187	TC-23
647729	898169	TC-24
	Channel 4	
648014	898111	TC-25
648025	898108	TC-26
648059	898100	TC-27

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Rotosonic drilling will be the primary tool used to collect the soil samples for laboratory analysis to determine whether COPCs are present in the ponds and channels. Boreholes will be drilled 5 ft into the native material if it is alluvium and 2 ft if it is bedrock, or until refusal. If the bottom interval of the hole exceeds the field-screening levels, the hole will be continued at 2-ft intervals until there are two consecutive clean intervals or until drill refusal. If a drilling location or any of its three alternate locations cannot be accessed by the drill rig, hand augers or similar hand tools will be used to collect the soil samples.

B.2.0 References

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- U.S. Environmental Protection Agency. 2000. *Guidance for Data Quality Assessment Practical Methods for Data Analysis*, EPA QA/G-9. Washington, DC.
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Appendix C Data Assessment

C.1.0 Data Assessment

The DQA process is the scientific evaluation of the investigation results to determine whether the DQO criteria established in the CAU 478 CAIP were met and whether the DQO decisions can be supported at the desired level of confidence. The DQO process ensures that the right type, quality, and quantity of data will be available to support the resolution of the decisions at an appropriate level of confidence. Using both the DQO and DQA processes helps to ensure that the DQO decisions are sound and defensible, and that the 90 percent level of confidence agreed to in the CAIP was achieved.

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 below.

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

Step 2: Conduct a Preliminary Data Review – The preliminary data review involves 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 data 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 are censored, determine the impact on the DQO decision error.

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

C.1.1 Review the DQOs and Sampling Design

This section contains a review of the DQO process presented in the CAU 478 CAIP (DTRA, 2003) and Appendix B of this document. The DQO decisions are presented with the DQO provisions for limiting false negative or false positive decision errors. Special features, potential problems, or any deviations from the sampling design are also presented.

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C.1.1.1 Review DQOs

The decision statement as presented in the CAU 478 CAIP is: "Are there concentrations of COPCs present in the ponds that exceed the PALs and, if so, do they pose a threat to human

health and/or the environment?"

DQO Provisions To Limit False Negative Decision Error

A false negative decision error (where consequences are more severe) was controlled by meeting

the following criteria:

1. Having a high degree of confidence that the combination of random and biased sampling

strategies will identify COCs if present in the CAS.

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 data are of sufficient quality and

completeness.

Criterion 1:

The following methods (stipulated in the CAU 478 DQOs [DTRA, 2003] and agreed to by

NDEP) were used in selecting the sample locations:

• Random locations to collect soil samples from the ponds and channels.

Biased locations based on professional judgment and site knowledge to collect soil

samples from the ponds and channels.

This provides a high degree of confidence that sampling will detect any COCs that may be

present.

Criterion 2:

All samples were analyzed using the analytical methods listed in Table 3-1 of the CAIP.

Table C.1-1 provides a reconciliation of environmental samples analyzed to the planned

analytical program. Samples were analyzed for all of the analytical methods specified in the

CAIP (DTRA, 2003).

Uncontrolled When Printed

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Table C.1-1
CAU 478 Number of Soil Samples Submitted per Analyte

		Analytes						
	VOCs	SVOCs	TPH-DRO	Metals	Beryllium	Gamma Spectroscopy	Isotopic Plutonium	Strontium-90
Pond Sediment	20	20	20	20	20	20	11	11
Native Soil	22	22	22	22	22	22	1	1
Channel Soil	43	43	43	43	43	43	10	10
Background	0	0	0	3	0	3	0	0

DRO = Diesel-range organics

SVOC = Semivolatile organic compound

TPH = Total petroleum hydrocarbons

VOC = Volatile organic compound

Sample results were assessed against the DQI of sensitivity as defined in the Industrial Sites QAPP (NNSA/NV, 2002). The sensitivity acceptance criteria defined in the CAIP is that analytical detection limits will be less than the corresponding action level. This goal was not achieved for the radiological analytes listed in Table C.1-2. All chemical 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.

Table C.1-2
Radiological Analytes Failing Sensitivity Criteria for CAU 478
(Page 1 of 2)

Sample Number	Parameter	Result (pCi/g)	Detection Limit (pCi/g)	PAL (pCi/g)
478CS1301.5	Bismuth-212	ND	5.9	5
478CS140.5	Bismuth-212	ND	5.2	5
478CS1501	Bismuth-212	ND	5.4	5
478CS1803	Bismuth-212	ND	5	5
478CS270.5	Bismuth-212	ND	5.5	5
478PS0105.5	Bismuth-212	ND	5.1	5
478PS040.5	Bismuth-212	ND	5.9	5
478PS050.5	Bismuth-212	ND	6.2	5
478PS0506.5	Bismuth-212	ND	5	5

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Table C.1-2
Radiological Analytes Failing Sensitivity Criteria for CAU 559
(Page 2 of 2)

Sample Number	Parameter	Result (pCi/g)	Detection Limit (pCi/g)	PAL (pCi/g)
478PS0602	Bismuth-212	ND	7.1	5
478PS0707	Bismuth-212	ND	5	5
478PS100.5	Bismuth-212	ND	5.3	5
478PS120.5	Bismuth-212	ND	5.4	5
478PS1404.5	Bismuth-212	ND	5.1	5
478PSB0101.5	Bismuth-212	ND	5	5
478PSB020.5	Bismuth-212	ND	5.3	5
478PSBX020.5	Bismuth-212	ND	8.5	5
478CS030.5	Thorium-227	ND	98	17.6
478CS1201	Thorium-227	ND	30	17.6
478CS180.5	Thorium-227	ND	63	17.6
478PS0202	Thorium-227	ND	370	17.6
478PS0805	Thorium-227	ND	34	17.6
478PSB0209.5	Thorium-227	ND	38	17.6
478PSB0306.5	Thorium-227	ND	33	17.6

ND = Nondetect PAL = Preliminary action level pCi/g = Picocuries per gram

Criterion 3:

To satisfy the third criterion, the entire dataset, as well as individual sample results, were assessed against the acceptance criteria for the DQIs of precision, accuracy, comparability, completeness, and representativeness, as defined in the Industrial Sites QAPP (NNSA/NV, 2002). The DQI acceptance criteria for precision and accuracy are defined in Table 3-1 of the CAIP (DTRA, 2003). The acceptance criteria for comparability, completeness, and representativeness are not specified in the CAIP. As presented in the following sections, these goals were met for each DQI except as noted.

Precision

Duplicate precision is evaluated using the relative percent difference (RPD) or normalized difference. For the purpose of determining the data precision of chemical analyses, the RPD between duplicate analyses was calculated. For radionuclides, the RPD was not calculated

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unless both the sample and its duplicate had a concentration of the target radionuclide exceeding five times their minimum detectable concentration. Otherwise, radionuclide duplicate results were evaluated using the normalized difference. Table C.1-3 provides the results for all constituents that were qualified for precision.

Table C.1-3
Precision Measurements

Parameter	CAS Number	User Test Panel	Number of Analyses Qualified	Number of Measurements Performed	Percent within Criteria
Barium	7440-39-3	EPA 6010B	8	90	91.1
Plutonium-238	13981-16-3	PAI 713R8	7	22	68.2

CAS = Chemical Abstracts Service

EPA = U.S. Environmental Protection Agency (EPA, 1998 and 2004)

PAI = Paragon Analytics Inc.

As shown in Table C.1-3, the precision rate for barium met the acceptance criterion of 80 percent; however, the precision rate for Pu-238 did not meet the 80 percent criterion. Plutonium-238 is a man-made contaminant that often is inhomogeneous when occurring in soil samples. Because the contaminant is fixed to particles of the matrix, mixing will not produce homogeneity. Measurement of duplicate soil aliquots from a container may result in unacceptable precision because the aliquots contain different isotopic Pu concentrations. This does not mean the precision of the measurement is poor but that the concentration of the contaminant is variable. Because all of the other constituents exceed the acceptance criteria for precision, the dataset is determined to be acceptable for the DQI of precision.

Accuracy

For the purpose of determining data accuracy of sample analyses, environmental soil samples were evaluated and incorporated into the accuracy calculation. The metals results qualified for accuracy were associated with MS recovery exceeding the QC limits and could potentially be reported at concentrations higher than actual concentration. Table C.1-4 provides the evaluation results for the constituents qualified for accuracy.

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Table C.1-4 Accuracy Measurements

Parameter	CAS Number	User Test Panel	Number of Analyses Qualified	Number of Measurements Performed	Percent within Criteria
Barium	7440-39-3	EPA 6010	8	90	91.1

CAS = Chemical Abstracts Service

The barium concentrations that were qualified for accuracy had reported concentrations between 38 and 1,000 mg/kg. The PAL for barium is 67,000 mg/kg. Because more was extracted from the MS/MSD samples than was expected, the sample results would be biased high so the qualified results will not have an effect on the decision. As the accuracy rate for all of the other constituents exceeds the acceptance criteria, the dataset is determined to be acceptable for the DQI of accuracy.

<u>Representativeness</u>

The DQO process as identified in Section 3.0 of the CAU 478 CAIP (DTRA, 2003) was used to address sampling and analytical requirements for CAU 478. During this process, appropriate locations were selected that enabled the samples collected to be representative of the population parameters identified in the DQO (random locations and biased locations that were most likely to encounter contamination). The sampling locations identified in the Criterion 1 discussion meet these criteria. Therefore, the analytical data acquired during the CAU 478 CAI are considered to be representative of the population parameters.

Comparability

Field sampling, as described in the CAU 478 CAIP (DTRA, 2003), was performed and documented in accordance with approved procedures that are comparable to standard industry practices. 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 at the NTS. Therefore, project datasets are considered comparable to other datasets generated using these same standardized DOE procedures, thereby meeting the DQO requirements. Also, standard, approved field and analytical methods ensure that data were appropriate for comparison to the investigation action levels specified in the CAIP (DTRA, 2003).

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Completeness

The CAU 478 CAIP did not define criteria for completeness; therefore, the criteria of 80 percent of CAS-specific non-critical analytes identified in the CAIP having valid results and 100 percent of critical analytes having valid results will be used for the CAU 478 evaluation. Also, the dataset must be sufficiently complete to be able to support the DQO decisions. Critical analytes for CAU 478 were not defined, so the COCs identified above the PALs listed in the CAIP (TPH-DRO, Pu-239, and Cs-137) have been defined as the critical analytes for CAU 478.

Rejected data (either qualified as rejected or data that failed the criterion of sensitivity) were not used in the resolution of DQO decisions. The completeness for all critical chemical and radiological analytes was 100 percent. The completeness for all non-critical chemical and radiological analytes exceeded 80 percent except for acetone, which had a completeness of only 60 percent. Although acetone did not meet the completeness criteria, it will not have any affect on the DQO decisions as the highest result for samples that were not rejected was 0.039 mg/kg and the PAL is 54,000 mg/kg. Acetone is also a common laboratory artifact and is typically identified at low concentrations in the VOC analytical results. Therefore, the dataset is considered complete for purposes of supporting the DQO decisions.

DQO Provisions To Limit False Positive Decision Error

The false positive decision error was controlled by assessing the potential for false positive analytical results. Quality Assurance/QC samples such as field blanks, trip blanks, laboratory control samples, and method blanks were used to determine whether a false positive analytical result may have occurred. Of the 51 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 minimized the potential for cross contamination that could lead to a false positive analytical result.

C.1.1.2 Sampling Design

The CAIP (DTRA, 2003) made the following commitments for sampling:

1. Random sampling was conducted in the ponds.

Result: The 15 random locations identified were drilled. Sixteen sediment and 18 native soil samples were collected from the borings.

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2. Biased locations were identified and drilled in the ponds to investigate areas with elevated radiological readings found in the radiological walkover survey.

Result: Four biased locations were identified and sampled to investigate the areas with elevated radiological readings in the ponds. Four sediment samples and four native soil samples were collected. In addition four biased samples were collected from the random borings.

3. Random sampling was conducted in the channels between the muckpile and the first pond and between the ponds.

Result: The 27 random locations identified were drilled. Thirty-seven soil samples were collected from the borings.

4. Biased locations were identified and drilled in the channels to investigate areas with elevated radiological readings found in the radiological walkover survey.

Result: Four biased locations were identified and sampled to investigate the areas with elevated radiological readings in the channels. Six soil samples were collected.

C.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 non-conformance report when data quality does not meet contractual requirements. All data received from the analytical laboratories met contractual requirements, and no QA non-conformance reports were generated. Data were validated and verified to ensure that the measurement systems performed in accordance with the criteria specified. The validated dataset quality was found to be satisfactory.

C.1.3 Select the Test

The CAIP (DTRA, 2003) committed to using the procedure described in Chapter 9 of the EPA SW-846 Method (EPA, 1998) to answer two questions: 1) Were enough samples collected to ensure a 90 percent confidence level in the mean COPC concentration and 2) Does the mean concentration exceed the regulatory threshold?

Because of the change in closure strategy agreed to by NDEP, DTRA, and the DOE, National Nuclear Security Administration Nevada Site Office, the regulatory threshold is now the risk-based FAL instead of the PALs discussed in the CAIP. Comparing the average

concentration of the most prevalent contaminants to their PAL and, if they exceed the PAL, comparing them to their respective FALs will also be used to help answer the questions.

C.1.4 SW-846 Evaluation

To answer the first question, equation (8) of Table 9-1 in SW-846 was used. To answer the second question, equation (6) of Table 9-1 in SW-846 was used (EPA, 1998). Only results from random samples were used for this evaluation. These questions were answered for the critical analytes Arsenic, Cs-137, and TPH-DRO.

Question 1: "Were enough samples collected?" is answered by solving equation (8) of Table 9-1 in SW-846 for each analyte.

$$n = t_{.20}^2 \times s^2 / (RT - \bar{x})^2 \qquad (Equation 1)$$

where:

n = minimum number of samples to ensure a 90 percent confidence level

 $t._{20}^2$ = the square of the " $t_{.20}$ " value in Table 9-2, SW-846 for a one-tailed 90 percent confidence interval

s² = variance in the concentration measured in the samples collected during characterization

RT = regulatory threshold and is set to the limiting PRG established by the EPA for the COPC for the industrial land use. For TPH, the RT is 100 mg/kg. For radionuclides, it is the U.S. Nuclear Regulatory Commission and National Council on Radiation Protection and Measurements screening levels

 \bar{x} = the mean concentration of the COPC in the collected samples.

Question 2: "Does the mean concentration exceed the regulatory threshold?" is answered by solving equation (6) of Table 9-1 in SW-846 for each analyte.

$$CI = \overline{\times} + / - \left(t_{.20} \times \left(\frac{s}{\sqrt{n}} \right) \right)$$
 (Equation 2)

where:

CI = confidence interval

 \bar{x} = the mean concentration of the COPC in the collected samples

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n = number of samples collected

t.₂₀ = the "t" value in Table 9-2, SW-846 for a one-tailed 90 percent confidence interval and the appropriate degrees of freedom

s = standard deviation of the sample

The values used for the calculations and the results are presented in Table C.1-5.

Table C.1-5
SW-846 Evaluation of the Number of Samples and
Comparison of 90% Confidence Level with the PAL

Comparison of Co76 Community With the 1712							
Variable	Ars	enic	Cs-137		TPH-DRO		
	Pond	Channel	Pond	Channel	Pond	Channel	
T. ₂₀	1.341	1.306	1.341	1.306	1.341	1.306	
T. ₂₀ ²	1.798	1.706	1.798	1.706	1.798	1.706	
S ²	4.401	0.368	9654.717	274.080	3709.006	12.293	
RT	23 mg/kg	23 mg/kg	259.21 pCi/g	259.21 pCi/g	100 mg/kg	100 mg/kg	
⊼Avg	4.594	2.430 mg/kg	93.951 pCi/g	13.428 pCi/g	46.275 mg/kg	4.573 mg/kg	
n collected	16	37	16	37	16	37	
n needed	< 1	< 1	< 1	< 1	3	< 1	
Upper Confidence Interval	5.297 mg/kg	2.560 mg/kg	126.892 pCi/g	16.982 pCi/g	66.692 mg/kg	5.326 mg/kg	
Upper Confidence>RT	No	No	No	No	No	No	

Cs = Cesium

DRO = Diesel-range organics

mg/kg = Milligrams per kilogram

PAL = Preliminary action level

pCi/g = Picocuries per gram

RT = Regulatory threshold

TPH = Total petroleum hydrocarbons

Based on the results of the calculations, an adequate number of samples were collected to meet the 90 percent confidence level for characterization of the ponds and channels for all three tested analytes. In comparing the 90 percent confidence level to the RT, the upper confidence interval is below the RT for all three analytes.

C.1.5 Verify the Assumptions

The results of the investigation support the assumptions identified in the CAU 478 DQOs and in Table C.1-6.

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Table C.1-6 Key Assumptions

1toy /todamptione
Exposure to contaminants is limited to industrial site workers, construction/remediation workers, and military personnel conducting training. Exposure could occur through ingestion, inhalation, external exposure, or dermal contact.
The investigation did not reveal any potential exposures that were not identified in the conceptual site model (CSM).
Surface and subsurface soils in and below the ponds and channels. Contamination of perched, deep, and regional groundwater is not a concern.
The investigation results did not identify any affected media that were not identified in the CSM.
The pad may contain small volumes of Resource Conservation and Recovery Act-regulated constituents in addition to radiological constituents.
The investigation results confirmed this and did not reveal any potential releases from the ponds.
Contamination may migrate through the ponds into the native material as a result of rainwater infiltration.
Low levels of total petroleum hydrocarbons (TPH)-diesel-range organics (DRO) were found in two native soil samples from under the pond sediments indicating that rainwater may be transporting the TPH-DRO.
Percolation of precipitation through the soils of the pond sediments.
Low levels of TPH-DRO were found in two native soil samples from under the pad.
Contamination could be locally significant, but vertical infiltration of contaminants is probably limited to less than 5 feet.
This was confirmed by the investigation for all contaminants except TPH-DRO, which was found under the pond sediments.
There are no groundwater impacts.
Nonresidential, zoned for nuclear and high explosives tests.
The investigation results did not reveal any future land uses other than those identified in the CSM.

C.1.6 Results

This section resolves the DQO decision for CAU 478.

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C.1.6.1 Decision Rules for CAU 478

<u>Original Decision Rule</u>: If laboratory results for the soil samples indicate the presence of COPCs above the PALs, then a CADD will be prepared.

<u>Result</u>: Representatives from DTRA and NDEP came to an agreement that a risk-based approach would be used for characterizing the ponds and channels. Using the risk-based approach for limited access occasional use scenario, FALs were exceeded for Cs-137 in one random sample and one biased sample, and for Pu-239 in one random channel sample. Therefore, the ponds and channels are considered to be contaminated with radionuclides and will be closed accordingly.

<u>Original Decision Rule</u>: If laboratory results for the soil samples do not indicate the presence of COPCs above the PALs, then a CADD or CADD/CR will be prepared.

<u>Result</u>: The PALS were exceeded; therefore, a CADD/CR will be prepared that will propose use restrictions for controlling access to the site.

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C.2.0 References

DTRA, see Defense Threat Reduction Agency.

- Defense Threat Reduction Agency. 2003. Corrective Action Investigation Plan for Corrective Action Unit 478: Area 12 T-Tunnel Ponds, Nevada Test Site. Rev. 0. Prepared by IT Corporation. Las Vegas, NV.
- EPA, see U.S. Environmental Protection Agency.
- 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*, DOE/NV--372, Rev. 3. Las Vegas, NV.
- U.S. Environmental Protection Agency. 1998. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, 3rd Edition. Washington, DC.
- U.S. Environmental Protection Agency. 2004. *Region 9 Preliminary Remediation Goals (PRGs)*. San Francisco, CA.

Appendix D Risk Assessment for CAU 478

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D.1.0 Risk-Based Corrective Action Process

The risk-based closure strategy was not specified in the CAIP; however, following an agreement between NDEP, DTRA, and NNSA/NSO, CAU 478 is being re-evaluated using that approach.

This section contains documentation of the ASTM Method E 1739-95 (ASTM, 1995) risk-based corrective action process as applied to CAU 478. The ASTM Method E 1739-95 defines three tiers or levels in evaluating DQO decisions involving increasingly more sophisticated analyses.

- Tier 1 Sample results from source areas (highest concentrations) compared to the PALs based on generic (non-site-specific) conditions.
- Tier 2 Sample results from exposure points compared to SSTLs calculated using site-specific inputs and Tier I formulas (from the ASTM procedure).
- Tier 3 Sample results from exposure points compared to SSTLs and points of compliance calculated using chemical fate/transport and probabilistic modeling.

The risk based corrective action decision process stipulated in ASTM Method E 1739-95 is summarized in Figure D.1-1.

D.1.1 Scenario

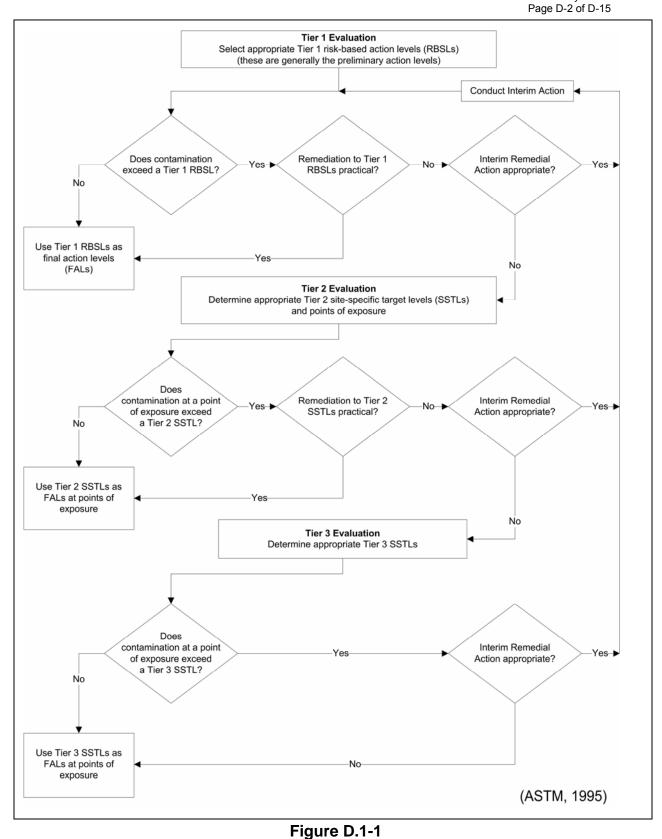
Corrective Action Unit 478 (Area 12, T-Tunnel Ponds) consists of one CAS:

• CAS 12-23-01, Ponds (5) RAD Area

In addition to this CAS, the channels from the T-Tunnel Muckpile to the first pond, between the ponds, and 100 ft below the last pond were characterized.

The ponds and channels are associated with the T-Tunnel, which was mined into bedded ash flow tuff under Aqueduct Mesa. The tunnel was used for six nuclear tests between 1970 and 1987. The Ponds were constructed downgradient of the muckpile to serve as settling ponds for groundwater encountered during tunnel excavation, construction water, and water produced during re-entry activities following each test. The T-Tunnel Ponds consist of six unlined ponds, ranging from 80 to 160 ft long and 50 to 170 ft wide. The ponds are located beside one another in an easterly trend with an earthen berm separating each pond from the one below it. Open channels connect each pond with the next pond, and extend downgradient from the last pond.

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ASTM Method E 1739-95 Risk-Based Corrective Action Decision Process

The upgradient end of the first pond is buried by the muckpile. In 1993, effluent discharge elimination plugs were emplaced in the tunnel as part of the T-Tunnel mothball program. No water or sediments have been discharged to the ponds since that time. Groundwater is 800 to 900 ft below ground surface (USGS/DOE, 2004).

D.1.2 Site Assessment

The CAI at CAU 478 involved soil sampling using rotosonic drilling techniques or hand tools. The investigation results identified TPH-DRO and radiological COCs that exceeded the PALs as defined in the CAIP (DTRA, 2003). The maximum concentration of the COCs identified and their corresponding PALs (Tier 1 comparison) are presented in Tables D.1-1 (chemical results) and D.1-2 (radiological results).

Table D.1-1

Maximum Reported Chemical Values for Tier 1 Comparison

Maximum Reported Chemical Values for ther i Comparison							
Contaminant	CAS Number	Sample No.	Result (mg/kg)	PAL (mg/kg)			
2-Hexanone	591-78-6	478PS130.5	0.33	110,000 ^a			
Acetone	67-64-1	478PS0112	0.039	54,000 ^a			
Arsenic	7440-38-2	478PSBX020.5	7.7	23 ^b			
Barium	7440-39-3	478PS0602	6,400	67,000 ^a			
Benzoic Acid	65-85-0	478CS210.5	0.93	100,000 ^a			
Beryllium	7440-41-7	478PS0906.5	2.4	1,900 ^a			
Bis(2-ethylhexyl)phthalate	117-81-7	478PS040.5	2.1	120 ^a			
Cadmium	7440-43-9	478PSB020.5	0.5	450 ^a			
Chromium	7440-47-3	478PS0607.5	9.7	450 ^a			
Diesel-Range Organics	68334-30-5	478PS0105.5	220	100 ^c			
Lead	7439-92-1	478PSBX020.5	43	800 ^a			
M+P Xylene	136777-61-2	478CS020.5	0.0034	420 ^d			
Mercury	7439-97-6	478PSBX020.5	0.084	310 ^a			
Methylene Chloride	75-09-2	478PS1505.5	0.035	21 ^a			
O Xylene	95-47-6	478CS020.5	0.0015	420 ^d			
P-Isopropyltoluene	99-87-6	478PS0404	0.0014	2,000 ^a			
Selenium	7782-49-2	478PS0906.5	0.84	5,100 ^a			
Silver	7440-22-4	478PS1304.5	0.1	5,100 ^a			

^aPAL based on Region 9 Preliminary Remediation Goals (PRGs) (EPA, 2004).

Bold indicates the result exceeds the PAL.

CAS = Chemical Abstracts Service mg/kg = Milligrams per kilogram PAL = Preliminary action level

^bNevada Test Site background plus two standard deviations.

^cNevada Administrative Code 445A.2272 (NAC, 2003b)

^dU.S. Environmental Protection Agency Region 9 PRG for total xylenes (m+p+o)

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Table D.1-2
Maximum Reported Radiological Values for Tier 1 Comparison

	taareregrear raraes			
Parameter	CAS Number	Sample No.	Result (pCi/g)	PAL (pCi/g)
Actinium-228	14331-83-0	478PS050.5	3.4	5 ^a
Antimony-125	14234-35-6	478PSB040.5	8.3	18.1 ^a
Americium-241	14596-10-2	478CS190.5	11	12.7 ^a
Bismuth-212	14913-49-6	478CS040.5	4.7	5 ^a
Bismuth-214	14733-03-0	478PSB0109.5	2.1	15 ^a
Cesium-137	10045-97-3	478PSB020.5	366	12.2 ^a
Europium-152	14683-23-9	478CSX230.5	1.12	5.7 ^a
Lead-212	15092-94-1	478PSB020.5	3.3	5 ^a
Lead-214	15067-28-4	478PSB0209.5	1.87	5 ^a
Plutonium-238	13981-16-3	478CS260.5	7.06	13 ^a
Plutonium-239	15117-48-3	478CS260.5	79	12.7 ^a
Strontium-90	10098-97-2	478PSB020.5	22.8	838 ^a
Thallium-208	14913-50-9	478PS0906.5	1.28	5 ^a

^a PALs used as action levels. The PALs for radiological contaminants are based on background or the National Council on Radiation Protection and Measurements Report No. 129 recommended screening limits for construction, commercial, and industrial land-use scenario (NCRP, 1999) scaled from 25- to 15-millirem-per-year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).

Bold indicates value exceeds the PAL.

CAS = Chemical Abstracts Service PAL = Preliminary action level pCi/g = Picocuries per gram

D.1.3 Site Classification and Initial Response Action

The four major site classifications listed in Table 3 of the ASTM standard are: (1) immediate threat to human health, safety, and/or the environment; (2) short-term (0 to 2 years) threat to human health, safety, and/or the environment; (3) long-term (greater than 2 years) threat to human health, safety, and/or the environment; (4) no demonstrated long-term threats.

Based on the CAI, CAU 478 and associated channels do not present an immediate threat to human health, safety, and\or the environment; therefore, no interim response actions are necessary at this CAU. The CAI demonstrated that the contamination present at CAU 478 is limited to the points of release: the ponds and channels. The results further showed that there has been only a minor amount of migration of TPH-DRO into the native material below at one location (PH-01) in Pond 1 and no downgradient migration in storm runoff. A detailed discussion of the nature and extent of contamination is presented in Appendix A of this report. Based on this information, this CAU is determined to be Classification 3 as defined by ASTM Method E 1739-95 (ASTM, 1995). At all of the sites, COCs were identified that may pose long-term threats to human health or the environment.

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D.1.4 Development of Tier 1 Lookup Table of Risk-Based Screening Level Selection

Tier 1 action levels have been defined as the PALs established during the DQO process. The PALs are a tabulation of chemical-specific (but not site-specific) screening levels based on the type of media (soil) and potential exposure scenarios (industrial). These are conservative estimates of risk, are preliminary in nature, and are used as action levels for site screening purposes. Although the PALs are not intended to be used as FALs, a FAL may be defined as the Tier 1 action level if individual constituent analytical results are below the corresponding Tier 1 action level. The FAL may also be established as the Tier I action level if individual constituent analytical results exceed the corresponding Tier 1 action level value and implementation of a corrective action based on the FAL is practical. The PALs are defined as:

- The EPA Region 9 Risk-Based PRGs for Industrial Soils (EPA, 2004).
- Background concentrations for RCRA metals will be evaluated when natural background exceeds the PAL, as is often the case with arsenic. Background is considered to be the mean plus two times the standard deviation of the mean based on data published in Mineral and Energy Resource Assessment of the Nellis Air Force Range (NBMG, 1998; Moore, 1999).
- Concentrations for TPH-DRO above 100 mg/kg per NAC 445A.2272 (NAC, 2003b).
- The PALs for radioactive contaminants are based on the NCRP Report No. 129 recommended screening limits for construction, commercial, and industrial land-use scenarios (NCRP, 1999) scaled to 25-mrem/yr dose constraint (Appenzeller-Wing, 2004) and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).

The PALs were developed based on an industrial scenario. Because CAU 478 in Area 12 is not assigned any work stations and is considered to be in a remote or occasional use area, the use of industrial land use based PALs is conservative. The Tier 1 lookup table is defined as the PAL concentrations or activities defined in the CAIP.

D.1.5 Exposure Pathway Evaluation

The DQOs stated that site workers would only be exposed to COCs through oral ingestion, inhalation, or dermal contact (absorption) due to exposure to potentially contaminated media (i.e., soil) at the CASs. The results of the CAI showed that all COCs identified in CAU 478 are localized near the release points and have not significantly migrated laterally or vertically in the subsurface. Because the contaminants were only identified in the pond sediments and channel

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soils, the only potential exposure pathway would be through worker contact with the contaminated soil. The lack of migration, elapsed time since the suspected release, and the depth to groundwater support the selection and evaluation of only the surface and shallow subsurface contact as the complete exposure pathway. Groundwater is not considered to be an exposure pathway.

D.1.6 Comparison of Site Conditions with Tier 1 Risk-Based Screening Levels

All analytical results for CAU 478 were less than corresponding Tier 1 action levels (i.e., PALs) except for those listed in Table D.1-3.

Table D.1-3
COPCs Detected Above Preliminary Action Levels

	TPH-DRO	Cs-137	Pu-239
CAS 12-23-01 Ponds (5) RAD Area	Х	Х	Х

COPC = Contaminant of potential concern

Cs = Cesium

DRO = Diesel-range organics

Pu = Plutonium

TPH = Total petroleum hydrocarbons

D.1.7 Evaluation of Tier 1 Results

For all constituents at CAU 478 not listed in Section D.1.6, the FALs were established as the Tier 1 risk-based screening levels. It was determined that no further action is required for these constituents at CAU 478.

It was determined by DTRA that remediation of the remaining constituents listed in Table D.1-3 is not practical. Therefore, Tier 2 SSTLs were calculated for those constituents.

D.1.8 Tier 1 Remedial Action Evaluation

TPH-DRO Evaluation

Remediation to Tier 1 action levels would be difficult and expensive while potentially not providing a significant risk reduction. Therefore, it was determined to assess the risk to human health posed by the COCs that exceeded the PALs at CAU 478 under a Tier 2 evaluation before establishing FALs for the COCs or implementing a corrective action.

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Chemical Evaluation

There are no organic or inorganic chemicals that exceeded the PALs, so they do not require a risk assessment.

Radionuclide Evaluation

Actions to remediate Cs-137 and Pu-239 to the Tier 1 action levels would be difficult and expensive while potentially not providing a significant risk reduction. Therefore, these radionuclides were moved to a Tier 2 evaluation before establishing FALs or implementing a corrective action.

D.1.9 Tier 2 Evaluation

No additional data were needed to complete a Tier 2 evaluation.

D.1.10 Development of Tier 2 Table of SSTLs

Evaluation of TPH-DRO SSTLs

The ASTM Method E 1739-95 (ASTM, 1995) stipulates that risk evaluations for TPH-DRO contamination be calculated and evaluated based on the risk posed by the potentially hazardous constituents of TPH-DRO. Section 6.4.3, "Use of Total Petroleum Hydrocarbon Measurements" of ASTM Method E 1739-95 states: "TPH-DRO should not be used for risk assessment because the general measure of TPH-DRO provides insufficient information about the amounts of individual chemical(s) of concern present" (see also Sections X1.5.4 and X1.42 of Method E 1739-95). Therefore, the individual potentially hazardous constituents in TPH-DRO were compared to corresponding Tier 2 SSTLs to evaluate the need for corrective action at CAU 478. Although Tier 2 SSTLs are generally calculated using site-specific inputs and general risk formulas, the Tier 2 SSTLs selected for the hazardous constituents of TPH-DRO are the EPA Region 9 PRGs (EPA, 2004). These SSTLs and the maximum reported level for each diesel constituent are presented in Table D.1-4.

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Table D.1-4
Tier 2 SSTLs and CAU 478 Results for Hazardous Constituents of Diesel

CAS No.	Common Name	Common Name SSTL (mg/kg)	
108-67-8	1,3,5-Trimethylbenzene	70	ND
91-57-6	2-Methylnaphthalene ^a	190	ND
120-12-7	Anthracene	100,000	ND
71-43-2	Benzene	1.4	ND
56-55-3	Benzo(a)anthracene	2.1	ND
50-32-8	Benzo(a)pyrene	0.21	ND
205-99-2	Benzo(b)fluoranthene	2.1	ND
191-24-2	Benzo(g,h,i)perylene	29,000	ND
207-08-9	Benzo(k)fluoranthene	21	ND
218-01-9	Chrysene	210	ND
100-41-4	Ethylbenzene	400	ND
206-44-0	Fluoranthene	22,000	ND
86-73-7	Fluorene	26,000	ND
91-20-3	Naphthalene	190	ND
104-51-8	N-Butylbenzene	240	ND
103-65-1	N-Propylbenzene	240	ND
85-01-8	Phenanthrene	100,000	ND
129-00-0	Pyrene	29,000	ND
108-88-3	Toluene	520	ND
1330-20-7	Total Xylene ^b	420	ND

^a Uses PRG for naphthalene as surrogate

CAS = Chemical Abstracts Service mg/kg = Milligrams per kilograms ND = Nondetect

PRG = Preliminary remediation goal SSTL = Site-specific target level

Evaluation of Chemical SSTLs

The only organic compound that exceeded its PAL is TPH-DRO. The Tier 2 evaluation consisted of comparing the individual potentially hazardous constituents in TPH-DRO to corresponding Tier 2 SSTLs (the PALs for the hazardous constituents in TPH-DRO). None of the constituents exceeded their PAL, so the PALs became the FALs for those constituents.

^b Total or m-, o-, and p-xylenes

Because all of the hazardous constituents of TPH-DRO are less than their Tier 2 SSTLs, TPH-DRO is not considered a COC.

Evaluation of Radiological Constituent SSTLs

The Tier 2 evaluation consisted of evaluating the mixture of all radionuclides detected at the CAS to develop Tier 2 action levels for the radionuclides that exceeded Tier 1 levels. The CAS-specific Tier 2 action levels were calculated using the RESRAD code (Yu et al., 2001) and site-specific parameters. The RESRAD calculations were based on continued use of the site under the Occasional Use Area scenario, assuming that a site worker will be on site for 10 days per year, 8 hours a day for 5 years. A more detailed discussion of the RESRAD code, site-specific parameters used, and the printed RESRAD outputs are provided in Attachment A of this appendix. These SSTLs, the maximum reported level, and the average level for each radiological constituent are presented in Table D.1-5.

Table D.1-5
Tier 2 SSTLs and CAU 478 Results for Radiological Constituents

	<u> </u>							
CAS Number	Common Name	SSTL (pCi/g)	Maximum Result (pCi/g)	Average (pCi/g)				
10045-97-3	Cesium-137	259	366	34.14 ^a				
15117-48-3	Plutonium-239	55.9	79	13.18 ^a				

^aThis is an average of both random and biased samples

CAS = Chemical Abstracts Service

pCi/g = Picocuries per gram

SSTL = Site-specific target level

Although all detected radionuclides at the CAS were used in the sum-of-fractions calculation, and a unique Tier 2 action level was developed for all radionuclides, only the radionuclides that initially exceeded Tier 1 levels have a Tier 2 based FAL. The CAS specific FALs established for these radionuclides are the SSTLs listed in Table D.1-5.

D.1.11 Comparison of Site Conditions with Tier 2 FALs

The Tier 2 action levels are typically 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. Points of exposure are defined as those locations or areas at which an individual or population may come in contact with a COC originating from a CAS. For CAU 478, the Tier 2 action levels were compared to maximum constituent concentrations from each sample location and to the average concentration for the site.

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A comparison of the maximum concentration of the hazardous constituents of TPH-DRO was conducted against the CAS-specific Tier 2 FALs as shown in Table D.1-4. All analytical results for potentially hazardous constituents in TPH-DRO were nondetect for CAS 12-23-01 (Ponds (5) RAD Area).

A point-by-point comparison between the maximum concentration of the radionuclides identified above Tier 1 action levels (Cs-137 and Pu-239) was conducted against the CAS-specific Tier 2-based FALs (the Mixture Radionuclide Guidelines) listed in Attachment A of this appendix. For CAS 12-23-01 (Ponds (5) RAD Area), the maximum concentration exceeded the CAS-specific Occasional Use Area FALs, but the average of each radionuclide identified in the randomly collected samples is below their CAS-specific Occasional Use Area FALs.

D.1.12 Tier 2 Remedial Action Evaluation

Based on the Tier 2 evaluation of TPH-DRO, the chemical constituents, and the radiological constituents, CAU 478 is not contaminated with organic or inorganic constituents under the Occasional Use Area scenario; it is, however, contaminated with radiological constituents at concentrations that would pose a risk to the occasional use worker. The radiological constituents Cs-137 and Pu-239 were identified at concentrations under a point-by-point comparison that would pose an unacceptable risk to the industrial worker, and the site will be closed with a use restriction.

As all contaminant FALs were established as Tier 1 or Tier 2 action levels, a Tier 3 evaluation was considered unnecessary.

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D.2.0 Regulatory Basis

The FFACO Part III, Section III.3 (FFACO, 1996) stipulates conformance with Chapter 445 of the NAC (NAC, 2003a). Section NAC 445A.227 lists the factors to be considered in determining whether a corrective action is required.

Section NAC 445A.227 states:

- 1. Except as otherwise provided in NAC 445A.22715, the Director may require an owner or operator to take corrective action if the release of a hazardous substance, hazardous waste, or a regulated substance contaminates soil and the level of contamination exceeds the action level established for the soil pursuant to NAC 445A.2272.
- 2. In determining whether corrective action is required, the Director shall consider:
 - (a) The depth of any groundwater.
 - (b) The distance to irrigation wells or wells for drinking water.
 - (c) The type of soil that is contaminated.
 - (d) The annual precipitation.
 - (e) The type of waste or substance that was released.
 - (f) The extent of the contamination.
 - (g) The present and potential use for the land.
 - (h) The preferred routes of migration.
 - (i) The location of structures or impediments.
 - (j) The potential for a hazard related to fire, vapor, or explosion.
 - (k) Any other information specifically related to the site that the director determines is appropriate.

For a site where it is determined that corrective action is required (the corrective action process applies to all FFACO sites), Section NAC 445A.22705 (NAC, 2003c) stipulates a process to determine the necessary remediation standards (or FALs) based on an evaluation of the risk the site poses to public health and the environment.

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Section NAC 445A.22705 states:

- 1. Except as otherwise provided in NAC 445A.22715, if an owner or operator is required to take corrective action pursuant to NAC 445A.227, the owner or operator may conduct an evaluation of the site, based on the risk it poses to public health and the environment, to determine the necessary remediation standards or to establish that corrective action is not necessary. Such an evaluation must be conducted using Method E 1739-95, adopted by the ASTM, as it exists on October 3, 1996, or an equivalent method approved by the Division.
- 2. The Division shall determine whether an evaluation complies with the requirements of Method E 1739-95, or an equivalent method of testing approved by the Division. The Division may reject, require revisions be made to, or withdraw its concurrence with the evaluation at any time after the completion of the evaluation for the following reasons:
 - (a) The evaluation does not comply with the applicable requirements for conducting the evaluation.
 - (b) Conditions at the site have changed.
 - (c) New information or previously unidentified information that would alter the results of the evaluation becomes available and demonstrates that the release may have a detrimental impact on public health or the environment.

Therefore, in compliance with Section NAC 445A.22705, DTRA conducted "an evaluation of the site, based on the risk it poses to public health and the environment, to determine the necessary remediation standards or to establish that corrective action is not necessary" using ASTM Method E 1739-95.

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D.3.0 Recommendations

Organic, inorganic, and radiological constituents detected in environmental samples during the CAI were evaluated against FALs to determine the nature and extent of COCs for CAU 478. Assessment of the data generated from the investigation activities indicates that the radionuclides Cs-137 and Pu-239 exceeded their Tier 2 FALs in the ponds, and Pu-239 exceeded its FAL in the channels. None of the other FALs for chemical or radiological constituents were exceeded, and Cs-137 and Pu-239 are identified as the only COCs present.

As COCs were identified above corresponding FALs, it was determined that closure in place with use restrictions is the best option for closing CAU 478. This is based on the fact that even though the FALs were exceeded, this remote, controlled access site poses only limited risk overall to public health and the environment. Given the limited number of COCs, the negligible lateral and vertical migration, and the lack to potential impact to groundwater, it would create a greater hazard to worker safety, public health, and the environment to remove the contamination, transport it, and bury it at another location.

No corrective action beyond the initiation of a use restriction is necessary.

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D.4.0 References

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Attachment A

Derivation of Residual Radioactive Material Guidelines for Radionuclides in Soil at Corrective Action Unit (CAU) 478, Area 12 T-Tunnel Ponds, Nevada Test Site, Nevada Derivation of Residual Radioactive Material Guidelines for Radionuclides in Soil at Corrective Action Unit (CAU) 478, Area 12 T-Tunnel Ponds, Nevada Test Site, Nevada

May 2007

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Work sponsored by United States Department of Energy, National Nuclear Security Administration Nevada Site Office, Environmental Restoration Division, Las Vegas, Nevada

Derivation of Residual Radioactive Material Guidelines for Radionuclides in Soil at Corrective Action Unit (CAU) 478, Area 12 T-Tunnel Ponds, Nevada Test Site, Nevada

1.0 Introduction

The U.S. Department of Energy (DOE), the U.S. Department of Defense (DoD) (through the Defense Threat Reduction Agency [DTRA]), and the DOE, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) Environmental Restoration Division have numerous sites impacted from the development, testing, and production of nuclear weapons. These impacts can take the form of chemical and/or radiological contaminants. Similar to its approach for chemical contamination, DoD and NNSA/NSO are committed to properly evaluating, radiologically characterizing, and where appropriate, remediating these sites to ensure the doses to radiation workers and members of the public are maintained as-low-as-reasonably achievable (ALARA), at a minimum, below the primary dose limits as stated in DOE Order 5400.5 (DOE, 1993).

To accomplish this, the potential for residual radioactive contamination in soils must be evaluated to determine the status of 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 478, Authorized Limits or final action levels (FALs) were derived using the Residual Radioactivity (RESRAD) model and computer code (Yu et al., 2001). The goal of this effort was to produce Authorized Limits, in units of picocuries per gram (pCi/g) in soil above background, for CAU 478 that would result in radiation doses less than 25 mrem per year (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 478, 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 478, Area 12 T-Tunnel Ponds, Nevada Test Site (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 CAU 478. Figure 1-1 shows the location of CAU 478 at the NTS.

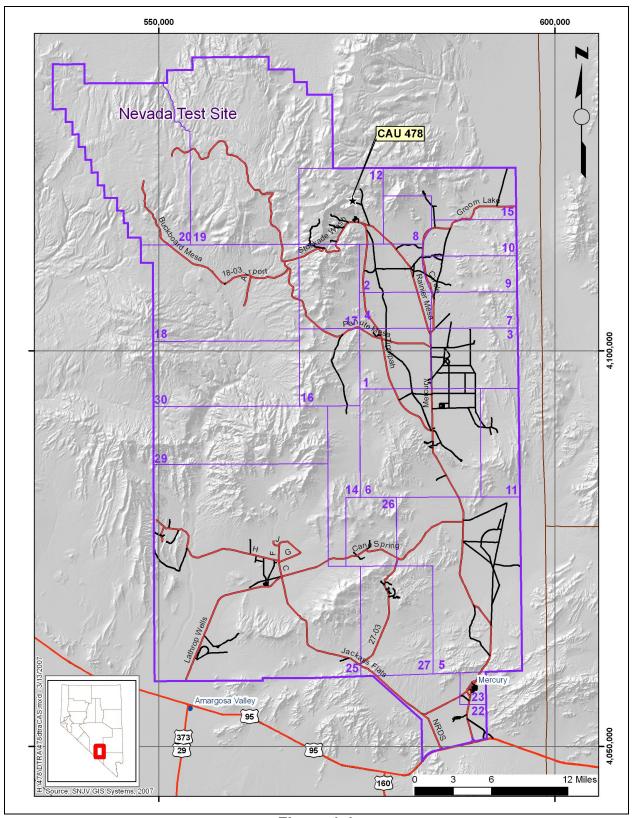


Figure 1-1
Nevada Test Site Map Showing CAU 478 Location

2.0 Facility Description

Corrective Action Unit 478 consists of one corrective action site (CAS), 12-23-01, Ponds (5), RAD Area. The T-Tunnel, constructed beneath Rainier Mesa, was mined horizontally into bedded, ash-flow tuff (USGS/DOE, 1999) from 850 to 1,400 feet (ft) below the mesa surface. The T-Tunnel Ponds consist of six unlined ponds, ranging from 80 to 160 ft long and 50 to 170 ft wide. The ponds are located beside one another in an easterly trend with an earthen berm separating each pond from the one above it. Open channels connect each pond with the next one, and extend downgradient from the last pond. The upgradient end of the first pond is buried by the muckpile. The last earthen berm is approximately 1,260 ft east of the muckpile. The channels were characterized to about 100 ft below the last pond berm.

2.1 Operational History

Between 1970 and 1987, T-Tunnel was used for six nuclear weapons effects tests and two high explosive tests. There is limited information available about the ponds. Specifics concerning potential wastes discharged to the ponds have not been documented. The T-Tunnel Ponds were used as settling ponds from groundwater encountered during tunnel excavation, construction water, and water produced during re-entry activities following each test. The water flowed from the tunnel through a pipe buried in the muckpile into the first pond. In 1993, effluent discharge elimination plugs were emplaced in the tunnel as part of the T-Tunnel mothball program. No water or sediment was further discharged to the ponds since that time.

2.2 Release Information

Release of radionuclides to the ponds, though not documented, may have occurred during tunnel re-entry operations. Venting from I, J, and K Tunnels, which are adjacent to CAU 478, impacted the ponds and surrounding area. Radioactive debris from the vent was projected across the canyon in which the ponds are located.

3.0 Site Investigation Activities

In February 2003, a radiological walkover survey was conducted. The site investigation activities were conducted between April 30 and May 7, 2003.

3.1 Site Investigation Plans

Corrective action investigation activities were performed as set forth in the CAU 478 Corrective Action Investigation Plan (CAIP) (DTRA, 2003). The objectives of the CAU 478 CAIP were to address the decision statements in the project-specific Data Quality Objectives (DQOs) by:

- Characterizing the pond sediments from the surface to native material interface.
- Characterizing the native materials underlying the ponds (from 2 to 5 ft below the ponds or until drill refusal) for contaminants of potential concern (COPCs).
- Establishing background levels of radioactivity and metals in the native soils surrounding the ponds.

The DQO process is a seven-step strategic planning approach based upon the scientific method used to plan data collection activities for CAU 478, Area 12 T-Tunnel Ponds, Nevada Test Site. 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 (i.e., 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 CAU 478. This objective was achieved by identifying the nature and extent, both horizontal and vertical of contaminants of concern (COCs) (i.e., COPCs at concentrations above action levels).

The investigation strategy was developed by representatives of the Nevada Division of Environmental Protection (NDEP) and DTRA, in accordance with U.S. Environmental Protection Agency (EPA) *Guidance for the Data Quality Objectives Process*, EPA QA/G-4 (EPA, 1994). The CAU 478 CAIP contains a description of the investigation strategy and the DQO process.

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 478.

From April 30 through May 7, 2003, Corrective Action Investigation (CAI) activities were performed at the T-Tunnel Ponds as set forth in the CAIP (DTRA, 2003). The purpose of the CAI was to determine whether or not the T-Tunnel Ponds, the underlying native soils, and/or the channels have been impacted by COPCs at concentrations that exceed regulatory limits, and to

provide sufficient information and data to develop appropriate corrective active strategies for the ponds and channels. As outlined in the CAIP, the following tasks were performed:

- Background sampling Three locations were identified and excavated by hand to a depth of approximately 18 inches to collect background native soil samples. Samples were field screened and submitted for radionuclide analysis.
- Sampling of the pond sediments and underlying native material 19 locations were drilled in the ponds to characterize the pond sediments and the native material under the ponds. A total of 159 ft was drilled in 19 boreholes ranging from 5 to 13.5 ft deep. Up to three samples were collected from each location. During the characterization, 42 environmental samples were collected. These included 20 pond sediment samples and 22 native material samples. All samples were sent for analyses of volatile organic compounds, semivolatile organic compounds, total petroleum hydrocarbons-diesel-range organics, total *Resource Conservation and Recovery Act* metals, beryllium, and radionuclides.
- Sampling of the channels 31 locations were drilled or hand sampled in the channels to characterize the site. A total of 111 ft was drilled in 21 boreholes ranging from 4.5 to 7.5 ft. Ten locations were sampled by hand. One or two samples were collected from each location. All samples were analyzed for the same analytes as the pond samples.
- Background soil samples were not collected around the ponds as CAU 476 (T-Tunnel Muckpile) characterized three background samples from undisturbed location around the muckpile.

4.0 Site Investigation Sample Results

Radionuclides were found in the samples from surface, channels, and sediments. The RESRAD calculations are based on validated analytical sample results obtained during site investigation activities and other applicable information specified in the CAIP. Because the lack of specific discharge information and potential impact from venting of I, J, and K Tunnels, RESRAD calculations are based upon the value of the maximum radionuclide concentration found in the samples. The RESRAD calculations of the area were performed for the COCs present in the CAU 478 T-Tunnel Ponds using the maximum radionuclide concentrations obtained from the CAI sample results. Appendix A of the CAU 478 CADD/CR contains a detailed description of the sample results, analytical parameters, and laboratory methods used to analyze the soil samples.

The maximum principal radionuclide concentrations (including background) detected at the CAU 478 are listed in Table 4-1.

Table 4-1
Maximum Results for Principal Radionuclides
Found in CAU 478 Soil Samples

Found in CAU 478 Soil Samples							
Sample	Radionuclide	pCi/g					
478CS1903	Aluminum-26	0.25					
478CS190.5	Americium-241	11					
478PSBX020	Cobalt-60	0.77					
478PS120.5	Cesium-134	0.2					
478PSB020.5	Cesium-137	366					
478PSBX020.5	Europium-152	1.3					
478PS050.5	478PS050.5 Europium-154						
478PSB0101	Europium-155	1.1					
478PS1404.5	Niobium-94	0.17					
478CS260.5	Plutonium-238	7.06					
478CS260.5	Plutonium-239	79					
478PSB040.5	Antimony-125	8.3					
478PSB020.5	Strontium-90	22.8					
478PSBX020	Uranium-235	1.5					

ft bgs = Feet below ground surface pCi/g = Picocuries per gram

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. 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.

5.1 Authorized Values for Initial Concentrations of Principal Radionuclides

The authorized exposure scenarios specify that value of the arithmetic mean plus the 95 percent upper confidence limit (UCL) obtained from site-specific sampling results be entered as the principal radionuclide concentrations for RESRAD calculates. 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, the maximum concentration from the sample dataset was used as the initial concentration for that radionuclide.

5.2 Authorized Values Initial Concentrations of Principal Radionuclides for Area Averaging/Location Specific 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 m²" (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 m², 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 "hot-spots" shall also be developed and applied" (5400.5, IV, 4.a.(1)). DOE Order 5400.5, IV, 4.a.(1) indicates that criterion for these location-specific analysis is discussed in DOE G 441.1-XX (DOE, 2002) Section 5.2.2.

The purpose of the location-specific analysis criterion is to ensure that applying the homogeneous criteria, in which the concentrations of residual radioactive material are averaged over a 100-square-meter (m²) area, does not result in the release of small areas that, because of averaging, contain unacceptably high concentrations of residual radioactive material. The location-specific 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 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 location-specific calculations. The authorized area parameters for RESRAD location-specific calculations are 1 m², 10 m², and 100 m² contamination areas.

5.3 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. 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., location-specific criteria, sum of fractions rule). The RESRAD User's Manual states that the inhomogeneous release criteria are generally more realistic and hence less restrictive than the homogeneous release criteria (Yu et al., 2001). This shows that the approved initial radionuclide concentration values (i.e., arithmetic mean plus 95 percent UCL or 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 concentration values are used for the initial concentrations of principal radionuclides when the sample results are obtained using a non-random (e.g., bias or judgmental sampling) sampling method.

RESRAD states that 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 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 (EPC) term,
- Determine the attainment of cleanup standards,
- Estimate background level mean contaminant concentrations, or
- 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 EPC 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 are 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.

5.4 Initial Concentrations of Principal Radionuclide for CAU 478

The initial radionuclide concentrations used for the RESRAD calculations are those listed in Table 4-1. These maximum radionuclide concentration values were used to perform the RESRAD calculations to demonstrate conservatism.

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 projects using the RESRAD computer code, as agreed to by NNSA/NSO, Stoller-Navarro Joint Venture (SNJV), the NTS Management and Operating (M&O) Contractor, and NDEP.

6.1 Guidance for RESRAD Calculations

The guidance in this section was developed by NNSA/NSO, SNJV, the M&O Contractor, 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-millirem (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 Chapter IV 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 amongst 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 are taken directly from National Council on Radiation Protection and Measurements 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* (DOE, 1993).

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 because the historical aspects of the NTS [e.g., aboveground and belowground testing, and other operations resulted in dispersion of radionuclides locally].)

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.

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 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 a total of 2,000 hr per year (hr/yr) (250 days per year, 8 hours per day) for a duration of 25 years.
- 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 hr/yr) by the total number of hours in a year (8,760 hr/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 land use restrictions with a low occupancy factor and lighter work activities at the site. The assumptions for Scenario B include the following:

- A worker will be at the site and outdoors for a total of 335 hr/yr for a duration of 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 hr/yr) by the total number of hours in a year (8,760 hr/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 6-1 lists the pathways considered for Scenarios A and B.

Table 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 onsite garden	No	No
Ingestion of meat from onsite livestock	No	No
Ingestion of milk from onsite livestock	No	No
Ingestion of fish from onsite pond	No	No
Ingestion of water from onsite well	No	No

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 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 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.

Table 6-2 Approved RESRAD Parameters (Page 1 of 6)

			(i age i oi	0)	
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 (CZ)					
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 6-2 Approved RESRAD Parameters (Page 2 of 6)

Parameter	Units	Scenario A	Scenario B	Defaults	Reference/Rationale
R013 Cover and Contaminated Zone Hydrolo	gical 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	.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	Site	2.000E+00	Data from Air Resources Laboratory (ARL, 2007)
		Specific	Specific		http://www.sord.nv.doe.gov/arlsord-1.htm
Humidity in Air	g/m³	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	Site	1.000E+00	Data from Air Resources Laboratory (ARL, 2007)
		Specific	Specific		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
Accuracy for Water/Soil Computations	-	not used	not used	1.000E-03	Not used with the above pathway selection

Table 6-2 Approved RESRAD Parameters (Page 3 of 6)

Parameter	Units	Scenario A	Scenario B	Defaults	Reference/Rationale
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	m³/yr	not used	not used	2.500E+02	Not used with the above pathway selection
R015 Uncontaminated and Unsaturated Strat	a Hydrologic	al 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
Hydraulic Conductivity	m/yr	not used	not used	1.000E+01	Not used with the above pathway selection

Table 6-2 Approved RESRAD Parameters (Page 4 of 6)

Parameter	Units	Scenario A	Scenario B	Defaults	Reference/Rationale
R016 Distribution Coefficients and Leach F	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	m³/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 m³/h (12,300 m³/yr) inhalation rate. (Yu, et. al., 1993)
Mass Loading for Inhalation	g/m³	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

Table 6-2 Approved RESRAD Parameters (Page 5 of 6)

Parameter	Units	Scenario A	Scenario B	Defaults	Reference/Rationale
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
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

Table 6-2 **Approved RESRAD Parameters**

(Page 6 of 6)

Parameter	Units	Scenario A	Scenario B	Defaults	Reference/Rationale
Livestock Soil Intake	kg/day	not used	not used	5.000E-01	Not used with the above pathway selection
Mass Loading for Foliar Deposition	g/m³	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

cm³/g = Cubic centimeters per gram FGR = Federal Guidance Report ft = foot

g/cm³ = Grams per cubic centimeter g/m³ = 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/sec = Meters per second

m/yr = Meters per year m² = Square meter

 $m^3/h = Cubic meters per hour$

m³/yr = Cubic meters per year mg/day = Milligrams per day

mrem/yr = Millirem per year

ND = Nondetect

PAL = Preliminary action level pCi/g = Picocuries per gram

RESRAD = Residual Radioactive

UCL = Upper confidence level

yr = Year

6.4 Residual Radioactive Material Guideline

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;

$$G = H_{EL}/DSR$$

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;

$$\overline{\mathbf{M}} = \sum_{i} \overline{\mathbf{S}}_{i}(\mathbf{t}_{o}) / G_{i}(\mathbf{t}_{m}) \leq 1$$

Where: \overline{M} = average mixture sum (dimensionless) $\overline{S}_i(t_o)$ = initial concentration of the *i*th principal radionuclide averaged over an area determined by scenario activities $G_i(t_m)$ = single radionuclide soil concentration guideline for the *i*th 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 so that the above equation is satisfied. Those adjusted values are then used as the FAL.

7.0 RESRAD Calculations for CAU 478, Area 12 T-Tunnel Ponds

This section discuses the RESRAD calculations and results for CAU 478.

7.1 Selection of RESRAD Exposure Scenario

Scenario B was selected as the exposure scenario for the CAU 478 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

7.2 User Input Parameters

The RESRAD default parameters that were modified for the calculations performed for CAU 478 in this report and the site-specific values entered are presented in Table 7-1. A complete list of the RESRAD default parameters and the site-specific parameters used for CAU 478 is provided in Table A-1 of Attachment A. The initial radionuclide concentrations used for analyses are those listed in Table 4-1.

Because the uncertainty of any specific radionuclide discharge and the positive analytical results for samples from surface, sediments, and channels, all ponds and channels are treated as one unit for RESRAD analysis.

7.3 Radionuclide Concentrations and Dose Estimates

The maximum dose results from RESRAD calculations for the CAU 478 is 35.30 mrem/yr occurring at year zero (current year) and the dose will not decrease to zero until year 300. The detailed RESRAD results for this CAS are provided in Exhibit 1, RESRAD Summary Report: CAU 478.

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 contributing to the total annual dose at the time of maximum dose occurs are almost all (97.98 percent) for external exposure, 1.34 percent for inhalation, and 0.68 percent for soil ingestion pathways. Therefore, uncertainties in the following parameters: Erosion rates, thickness of contaminated zone, occupancy factors, and wind speed have the greatest significance on the model predictions.

The maximum dose contributions and total dose/source concentration ratios for the ponds under Scenario B parameters have been predicted to occur at year zero. The calculated maximum dose contributions for all considered pathways are presented in Table 7-2. Figure 7-1 shows that the TEDE to remote worker for the considered pathway decreases to the 25 mrem/yr dose constraint at year 12.32. The dose from cesium-137, the dominating contributing radionuclide, at year zero is 33.25 mrem/yr and doses from all radionuclides drop to 24.0 mrem/yr for year 12.32.

Because the radionuclide concentrations found at this site pose a dose level above the 25 mrem/yr constraint under the current site conditions, remediation alternative should be considered for the site. Nonetheless, controls that minimize the spread of radioactive contamination into uncontaminated areas and reduced erosion rate are recommended for this site. Unless the soils from the ponds are removed during remediation, the site should be radiologically posted in accordance with applicable regulation and procedures.

7.4 Residual Radioactive Material Guidelines for CAU 478

The sum of the ratios for CAU 478 exceeds unity. Table 7-3 presents the calculations results for deriving guidelines for radionuclides for this CAU. The FALs for the CAU 478 scenario are the residual radioactive material guideline values for mixture radionuclides.

Table 7-1 RESRAD Parameters Input Values for CAU 478 (Page 1 of 2)

Parameter	Units	CAU 478	Defaults	Reference/Rationale
Area of CZ	m ²	1.000E+02	1.000E+04	Estimated using the site boundary
Thickness of CZ	m	1.500E-01	2.000E+00	Top layer of the contamination soil
Principal radionuclides	pCi/g	See Table 4-1	0.0	Initial concentrations are the maximum concentrations from sample results: maximum for biased sample or average for random sample.
Average Annual Wind Speed	m/sec	3.4	2.000E+00	Data from Air Resource Laboratory (2007)
Precipitation	m/yr	3.260E-01	1.000E+00	Data from Air Resources Laboratory (2007)
Runoff Coefficient	-	4.000E-01	2.000E-01	Open Sandy Loam 30% impervious Table 10.1 (Yu, et al., 1993)
Inhalation Rate	m³/yr	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 m³/h (12,300 m³/yr) inhalation rate. (Yu, et al., 1993)
Mass Loading for Inhalation	g/m³	6.00E-04	1E-04	The estimated mass loading for construction activities. (Yu, et al., 1993)
Exposure Duration	yr	25	30	Standard for Industrial/Commercial Scenario
Shielding Factor Inhalation	-	1.0	0.4	Assumes no indoor time fraction
Shielding Factor External Gamma	-	1.0	0.7	Assumes no indoor time fraction
Fraction of Time Spent Indoors	-	0.0	0.5	Assumes no indoor time fraction
Fraction of Time Spent Outdoors	-	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	36.5	EPA, 1991; 480 mg/day

Table 7-1 RESRAD Parameters Input Values for CAU 478 (Page 2 of 2)

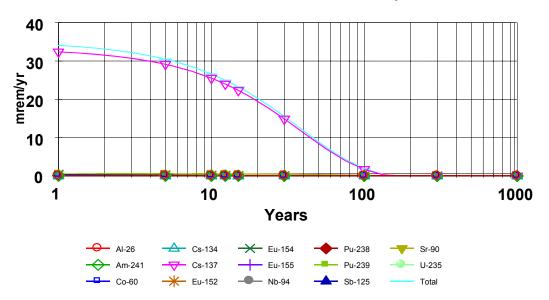
Parameter	Units	CAU 478	Defaults	Reference/Rationale
CZ = Contaminated Zone g/m³ = Grams per cubic meter g/yr = Grams per year m = Meter			m³/h = Cubic meters per hour m³/yr = Cubic meters per year mg/day = Milligrams per day pCi/g = Picocuries per gram	
m² = Square meter m/sec = Meters per second m/yr = Meters per year			RESRAD = Residual Radioact yr = Year	tive

Table 7-2
Maximum Dose Contributions for CAU 478
Using Scenario B (dose as mrem/yr)

	Grou	ınd	Inhalation		Soil		Total	
Radionuclide	Annual Dose	Fraction	Annual Dose	Fraction	Annual Dose	Fraction	Annual Dose	Fraction
Aluminum-26	4.441E-02	0.0013	9.280E-08	0.0000	9.963E-07	0.0000	4.441E-02	0.0013
Americium-241	1.504E-02	0.0004	5.477E-02	0.0016	2.628E-02	0.0007	9.609E-02	0.0027
Cobalt-60	2.945E-01	0.0083	1.791E-06	0.0000	1.288E-05	0.0000	2.945E-01	0.0083
Cesium-134	4.308E-02	0.0012	8.897E-08	0.0000	8.263E-06	0.0000	4.309E-02	0.0012
Cesium-137	3.324E+01	0.9415	1.308E-04	0.0000	1.200E-02	0.0003	3.325E+01	0.9418
Europium-152	2.308E-01	0.0065	3.173E-06	0.0000	5.446E-06	0.0000	2.309E-01	0.0065
Europium-154	4.382E-01	0.0124	7.170E-06	0.0000	1.401E-05	0.0000	4.383E-01	0.0124
Europium-155	5.838E-03	0.0002	4.817E-07	0.0000	1.042E-06	0.0000	5.839E-03	0.0002
Nibium-94	1.800E-02	0.0005	3.282E-07	0.0000	3.313E-07	0.0000	1.800E-02	0.0005
Plutonium-238	3.657E-05	0.0000	3.125E-02	0.0009	1.493E-02	0.0004	4.621E-02	0.0013
Plutonium-239	7.096E-04	0.0000	3.842E-01	0.0109	1.855E-01	0.0053	5.704E-01	0.0162
Antimony-125	2.110E-01	0.0060	4.947E-07	0.0000	7.618E-06	0.0000	2.110E-01	0.0060
Strotium-90	1.564E-02	0.0004	3.320E-04	0.0000	2.269E-03	0.0001	1.824E-02	0.0005
Uranium-235	3.403E-02	0.0010	2.083E-03	0.0001	2.651E-04	0.0000	3.638E-02	0.0010
Total	3.459E-01	0.9798	4.727E-01	0.0134	2.413E-01	0.0068	3.530E+01	1.0000

mrem/yr = Millirem per year

DOSE: All Radionuclides Summed, All Pathways Summed



DOSE: All Radionuclides Summed, Component Pathways

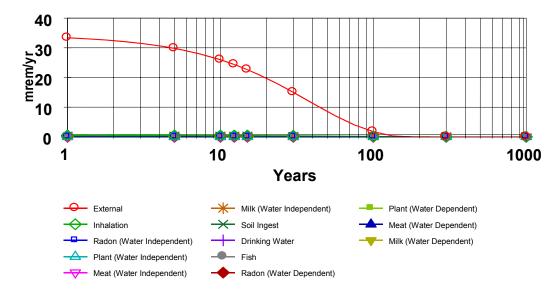


Figure 7-1
CAU 478 Dose Rate Per Year All Radionuclides Summed,
All Pathways Summed and Component Pathways

Table 7-3
CAU 478 Sum of Fractions and Proportional Scaling and Final Action Level Determination

Radionuclide	Initial Radionuclide Concentration (pCi/g)	Contribution %	Single Radionuclide Guidelines (pCi/g)	Ratio for Single Radionuclide Guideline	Mixture Radionuclides Guidelines ^a (pCi/g) (FAL)	Ratio for Mixture Radionuclide Guidelines
Aluminum-26	2.5000E-01	4.9826E-04	1.4070E+02	1.7768E-03	1.7705E-01	1.2584E-03
Americium-241	1.1000E+01	2.1923E-02	2.8620E+03	3.8435E-03	7.7904E+00	2.7220E-03
Cobalt-60	7.7000E-01	1.5346E-03	6.5360E+01	1.1781E-02	5.4533E-01	8.3434E-03
Cesium-134	2.0000E-01	3.9860E-04	1.1600E+02	1.7241E-03	1.4164E-01	1.2211E-03
Cesium-137	3.6600E+02	7.2945E-01	2.7520E+02	1.3299E+00	2.5921E+02	9.4189E-01
Europium-152	1.3000E+00	2.5909E-03	1.4080E+02	9.2330E-03	9.2068E-01	6.5389E-03
Europium-154	2.3000E+00	4.5840E-03	1.3120E+02	1.7530E-02	1.6289E+00	1.2415E-02
Europium-155	1.1000E+00	2.1923E-03	4.7090E+03	2.3360E-04	7.7904E-01	1.6544E-04
Niobium-94	1.7000E-01	3.3881E-04	2.3610E+02	7.2003E-04	1.2040E-01	5.0994E-04
Plutonium-238	7.0600E+00	1.4071E-02	3.8190E+03	1.8487E-03	5.0000E+00	1.3092E-03
Plutonium-239	7.9000E+01	1.5745E-01	3.4620E+03	2.2819E-02	5.5949E+01	1.6161E-02
Antimony-125	8.3000E+00	1.6542E-02	9.8330E+02	8.4410E-03	5.8782E+00	5.9780E-03
Strontium-90	2.2800E+01	4.5441E-02	3.1250E+04	7.2960E-04	1.6147E+01	5.1671E-04
Uranium-235	1.5000E+00	2.9895E-03	1.0300E+00	1.4563E+00	1.0623E+00	1.0314E+00
Total	5.0175E+02	N/A	N/A	2.8652E+00 ^b	N/A	2.0304E+00

^aSingle 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 FALs for CAU 478 are the radionuclide guidelines for mixture radionuclides (i.e., Mixture Radionuclide Guidelines column).

^bunity > 1

FAL = Final action level N/A = Not applicable pCi/g = Picocuries per gram

8.0 References

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Attachment A

RESRAD Parameters Used for Analysis of CAU 478 Site

The parametric values used in the RESRAD code for the analysis of the CAU 478 site are listed in Table A-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 Federal Guidance Report 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 A-1 RESRAD Parameters

(Page 1 of 6)

Parameter	Units	CAU 478	Defaults	Reference/Rationale
R011 Contaminated Zone (CZ)				
Area of CZ	m^2	1.00E+02	1.000E+04	10x10 m specific location area
Thickness of CZ	m	1.200E+00	2.000E+00	Maximum depth from contaminated samples
Length Parallel to Aquifer Flow	m	not used	1.000E+02	Not Used
Radiation Dose Limit	mrem/yr	2.5E+001	2.5E+001	RESRAD Default (Yu, et al., 1993)
Elapsed Time Since Placement of Material	yr	0.0	0.0	RESRAD Default
R012 Initial Principal Radionuclide				
Principal radionuclides	pCi/g	See Table 4-1	0.0	Site specific

Table A-1 RESRAD Parameters

(Page 2 of 6)

Parameter	Units	CAU 478	Defaults	Reference/Rationale
R013 Cover and Contaminated Zone Hydrolog	ical Data			
Cover Depth	m	0.0	0.0	No Cover Assumed
Density of Cover Material	g/cm ³	not used	1.5	No Cover Assumed
Cover Depth Erosion Rate	m/yr	not used	1.000E-03	No Cover Assumed
Density of Contaminated Zone	g/cm ³	1.5	1.5	RESRAD Default
Contamination Zone Erosion Rate	m/yr	1.000E-03	1.000E-03	RESRAD Default
Contaminated Zone Total Porosity	-	4.000E-01	4.000E-01	RESRAD Default
Contaminated Zone Field Capacity	-	2.000E-01	2.000E-01	RESRAD Default
Contaminated Zone Hydraulic Conductivity	m/yr	1.000E+01	1.000E+01	RESRAD Default
Contaminated Zone b Parameter	-	5.300E+00	5.300E+00	RESRAD Default
Average Annual Wind Speed	m/sec	3.4	2.000E+00	Data from Air Resource Laboratory (2007)
Humidity in Air	g/m ³	not used	8.000E+00	Not used
Evapotranspiration Coefficient	-	5.000E-01	5.000E-01	RESRAD Default
Precipitation	m/yr	3.260E-01	1.000E+00	Data from Air Resources Laboratory (2007)
Irrigation	m/yr	2.000E-01	2.000E-01	RESRAD Default
Irrigation Mode	-	overhead	overhead	RESRAD Default
Runoff Coefficient	-	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	1.000E+06	Not used
Accuracy for Water/Soil Computations	-	not used	1.000E-03	Not used

Table A-1 RESRAD Parameters

(Page 3 of 6)

		`		
Parameter	Units	CAU 478	Defaults	Reference/Rationale
R014 Saturated Zone Hydrological Data				
Density of Saturated Zone	g/cm ³	not used	1.500E+00 N	ot used
Saturated Zone Total Porosity	-	not used	4.000E-01 N	ot used
Saturated Zone Effective Porosity	-	not used	2.000E-01 N	ot used
Saturated Zone Field Capacity	-	not used	2.000E-01 N	ot used
Saturated Zone Hydraulic Conductivity	m/yr	not used	1.000E+02 N	ot used
Saturated Zone Hydraulic Gradient	-	not used	2.000E-02 N	ot used
Saturated Zone b Parameter	-	not used	5.300E+00 N	ot used
Water Table Drop Rate	m/yr	not used	1.000E-03 N	ot used
Well Pump Intake Depth	m	not used	1.000E+01 N	ot used
Model: Nondispersion or Mass-Balance	-	not used	ND N	ot used
Well Pumping Rate	m³/yr	not used	2.500E+02 N	ot used
R015 Uncontaminated and Unsaturated Strat	a Hydrological Data			
Number of Unsaturated Zone Strata	-	not used	1	Not used
Thickness	m	not used	4.000E+00	Not used
Soil Density	g/cm ³	not used	1.500E+00	Not used
Total Porosity	-	not used	4.000E-01	Not used
Effective Porosity	-	not used	2.000E-01	Not used
Field Capacity	-	not used	2.000E-01	Not used
Soil-specific b Parameter	-	not used	5.300E+00	Not used
Hydraulic Conductivity	m/yr	not used	1.000E+01	Not used

Table A-1 RESRAD Parameters

(Page 4 of 6)

Parameter	Units	CAU 478	Defaults	Reference/Rationale
R016 Distribution Coefficients and Leach Rate	es		•	
Contaminated Zone K _d (all Zones)	cm³/g			RESRAD Default
Saturated Leach Rate	/yr	0.0	0.0	Not used
Solubility Constant	-	0.0	0.0	Not used
R017 Inhalation and External Gamma				
Inhalation Rate	m ³ /yr	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 m³/h (12,300 m³/yr) inhalation rate. (Yu, et al., 1993)
Mass Loading for Inhalation	g/m³	6.00E-04	1E-04	The estimated mass loading for construction activities. (Yu, et al., 1993)
Exposure Duration	yr	25	30	Standard for Industrial/Commercial Scenario
Shielding Factor Inhalation	-	1.0	0.4	Assumes no indoor time fraction
Shielding Factor External Gamma	-	1.0	0.7	Assumes no indoor time fraction
Fraction of Time Spent Indoors	-	0.0	0.5	Assumes no indoor time fraction
Fraction of Time Spent Outdoors	-	0.038	0.25	Scenario specific based on Industrial/ Commercial Use Scenarios for standard occupancy and low occupancy.
Shape Factor	-	1.0	1.0	RESRAD Default
R018 Ingestion Pathway Data, Dietary Param	eters			
Fruits, Vegetables, and Grain Consumption	kg/yr	not used	1.600E+02	Not used
Leafy Vegetable Consumption	kg/yr	not used	1.400E+01	Not used
Milk Consumption	L/yr	not used	9.200E+01	Not used
Meat and Poultry Consumption	kg/yr	not used	6.300E+01	Not used

Table A-1 RESRAD Parameters

(Page 5 of 6)

Parameter	Units	CAU 478	Defaults	Reference/Rationale
Fish Consumption	kg/yr	not used	5.400E+00	Not used
Other Seafood Consumption	kg/yr	not used	9.000E-01	Not used
Soil Ingestion Rate	g/yr	1.752E+02	36.5	EPA, 1991; 480 mg/day
Drinking Water Intake	L/yr	not used	5.100E+02	Not used
Drinking Water Contaminated Fraction	-	not used	1.000E+00	Not used
Household Water Contaminated Fraction	-	not used	1.000E+00	Not used
Livestock Water Contaminated Fraction	-	not used	1.000E+00	Not used
Irrigation Water Contaminated Fraction	-	not used	1.000E+00	Not used
Aquatic Food Contamination Fraction	-	not used	5.000E-01	Not used
Plant Food Contamination Fraction	-	not used	-1	Not used
Meat Contamination Fraction	-	not used	-1	Not used
Milk Contamination Fraction	-	not used	-1	Not used
R019 Ingestion Pathway Data, Nondietary				
Livestock Fodder Intake for Meat	kg/day	not used	6.800E+01	Not used
Livestock Fodder Intake for Milk	kg/day	not used	5.500E+01	Not used
Livestock Water Intake for Meat	L/day	not used	5.000E+01	Not used
Livestock Water Intake for Milk	L/day	not used	1.600E+02	Not used
Livestock Soil Intake	kg/day	not used	5.000E-01	Not used
Mass Loading for Foliar Deposition	g/m³	not used	1.000E-04	Not used
Depth of Soil Mixing Layer	m	1.500E-01	1.500E-01	RESRAD Default
Depth of Roots	m	not used	9.000E-01	Not used

Table A-1 **RESRAD Parameters**

(Page 6 of 6)

		,		
Parameter	Units	CAU 478	Defaults	Reference/Rationale
Drinking Water Fraction from Groundwater	-	not used	1.000E+00	Not used
Household Water Fraction from Groundwater	-	not used	1.000E+00	Not used
Livestock Water Fraction from Groundwater	-	not used	1.000E+00	Not used
Irrigation Fraction from Groundwater	-	not used	1.000E+00	Not used
R021 Radon				
Radon Parameters Not Used				Not used
cm³/g = Cubic centimeters per gram g/cm³ = Grams per cubic centimeter g/m³ = Grams per cubic meter g/yr = Grams per year kg/day = Kilograms per day kg/yr = Kilograms per year L/day = Liters per day		m/sec = Meters m/yr = Meters p m ³ /h = Cubic m m ³ /yr = Cubic n mg/day = Millig mrem/yr = Millin ND = Nondeco	per year eters per hour neters per year rams per day rem per year tt	

L/yr = Liters per day L/yr = Liters per year m = Meter m² = Square meter pCi/g = Picocuries per gram RESRAD = Residual Radioactive

yr = Year /yr = Per year

Exhibit 1

RESRAD Summary Report: CAU 478

(32 pages)

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Total Dose Components	
Time = 0.000E+00	16
Time = 1.000E+00	17
Time = 5.000E+00	18
Time = 1.000E+01	19
Time = 1.232E+01	20
Time = 1.500E+01	21
Time = 3.000E+01	22
Time = 1.000E+02	23
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Dose Conversion Factor (and Related) Parameter Summary File: FGR 13 MORBIDITY

	File: FGR 13 MORBIDITY							
0	3	3	Current	3	Base	3	Para	meter
Menu	Parameter	3	Value	3	Case*	3	Nai	ne
	ĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸĸ	äå		åäi		åź		
	3 Dose conversion factors for inhalation, mrem/pCi:	3		3		3		
	³ Ac-227+D	3	6.724E+00	3 4	5 700E±00	3	DCE3/	1 \
								,
B-1	³ Al-26		7.960E-05					,
	³ Am-241		4.440E-01					,
B-1	³ Co-60		2.190E-04					,
B-1	³ Cs-134		4.620E-05					
B-1	³ Cs-137+D		3.190E-05					,
B-1	³ Eu-152	3	2.210E-04	3 2	2.210E-04	3	DCF2(7)
B-1	³ Eu-154	3	2.860E-04	3 2	2.860E-04	3	DCF2(9)
B-1	³ Eu-155	3	4.140E-05	3 4	1.140E-05	3	DCF2(10)
B-1	³ Gd-152	3	2.430E-01	3 2	2.430E-01	3	DCF2(11)
B-1	³ Nb-94	3	4.140E-04	3 4	1.140E-04	3	DCF2(12)
	³ Np-237+D		5.400E-01					,
	³ Pa-231		1.280E+00					
B-1	³ Pb-210+D		2.320E-02					,
B-1	³ Pu-238		3.920E-01					
	³ Pu-239		4.290E-01					
	³ Ra-226+D		8.594E-03					
	³ Sb-125+D		1.386E-05					
	3 Sr-90+D		1.308E-03					
B-1	³ Th-229+D		2.169E+00					
	³ Th-230		3.260E-01					
B-1	³ U-233		1.350E-01					,
B-1	³ U-234		1.320E-01					
B-1	³ U-235+D	3	1.230E-01	3 1	L.230E-01	3	DCF2(26)
	3	3		3		3		
D-1	3 Dose conversion factors for ingestion, mrem/pCi:	3		3		3		
D-1	³ Ac-227+D	3	1.480E-02	3 1	L.410E-02	3	DCF3(1)
D-1	³ Al-26	3	1.460E-05	3 1	L.460E-05	3	DCF3(2)
D-1	³ Am-241	3	3.640E-03	3 3	3.640E-03	3	DCF3(3)
D-1	³ Co-60	3	2.690E-05	3 2	2.690E-05	3	DCF3(4)
D-1	³ Cs-134		7.330E-05					,
D-1	³ Cs-137+D		5.000E-05					,
D-1	³ Eu-152		6.480E-06					,
D-1	³ Eu-154		9.550E-06					,
D-1	³ Eu-155		1.530E-06					,
	³ Gd-152		1.610E-04					,
D-1 D-1	³ Nb-94		7.140E-06					
								,
D-1	³ Np-237+D		4.444E-03					,
	³ Pa-231		1.060E-02					,
D-1	³ Pb-210+D		7.276E-03					,
D-1	³ Pu-238		3.200E-03					
	³ Pu-239		3.540E-03					,
	³ Ra-226+D		1.321E-03					
D-1	³ Sb-125+D	3	3.647E-06	3 2	2.810E-06	3	DCF3(20)
D-1	³ Sr-90+D	3	1.528E-04	3 1	L.420E-04	3	DCF3(21)
D-1	³ Th-229+D	3	4.027E-03	3 3	3.530E-03	3	DCF3(22)
D-1	³ Th-230	3	5.480E-04	3 [5.480E-04	3	DCF3(23)
D-1	³ U-233	3	2.890E-04	3 2	2.890E-04	3	DCF3(24)
D-1	³ U-234	3	2.830E-04	3 2	2.830E-04	3	DCF3(25)

Dose Conversion Factor (and Related) Parameter Summary (continued)

		Dose Conversion Factor (and Related) Parameter	Summary (cont	cinued)	
0 3		File: FGR 13 MORBIDITY	3 Current 3	Base	³ Parameter
Menu 3		Parameter	CULLCIIC		Name
		Palamerei ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	, 01		
	U-235+D			3 2.660E-04	
- 1			3		3
D-34	Food trans	sfer factors:	3	3	3
D-34	Ac-227+D	, plant/soil concentration ratio, dimensionless	3 2.500E-03 3	3 2.500E-03	³ RTF(1,1)
D-34	Ac-227+D	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3 2.000E-05 3	3 2.000E-05	³ RTF(1,2)
D-34	Ac-227+D	<pre>, milk/livestock-intake ratio, (pCi/L)/(pCi/d)</pre>	3 2.000E-05 3	3 2.000E-05	³ RTF(1,3)
D-34	1		3	3	3
	Al-26	, plant/soil concentration ratio, dimensionless	3 4.000E-03		
	Al-26	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3 5.000E-04		
	Al-26	<pre>, milk/livestock-intake ratio, (pCi/L)/(pCi/d)</pre>	3 2.000E-04 3	3 2.000E-04	³ RTF(2,3)
D-34			3 1 000= 00 3	. 1 000= 00	3 7 7 7 2 1 1
	Am-241	, plant/soil concentration ratio, dimensionless	3 1.000E-03		
	Am-241 Am-241	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3 5.000E-05	3 2.000E-05	
D-34 S		, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3 Z.UUUE-UU	2.000E-06	3 KIF(3,3)
	Co-60	, plant/soil concentration ratio, dimensionless	3 8.000E-02	8 በበበፑ=በ2	³ RTF(4,1)
	Co-60	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		3 2.000E-02	
	Co-60	, milk/livestock-intake ratio, (pCi/L)/(pCi/d)		3 2.000E-03	
D-34		, mility livebessii insuite lasto, (pol/l/, (pol/a)	3		3
D-34	Cs-134	, plant/soil concentration ratio, dimensionless	3 4.000E-02 3	4.000E-02	³ RTF(5,1)
D-34	Cs-134	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3 3.000E-02 3	3.000E-02	³ RTF(5,2)
D-34	Cs-134	<pre>, milk/livestock-intake ratio, (pCi/L)/(pCi/d)</pre>	3 8.000E-03	8.000E-03	³ RTF(5,3)
D-34	1		3	3	3
D-34	Cs-137+D	, plant/soil concentration ratio, dimensionless	3 4.000E-02 3	4.000E-02	³ RTF(6,1)
	Cs-137+D	<pre>, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)</pre>	3 3.000E-02		
	Cs-137+D	<pre>, milk/livestock-intake ratio, (pCi/L)/(pCi/d)</pre>		8.000E-03	³ RTF(6,3)
D-34			3 0 500= 00		3 2 2 2 1 1
	Eu-152	, plant/soil concentration ratio, dimensionless	3 2.500E-03		
	Eu-152 Eu-152	<pre>, beef/livestock-intake ratio, (pCi/kg)/(pCi/d) , milk/livestock-intake ratio, (pCi/L)/(pCi/d)</pre>	3 5.000E-05	3 2.000E-03	
D-34 S		, milk/livestock-intake fatto, (pcf/L)/(pcf/d)	3 5.000E-05		3 KIF(/, 5)
	Eu-154	, plant/soil concentration ratio, dimensionless	3 2.500E-03	3 2 500E-03	³ RTF(9,1)
	Eu-154	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3 2.000E-03		
	Eu-154	, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3 5.000E-05		
D-34	ı		3	3	3
D-34	Eu-155	, plant/soil concentration ratio, dimensionless	3 2.500E-03 3	3 2.500E-03	³ RTF(10,1)
D-34 3	Eu-155	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3 2.000E-03 3	3 2.000E-03	³ RTF(10,2)
D-34	Eu-155	<pre>, milk/livestock-intake ratio, (pCi/L)/(pCi/d)</pre>	3 5.000E-05 3	5.000E-05	³ RTF(10,3)
D-34			3	3	3
	Gd-152	, plant/soil concentration ratio, dimensionless			³ RTF(11,1)
	Gd-152	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3 2.000E-03 3		
	Gd-152	, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3 2.000E-05	2.000E-05	3 RTF(11,3)
D-34 3		plant/goil gongontration matic dimangianless	3 1.000E-02	, 3 1 000 = 00	3 ውጥሮ/ 10 1\
	Nb-94 Nb-94	<pre>, plant/soil concentration ratio, dimensionless , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)</pre>			³ RTF(12,1)
	Nb-94 Nb-94	, milk/livestock-intake ratio, (pCi/kg)/(pCi/d)			³ RTF(12, 3)
D-34		, mill, livebecon incane racto, (per/h//per/d)	3 3	3.00000	3
	Np-237+D	, plant/soil concentration ratio, dimensionless	3 2.000E-02 3	3 2.000E-02	³ RTF(13,1)
	Np-237+D	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3 1.000E-03		
	Np-237+D	, milk/livestock-intake ratio, (pCi/L)/(pCi/d)			³ RTF(13,3)
D-34 3	ı		3	3	3

Dose Conversion Factor (and Related) Parameter Summary (continued) File: FGR 13 MORBIDITY

0 3		FILE. FOR 15 MORDIDITI	3	Current	3	Base	3 Da	ramet	er
Menu ³		Parameter	3		3	Case*	3	Name	CI
		TOJOMIT AKKAKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKKK							ääääää
	Pa-231	, plant/soil concentration ratio, dimensionless		1.000E-02					
	Pa-231	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		5.000E-03					
	Pa-231	, milk/livestock-intake ratio, (pCi/L)/(pCi/d)		5.000E-06				. ,	,
D-34 ³		, mility livescook income racto, (per/ly) (per/a)	3		3	J.000L 00	3	(,	<i>J</i> ,
	Pb-210+D	, plant/soil concentration ratio, dimensionless	3	1.000E-02	3	1.000E-02	3 RTF	1 15.	1)
	Pb-210+D	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		8.000E-04					
	Pb-210+D	, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3	3.000E-04					
D-34 ³		,,, (F -= , -), (F -= , -), (F -= , -),	3		3		3	(== ,	- /
	Pu-238	, plant/soil concentration ratio, dimensionless	3	1.000E-03	3	1.000E-03	3 RTE	'(16,	1)
D-34 3	Pu-238	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3	1.000E-04	3	1.000E-04	3 RTE	'(16,	2)
D-34 3	Pu-238	, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3	1.000E-06	3	1.000E-06	3 RTE	'(16,	3)
D-34 3			3	:	3		3		
D-34 3	Pu-239	, plant/soil concentration ratio, dimensionless	3	1.000E-03	3	1.000E-03	3 RTE	18,	1)
D-34 3	Pu-239	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3	1.000E-04	3	1.000E-04	3 RTE	18,	2)
D-34 3	Pu-239	<pre>, milk/livestock-intake ratio, (pCi/L)/(pCi/d)</pre>	3	1.000E-06	3	1.000E-06	3 RTE	18,	3)
D-34 ³			3	:	3		3		
D-34 3	Ra-226+D	, plant/soil concentration ratio, dimensionless	3	4.000E-02	3	4.000E-02	3 RTI	'(19,	1)
D-34 ³	Ra-226+D	<pre>, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)</pre>	3	1.000E-03	3	1.000E-03	3 RTE	'(19,	2)
D-34 ³	Ra-226+D	<pre>, milk/livestock-intake ratio, (pCi/L)/(pCi/d)</pre>	3	1.000E-03	3	1.000E-03	3 RTE	'(19,	3)
D-34 ³			3	:	3		3		
	Sb-125+D	, plant/soil concentration ratio, dimensionless		1.000E-02					
	Sb-125+D	<pre>, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)</pre>		1.000E-03					
	Sb-125+D	, milk/livestock-intake ratio, (pCi/L)/(pCi/d)		1.000E-04		1.000E-04		'(20,	3)
D-34 ³			3		3		3		
	Sr-90+D	, plant/soil concentration ratio, dimensionless		3.000E-01					
	Sr-90+D	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		8.000E-03					
	Sr-90+D	, milk/livestock-intake ratio, (pCi/L)/(pCi/d)		2.000E-03	3	2.000E-03	³ RTE	'(21,	3)
D-34 ³			3		3		3		
	Th-229+D	, plant/soil concentration ratio, dimensionless		1.000E-03					
	Th-229+D	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		1.000E-04					
	Th-229+D	, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3	5.000E-06	2	5.000E-06	3 K.I.F	. (22,	3)
D-34 ³			3	1 0000 00	2	1 0000 00	3 5 5 5		1 \
	Th-230	, plant/soil concentration ratio, dimensionless		1.000E-03					
	Th-230	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		1.000E-04 5.000E-06					
D-34 ³	Th-230	, milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3		3	5.000E-06	3	(23,	3)
	U-233	, plant/soil concentration ratio, dimensionless		2.500E-03		2 500-03		1/ 24	1)
D-34 ³		, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		3.400E-04					
D-34 ³		, milk/livestock-intake ratio, (pCi/L)/(pCi/d)		6.000E-04					
D-34 ³		, milk/livescock incake lacto, (pel/H// (pel/d)	3		3	0.0001 01	3	(21,	5 /
	U-234	, plant/soil concentration ratio, dimensionless	3	2.500E-03	3	2 500E-03	3 RTF	1 25	1)
D-34 ³		, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		3.400E-04					
D-34 ³		, milk/livestock-intake ratio, (pCi/L)/(pCi/d)		6.000E-04					
D-34 ³		, mility livescook income racto, (per/ly) (per/a)	3		3	0.0001 01	3	(23,	5,
	U-235+D	, plant/soil concentration ratio, dimensionless	3	2.500E-03	3	2.500E-03	3 RTF	(26.	1)
	U-235+D	, beef/livestock-intake ratio, (pCi/kg)/(pCi/d)		3.400E-04					
	U-235+D	, milk/livestock-intake ratio, (pCi/L)/(pCi/d)		6.000E-04					
3	-		3		3		3	/	•
D-5 3	Bioaccumul	lation factors, fresh water, L/kg:	3	:	3		3		
	Ac-227+D	, fish	3	1.500E+01	3	1.500E+01	3 BIC	FAC(1,1)
D-5 3	Ac-227+D	, crustacea and mollusks		1.000E+03					1,2)

Dose Conversion Factor (and Related) Parameter Summary (continued)

File: FGR 13 MORBIDITY

0	3	FILE: FGR 13 MO.	3 Curr	ent 3	Base 3	Paramet	. 0.20
Menu		Parameter	³ Val	0110	Dabe	Name	CI
		Parameter ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	,				
	aaaaaaaaaa 3 Al-26	-налалалалалалалалалалалалалалалалалалал			5.000E+02		2,1)
	3 Al-26				1.000E+02		2,1)
	3 3	, crustacea and mollusks	3	3	1.0005+03		4,4)
	3 Am-241	, fish	3 2 000		3.000E+01		3,1)
	3 Am-241	, crustacea and mollusks			1.000E+01		3,2)
	3	, crustacea and morrusks	3	3	1.000103	BIOFAC	3,4)
	³ Co-60	, fish	3 2 000	r⊥∩2 3	3.000E+02	B BIOENC/	4,1)
	³ Co-60	, crustacea and mollusks			2.000E+02		4,2)
	3	, crastacea ana morrasks	3	3	2.0001.02		1,2,
	³ Cs-134	, fish	3 2 000	E+03 3	2.000E+03	BTOFAC(5,1)
	3 Cs-134	, crustacea and mollusks			1.000E+02		5,2)
	3	, oraș cacca ana morraș no	3	3	1.0002.02	,	3,2,
	3 Cs-137+D	, fish	3 2 000	E+03 3	2.000E+03	BTOFAC(6,1)
	3 Cs-137+D	, crustacea and mollusks			1.000E+02		6,2)
	3	, orapoacea and morraphs	3	3	1.0002.02		0,2,
	³ Eu-152	, fish	³ 5.000	E+01 3	5.000E+01	BIOFAC(7,1)
	³ Eu-152	, crustacea and mollusks			1.000E+03		7,2)
	3	,	3	3	1		. ,
	³ Eu-154	, fish	³ 5.000	E+01 3	5.000E+01	BIOFAC(9,1)
	³ Eu-154	, crustacea and mollusks			1.000E+03		9,2)
D-5	3	•	3	3	3	3	
D-5	³ Eu-155	, fish	³ 5.000	E+01 3	5.000E+01	BIOFAC(10,1)
D-5	³ Eu-155	, crustacea and mollusks	3 1.000	E+03 3	1.000E+03	BIOFAC(10,2)
D-5	3		3	3	3	3	
D-5	³ Gd-152	, fish	3 2.500	E+01 3	2.500E+01	BIOFAC(11,1)
D-5	³ Gd-152	, crustacea and mollusks	3 1.000	E+03 3	1.000E+03	BIOFAC(11,2)
D-5	3		3	3	1	3	
D-5	3 Nb-94	, fish	3 3.000	E+02 3	3.000E+02	BIOFAC(12,1)
D-5	3 Nb-94	, crustacea and mollusks	3 1.000	E+02 3	1.000E+02	BIOFAC(12,2)
D-5	3		3	3	1	3	
	³ Np-237+D	, fish			3.000E+01		
	³ Np-237+D	, crustacea and mollusks	³ 4.000		4.000E+02		13,2)
D-5	3		3	3	1		
	³ Pa-231	, fish			1.000E+01		
	³ Pa-231	, crustacea and mollusks	³ 1.100		1.100E+02	BIOFAC(14,2)
D-5	3		3	3			
	³ Pb-210+D	, fish			3.000E+02		
	³ Pb-210+D	, crustacea and mollusks	3 1.000		1.000E+02	BIOFAC(15,2)
ט ט	3 - 000	6' 1	3 2 2 2 2	3	2 000= 01		16 1)
	³ Pu-238	, fish			3.000E+01		
	³ Pu-238 ³	, crustacea and mollusks	3 1.000	E+02 3	1.000E+02	BIOFAC(16,2)
ט ט		64	3 2 000	n. 01 2	2 0000.01	, , , , , , , , , , , , , , , , , , , ,	10 1)
	³ Pu-239	, fish			3.000E+01		
	³ Pu-239 ₃	, crustacea and mollusks	3 1.000	E+UZ 3	1.000E+02	BIOFAC(18,2)
	3 Ra-226+D	, fish	3 5 000		5.000E+01	B BIOENC/	10 11
		, crustacea and mollusks			2.500E+01 3		
	3 Ra-220+D	, crastacca and morrashs	3	3	2.500102	BIOLUC (10,41
	³ Sb-125+D	fich	3 1 000		1.000E+02	BIOFAC/	20 11
		, crustacea and mollusks			1.000E+01		
	3	,	3	3		BIOTAC	_ = (/ _ /

Dose Conversion Factor (and Related) Parameter Summary (continued) File: FGR 13 MORBIDITY

0	3		3	Current	3	Base	3	Paramet	cer
Menu	3	Parameter	3	Value	3	Case*	3	Name	
ÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	. AÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÅ	ÄÄÄÄÄÄÄÄÄÄ	ÀŻ	ÄÄÄÄÄÄÄÄÄÄÄÄ	ÅÅ	نَدْدُدُدُدُ نَدْدُدُدُدُ	ÄÄÄÄÄÄ
D-5	3 Sr-90+D	, fish	3	6.000E+01	3	6.000E+01	3	BIOFAC(21,1)
D-5	3 Sr-90+D	, crustacea and mollusks	3	1.000E+02	3	1.000E+02	3	BIOFAC(21,2)
D-5	3		3		3		3		
D-5	3 Th-229+D	, fish	3	1.000E+02	3	1.000E+02	3	BIOFAC(22,1)
D-5	3 Th-229+D	, crustacea and mollusks	3	5.000E+02	3	5.000E+02	3	BIOFAC(22,2)
D-5	3		3		3		3		
D-5	3 Th-230	, fish	3	1.000E+02	3	1.000E+02	3	BIOFAC(23,1)
D-5	3 Th-230	, crustacea and mollusks	3	5.000E+02	3	5.000E+02	3	BIOFAC(23,2)
D-5	3		3		3		3		
D-5	³ U-233	, fish	3	1.000E+01	3	1.000E+01	3	BIOFAC(24,1)
D-5	³ U-233	, crustacea and mollusks	3	6.000E+01	3	6.000E+01	3	BIOFAC(24,2)
D-5	3		3		3		3		
D-5	³ U-234	, fish	3	1.000E+01	3	1.000E+01	3	BIOFAC(25,1)
D-5	³ U-234	, crustacea and mollusks	3	6.000E+01	3	6.000E+01	3	BIOFAC(25,2)
D-5	3		3		3		3		
D-5	3 U-235+D	, fish	3	1.000E+01	3	1.000E+01	3	BIOFAC(26,1)
D-5	3 U-235+D	, crustacea and mollusks	3	6.000E+01	3	6.000E+01	3	BIOFAC(26,2)
ÍÍÍÍÍ	ÏÍÍÍÍÍÍÍÍÍÍ		ÍÍÏ	ííííííííííííííííííííííííííííííííííííííí	ÍÏÍ	ííííííííííííííííííííííííííííííííííííííí	ĹΪ	ÍÍÍÍÍÍÍÍ	íííííí

^{*}Base Case means Default.Lib w/o Associate Nuclide contributions.

Summary : CAU 478

Site-Specific Parameter Summary 0 3 User 3 3 Used by RESRAD 3 Parameter Menu ³ Parameter Input ³ Default ³ (If different from user input) ³ Name R011 ³ Area of contaminated zone (m**2) ³ 1.000E+02 ³ 1.000E+04 ³ R011 ³ Thickness of contaminated zone (m) 3 1.500E-01 3 2.000E+00 3 3 THICKO 3 not used 3 1.000E+02 3 R011 ³ Length parallel to aquifer flow (m) 3 LCZPAO R011 ³ Basic radiation dose limit (mrem/yr) 3 2.500E+01 3 3.000E+01 3 3 BRDL RO11 3 Time since placement of material (yr) 3 0.000E+00 3 0.000E+00 3 3 TI R011 ³ Times for calculations (yr) 3 1.000E+00 3 1.000E+00 3 3 T(2) 3 5.000E+00 3 5.000E+01 3 1.000E+01 3 1.232E+01 3 3.000E+01 3 1.500E+01 3 1.000E+02 3 2.000E+01 3 3.000E+02 3 R011 ³ Times for calculations (yr) ³ T(3) R011 ³ Times for calculations (yr) ³ T(4) R011 ³ Times for calculations (yr) 3 T(5) R011 ³ Times for calculations (yr) 3 T(6) ³ T(7) R011 ³ Times for calculations (yr) R011 ³ Times for calculations (yr) 3 T(8) R011 ³ Times for calculations (yr) 3 T(9) 3 T(10) R011 ³ Times for calculations (yr) 3 3 R012 ³ Initial principal radionuclide (pCi/g): Al-26 ³ 2.500E-01 ³ 0.000E+00 ³ 3 S1(2) R012 ³ Initial principal radionuclide (pCi/g): Am-241 ³ 1.100E+01 ³ 0.000E+00 ³ 3 S1(3) R012 ³ Initial principal radionuclide (pCi/q): Co-60 ³ 7.700E-01 ³ 0.000E+00 ³ 3 S1(4) R012 ³ Initial principal radionuclide (pCi/q): Cs-134 ³ 2.000E-01 ³ 0.000E+00 ³ 3 S1(5) R012 ³ Initial principal radionuclide (pCi/g): Cs-137 ³ 3.660E+02 ³ 0.000E+00 ³ 3 S1(6) R012 3 Initial principal radionuclide (pCi/q): Eu-152 3 1.300E+00 3 0.000E+00 3 3 S1(7) R012 ³ Initial principal radionuclide (pCi/g): Eu-154 ³ 2.300E+00 ³ 0.000E+00 ³ 3 S1(9) R012 ³ Initial principal radionuclide (pCi/g): Eu-155 ³ 1.100E+00 ³ 0.000E+00 ³ 3 S1(10) 3 S1(12) R012 ³ Initial principal radionuclide (pCi/g): Nb-94 ³ 1.700E-01 ³ 0.000E+00 ³ R012 ³ Initial principal radionuclide (pCi/g): Pu-238 ³ 7.060E+00 ³ 0.000E+00 ³ 3 S1(16) R012 ³ Initial principal radionuclide (pCi/q): Pu-239 ³ 7.900E+01 ³ 0.000E+00 ³ 3 S1(18) 3 S1(20) R012 ³ Initial principal radionuclide (pCi/q): Sb-125 ³ 8.300E+00 ³ 0.000E+00 ³ 3 S1(21) R012 ³ Initial principal radionuclide (pCi/g): Sr-90 ³ 2.280E+01 ³ 0.000E+00 ³ R012 ³ Initial principal radionuclide (pCi/g): U-235 3 1.500E+00 3 0.000E+00 3 3 S1(26) R012 ³ Concentration in groundwater (pCi/L): A1-26 ³ not used ³ 0.000E+00 ³ 3 W1(2) R012 ³ Concentration in groundwater (pCi/L): Am-241 ³ not used ³ 0.000E+00 ³ 3 W1(3) R012 ³ Concentration in groundwater (pCi/L): Co-60 ³ not used ³ 0.000E+00 ³ 3 W1(4) R012 3 Concentration in groundwater (pCi/L): Cs-134 3 not used 3 0.000E+00 3 3 W1(5) R012 ³ Concentration in groundwater (pCi/L): Cs-137 ³ not used ³ 0.000E+00 ³ 3 W1(6) R012 ³ Concentration in groundwater (pCi/L): Eu-152 3 not used 3 0.000E+00 3 3 W1(7) R012 ³ Concentration in groundwater (pCi/L): Eu-154 ³ not used ³ 0.000E+00 ³ 3 W1(9) R012 ³ Concentration in groundwater (pCi/L): Eu-155 ³ not used ³ 0.000E+00 ³ 3 W1(10) 3 W1(12) R012 ³ Concentration in groundwater (pCi/L): Nb-94 ³ not used ³ 0.000E+00 ³ R012 ³ Concentration in groundwater (pCi/L): Pu-238 3 not used 3 0.000E+00 3 3 W1(16) R012 ³ Concentration in groundwater (pCi/L): Pu-239 ³ not used ³ 0.000E+00 ³ 3 W1(18) (pCi/L): Sb-125 ³ not used ³ 0.000E+00 ³ 3 W1(20) R012 ³ Concentration in groundwater R012 ³ Concentration in groundwater (pCi/L): Sr-90 ³ not used ³ 0.000E+00 ³ 3 W1(21) (pCi/L): U-235 ³ not used ³ 0.000E+00 ³ R012 ³ Concentration in groundwater 3 W1(26) 3 3 3 3 3 0.000E+00 3 0.000E+00 3 3 COVERO R013 ³ Cover depth (m) R013 ³ Density of cover material (q/cm**3) 3 not used 3 1.500E+00 3 3 DENSCV R013 ³ Cover depth erosion rate (m/yr) 3 not used 3 1.000E-03 3 3 VCV 3 1.500E+00 3 1.500E+00 3 3 DENSCZ R013 3 Density of contaminated zone (g/cm**3) R013 ³ Contaminated zone erosion rate (m/yr) ³ 1.000E-03 ³ 1.000E-03 ³ R013 ³ Contaminated zone total porosity ³ 4.000E-01 ³ 4.000E-01 ³ R013 ³ Contaminated zone field capacity ³ 2.000E-01 ³ 2.000E-01 ³ 3 VCZ 3 TPCZ

3 FCCZ

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Site-Specific Parameter Summary (continued) 0 3 3 User 3 3 Used by RESRAD ³ Parameter 3 Input 3 Default 3 (If different from user input) 3 Name Menu ³ R013 3 Contaminated zone hydraulic conductivity (m/yr) 3 1.000E+01 3 1.000E+01 3 ---3 HCCZ R013 3 Contaminated zone b parameter 3 5.300E+00 3 5.300E+00 3 3 BCZ 3 5.170E+00 3 2.000E+00 3 3 not used 3 8.000E+00 3 5.000E-01 3 5.000E-01 3 2.000E+00 3 R013 3 Average annual wind speed (m/sec) R013 3 Humidity in air (g/m**3) 3 WIND 3 HUMID 3 5.000E-01 3 5.000E-01 3 3 3.045E-01 3 1.000E+00 3 0.000E+00 3 2.000E-01 3 overhead 3 4.000E-01 3 2.000E-01 3 R013 ³ Evapotranspiration coefficient R013 ³ Precipitation (m/yr) 3 EVAPTR 3 PRECTP R013 ³ Irrigation (m/yr) 3 RI R013 ³ Irrigation mode 3 IDITCH R013 ³ Runoff coefficient 3 4.000E-01 3 2.000E-01 3 3 RUNOFF 3 WAREA R013 ³ Watershed area for nearby stream or pond (m**2) ³ not used ³ 1.000E+06 ³ R013 3 Accuracy for water/soil computations

R014 3 Density of saturated zone (g/cm**3) 3 not used 3 1.500E+00 3
R014 3 Saturated zone total porosity 3 not used 3 4.000E-01 3
R014 3 Saturated zone effective porosity 3 not used 3 2.000E-01 3
R014 3 Saturated zone field capacity 3 not used 3 2.000E-01 3
R014 3 Saturated zone field capacity 3 not used 3 2.000E-01 3
R014 3 Saturated zone hydraulic conductivity (m/yr) 3 not used 3 1.000E+02 3
3 not used 3 2.000E-02 3 3 not used 3 1.000E-03 3 ---3 EPS 3 DENSAQ 3 TPSZ 3 EPSZ 3 FCSZ 3 HCSZ R014 ³ Saturated zone hydraulic gradient ³ not used ³ 2.000E-02 ³ R014 ³ Saturated zone b parameter ³ not used ³ 5.300E+00 ³ R014 ³ Water table drop rate (m/yr) ³ not used ³ 1.000E-03 ³ 3 HGWT 3 BSZ 3 VWT R014 ³ Well pump intake depth (m below water table) ³ not used ³ 1.000E+01 ³ 3 DWIBWT R014 ³ Model: Nondispersion (ND) or Mass-Balance (MB) ³ not used ³ ND ³ 3 MODEL R014 3 Well pumping rate (m**3/yr)

R014 3 Well pumping rate (m**3/yr)

R015 3 Number of unsaturated zone strata

R015 3 Unsat. zone 1, thickness (m)

R015 3 Unsat. zone 1, soil density (g/cm**3)

R015 3 Unsat. zone 1, total poposity

R015 3 Unsat. zone 1, total poposity

R015 3 Unsat. zone 1, total poposity

3 not used 3 1.500E+00 3

R015 3 Unsat. zone 1, total poposity

3 not used 3 4.000E+01 3 3 LIM 3 NS 3 H(1) 3 DENSUZ(1) R015 ³ Unsat. zone 1, total porosity ³ not used ³ 4.000E-01 ³ R015 ³ Unsat. zone 1, effective porosity ³ not used ³ 2.000E-01 ³ R015 ³ Unsat. zone 1, field capacity ³ not used ³ 2.000E-01 ³ 3 TPUZ(1) 3 EPUZ(1) 3 FCUZ(1) R015 ³ Unsat. zone 1, soil-specific b parameter ³ not used ³ 5.300E+00 ³ 3 BUZ(1) R015 ³ Unsat. zone 1, hydraulic conductivity (m/yr) 3 not used 3 1.000E+01 3 3 HCUZ(1) 3 3 R016 ³ Distribution coefficients for Al-26 R016 3 Contaminated zone (cm**3/g) 3 0.000E+00 3 0.000E+00 3 R016 3 Unsaturated zone 1 (cm**3/g) 3 not used 3 0.000E+00 3 R016 3 Saturated zone (cm**3/g) 3 not used 3 0.000E+00 3 R016 3 Leach rate (/yr) 3 0.000E+00 3 0.000E+00 3 R016 3 Solubility constant 3 0.000E+00 3 0.000E+00 3 R016 3 Distribution coefficients for Am-241 3 3 3 R016 3 Contaminated zone (cm**3/g) 3 2.000E+01 3 2.000E+01 3 R016 ³ Contaminated zone (cm**3/g) 3 0.000E+00 3 0.000E+00 3 3 DCNUCC(2) 3 DCNUCU(2,1) 3 DCNUCS(2) 2.150E+00 not used 3 ALEACH(2) 3 SOLUBK(2) 3 2.000E+01 3 2.000E+01 3 3 not used 3 2.000E+01 3 3 not used 3 2.000E+01 3 3 0.000E+00 3 0.000E+00 3 0.000E+00 3 0.000E+00 3 Contaminated zone (cm**3/g) 3 DCNUCC(3) Unsaturated zone 1 (cm**3/q) 3 DCNUCU(3,1) R016 ³ Saturated zone (cm**3/g) R016 ³ 3 DCNUCS(3) 2.011E-02 3 ALEACH(3) R016 ³ Leach rate (/yr) Solubility constant 3 0.000E+00 3 0.000E+00 3 not used 3 SOLUBK(3)

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R016 ³ Leach rate (/yr)

R016 ³ Solubility constant

Site-Specific Parameter Summary (continued) ³ User ³ Used by RESRAD ³ Parameter 0 3 3 Input 3 Default 3 (If different from user input) 3 Name Menu ³ R016 ³ Distribution coefficients for Co-60 ³ ³ R016 ³ Contaminated zone (cm**3/g) 3 1.000E+03 3 1.000E+03 3 3 DCNUCC(4) R016 3 Unsaturated zone (cm**3/g) 3 1.000E+03 3 1.000E+03 3 --- 3 DCNUCC(4) R016 3 Saturated zone (cm**3/g) 3 not used 3 1.000E+03 3 --- 3 DCNUCU(4,1 R016 3 Leach rate (/yr) 3 0.000E+00 3 0.000E+00 3 4.059E-04 3 ALEACH(4) R016 3 Solubility constant 3 0.000E+00 3 0.000E+00 3 not used 3 SOLUBK(4) R016 3 Distribution coefficients for Cs-134 3 3 3 3 3 3 R016 3 Contaminated zone (cm**3/g) 3 4.600E+03 3 4.600E+03 3 --- 3 DCNUCC(5) R016 3 Unsaturated zone 1 (cm**3/g) 3 not used 3 4.600E+03 3 --- 3 DCNUCC(5) R016 3 Contaminated zone 1 (cm**3/g) 3 not used 3 4.600E+03 3 --- 3 DCNUCC(5) R016 3 Contaminated zone (cm**3/g) 3 not used 3 4.600E+03 3 --- 3 DCNUCC(5) R016 3 Contaminated zone (cm**3/g) 3 not used 3 4.600E+03 3 --- 3 DCNUCC(5) ³ DCNUCU(4,1) 3 DCNUCU(5,1) 3 not used 3 4.600E+03 3 --3 0.000E+00 3 0.000E+00 3 8.826E-05
3 0.000E+00 3 0.000E+00 3 not used
3 3 3 3 3 DCNUCU(6,1) R016 ³ Distribution coefficients for Eu-152 R016 ³ Contaminated zone (cm**3/q) Unsaturated zone 1 (cm**3/g) 3 DCNUCU(7,1) R016 ³ Saturated zone (cm**3/g) R016 ³ Leach rate (/yr)
R016 ³ Solubility constant 3 R016 ³ Distribution coefficients for Eu-154 ³ DCNUCC(9)
 ³ DCNUCU(9,1) R016 ³ Contaminated zone (cm**3/g) R016 ³ Unsaturated zone 1 (cm**3/q) R016 ³ Saturated zone (cm**3/g) R016 ³ Saturated zone (cm 5,5, R016 ³ Leach rate (/yr) R016 ³ Solubility constant R016 ³ Distribution coefficients for Eu-155 R016 ³ Contaminated zone (cm**3/g) R016 ³ Unsaturated zone 1 (cm**3/g) 3 not used 3-1.000E+00 3 3 DCNUCU(10,1) 3 0.000E+00 3 0.000E+00 3 4.921E-04
3 0.000E+00 3 0.000E+00 3 not used
3 3 3 3 3 R016 ³ Saturated zone (cm**3/g) 3 DCNUCS(10) R016 3 Saturated Zone (cm. 5,5, R016 3 Leach rate (/yr) 3 0.000E+00 3 0.000E+00 - R016 3 Solubility constant 3 0.000E+00 3 0.000E+00 3 3 3 3 3 ALEACH(10) 3 SOLUBK(10) R016 ³ Distribution coefficients for Nb-94 3 0.000E+00 3 0.000E+00 3 not used 3 0.000E+00 3 R016 ³ Contaminated zone (cm**3/g) 3 DCNUCC(12) Unsaturated zone 1 (cm**3/g) 3 DCNUCU(12,1) R016 ³ 3 not used 3 0.000E+00 3 Saturated zone (cm**3/g) 3 DCNUCS(12)

3 0.000E+00 3 0.000E+00 3

3 0.000E+00 3 0.000E+00 3

2.150E+00

not used

3 ALEACH(12)

3 SOLUBK(12)

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Site-Specific Parameter Summary (continued) 0 3 ³ User ³ Used by RESRAD ³ Parameter 3 Input 3 Default 3 (If different from user input) 3 Name Menu ³ R016 ³ Distribution coefficients for Pu-238 ³ ³ 3 2.000E+03 3 2.000E+03 3 R016 ³ Contaminated zone (cm**3/g) DCNUCC(16)
DCNUCU(16,1) 3 DCNUCC(16) R016 3 Unsaturated zone (cm**3/g) 3 2.000E+03 3 2.000E+03 3 --- 3 DCNUCC(16), R016 3 Saturated zone (cm**3/g) 3 not used 3 2.000E+03 3 --- 3 DCNUCU(16,1 R016 3 Leach rate (/yr) 3 0.000E+00 3 0.000E+00 3 2.030E-04 3 ALEACH(16) R016 3 Solubility constant 3 0.000E+00 3 0.000E+00 3 not used 3 SOLUBK(16) 3 R016 3 Distribution coefficients for Pu-239 3 3 3 3 R016 3 Contaminated zone (cm**3/g) 3 2.000E+03 3 2.000E+03 3 --- 3 DCNUCC(18) R016 3 Unsaturated zone 1 (cm**3/g) 3 not used 3 2.000E+03 3 --- 3 DCNUCC(18) R016 3 Contaminated zone 1 (cm**3/g) 3 not used 3 2.000E+03 3 --- 3 DCNUCC(18) R016 3 Contaminated zone 2 Cm**3/g) 3 not used 3 2.000E+03 3 --- 3 DCNUCC(18) R016 3 Contaminated zone 2 Cm**3/g) 3 not used 3 2.000E+03 3 --- 3 DCNUCC(18) 3 DCNUCS(16) 3 DCNUCU(18,1) 3 DCNUCU(20,1) 3 DCNUCU(21,1) 3 DCNUCU(26,1) 3 DCNUCU(1,1) R016 ³ Unsaturated zone 1 (cm**3/g) 3 not used 3 2.000E+01 3 R016 ³ Saturated zone (cm**3/g) 3 not used 3 2.000E+01 3 3 not used 3 2.000E+01 3 --3 0.000E+00 3 0.000E+00 3 2.011E-02
3 0.000E+00 3 0.000E+00 3 not used
3 3 3 3 3 DCNUCS(1) R016 ³ Leach rate (/yr) 3 ALEACH(1) 3 SOLUBK(1)
3
3-1.000E+00 3-1.000E+00 3 8.249E+02 3 DCNUCC(11)
3 not used 3-1.000E+00 3 --- 3 DCNUCU(11,1
3 not used 3-1.000E+00 3 --3 0.000E+00 3 0.000E+00 3 R016 ³ Solubility constant 3 SOLUBK(1) R016 3 Distribution coefficients for daughter Gd-152 3 3 R016 ³ Contaminated zone (cm**3/g) Unsaturated zone 1 (cm**3/g) 3 DCNUCU(11,1) R016 ³ Saturated zone (cm**3/g) 3 not used 3-1.000E+00 3 3 0.000E+00 3 0.000E+00 3 R016 ³ Leach rate (/yr) R016 ³ Solubility constant 3 SOLUBK(11) 3 0.000E+00 3 0.000E+00 3 not used

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R016 ³ Solubility constant

Site-Specific Parameter Summary (continued) 0 3 ³ User ³ Used by RESRAD ³ Parameter 3 Input 3 Default 3 (If different from user input) 3 Name Menu ³ 3 DCNUCC(13) 3 DCNUCU(13,1) R016 3 Saturated zone (cm**3/g) 3 not used 3-1.000E+00 3 --- 3 DCNUCS(13)
R016 3 Leach rate (/yr) 3 0.000E+00 3 0.000E+00 3 1.576E-03 3 ALEACH(13)
R016 3 Solubility constant 3 0.000E+00 3 0.000E+00 3 not used 3 SOLUBK(13)
R016 3 Distribution coefficients for daughter Pa-231 3 3 3 3 3 DCNUCS(13) 3 5.000E+01 3 5.000E+01 3 3 DCNUCC(14) - not used 3 5.000E+01 3 --3 0.000E+00 3 0.000E+00 3 0.000E+00 3 8.089E-03
not used
3 0.000E+00 3 0.000E+00 3 0.000E+00 3 not used
3 0.000E+00 3 0.000E+00 3 0.000E+00 3 not used
3 0.000E+00 3 0.000E+00 3 0.000E+00 3 not used
3 0.000E+00 3 0.000 Contaminated zone (cm**3/g) 3 DCNUCU(14,1) 3 DCNUCS(14) 3 ALEACH(14) 3 SOLUBK (14) DCNUCC(15)
 DCNIICII(15) 3 DCNUCU(15,1) 3 DCNUCS(15) 3 ALEACH(15) 3 0.000L
3 3 3 3
3 7.000E+01 3 7.000E+01 3 --3 not used 3 7.000E+01 3 --- 3 DCNUCS(19)
3 0.000E+00 3 0.000E+00 3 5.784E-03 3 ALEACH(19)
3 0.000E+00 3 0.000E+00 3 not used 3 SOLUBK(19)
3 0.000E+00 3 0.000E+00 3 --- 3 DCNUCS(22)
3 DCNUCC(22 3 DCNUCC(22) 3 SOLUBK(15) R016 ³ Contaminated zone (cm**3/g) 3 DCNUCU(19,1) Unsaturated zone 1 (cm**3/q) Saturated zone (cm**3/g) R016 ³ R016 ³ Leach rate (/yr) R016 ³ Solubility constant 3 R016 ³ Distribution coefficients for daughter Th-229 ³ 3 DCNUCU(22,1) 3 not used 3 6.000E+04 3 R016 ³ Unsaturated zone 1 (cm**3/g) 3 DCNUCU(23,1) R016 3 Distribution coefficients for daughter U-233 R016 3 Contaminated zone (cm**3/g) R016 3 Unsaturated zone 1 (cm**3/g) Saturated zone 2 Sa R016 ³ Saturated zone (cm**3/g) 3 DCNUCS(23) 3 ALEACH(23) 3 SOLUBK(23) 3 DCNUCC (24) 3 DCNUCU(24,1) 3 DCNUCS(24) 8.089E-03 R016 ³ Leach rate (/yr) 3 0.000E+00 3 0.000E+00 3 3 ALEACH(24)

3 0.000E+00 3 0.000E+00 3

not used

3 SOLUBK(24)

Site-Specific Parameter Summary (continued) 0 3 User 3 Used by RESRAD 3 Parameter 3 Input 3 Default 3 (If different from user input) 3 Name Menu ³ R016 ³ Distribution coefficients for daughter U-234 ³ ³ ³ R016 3 Contaminated zone (cm**3/g) 3 5.000E+01 3 5.000E+01 3 --R016 3 Unsaturated zone 1 (cm**3/g) 3 not used 3 5.000E+01 3 --R016 3 Saturated zone (cm**3/g) 3 not used 3 5.000E+01 3 --R016 3 Leach rate (/yr) 3 0.000E+00 3 0.000E+00 3 8.089E-03
R016 3 Solubility constant 3 0.000E+00 3 0.000E+00 3 not used

8 R017 3 Inhalation rate (m**3/yr) 3 1.230E+04 3 8.400E+03 3 --R017 3 Mass loading for inhalation (g/m**3) 3 6.000E+04 3 1.000E+04 3 --R017 3 Exposure duration 3 2.500E+01 3 3.000E+01 3 --R017 3 Shielding factor, inhalation 3 1.000E+00 3 4.000E-01 3 --R017 3 Fraction of time spent indoors 3 1.000E+00 3 7.000E-01 3 --R017 3 Fraction of time spent outdoors (on site) R017 3 Shape factor flag, external gamma 3 1.000E+00 3 2.500E+01 3 --R017 3 Radii of shape factor array (used if FS = -1): 3 3 800E+00 3 5.000E+00 3 >0 shows circular AREA. R016 3 Contaminated zone (cm**3/g) 3 5.000E+01 3 5.000E+01 3 3 DCNUCC(25) 3 DCNUCU(25,1) 3 DCNUCS(25) 3 ALEACH(25) 3 SOLUBK(25) 3 INHALR 3 MLINH 3 ED 3 SHF3 3 SHF1 3 FIND 3 FOTD R017 3 Radii of shape factor array (used if FS = -1): 3 3 3 3 R017 3 Outer annular radius (m), ring 1: 3 not used 3 5.000E+01 3 R017 3 Outer annular radius (m), ring 2: 3 not used 3 7.071E+01 3 3 RAD SHAPE(1) 3 not used -
3 not used 3 0.000E+00 3
3 not used 3 0.000E+00 3 3 RAD_SHAPE(2) 3 not used 3 0.000E+00 3 --3 not used 3 0.000E+00 3 ---Outer annular radius (m), ring 3: 3 RAD SHAPE(3) R017 3 Outer annular radius (m), ring 4: 3 RAD SHAPE(4) 3 RAD_SHAPE(5) Outer annular radius (m), ring 5: R017 ³ Outer annular radius (m), ring 6: 3 RAD SHAPE(6) R017 ³ R017 ³ Outer annular radius (m), ring 7: 3 RAD SHAPE(7) 3 RAD SHAPE(8) Outer annular radius (m), ring 8: R017 ³ Outer annular radius (m), ring 9: 3 RAD SHAPE(9) Outer annular radius (m), ring 10: 3 RAD SHAPE(10) R017 ³ Outer annular radius (m), ring 11: 3 RAD SHAPE(11) Outer annular radius (m), ring 12: 3 RAD_SHAPE(12) R017 ³ R017 ³ Fractions of annular areas within AREA: 3 FRACA(1) R017 ³ Ring 1 R017 ³ Ring 2 3 FRACA(2) R017 ³ Ring 3 3 FRACA(3) Ring 4 3 FRACA(4) R017 ³ 3 FRACA(5) R017 ³ Ring 5 R017 ³ Ring 6 3 FRACA(6) R017 ³ Ring 7 3 FRACA(7) 3 FRACA(8) R017 ³ Ring 8 3 FRACA(9) R017 ³ Ring 9 R017 ³ Ring 10 3 not used 3 0.000E+00 3 3 FRACA(10) R017 ³ 3 not used 3 0.000E+00 3 3 FRACA(11) Ring 11 3 not used 3 0.000E+00 3 R017 ³ Ring 12 3 FRACA(12) R018 ³ Fruits, vegetables and grain consumption (kg/yr) ³ not used ³ 1.600E+02 ³ 3 DIET(1) R018 ³ Leafy vegetable consumption (kg/yr) 3 not used 3 1.400E+01 3 3 DIET(2) ³ not used ³ 9.200E+01 ³ R018 ³ Milk consumption (L/yr) 3 DIET(3) R018 3 Milk consumption (L/yr) $^{\circ}$ Not used $^{\circ}$ 3.200E+01 $^{\circ}$ R018 3 Meat and poultry consumption (kg/yr) $^{\circ}$ not used $^{\circ}$ 5.200E+01 $^{\circ}$ R018 3 Fish consumption (kg/yr) $^{\circ}$ not used $^{\circ}$ 5.400E+00 $^{\circ}$ 3 DIET(4) 3 DIET(5) 3 DIET(6) 3 SOIL 3 DWT

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Site-Specific Parameter Summary (continued) 0 3 User 3 3 3 Parameter Used by RESRAD Menu ³ Input ³ Default ³ (If different from user input) ³ Name R018 ³ Contamination fraction of drinking water 3 not used 3 1.000E+00 3 3 FDW R018 ³ Contamination fraction of household water 3 not used 3 1.000E+00 3 3 FHHW R018 ³ Contamination fraction of livestock water 3 not used 3 1.000E+00 3 3 FT.W R018 ³ Contamination fraction of irrigation water 3 not used 3 1.000E+00 3 3 FIRW ³ not used ³ 5.000E-01 ³ R018 ³ Contamination fraction of aquatic food 3 FR9 R018 ³ Contamination fraction of plant food 3 not used 3-1 3 FPLANT 3 not used 3-1 3 FMEAT R018 ³ Contamination fraction of meat R018 ³ Contamination fraction of milk 3 not used 3-1 3 FMILK ³ not used ³ 6.800E+01 ³ 3 LFI5 R019 ³ Livestock fodder intake for meat (kg/day) R019 ³ Livestock fodder intake for milk (kg/day) ³ not used ³ 5.500E+01 ³ 3 LFI6 ³ not used ³ 5.000E+01 ³ R019 ³ Livestock water intake for meat (L/day) 3 LWI5 R019 ³ Livestock water intake for milk (L/day) 3 not used 3 1.600E+02 3 3 T.WT6 R019 3 Livestock soil intake (kg/day) 3 not used 3 5.000E-01 3 3 T.S.T R019 3 Mass loading for foliar deposition (g/m**3) 3 not used 3 1.000E-04 3 3 MIJFD 3 1.500E-01 3 1.500E-01 3 3 DM R019 3 Depth of soil mixing layer (m) R019 3 Depth of roots (m) 3 not used 3 9.000E-01 3 3 DROOT R019 ³ Drinking water fraction from ground water ³ not used ³ 1.000E+00 ³ 3 FGWDW 3 not used 3 1.000E+00 3 R019 ³ Household water fraction from ground water 3 FGWHH R019 ³ Livestock water fraction from ground water 3 not used 3 1.000E+00 3 3 FGWLW R019 ³ Irrigation fraction from ground water ³ not used ³ 1.000E+00 ³ 3 FGWIR ³ not used ³ 7.000E-01 ³ 3 YV(1) R19B ³ Wet weight crop yield for Non-Leafy (kg/m**2) R19B ³ Wet weight crop yield for Leafy (kg/m**2) ³ not used ³ 1.500E+00 ³ 3 YV(2) R19B ³ Wet weight crop yield for Fodder (kq/m**2)3 not used 3 1.100E+00 3 3 YV(3) R19B ³ Growing Season for Non-Leafy (years) ³ not used ³ 1.700E-01 ³ 3 TE(1) 3 TE(2) R19B ³ Growing Season for Leafy (vears) ³ not used ³ 2.500E-01 ³ 3 not used 3 8.000E-02 3 R19B ³ Growing Season for Fodder (years) 3 TE(3) R19B ³ Translocation Factor for Non-Leafy 3 not used 3 1.000E-01 3 3 TIV(1) R19B ³ Translocation Factor for Leafy ³ not used ³ 1.000E+00 ³ 3 TIV(2) R19B ³ Translocation Factor for Fodder 3 not used 3 1.000E+00 3 3 TIV(3) R19B ³ Dry Foliar Interception Fraction for Non-Leafy ³ not used ³ 2.500E-01 ³ 3 RDRY(1) R19B ³ Dry Foliar Interception Fraction for Leafy 3 not used 3 2.500E-01 3 3 RDRY(2) 3 not used 3 2.500E-01 3 R19B ³ Dry Foliar Interception Fraction for Fodder 3 RDRY(3) R19B ³ Wet Foliar Interception Fraction for Non-Leafy ³ not used ³ 2.500E-01 ³ 3 RWET(1) R19B ³ Wet Foliar Interception Fraction for Leafy ³ not used ³ 2.500E-01 ³ 3 RWET(2) R19B ³ Wet Foliar Interception Fraction for Fodder ³ not used ³ 2.500E-01 ³ 3 RWET(3) 3 not used 3 2.000E+01 3 R19B ³ Weathering Removal Constant for Vegetation 3 WT.AM C14 ³ C-12 concentration in water (g/cm**3) ³ not used ³ 2.000E-05 ³ 3 C12WTR ³ not used ³ 3.000E-02 ³ C14 ³ C-12 concentration in contaminated soil (g/g) 3 C12C7 C14 ³ Fraction of vegetation carbon from soil 3 not used 3 2.000E-02 3 3 CSOIL C14 ³ Fraction of vegetation carbon from air 3 not used 3 9.800E-01 3 3 CAIR C14 ³ C-14 evasion layer thickness in soil (m) ³ not used ³ 3.000E-01 ³ 3 DMC C14 ³ C-14 evasion flux rate from soil (1/sec) ³ not used ³ 7.000E-07 ³ 3 EVSN C14 ³ C-12 evasion flux rate from soil (1/sec) ³ not used ³ 1.000E-10 ³ 3 REVSN C14 ³ Fraction of grain in beef cattle feed ³ not used ³ 8.000E-01 ³ 3 AVFG4 3 not used 3 2.000E-01 3 3 AVFG5 C14 ³ Fraction of grain in milk cow feed C14 ³ DCF correction factor for gaseous forms of C14 3 not used 3 0.000E+00 3 3 CO2F STOR ³ Storage times of contaminated foodstuffs (days): ³

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Site-Specific Parameter Summary (continued) 0 3 User 3 3 Parameter Used by RESRAD Input ³ Default ³ (If different from user input) ³ Menu ³ Fruits, non-leafy vegetables, and grain 3 1.400E+01 3 1.400E+01 3 3 STOR T(1) 3 STOR_T(2) STOR 3 Leafy vegetables 3 1.000E+00 3 1.000E+00 3 STOR 3 Milk 3 1.000E+00 3 1.000E+00 3 3 STOR_T(3) STOR 3 Meat and poultry 3 2.000E+01 3 2.000E+01 3 3 STOR T(4) STOR 3 Fish 3 7.000E+00 3 7.000E+00 3 3 STOR_T(5) Crustacea and mollusks 3 7.000E+00 3 7.000E+00 3 3 STOR T(6) STOR 3 3 1.000E+00 3 1.000E+00 3 3 STOR T(7) STOR 3 Well water STOR 3 Surface water 3 1.000E+00 3 1.000E+00 3 3 STOR T(8) Livestock fodder 3 4.500E+01 3 4.500E+01 3 STOR 3 3 STOR_T(9) 3 3 R021 ³ Thickness of building foundation (m) 3 not used 3 1.500E-01 3 3 FLOOR1 R021 ³ Bulk density of building foundation (g/cm**3) ³ not used ³ 2.400E+00 ³ 3 DENSFL R021 ³ Total porosity of the cover material 3 not used 3 4.000E-01 3 3 TPCV R021 ³ Total porosity of the building foundation 3 not used 3 1.000E-01 3 3 TPFL R021 ³ Volumetric water content of the cover material ³ not used ³ 5.000E-02 ³ 3 PH2OCV R021 ³ Volumetric water content of the foundation 3 not used 3 3.000E-02 3 3 PH2OFL 3 3 3 R021 3 Diffusion coefficient for radon gas (m/sec): R021 ³ in cover material ³ not used ³ 2.000E-06 ³ 3 DIFCV R021 ³ in foundation material 3 not used 3 3.000E-07 3 3 DIFFL R021 ³ in contaminated zone soil 3 not used 3 2.000E-06 3 3 DIFCZ 3 HMIX R021 ³ Radon vertical dimension of mixing (m) 3 not used 3 2.000E+00 3 R021 ³ Average building air exchange rate (1/hr) 3 not used 3 5.000E-01 3 3 REXG R021 ³ Height of the building (room) (m) 3 not used 3 2.500E+00 3 3 HRM 3 not used 3 0.000E+00 3 R021 ³ Building interior area factor 3 FAI R021 ³ Building depth below ground surface (m) 3 not used 3-1.000E+00 3 3 DMFL R021 ³ Emanating power of Rn-222 gas 3 not used 3 2.500E-01 3 3 EMANA(1) 3 not used 3 1.500E-01 3 R021 ³ Emanating power of Rn-220 gas 3 EMANA(2) 3 TITL ³ Number of graphical time points 32 3 3 NPTS TITL ³ Maximum number of integration points for dose ³ 17 3 3 LYMAX TITL ³ Maximum number of integration points for risk 257 3 KYMAX

Summary of Pathway Selections

Pathway 3 User Selection 1 -- external gamma ³ active 2 -- inhalation (w/o radon)³ active 3 -- plant ingestion ³ 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 3 suppressed

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		Dimensions ÄÄÄÄÄÄÄÄÄÄÄ	Initial Soil ÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		,	
Area:	100.00	square meters	Al-26	5	2.500E-01	
Thickness:	0.15	meters	Am-24	1	1.100E+01	
Cover Depth:	0.00	meters	Co-60)	7.700E-01	
			Cs-13	34	2.000E-01	
			Cs-13	37	3.660E+02	
			Eu-15	52	1.300E+00	
			Eu-15	54	2.300E+00	
			Eu-15	55	1.100E+00	
			Nb-94	<u> </u>	1.700E-01	
			Pu-23	88	7.060E+00	
			Pu-23	39	7.900E+01	
			Sb-12	25	8.300E+00	
			Sr-90)	2.280E+01	
			U-235	5	1.500E+00	

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 2.500E+01 mrem/yr

t (years): 0.000E+00 1.000E+00 5.000E+00 1.000E+01 1.232E+01 1.500E+01 3.000E+01 1.000E+02 3.000E+02 1.000E+03

TDOSE(t): 3.530E+01 3.409E+01 3.050E+01 2.662E+01 2.500E+01 2.326E+01 1.552E+01 1.933E+00 0.000E+00 0.000E+00

M(t): 1.412E+00 1.363E+00 1.220E+00 1.065E+00 1.000E+00 9.303E-01 6.207E-01 7.732E-02 0.000E+00 0.000E+00

OMaximum TDOSE(t): 3.530E+01 mrem/yr at t = 0.000E+00 years

0

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Total Dose Contributions TDOSE(i,p,t)	for Individual	Radionuclides (i) and P	athways (p)
As mrem/yr and Fraction of	of Total Dose At	t = 0.000E + 00 years	
Water Independent Patl	hways (Inhalatic	on excludes radon)	

0	Water Independent Pathways (Inhalation excludes radon)								
0	Ground	Inhalation	Radon	Plant	Meat	Milk	Soil		
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		
Nuclide		mrem/yr fract.							
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ							
Al-26	4.441E-02 0.0013	9.280E-08 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	9.963E-07 0.0000		
Am-241	1.504E-02 0.0004	5.477E-02 0.0016	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	2.628E-02 0.0007		
Co-60	2.945E-01 0.0083	1.791E-06 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.288E-05 0.0000		
Cs-134	4.308E-02 0.0012	8.897E-08 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	8.263E-06 0.0000		
Cs-137	3.324E+01 0.9415	1.308E-04 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.200E-02 0.0003		
Eu-152	2.308E-01 0.0065	3.173E-06 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	5.446E-06 0.0000		
Eu-154	4.382E-01 0.0124	7.170E-06 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.401E-05 0.0000		
Eu-155	5.838E-03 0.0002	4.817E-07 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.042E-06 0.0000		
Nb-94	1.800E-02 0.0005	3.282E-07 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	3.313E-07 0.0000		
Pu-238	3.657E-05 0.0000	3.125E-02 0.0009	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.493E-02 0.0004		
Pu-239	7.096E-04 0.0000	3.842E-01 0.0109	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.855E-01 0.0053		
Sb-125	2.110E-01 0.0060	4.947E-07 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	7.618E-06 0.0000		
Sr-90	1.564E-02 0.0004	3.320E-04 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	2.269E-03 0.0001		
U-235	3.403E-02 0.0010	2.083E-03 0.0001	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	2.651E-04 0.0000		
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Total	3.459E+01 0.9798	4.727E-01 0.0134	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	2.413E-01 0.0068		
0									

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

0			Water D	ependent Pathways			
0	Water	Fish	Radon	Plant	Meat	Milk	All Pathways*
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ						
Nuclide	mrem/yr fract.						
ÄÄÄÄÄÄÄ	. ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ	äääääääää ääääää	äääääääää ääääää	äääääääää ääääää	äääääääää ääääää	äääääääää ääääää	ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
Al-26	0.000E+00 0.0000	4.441E-02 0.0013					
Am-241	0.000E+00 0.0000	9.609E-02 0.0027					
Co-60	0.000E+00 0.0000	2.945E-01 0.0083					
Cs-134	0.000E+00 0.0000	4.309E-02 0.0012					
Cs-137	0.000E+00 0.0000	3.325E+01 0.9418					
Eu-152	0.000E+00 0.0000	2.309E-01 0.0065					
Eu-154	0.000E+00 0.0000	4.383E-01 0.0124					
Eu-155	0.000E+00 0.0000	5.839E-03 0.0002					
Nb-94	0.000E+00 0.0000	1.800E-02 0.0005					
Pu-238	0.000E+00 0.0000	4.621E-02 0.0013					
Pu-239	0.000E+00 0.0000	5.704E-01 0.0162					
Sb-125	0.000E+00 0.0000	2.110E-01 0.0060					
Sr-90	0.000E+00 0.0000	1.824E-02 0.0005					
U-235	0.000E+00 0.0000	3.638E-02 0.0010					
ÍÍÍÍÍÍÍ	iiiiiiii iiiiii	iiiiiiiii iiiiii	iiiiiiiii iiiiii	iiiiiiii iiiiii	iiiiiiiii iiiiii	íííííííííííííííííííííííííííííííííííííí	íííííííííííííííííííííííííííííííííííííí
Total	0.000E+00 0.0000	3.530E+01 1.0000					
0*Sum of	all water indepen	dent and dependent	pathways.				

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Summary: CAU 478 File: CAU 478.RAD

	To	tal Dose Contribut	ions TDOSE(i,p,t)	for Individual Rad	ionuclides (i) and	Pathways (p)
		As mrem	/yr and Fraction o	of Total Dose At t	= 1.000E+00 years	
0		Wate	r Independent Path	ways (Inhalation e	xcludes radon)	
0	Ground	Inhalation	Radon	Plant	Meat	Milk
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.		mrem/yr fract.	mrem/yr frac
* * * * * * * * *	*****	*****	*****	*****	*****	*******

act. mrem/yr fract. ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ 5.154E-03 0.0002 1.074E-08 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.153E-07 0.0000 Am-241 1.472E-02 0.0004 5.324E-02 0.0016 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.555E-02 0.0007 2.572E-01 0.0075 1.559E-06 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 Cs-134 3.068E-02 0.0009 6.314E-08 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.864E-06 0.0000 Cs-137 3.238E+01 0.9498 1.270E-04 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.165E-02 0.0003 2.183E-01 0.0064 2.991E-06 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.133E-06 0.0000 4.035E-01 0.0118 6.579E-06 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 0.000E+00 0.0000 0.000E+00 0.0000 Eu-155 5.070E-03 0.0001 4.159E-07 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 8.996E-07 0.0000 2.090E-03 0.0001 3.798E-08 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 3.834E-08 0.0000 3.627E-05 0.0000 3.079E-02 0.0009 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.471E-02 0.0004 7.082E-04 0.0000 3.815E-01 0.0112 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.843E-01 0.0054

Soil

Sb-125 1.909E-02 0.0006 4.458E-08 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 6.865E-07 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.172E-03 0.0001 1.503E-02 0.0004 3.177E-04 0.0000 3.369E-02 0.0010 2.053E-03 0.0001 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.615E-04 0.0000 3.338E+01 0.9793 4.680E-01 0.0137 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.000E 0

> 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

0 Water Dependent Pathways 0 Water Fish Radon Plant Meat Milk All Pathways* Nuclide mrem/vr fract. ÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ 0.000E+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 5.154E-03 0.0002 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 Am-241 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 9.350E-02 0.0027 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 2.572E-01 0.0075 Cs-134 0.000E+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 0.0009 0.000E+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 3.239E+01 0.9501 0.000E+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 2.183E-01 0.0064 Eu-154 0.000E+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 4.035E-01 0.0118 Eu-155 0.000E+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 5.071E-03 0.0001 0.000E+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 2.090E-03 0.0001 0.000E+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 4.553E-02 0.0013 0.000E+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 5.665E-01 0.0166 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.909E-02 0.0006 Sb-125 0.000E+00 0.0000 1.752E-02 0.0005 0.000E+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 3.601E-02 0.0011 0*Sum of all water independent and dependent pathways.

File: CAU 478.RAD Summary : CAU 478

	То	tal Dose Contribut	· · · · ·			Pathways (p)	
0			/yr and Fraction o		-		
0			r Independent Path	_			- 12
0	Ground	Inhalation	Radon	Plant	Meat	Milk	Soil
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
Nuclide	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.
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Al-26	9.331E-07 0.0000	1.921E-12 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	2.063E-11 0.0000
Am-241	1.349E-02 0.0004	4.749E-02 0.0016	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	2.279E-02 0.0007
Co-60	1.495E-01 0.0049	8.952E-07 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	6.436E-06 0.0000
Cs-134	7.893E-03 0.0003	1.601E-08 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.487E-06 0.0000
Cs-137	2.914E+01 0.9553	1.126E-04 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.033E-02 0.0003
Eu-152	1.745E-01 0.0057	2.359E-06 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	4.049E-06 0.0000
Eu-154	2.897E-01 0.0095	4.662E-06 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	9.113E-06 0.0000
Eu-155	2.883E-03 0.0001	2.309E-07 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	4.996E-07 0.0000
Nb-94	3.792E-07 0.0000	6.794E-12 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	6.858E-12 0.0000
Pu-238	3.510E-05 0.0000	2.900E-02 0.0010	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.386E-02 0.0005
Pu-239	7.024E-04 0.0000	3.709E-01 0.0122	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.791E-01 0.0059
Sb-125	1.274E-06 0.0000	2.932E-12 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	4.514E-11 0.0000
Sr-90	1.281E-02 0.0004	2.663E-04 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.821E-03 0.0001
U-235	3.236E-02 0.0011	1.937E-03 0.0001	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	2.473E-04 0.0000
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Total	2.982E+01 0.9778	4.497E-01 0.0147	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	2.282E-01 0.0075
0							
	To	tal Dose Contribut	ions TDOSE(i,p,t)	for Individual Rad	ionuclides (i) and	Pathways (p)	
		As mrem	/yr and Fraction o	f Total Dose At t	= 5.000E+00 years	- \-	

(J			Water D	ependent Pathways			
(0	Water	Fish	Radon	Plant	Meat	Milk	All Pathways*
	Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
	Nuclide	mrem/yr fract.	mrem/yr fract.					
	ÄÄÄÄÄÄÄ	äääääääää ääääää	äääääääää ääääää					
	Al-26	0.000E+00 0.0000	9.331E-07 0.0000					
	Am-241	0.000E+00 0.0000	8.377E-02 0.0027					
	Co-60	0.000E+00 0.0000	1.495E-01 0.0049					
	Cs-134	0.000E+00 0.0000	7.894E-03 0.0003					
	Cs-137	0.000E+00 0.0000	2.915E+01 0.9557					
	Eu-152	0.000E+00 0.0000	1.745E-01 0.0057					
	Eu-154	0.000E+00 0.0000	2.897E-01 0.0095					
	Eu-155	0.000E+00 0.0000	2.884E-03 0.0001					
	Nb-94	0.000E+00 0.0000	3.792E-07 0.0000					
	Pu-238	0.000E+00 0.0000	4.290E-02 0.0014					
	Pu-239	0.000E+00 0.0000	5.507E-01 0.0181					
	Sb-125	0.000E+00 0.0000	1.275E-06 0.0000					
	Sr-90	0.000E+00 0.0000	1.490E-02 0.0005					
	U-235	0.000E+00 0.0000	3.455E-02 0.0011					
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	Total	0.000E+00 0.0000	3.050E+01 1.0000					
(0*Sum of	all water indepen	dent and dependent	pathways.				

Summary : CAU 478 File: CAU 478.RAD

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	То	tal Dose Contribut	ions TDOSE(i,p,t)	for Individual Rad	ionuclides (i) and	Pathways (p)			
	As mrem/yr and Fraction of Total Dose At $t = 1.000E + 01$ years								
0		Wate	r Independent Path	ways (Inhalation e	xcludes radon)				
0	Ground	Inhalation	Radon	Plant	Meat	Milk	Soil		
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ		
Nuclide	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.		
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Al-26	1.958E-11 0.0000	3.971E-17 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	4.264E-16 0.0000		

ÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ 0000 4.264E-16 0.0000 Am-241 1.210E-02 0.0005 4.113E-02 0.0015 0.000E+00 0.0000 0.000E+00 0.000E+0 Co-60 7.579E-02 0.0028 4.469E-07 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 3.213E-06 0.0000 Cs-134 1.445E-03 0.0001 2.877E-09 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.672E-07 0.0000 Cs-137 2.552E+01 0.9587 9.681E-05 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 8.882E-03 0.0003 Eu-152 1.318E-01 0.0050 1.752E-06 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 3.006E-06 0.0000 Eu-154 1.914E-01 0.0072 3.028E-06 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.919E-06 0.0000 Eu-155 1.423E-03 0.0001 1.106E-07 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.392E-07 0.0000 Nb-94 7.978E-12 0.0000 1.404E-16 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.417E-16 0.0000 Pu-238 3.369E-05 0.0000 2.689E-02 0.0010 0.000E+00 0.0000 0.000E+00 0.000E+0

Pu-239 6.950E-04 0.0000 3.576E-01 0.0134 0.000E+00 0.0000 0.000E+00 0.000E+0 Sb-125 7.686E-12 0.0000 1.734E-17 0.0000 0.000E+00 0.000 Sr-90 1.049E-02 0.0004 2.134E-04 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.459E-03 0.0001 U-235 3.076E-02 0.0012 1.800E-03 0.0001 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.305E-04 0.0000 Total 2.598E+01 0.9758 4.278E-01 0.0161 0.000E+00 0.0000 0.000E+00 0.000E+00 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.159E-01 0.0081

0 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

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0			Water D	ependent Pathways			
0	Water	Fish	Radon	Plant	Meat	Milk	All Pathways*
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
Nuclide	mrem/yr fract.	mrem/yr fract.					
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Al-26	0.000E+00 0.0000	1.958E-11 0.0000					
Am-241	0.000E+00 0.0000	7.297E-02 0.0027					
Co-60	0.000E+00 0.0000	7.580E-02 0.0028					
Cs-134	0.000E+00 0.0000	1.445E-03 0.0001					
Cs-137	0.000E+00 0.0000	2.553E+01 0.9590					
Eu-152	0.000E+00 0.0000	1.318E-01 0.0050					
Eu-154	0.000E+00 0.0000	1.914E-01 0.0072					
Eu-155	0.000E+00 0.0000	1.424E-03 0.0001					
Nb-94	0.000E+00 0.0000	7.978E-12 0.0000					
Pu-238	0.000E+00 0.0000	3.977E-02 0.0015					
Pu-239	0.000E+00 0.0000	5.311E-01 0.0200					
Sb-125	0.000E+00 0.0000	7.686E-12 0.0000					
Sr-90	0.000E+00 0.0000	1.216E-02 0.0005					
U-235	0.000E+00 0.0000	3.279E-02 0.0012					
ÍÍÍÍÍÍÍ	íííííííííííííííííííííííííííííííííííííí	iiiiiiii iiiiii	íííííííííííííííííííííííííííííííííííííí	íííííííííííííííííííííííííííííííííííííí	iiiiiiiii iiiiii	íííííííííííííííííííííííííííííííííííííí	iiiiiiiii iiiiii
Total	0.000E+00 0.0000	2.662E+01 1.0000					
0*Sum of	all water indepen	dent and dependent	pathways.				

0*Sum of all water independent and dependent pathways.

Summary : CAU 478 File: CAU 478.RAD

	То	tal Dose Contribut				Pathways (p)	
0			/yr and Fraction o				
0	C		r Independent Path	<u> </u>	,	M - 7 1-	0-41
∪ Radio-	Ground ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	Inhalation ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	Radon ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	Plant ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	Meat ääääääääääääääää	Milk ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	Soil ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
Nuclide		mrem/yr fract.					
	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ						
Al-26	1.322E-13 0.0000	2.661E-19 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	2.857E-18 0.0000
Am-241	1.151E-02 0.0005	3.846E-02 0.0015	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.846E-02 0.0007
Co-60	5.529E-02 0.0022	3.236E-07 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	2.326E-06 0.0000
Cs-134	6.569E-04 0.0000	1.297E-09 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.204E-07 0.0000
Cs-137	2.399E+01 0.9596	9.022E-05 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	8.277E-03 0.0003
Eu-152	1.157E-01 0.0046	1.525E-06 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	2.617E-06 0.0000
Eu-154	1.578E-01 0.0063	2.478E-06 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	4.843E-06 0.0000
Eu-155	1.026E-03 0.0000	7.854E-08 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.699E-07 0.0000
Nb-94	5.390E-14 0.0000	9.408E-19 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	9.497E-19 0.0000
Pu-238	3.305E-05 0.0000	2.595E-02 0.0010	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.240E-02 0.0005
Pu-239	6.915E-04 0.0000	3.515E-01 0.0141	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.698E-01 0.0068
Sb-125	2.908E-14 0.0000	6.503E-20 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.001E-18 0.0000
Sr-90	9.556E-03 0.0004	1.925E-04 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.316E-03 0.0001
U-235	3.004E-02 0.0012	1.739E-03 0.0001	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	2.230E-04 0.0000
	iiiiiiiii iiiiii	íííííííííííííííííííííííííííííííííííííí	íííííííííííííííííííííííííííííííííííííí	íííííííííííííííííííííííííííííííííííííí	íííííííííííííííííííííííííííííííííííííí	íííííííííííííííííííííííííííííííííííííí	íííííííííí ííííííí
Total	2.437E+01 0.9749	4.179E-01 0.0167	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	2.104E-01 0.0084
0							
	То	tal Dose Contribut	ions TDOSE(i,p,t) /yr and Fraction o			Pathways (p)	
0		AS III CIII	-	ependent Pathways	- 1.232E:01 years		
0	Water	Fish	Radon	Plant	Meat	Milk	All Pathways*
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ						
Nuclide	mrem/yr fract.						
ÄÄÄÄÄÄÄ	ääääääääääääääääääääääääääääääääääääää	äääääääää ääääää	äääääääää ääääää	ääääääääääääääääääääääääääääääääääääää	äääääääää ääääää	äääääääää ääääää	äääääääää ääääää
Al-26	0.000E+00 0.0000	1.322E-13 0.0000					
Am-241	0.000E+00 0.0000	6.842E-02 0.0027					
Co-60	0.000E+00 0.0000	5.529E-02 0.0022					
Cs-134	0.000E+00 0.0000	6.570E-04 0.0000					
Cs-137	0.000E+00 0.0000	2.400E+01 0.9599					
Eu-152	0.000E+00 0.0000	1.157E-01 0.0046					
Eu-154	0.000E+00 0.0000	1.578E-01 0.0063					
Eu-155	0.000E+00 0.0000	1.026E-03 0.0000					
Nb-94	0.000E+00 0.0000	5.391E-14 0.0000					
Pu-238	0.000E+00 0.0000	3.838E-02 0.0015					

Pu-239 0.000E+00 0.0000 5.220E-01 0.0209 $\texttt{Sr-90} \\ \texttt{0.000E+00 0.0000} \\ \texttt{0.000E+00 0.0000} \\ \texttt{0.0000E+00 0.0000} \\ \texttt{0.000E+00 0.0000} \\ \texttt{0.000E$ $\texttt{U-235} \\ \texttt{0.000E+00 0.0000} \\ \texttt{0.000E+00 0.0000} \\ \texttt{0.0000E+00 0.0000} \\ \texttt{0.000E+00 0.0000} \\ \texttt{0.000E$ Total 0.000E+00 0.0000 2.500E+01 1.0000

Summary: CAU 478 File: CAU 478.RAD

0

	To	tal Dose Contribut	ions TDOSE(i,p,t)	for Individual Rad	ionuclides (i) and	Pathways (p)	
		As mrem	/yr and Fraction o	f Total Dose At t	= 1.500E+01 years		
0		Wate	r Independent Path	ways (Inhalation e	xcludes radon)		
0	Ground	Inhalation	Radon	Plant	Meat	Milk	Soil
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ						
Nuclide	mrem/yr fract.						
ÄÄÄÄÄÄÄ	ääääääääääääääääääääääääääääääääääääää	äääääääää ääääää					
Al-26	4.106E-16 0.0000	8.198E-22 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	8.801E-21 0.0000
Am-241	1.086E-02 0.0005	3.558E-02 0.0015	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.707E-02 0.0007
Co-60	3.840E-02 0.0017	2.228E-07 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.602E-06 0.0000
Cs-134	2.642E-04 0.0000	5.163E-10 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	4.795E-08 0.0000
Cs-137	2.233E+01 0.9602	8.312E-05 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	7.626E-03 0.0003
E. 1E2	0 0465 02 0 0042	1 2000 06 0 0000	0 0005:00 0 0000	0 000 0 0000	0 000 - 00 0 0000	0 000 - 00 0 0000	2 2202 06 0 0000

Eu-152 9.946E-02 0.0043 1.299E-06 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 2.229E-06 0.0000 1.263E-01 0.0054 1.964E-06 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 3.840E-06 0.0000 0.000E+00 0.0000 7.024E-04 0.0000 5.288E-08 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.144E-07 0.0000 1.677E-16 0.0000 2.898E-21 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.925E-21 0.0000 3.233E-05 0.0000 2.489E-02 0.0011 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.189E-02.0.0005 6.873E-04 0.0000 3.444E-01 0.0148 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.663E-01 0.0072 Sb-125 4.631E-17 0.0000 1.024E-22 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.577E-21 0.0000 8.580E-03 0.0004 1.708E-04 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.168E-03 0.0001 0.000E+00 0.0000 2.922E-02 0.0013 1.672E-03 0.0001 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.147E-04 0.0000 Total 2.265E+01 0.9737 4.068E-01 0.0175 0.000E+00 0.0000 0.000E+00 0.000E+00

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p) As mrem/yr and Fraction of Total Dose At t = 1.500E+01 years

0 Water Dependent Pathways 0 Water Fish Radon Plant Meat Milk All Pathways* Nuclide mrem/vr fract. ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ 0.000E+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 4.106E-16 0.0000 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 6.351E-02 0.0027 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 3.840E-02 0.0017 Cs-134 0.000E+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 2.643E-04 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 2.234E+01 0.9605 0.000E+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 9.946E-02 0.0043 Eu-154 0.000E+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 1.263E-01 0.0054 Eu-155 0.000E+00 0.0000 1.677E-16 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 3.682E-02 0.0016 0.000E+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 Sb-125 0.000E+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 4.631E-17 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 9.918E-03 0.0004 0.000E+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 3.111E-02 0.0013 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.000 0*Sum of all water independent and dependent pathways.

File: CAU 478.RAD Summary : CAU 478

Total Dos	se 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)	

^		110 1112 011	., T. dana 11acotton C		3.0002.02 /Cars		
0			r Independent Path	<u>-</u> '	•		
0	Ground	Inhalation	Radon	Plant	Meat	Milk	Soil
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ						
Nuclide	mrem/yr fract.						
ÄÄÄÄÄÄÄ	. ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ	äääääääää ääääää	äääääääää ääääää	ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ	äääääääää ääääää
Al-26	3.759E-30 0.0000	0.000E+00 0.0000					
Am-241	7.830E-03 0.0005	2.282E-02 0.0015	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.095E-02 0.0007
Co-60	4.958E-03 0.0003	2.737E-08 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.968E-07 0.0000
Cs-134	1.606E-06 0.0000	2.959E-12 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	2.748E-10 0.0000
Cs-137	1.487E+01 0.9585	5.215E-05 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	4.785E-03 0.0003
Eu-152	4.246E-02 0.0027	5.252E-07 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	9.013E-07 0.0000
Eu-154	3.606E-02 0.0023	5.316E-07 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.039E-06 0.0000
Eu-155	8.420E-05 0.0000	5.733E-09 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.240E-08 0.0000
Nb-94	1.548E-30 0.0000	0.000E+00 0.0000					
Pu-238	2.855E-05 0.0000	1.959E-02 0.0013	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	9.359E-03 0.0006
Pu-239	6.621E-04 0.0000	3.049E-01 0.0197	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.473E-01 0.0095
Sb-125	0.000E+00 0.0000						
Sr-90	4.672E-03 0.0003	8.679E-05 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	5.933E-04 0.0000
U-235	2.493E-02 0.0016	1.330E-03 0.0001	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.724E-04 0.0000
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Total	1.500E+01 0.9664	3.488E-01 0.0225	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.731E-01 0.0112
0							

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

	AS III CII	i/yr and rraction o		- 5.000E.OI years		
0		Water D	ependent Pathways			
0 Water	Fish	Radon	Plant	Meat	Milk	All Pathways*
Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
Nuclide mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.
äääääää ääääääääääääääääääääääääääääää	äääääääää ääääää					
Al-26 0.000E+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	3.759E-30 0.0000
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	4.161E-02 0.0027
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	4.958E-03 0.0003
Cs-134 0.000E+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	1.606E-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	1.488E+01 0.9588
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	4.247E-02 0.0027
Eu-154 0.000E+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	3.607E-02 0.0023
Eu-155 0.000E+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	8.422E-05 0.0000
Nb-94 0.000E+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	1.548E-30 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	2.897E-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	4.529E-01 0.0292
Sb-125 0.000E+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	5.353E-03 0.0003
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	2.644E-02 0.0017
iiiiiii iiiiiiiii iiiiii	ííííííííí íííííí	íííííííííí íííííí				
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	1.552E+01 1.0000
0*Sum of all water indeper	ndent and dependent	pathways.				

T« Limit = 180 days 03/14/2007 01:48 Page 23 1RESRAD, Version 6.3

Summary : CAU 478 File: CAU 478.RAD

	10	car bose concribat			· ·	raciiways (P)	
		As mrem	/yr and Fraction o	f Total Dose At t	= 1.000E+02 years		
0		Wate	r Independent Path	ways (Inhalation e	xcludes radon)		
0	Ground	Inhalation	Radon	Plant	Meat	Milk	Soil
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ						
Nuclide		mrem/yr fract.					
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ						
Al-26	0.000E+00 0.0000						
Am-241	1.580E-03 0.0008	2.068E-03 0.0011	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	9.924E-04 0.0005
Co-60	2.710E-07 0.0000	1.108E-12 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	7.964E-12 0.0000
Cs-134	5.643E-17 0.0000	7.356E-23 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	6.831E-21 0.0000
Cs-137	1.726E+00 0.8927	4.260E-06 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	3.908E-04 0.0002
Eu-152	6.216E-04 0.0003	5.518E-09 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	9.471E-09 0.0000
Eu-154	8.074E-05 0.0000	8.577E-10 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.676E-09 0.0000
Eu-155	3.596E-09 0.0000	1.295E-13 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	2.802E-13 0.0000
Nb-94	0.000E+00 0.0000						
Pu-238	1.530E-05 0.0000	4.602E-03 0.0024	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	2.199E-03 0.0011
Pu-239	4.658E-04 0.0002	1.243E-01 0.0643	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	6.003E-02 0.0311
Sb-125	0.000E+00 0.0000						
Sr-90	2.170E-04 0.0001	2.650E-06 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	1.811E-05 0.0000
U-235	9.516E-03 0.0049	3.340E-04 0.0002	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	4.496E-05 0.0000
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Total	1.738E+00 0.8991	1.313E-01 0.0679	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	0.000E+00 0.0000	6.367E-02 0.0329
0							

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

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

		AD IIII CII	i, yr and rraction o		- 1.000H.02 years		
0			Water D	ependent Pathways			
0	Water	Fish	Radon	Plant	Meat	Milk	All Pathways*
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ						
Nuclide	e mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.
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Al-26	0.000E+00 0.0000						
Am-241	0.000E+00 0.0000	4.641E-03 0.0024					
Co-60	0.000E+00 0.0000	2.710E-07 0.0000					
Cs-134	0.000E+00 0.0000	5.644E-17 0.0000					
Cs-137	0.000E+00 0.0000	1.726E+00 0.8929					
Eu-152	0.000E+00 0.0000	6.216E-04 0.0003					
Eu-154	0.000E+00 0.0000	8.074E-05 0.0000					
Eu-155	0.000E+00 0.0000	3.597E-09 0.0000					
Nb-94	0.000E+00 0.0000						
Pu-238	0.000E+00 0.0000	6.815E-03 0.0035					
Pu-239	0.000E+00 0.0000	1.848E-01 0.0956					
Sb-125	0.000E+00 0.0000						
Sr-90	0.000E+00 0.0000	2.377E-04 0.0001					
U-235	0.000E+00 0.0000	9.895E-03 0.0051					
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Total	0.000E+00 0.0000	1.933E+00 1.0000					
0*Sum of	all water indepen	dent and dependent	pathways.				

Summary : CAU 478 File: CAU 478.RAD

0*Sum of all water independent and dependent pathways.

	То	tal Dose Contribut	ions TDOSE(i,p,t)	for Individual Rad	ionuclides (i) and	Pathways (p)	
		As mrem	/yr and Fraction o	f Total Dose At t	= 3.000E+02 years		
0		Wate	r Independent Path	ways (Inhalation e	xcludes radon)		
0	Ground	Inhalation	Radon	Plant	Meat	Milk	Soil
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
Nuclide	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.
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Al-26	0.000E+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
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
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-134	0.000E+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
Eu-154	0.000E+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-155	0.000E+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
Nb-94	0.000E+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
Sb-125	0.000E+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-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
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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
0							
	То		ions TDOSE(i,p,t)		ionuclides (i) and	Pathways (p)	
		As mrem			= 3.000E+02 years		
0			Water D	ependent Pathways	•	20133	
0	Water	Fish	Water D Radon	ependent Pathways Plant	Meat	Milk	All Pathways*
0 Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	Fish ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	Water D Radon ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ependent Pathways Plant ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	Meat ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
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Radio- Nuclide ÄÄÄÄÄÄÄ Al-26 Am-241 Co-60 Cs-134	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	Fish ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	Water D Radon ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ mrem/yr fract. ÄÄÄÄÄÄÄÄÄÄÄÄ 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000	ependent Pathways Plant ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	Meat ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ mrem/yr fract. ÄÄÄÄÄÄÄÄÄÄÄÄ 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
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0 Radio- Nuclide ÄÄÄÄÄÄÄ Al-26 Am-241 Co-60 Cs-134 Cs-137 Eu-152 Eu-154 Eu-155 Nb-94	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	Fish ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ mrem/yr fract. ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÖÖOOOE+OO 0.0000 0.000E+OO 0.0000	Water D Radon ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ mrem/yr fract. ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ 0.000E+00 0.0000	ependent Pathways Plant ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ mrem/yr fract. ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ 0.000E+00 0.0000	Meat ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
0 Radio- Nuclide ÄÄÄÄÄÄÄ Al-26 Am-241 Co-60 Cs-134 Cs-137 Eu-152 Eu-154 Eu-155 Nb-94 Pu-238	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	Fish AÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	Water D Radon ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ mrem/yr fract. ÄÄÄÄÄÄÄÄÄÄÄÄÄ 0.000E+00 0.0000	ependent Pathways Plant ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	Meat ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
0 Radio- Nuclide ÄÄÄÄÄÄÄ Al-26 Am-241 Co-60 Cs-134 Cs-137 Eu-152 Eu-154 Eu-155 Nb-94	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	Fish ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ mrem/yr fract. ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÖÖOOOE+OO 0.0000 0.000E+OO 0.0000	Water D Radon ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ mrem/yr fract. ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ 0.000E+00 0.0000	ependent Pathways Plant ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ mrem/yr fract. ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ 0.000E+00 0.0000	Meat ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

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File: CAU 478.RAD Summary : CAU 478

0

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)

•		110 1112 011	., 1		1.0002.03 /0012		
0		Wate	r Independent Path	ways (Inhalation e	excludes radon)		
0	Ground	Inhalation	Radon	Plant	Meat	Milk	Soil
Radio-	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
Nuclide	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.	mrem/yr fract.
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Al-26	0.000E+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
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
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-134	0.000E+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
Eu-154	0.000E+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-155	0.000E+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
Nb-94	0.000E+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
Sb-125	0.000E+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-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
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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

0 Water Dependent Pathways	
0 Water Fish Radon Plant Meat Milk Al	l Pathways*
Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄ
Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr	m/yr fract.
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A1-26 0.000E+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 0.000	0E+00 0.0000
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 0.000	0E+00 0.0000
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 0.000	0E+00 0.0000
Cs-134 0.000E+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 0.000	0E+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 0.000	0E+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 0.000	0E+00 0.0000
Eu-154 0.000E+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 0.000	0E+00 0.0000
Eu-155 0.000E+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 0.000	0E+00 0.0000
Nb-94 0.000E+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 0.000	0E+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 0.000	0E+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 0.000	0E+00 0.0000
Sb-125 0.000E+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 0.000	0E+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 0.00	0E+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 0.00	0E+00 0.0000
1111111 111111111 1111111 11111111 11111	ííííí íííííí
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 0.00	0E+00 0.0000
0*Sum of all water independent and dependent pathways.	

Summary : CAU 478 File: CAU 478.RAD

			DOSE/SOUTCE RACIOS Sammed OVER ALL FACILITIES
		_, ,	Parent and Progeny Principal Radionuclide Contributions Indicated
0 Parent	Product	Thread	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g)
(i)	(j)	Fraction	0.000E+00 1.000E+00 5.000E+00 1.000E+01 1.232E+01 1.500E+01 3.000E+01 1.000E+02 3.000E+02 1.000E+03
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Al-26	Al-26	1.000E+00	1.776E-01 2.061E-02 3.733E-06 7.833E-11 5.287E-13 1.642E-15 1.503E-29 0.000E+00 0.000E+00 0.000E+00
0Am-241	Am-241	1.000E+00	8.736E-03 8.500E-03 7.616E-03 6.634E-03 6.220E-03 5.773E-03 3.782E-03 4.216E-04 0.000E+00 0.000E+00
Am-241	Np-237+D	1.000E+00	6.612E-09 1.957E-08 6.767E-08 1.200E-07 1.415E-07 1.644E-07 2.590E-07 2.624E-07 0.000E+00 0.000E+00
Am-241	U-233	1.000E+00	4.126E-16 2.846E-15 3.460E-14 1.155E-13 1.653E-13 2.306E-13 6.836E-13 1.624E-12 0.000E+00 0.000E+00
Am-241	Th-229+D	1.000E+00	4.002E-19 5.942E-18 2.537E-16 1.652E-15 2.922E-15 4.996E-15 3.158E-14 3.876E-13 0.000E+00 0.000E+00
Am-241	äDSR(j)		8.736E-03 8.500E-03 7.616E-03 6.634E-03 6.220E-03 5.773E-03 3.782E-03 4.219E-04 0.000E+00 0.000E+00
0Co-60	Co-60	1.000E+00	3.825E-01 3.340E-01 1.941E-01 9.844E-02 7.181E-02 4.987E-02 6.440E-03 3.519E-07 0.000E+00 0.000E+00
0Cs-134	Cs-134	1.000E+00	2.155E-01 1.535E-01 3.947E-02 7.225E-03 3.285E-03 1.321E-03 8.031E-06 2.822E-16 0.000E+00 0.000E+00
0Cs-137+D	Cs-137+D	1.000E+00	9.085E-02 8.849E-02 7.964E-02 6.975E-02 6.557E-02 6.104E-02 4.065E-02 4.716E-03 0.000E+00 0.000E+00
0Eu-152	Eu-152	7.208E-01	1.280E-01 1.210E-01 9.676E-02 7.308E-02 6.414E-02 5.515E-02 2.355E-02 3.446E-04 0.000E+00 0.000E+00
0Eu-152	Eu-152	2.792E-01	4.958E-02 4.689E-02 3.748E-02 2.831E-02 2.484E-02 2.136E-02 9.120E-03 1.335E-04 0.000E+00 0.000E+00
Eu-152	Gd-152	2.792E-01	2.516E-18 7.331E-18 2.363E-17 3.851E-17 4.374E-17 4.871E-17 6.175E-17 3.091E-17 0.000E+00 0.000E+00
Eu-152	äDSR(j)		4.958E-02 4.689E-02 3.748E-02 2.831E-02 2.484E-02 2.136E-02 9.120E-03 1.335E-04 0.000E+00 0.000E+00
0Eu-154	Eu-154	1.000E+00	1.906E-01 1.754E-01 1.260E-01 8.321E-02 6.862E-02 5.491E-02 1.568E-02 3.510E-05 0.000E+00 0.000E+00
0Eu-155	Eu-155	1.000E+00	5.309E-03 4.610E-03 2.622E-03 1.294E-03 9.326E-04 6.387E-04 7.656E-05 3.270E-09 0.000E+00 0.000E+00
0Nb-94	Nb-94	1.000E+00	1.059E-01 1.229E-02 2.231E-06 4.693E-11 3.171E-13 9.864E-16 9.104E-30 0.000E+00 0.000E+00 0.000E+00
0Pu-238	Pu-238	1.840E-09	1.204E-11 1.187E-11 1.118E-11 1.036E-11 1.000E-11 9.597E-12 7.551E-12 1.776E-12 0.000E+00 0.000E+00
0Pu-238	Pu-238	1.000E+00	$6.546 \pm -03 \ 6.450 \pm -03 \ 6.076 \pm -03 \ 5.633 \pm -03 \ 5.436 \pm -03 \ 5.216 \pm -03 \ 4.104 \pm -03 \ 9.653 \pm -04 \ 0.000 \pm +00 \ 0.000 \pm +00$
Pu-238	U-234	1.000E+00	2.390E-09 7.076E-09 2.446E-08 4.331E-08 5.104E-08 5.921E-08 9.176E-08 7.170E-08 0.000E+00 0.000E+00
Pu-238	Th-230	1.000E+00	1.733E-14 1.200E-13 1.488E-12 5.088E-12 7.366E-12 1.041E-11 3.309E-11 1.047E-10 0.000E+00 0.000E+00
Pu-238	Ra-226+D	1.000E+00	1.298E-16 1.932E-15 8.336E-14 5.501E-13 9.786E-13 1.685E-12 1.104E-11 1.527E-10 0.000E+00 0.000E+00
Pu-238	Pb-210+D	1.000E+00	1.494E-20 4.559E-19 6.379E-17 7.650E-16 1.627E-15 3.308E-15 3.747E-14 9.362E-13 0.000E+00 0.000E+00
Pu-238	äDSR(j)		$6.546 \pm -03 \ 6.450 \pm -03 \ 6.076 \pm -03 \ 5.633 \pm -03 \ 5.436 \pm -03 \ 5.216 \pm -03 \ 4.104 \pm -03 \ 9.654 \pm -04 \ 0.000 \pm +00 \ 0.000 \pm +00$
0Pu-239	Pu-239	1.000E+00	7.220E-03 7.170E-03 6.971E-03 6.722E-03 6.607E-03 6.474E-03 5.733E-03 2.339E-03 0.000E+00 0.000E+00
Pu-239	U-235+D	1.000E+00	1.195E-11 3.566E-11 1.275E-10 2.355E-10 2.832E-10 3.364E-10 5.972E-10 9.879E-10 0.000E+00 0.000E+00
Pu-239	Pa-231	1.000E+00	9.346E-17 6.479E-16 8.053E-15 2.765E-14 4.010E-14 5.678E-14 1.829E-13 6.352E-13 0.000E+00 0.000E+00
Pu-239	Ac-227+D	1.000E+00	3.928E-18 5.782E-17 2.375E-15 1.475E-14 2.552E-14 4.257E-14 2.359E-13 1.744E-12 0.000E+00 0.000E+00
Pu-239	äDSR(j)		$7.220 \pm -03 \ \ 7.170 \pm -03 \ \ 6.971 \pm -03 \ \ 6.722 \pm -03 \ \ 6.607 \pm -03 \ \ 6.474 \pm -03 \ \ 5.733 \pm -03 \ \ 2.339 \pm -03 \ \ 0.000 \pm +00 $
0Sb-125+D	Sb-125+D	1.000E+00	2.543E-02 2.300E-03 1.536E-07 9.261E-13 3.504E-15 5.580E-18 1.213E-33 0.000E+00 0.000E+00 0.000E+00
0Sr-90+D	Sr-90+D	1.000E+00	8.000E-04 7.683E-04 6.534E-04 5.334E-04 4.853E-04 4.350E-04 2.348E-04 1.043E-05 0.000E+00 0.000E+00

Dose/Source Ratios Summed Over All Pathways

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Dose/Source Ratios Summed Over All Pathways

Parent and Progeny Principal Radionuclide Contributions Indicated

<pre>0 Parent</pre>	Product	Thread	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g)
(i)	(j)	Fraction	0.000E+00 1.000E+00 5.000E+00 1.000E+01 1.232E+01 1.500E+01 3.000E+01 1.000E+02 3.000E+02 1.000E+03
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U-235+D	U-235+D	1.000E+00	2.425E-02 2.400E-02 2.303E-02 2.185E-02 2.132E-02 2.072E-02 1.759E-02 6.554E-03 0.000E+00 0.000E+00
U-235+D	Pa-231	1.000E+00	2.845E-07 8.428E-07 2.923E-06 5.197E-06 6.137E-06 7.137E-06 1.122E-05 9.685E-06 0.000E+00 0.000E+00
U-235+D	Ac-227+D	1.000E+00	1.590E-08 1.087E-07 1.269E-06 4.033E-06 5.648E-06 7.685E-06 2.006E-05 3.314E-05 0.000E+00 0.000E+00
U-235+D	äDSR(j)		$2.425E-02 \ 2.400E-02 \ 2.303E-02 \ 2.186E-02 \ 2.133E-02 \ 2.074E-02 \ 1.762E-02 \ 6.597E-03 \ 0.000E+00 \ 0.000E+00$
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The DSR in	cludes conti	ributions f	rom associated (half-life ó 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g Basic Radiation Dose Limit = 2.500E+01 mrem/yr

			Dasi	C Radiation	DOSE DIMITE -	Z. JUUE 1 UI III	I CIII/ YI			
0Nuclide										
(i)	t = 0.000E + 00	1.000E+00	5.000E+00	1.000E+01	1.232E+01	1.500E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Al-26	1.407E+02	1.213E+03	6.698E+06	*1.921E+10	*1.921E+10	*1.921E+10	*1.921E+10	*1.921E+10	*1.921E+10	*1.921E+10
Am-241	2.862E+03	2.941E+03	3.283E+03	3.769E+03	4.019E+03	4.330E+03	6.610E+03	5.926E+04	*3.431E+12	*3.431E+12
Co-60	6.536E+01	7.485E+01	1.288E+02	2.540E+02	3.481E+02	5.013E+02	3.882E+03	7.104E+07	*1.132E+15	*1.132E+15
Cs-134	1.160E+02	1.629E+02	6.334E+02	3.460E+03	7.611E+03	1.892E+04	3.113E+06	*1.295E+15	*1.295E+15	*1.295E+15
Cs-137	2.752E+02	2.825E+02	3.139E+02	3.584E+02	3.813E+02	4.096E+02	6.150E+02	5.301E+03	*8.704E+13	*8.704E+13
Eu-152	1.408E+02	1.489E+02	1.862E+02	2.466E+02	2.809E+02	3.268E+02	7.653E+02	5.229E+04	*1.765E+14	*1.765E+14
Eu-154	1.312E+02	1.425E+02	1.985E+02	3.004E+02	3.643E+02	4.553E+02	1.594E+03	7.122E+05	*2.639E+14	*2.639E+14
Eu-155	4.709E+03	5.423E+03	9.537E+03	1.932E+04	2.681E+04	3.914E+04	3.265E+05	7.646E+09	*4.652E+14	*4.652E+14
Nb-94	2.361E+02	2.033E+03	1.121E+07	*1.875E+11	*1.875E+11	*1.875E+11	*1.875E+11	*1.875E+11	*1.875E+11	*1.875E+11
Pu-238	3.819E+03	3.876E+03	4.115E+03	4.438E+03	4.599E+03	4.793E+03	6.092E+03	2.590E+04	*1.712E+13	*1.712E+13
Pu-239	3.462E+03	3.487E+03	3.586E+03	3.719E+03	3.784E+03	3.862E+03	4.361E+03	1.069E+04	*6.214E+10	*6.214E+10
Sb-125	9.833E+02	1.087E+04	1.628E+08	2.700E+13	*1.033E+15	*1.033E+15	*1.033E+15	*1.033E+15	*1.033E+15	*1.033E+15
Sr-90	3.125E+04	3.254E+04	3.826E+04	4.687E+04	5.152E+04	5.747E+04	1.065E+05	2.398E+06	*1.365E+14	*1.365E+14
U-235	1.031E+03	1.041E+03	1.085E+03	1.144E+03	1.172E+03	1.206E+03	1.418E+03	3.790E+03	*2.161E+06	*2.161E+06
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍ

*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	d at tmax =	time of maximum	total dose =	0.000E+00	years	
0Nuclide	Initial	tmin	DSR(i,tmin)	G(i,tmin)	<pre>DSR(i,tmax)</pre>	G(i,tmax)
(i)	(pCi/g)	(years)		(pCi/g)		(pCi/g)
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Al-26	2.500E-01	0.000E+00	1.776E-01	1.407E+02	1.776E-01	1.407E+02
Am-241	1.100E+01	0.000E+00	8.736E-03	2.862E+03	8.736E-03	2.862E+03
Co-60	7.700E-01	0.000E+00	3.825E-01	6.536E+01	3.825E-01	6.536E+01
Cs-134	2.000E-01	0.000E+00	2.155E-01	1.160E+02	2.155E-01	1.160E+02
Cs-137	3.660E+02	0.000E+00	9.085E-02	2.752E+02	9.085E-02	2.752E+02
Eu-152	1.300E+00	0.000E+00	1.776E-01	1.408E+02	1.776E-01	1.408E+02
Eu-154	2.300E+00	0.000E+00	1.906E-01	1.312E+02	1.906E-01	1.312E+02
Eu-155	1.100E+00	0.000E+00	5.309E-03	4.709E+03	5.309E-03	4.709E+03
Nb-94	1.700E-01	0.000E+00	1.059E-01	2.361E+02	1.059E-01	2.361E+02
Pu-238	7.060E+00	0.000E+00	6.546E-03	3.819E+03	6.546E-03	3.819E+03
Pu-239	7.900E+01	0.000E+00	7.220E-03	3.462E+03	7.220E-03	3.462E+03
Sb-125	8.300E+00	0.000E+00	2.543E-02	9.833E+02	2.543E-02	9.833E+02
Sr-90	2.280E+01	0.000E+00	8.000E-04	3.125E+04	8.000E-04	3.125E+04
U-235	1.500E+00	0.000E+00	2.425E-02	1.031E+03	2.425E-02	1.031E+03
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ	ííííííííí	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍ

Individual Nuclide Dose Summed Over All Pathways Parent Nuclide and Branch Fraction Indicated

0Nuclide	Parent	THF(i)						DOSE(j,t)	, mrem/yr				
(j)	(i)		t=	0.000E+00	1.000E+00	5.000E+00	1.000E+01	1.232E+01	1.500E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄ									
Al-26	Al-26	1.000E+00		4.441E-02	5.154E-03	9.331E-07	1.958E-11	1.322E-13	4.106E-16	3.759E-30	0.000E+00	0.000E+00	0.000E+00
0Am-241	Am-241	1.000E+00		9.609E-02	9.350E-02	8.377E-02	7.297E-02	6.842E-02	6.350E-02	4.160E-02	4.638E-03	0.000E+00	0.000E+00
0Np-237	Am-241	1.000E+00		7.273E-08	2.153E-07	7.443E-07	1.319E-06	1.557E-06	1.809E-06	2.849E-06	2.886E-06	0.000E+00	0.000E+00
0U-233	Am-241	1.000E+00		4.539E-15	3.131E-14	3.806E-13	1.270E-12	1.819E-12	2.537E-12	7.520E-12	1.787E-11	0.000E+00	0.000E+00
0Th-229	Am-241	1.000E+00		4.402E-18	6.536E-17	2.790E-15	1.817E-14	3.214E-14	5.495E-14	3.474E-13	4.263E-12	0.000E+00	0.000E+00
0Co-60	Co-60	1.000E+00		2.945E-01	2.572E-01	1.495E-01	7.580E-02	5.529E-02	3.840E-02	4.958E-03	2.710E-07	0.000E+00	0.000E+00
0Cs-134	Cs-134	1.000E+00		4.309E-02	3.069E-02	7.894E-03	1.445E-03	6.570E-04	2.643E-04	1.606E-06	5.644E-17	0.000E+00	0.000E+00
0Cs-137	Cs-137	1.000E+00		3.325E+01	3.239E+01	2.915E+01	2.553E+01	2.400E+01	2.234E+01	1.488E+01	1.726E+00	0.000E+00	0.000E+00
0Eu-152	Eu-152	7.208E-01		1.664E-01	1.574E-01	1.258E-01	9.501E-02	8.338E-02	7.169E-02	3.061E-02	4.480E-04	0.000E+00	0.000E+00
Eu-152	Eu-152	2.792E-01		6.445E-02	6.095E-02	4.872E-02	3.680E-02	3.230E-02	2.777E-02	1.186E-02	1.735E-04	0.000E+00	0.000E+00
Eu-152	äDOSE(j))		2.309E-01	2.183E-01	1.745E-01	1.318E-01	1.157E-01	9.946E-02	4.247E-02	6.216E-04	0.000E+00	0.000E+00
0Gd-152	Eu-152	2.792E-01		3.271E-18	9.531E-18	3.072E-17	5.006E-17	5.687E-17	6.333E-17	8.027E-17	4.018E-17	0.000E+00	0.000E+00
0Eu-154	Eu-154	1.000E+00		4.383E-01	4.035E-01	2.897E-01	1.914E-01	1.578E-01	1.263E-01	3.607E-02	8.074E-05	0.000E+00	0.000E+00
0Eu-155	Eu-155	1.000E+00		5.839E-03	5.071E-03	2.884E-03	1.424E-03	1.026E-03	7.026E-04	8.422E-05	3.597E-09	0.000E+00	0.000E+00
0Nb-94	Nb-94	1.000E+00		1.800E-02	2.090E-03	3.792E-07	7.978E-12	5.391E-14	1.677E-16	1.548E-30	0.000E+00	0.000E+00	0.000E+00
0Pu-238	Pu-238	1.840E-09		8.503E-11	8.378E-11	7.893E-11	7.317E-11	7.062E-11	6.775E-11	5.331E-11	1.254E-11	0.000E+00	0.000E+00
Pu-238	Pu-238	1.000E+00		4.621E-02	4.553E-02	4.290E-02	3.977E-02	3.838E-02	3.682E-02	2.897E-02	6.815E-03	0.000E+00	0.000E+00
Pu-238	äDOSE(j))		4.621E-02	4.553E-02	4.290E-02	3.977E-02	3.838E-02	3.682E-02	2.897E-02	6.815E-03	0.000E+00	0.000E+00
0U-234	Pu-238	1.000E+00		1.687E-08	4.996E-08	1.727E-07	3.058E-07	3.603E-07	4.180E-07	6.479E-07	5.062E-07	0.000E+00	0.000E+00
0Th-230	Pu-238	1.000E+00		1.223E-13	8.475E-13	1.050E-11	3.592E-11	5.200E-11	7.348E-11	2.336E-10	7.393E-10	0.000E+00	0.000E+00
0Ra-226	Pu-238	1.000E+00		9.166E-16	1.364E-14	5.885E-13	3.884E-12	6.909E-12	1.189E-11	7.791E-11	1.078E-09	0.000E+00	0.000E+00
0Pb-210	Pu-238	1.000E+00		1.055E-19	3.219E-18	4.503E-16	5.401E-15	1.149E-14	2.336E-14	2.645E-13	6.609E-12	0.000E+00	0.000E+00
0Pu-239	Pu-239	1.000E+00		5.704E-01	5.665E-01	5.507E-01	5.311E-01	5.220E-01	5.114E-01	4.529E-01	1.848E-01	0.000E+00	0.000E+00
0U-235	Pu-239	1.000E+00		9.443E-10	2.817E-09	1.007E-08	1.861E-08	2.237E-08	2.658E-08	4.718E-08	7.805E-08	0.000E+00	0.000E+00
U-235	U-235	1.000E+00		3.638E-02	3.600E-02	3.454E-02	3.278E-02	3.198E-02	3.108E-02	2.639E-02	9.831E-03	0.000E+00	0.000E+00
U-235	äDOSE(j))		3.638E-02	3.600E-02	3.454E-02	3.278E-02	3.198E-02	3.108E-02	2.639E-02	9.831E-03	0.000E+00	0.000E+00
0Pa-231	Pu-239	1.000E+00		7.383E-15	5.118E-14	6.362E-13	2.184E-12	3.168E-12	4.486E-12	1.445E-11	5.018E-11	0.000E+00	0.000E+00
Pa-231	U-235	1.000E+00		4.267E-07	1.264E-06	4.385E-06	7.796E-06	9.206E-06	1.071E-05	1.683E-05	1.453E-05	0.000E+00	0.000E+00
Pa-231	äDOSE(j))		4.267E-07	1.264E-06	4.385E-06	7.796E-06	9.206E-06	1.071E-05	1.683E-05	1.453E-05	0.000E+00	0.000E+00

Individual Nuclide Dose Summed Over All Pathways Parent Nuclide and Branch Fraction Indicated

0Nuclide	Parent	THF(i)						DOSE(j,t)	, mrem/yr				
(j)	(i)		t=	0.000E+00	1.000E+00	5.000E+00	1.000E+01	1.232E+01	1.500E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Ac-227	Pu-239	1.000E+00		3.103E-16	4.568E-15	1.877E-13	1.165E-12	2.016E-12	3.363E-12	1.864E-11	1.378E-10	0.000E+00	0.000E+00
Ac-227	U-235	1.000E+00		2.385E-08	1.631E-07	1.904E-06	6.050E-06	8.472E-06	1.153E-05	3.009E-05	4.971E-05	0.000E+00	0.000E+00
Ac-227	äDOSE(j)		2.385E-08	1.631E-07	1.904E-06	6.050E-06	8.472E-06	1.153E-05	3.009E-05	4.971E-05	0.000E+00	0.000E+00
0Sb-125	Sb-125	1.000E+00		2.110E-01	1.909E-02	1.275E-06	7.686E-12	2.909E-14	4.631E-17	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Sr-90	Sr-90	1.000E+00		1.824E-02	1.752E-02	1.490E-02	1.216E-02	1.106E-02	9.918E-03	5.353E-03	2.377E-04	0.000E+00	0.000E+00
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ		ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ
THF(i)	is the tl	hread fract	tio	n of the pa	arent nucl:	ide.							

Individual Nuclide Soil Concentration Parent Nuclide and Branch Fraction Indicated

0Nuclide	Parent	THF(i)						S(j,t),	pCi/g				
(j)	(i)		t=	0.000E+00	1.000E+00	5.000E+00	1.000E+01	1.232E+01	1.500E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄ									
Al-26	Al-26	1.000E+00		2.500E-01	2.911E-02	5.352E-06	1.146E-10	7.809E-13	2.453E-15	2.408E-29	0.000E+00	0.000E+00	0.000E+00
0Am-241	Am-241	1.000E+00		1.100E+01	1.076E+01	9.868E+00	8.853E+00	8.418E+00	7.942E+00	5.734E+00	1.254E+00	1.631E-02	4.085E-09
0Np-237	Am-241	1.000E+00		0.000E+00	3.522E-06	1.681E-05	3.177E-05	3.813E-05	4.505E-05	7.652E-05	1.310E-04	1.100E-04	3.658E-05
0U-233	Am-241	1.000E+00		0.000E+00	7.710E-12	1.849E-10	7.023E-10	1.041E-09	1.501E-09	5.163E-09	2.975E-08	5.859E-08	2.449E-08
0Th-229	Am-241	1.000E+00		0.000E+00	2.433E-16	2.948E-14	2.268E-13	4.167E-13	7.367E-13	5.262E-12	1.194E-10	1.048E-09	3.648E-09
0Co-60	Co-60	1.000E+00		7.700E-01	6.748E-01	3.982E-01	2.059E-01	1.516E-01	1.065E-01	1.472E-02	1.438E-06	5.017E-18	0.000E+00
0Cs-134	Cs-134	1.000E+00		2.000E-01	1.429E-01	3.723E-02	6.930E-03	3.177E-03	1.290E-03	8.321E-06	4.992E-16	2.803E-45	0.000E+00
0Cs-137	Cs-137	1.000E+00		3.660E+02	3.576E+02	3.259E+02	2.902E+02	2.750E+02	2.585E+02	1.825E+02	3.599E+01	3.481E-01	3.096E-08
0Eu-152	Eu-152	7.208E-01		9.370E-01	8.891E-01	7.207E-01	5.544E-01	4.908E-01	4.264E-01	1.940E-01	4.921E-03	1.358E-07	1.497E-23
Eu-152	Eu-152	2.792E-01		3.630E-01	3.444E-01	2.792E-01	2.147E-01	1.901E-01	1.652E-01	7.516E-02	1.906E-03	5.259E-08	5.798E-24
Eu-152	äS(j):			1.300E+00	1.234E+00	9.999E-01	7.691E-01	6.809E-01	5.916E-01	2.692E-01	6.828E-03	1.883E-07	2.077E-23
0Gd-152	Eu-152	2.792E-01		0.000E+00	2.269E-15	1.023E-14	1.808E-14	2.106E-14	2.408E-14	3.487E-14	4.241E-14	3.865E-14	2.739E-14
0Eu-154	Eu-154	1.000E+00		2.300E+00	2.125E+00	1.547E+00	1.041E+00	8.663E-01	7.005E-01	2.133E-01	8.309E-04	1.084E-10	8.711E-35
0Eu-155	Eu-155	1.000E+00		1.100E+00	9.561E-01	5.456E-01	2.706E-01	1.955E-01	1.342E-01	1.638E-02	8.930E-07	5.886E-19	0.000E+00
0Nb-94	Nb-94	1.000E+00		1.700E-01	1.980E-02	3.639E-06	7.790E-11	5.308E-13	1.668E-15	1.636E-29	0.000E+00	0.000E+00	0.000E+00
0Pu-238	Pu-238	1.840E-09		1.299E-08	1.289E-08	1.247E-08	1.198E-08	1.176E-08	1.150E-08	1.019E-08	5.777E-09	1.143E-09	3.931E-12
Pu-238	Pu-238	1.000E+00		7.060E+00	7.003E+00	6.780E+00	6.510E+00	6.389E+00	6.252E+00	5.536E+00	3.140E+00	6.210E-01	2.137E-03
Pu-238	äS(j):			7.060E+00	7.003E+00	6.780E+00	6.510E+00	6.389E+00	6.252E+00	5.536E+00	3.140E+00	6.210E-01	2.137E-03
0U-234	Pu-238	1.000E+00		0.000E+00	1.985E-05	9.610E-05	1.846E-04	2.232E-04	2.659E-04	4.709E-04	8.906E-04	5.290E-04	6.090E-06
0Th-230	Pu-238	1.000E+00		0.000E+00	8.960E-11	2.192E-09	8.536E-09	1.280E-08	1.870E-08	6.906E-08	5.347E-07	1.913E-06	2.708E-06
0Ra-226	Pu-238	1.000E+00		0.000E+00	1.294E-14	1.581E-12	1.230E-11	2.271E-11	4.037E-11	2.972E-10	7.511E-09	7.288E-08	1.852E-07
0Pb-210	Pu-238	1.000E+00		0.000E+00	9.993E-17	5.966E-14	9.020E-13	2.025E-12	4.318E-12	5.859E-11	3.558E-09	5.502E-08	1.631E-07
0Pu-239	Pu-239	1.000E+00		7.900E+01	7.898E+01	7.891E+01	7.882E+01	7.877E+01	7.873E+01	7.845E+01	7.719E+01	7.369E+01	6.266E+01
0U-235	Pu-239	1.000E+00		0.000E+00	7.748E-08	3.810E-07	7.465E-07	9.110E-07	1.097E-06	2.065E-06	5.265E-06	8.362E-06	7.850E-06
U-235	U-235	1.000E+00		1.500E+00	1.488E+00	1.441E+00	1.383E+00	1.358E+00	1.329E+00	1.177E+00	6.680E-01	1.325E-01	4.601E-04
U-235	äS(j):			1.500E+00	1.488E+00	1.441E+00	1.383E+00	1.358E+00	1.329E+00	1.177E+00	6.680E-01	1.325E-01	4.680E-04
0Pa-231	Pu-239	1.000E+00		0.000E+00	8.186E-13	2.002E-11	7.794E-11	1.168E-10	1.707E-10	6.295E-10	4.845E-09	1.694E-08	2.102E-08
Pa-231	U-235	1.000E+00		0.000E+00	3.148E-05	1.524E-04	2.927E-04	3.539E-04	4.216E-04	7.467E-04	1.412E-03	8.382E-04	9.633E-06
Pa-231	äS(j):			0.000E+00	3.148E-05	1.524E-04	2.927E-04	3.539E-04	4.216E-04	7.467E-04	1.412E-03	8.382E-04	9.654E-06

Individual Nuclide Soil Concentration Parent Nuclide and Branch Fraction Indicated

0Nuclide	Parent	THF(i)						S(j,t),	pCi/g					
(j)	(i)		t=	0.000E+00	1.000E+00	5.000E+00	1.000E+01	1.232E+01	1.500E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03	
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ		ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄ									
Ac-227	Pu-239	1.000E+00		0.000E+00	8.587E-15	1.003E-12	7.392E-12	1.331E-11	2.302E-11	1.462E-10	2.186E-09	9.863E-09	1.293E-08	
Ac-227	U-235	1.000E+00		0.000E+00	4.939E-07	1.129E-05	4.046E-05	5.842E-05	8.179E-05	2.406E-04	7.942E-04	5.623E-04	6.835E-06	
Ac-227	äS(j):			0.000E+00	4.939E-07	1.129E-05	4.046E-05	5.842E-05	8.179E-05	2.406E-04	7.942E-04	5.624E-04	6.848E-06	
0Sb-125	Sb-125	1.000E+00		8.300E+00	7.525E-01	5.085E-05	3.116E-10	1.188E-12	1.909E-15	4.391E-31	0.000E+00	0.000E+00	0.000E+00	
0Sr-90	Sr-90	1.000E+00		2.280E+01	2.197E+01	1.893E+01	1.571E+01	1.441E+01	1.304E+01	7.457E+00	5.497E-01	3.195E-04	1.512E-15	
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ		ÍÍÍÍÍÍÍÍ										
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THF(i) is the thread fraction of the parent nuclide.

ORESCALC.EXE execution time = 6.70 seconds

Appendix E Closure Summary

CAU 478 CADD/CR Appendix E Revision: 0 Date: May 2007 Page E-1 of E-3

E.1.0 Closure Summary

A land use restriction will be applied as the closure in place alternative for CAU 478. The use restrictions will be applied to control use and limit access to the sites to prevent inadvertent exposure to the radionuclide contaminated soil identified in the channels and pond sediments (CAS 12-23-01). The completed land use restriction form and map are included in this appendix.

The following warning will appear on a large sign posted adjacent to the gate that controls access to CAU 309, CAU 476, CAU 478, and CAU 559:

WARNING

Radiologically Contaminated Areas Beyond This Point

FFACO Sites

CAU 476, Area 12, T-Tunnel Sites CAS 12-06-02, Muckpile

CAU 559, T-Tunnel Compressor/Blower Pad CAS 12-25-13, Oil Stained Soil and Concrete

CAU 478, Area 12, T-Tunnel Ponds CAS 12-23-01, Ponds (5), RAD Area

CAU 309, Area 12, Muckpiles CAS 12-06-09, Muckpile CAS 12-08-02, Contaminated Waste Drums CAS 12-28-01, I, J, and K-Tunnel Debris

Access to this area is not permitted without U.S. Government Permission

Before Working In This Area,
Contact Real Estate Services at 295-2528

This site can be closed without further corrective action.

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CAU Use Restriction Information

CAU Number/Description: 478/Area 12 T-Tunnel Ponds
Applicable CAS Numbers/Descriptions: 12-23-01/Ponds (5) RAD Area
Contact (organization/project): NNSA/NSO, Environmental Management
Surveyed Area (UTM, Zone 11, NAD 27, meters): See attached figure NW Corner
Survey Date: 4/3/2007 Survey Method (GPS, etc): GPS
Site Monitoring Requirements: Certify that markers and postings are in place, intact, and readable
Required Frequency (quarterly, annually?): _Annually
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 documentation unless appropriate concurrence is obtained in advance.
Comments: See the Closure Report for additional information on the condition of the site(s). Results of the annual inspection will be provided in the annual Post Closure Inspection Monitoring Report.
Submitted By: Poter Saulu For Kerin Cabble Date: 05/15/2007
cc with copy of survey map (paper and digital (dgn) formats):

CAU 478 CADD/CR Appendix E Revision: 0 Date: May 2007 Page E-3 of E-3

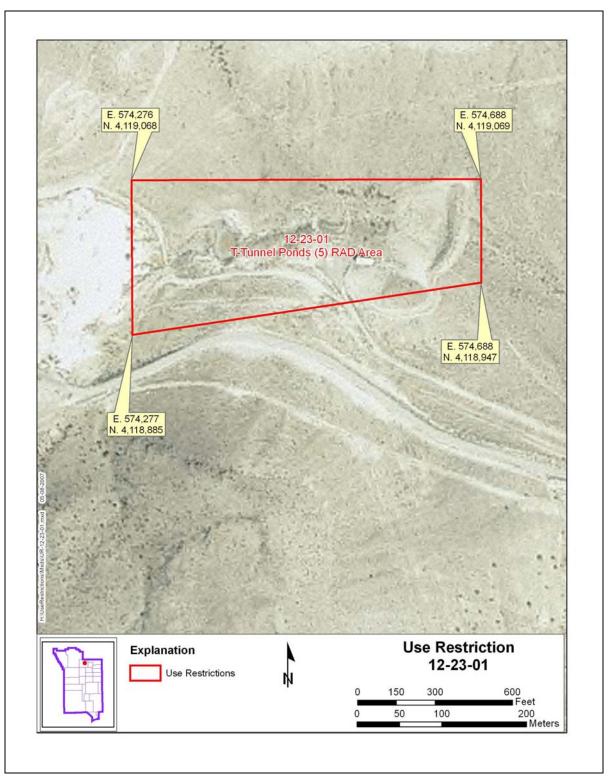


Figure E.1-1 CAU 478 Area 12 T-Tunnel Ponds

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