TA-21

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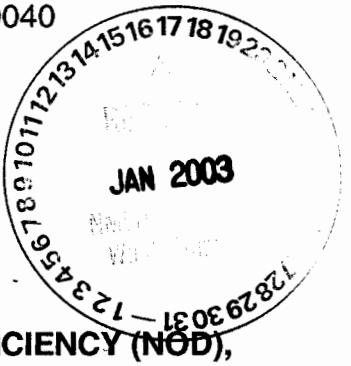
Date: January 16, 2003
Refer to: ER2003-0040



Mr. John Young, Corrective Action Project Leader
Permits Management Program
NMED – Hazardous Waste Bureau
2905 Rodeo Park Drive East
Building 1
Santa Fe, NM 87505-6303

SUBJECT: SUBMITTAL OF RESPONSE TO NOTICE OF DEFICIENCY (NOD), VOLUNTARY CORRECTIVE MEASURE (VCM) PLAN FOR SOLID WASTE MANAGEMENT UNIT (SWMU) 21-011(K) AT TECHNICAL AREA (TA) 21 (REVISION 2. LOS ALAMOS NATIONAL LABORATORY EPA ID NO: NM0890010515 TASK NUMBER HWB-02-020)

Dear Mr. Young:

Enclosed are two copies of the Los Alamos National Laboratory (LANL) Risk Reduction and Environmental Stewardship Remediation (RRES-R) Programs Response to the NOD received on December 23, 2003 on Revision 2 of the VCM Plan for SWMU 21-011(k). Per personnel communication and follow-up electronic confirmation from Vickie Maranville of your staff LANL is submitting the enclosed NOD response at this time in lieu of a revised VCM Plan. Once the response to the NOD has been approved by the New Mexico Environment Department (NMED) LANL will submit a revised VCM plan within 15 days of NMEDs written approval.

If you have any questions, please contact Mark Thacker at (505) 665-5342.

Sincerely,

David McInroy, Acting Program Manager
Remediation Program
Los Alamos National Laboratory

Sincerely,

Everett Trollinger, Project Manager
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10680

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Enclosure: Response to NOD (ER2003-0038)

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Response to Notice of Deficiency (NOD) on the Voluntary Corrective Measure (VCM) Plan for Solid Waste Management Unit (SWMU) 21-011(k) at Technical Area 21, Revision 2
Los Alamos National Laboratory, EPA ID#NM0890010515

INTRODUCTION

To facilitate review of this response, the New Mexico Environment Department's (NMED's) comments are included verbatim. The comments are divided into general and specific categories, as presented in the letter. Los Alamos National Laboratory's (LANL's) responses follow each NMED comment.

GENERAL COMMENTS

NMED Comment

1. *Maps displaying data using a colorimetric scale must be submitted in color. Since the maps were not submitted in color, it is difficult for the reader to determine contaminant distribution. In addition, color photographs (Attachment 1) should be submitted in color, not black and white. Please revise all maps displaying data using a colorimetric scale and submit color maps and photographs to NMED in the revised VCM Plan.*

LANL Response

1. Maps displaying data using a colorimetric scale are included as Attachment 1 to this NOD. The photographs provided in Attachment 1 of Revision 2 of the VCM plan (Release/Discharge Notification PRS 21-011k) were taken by an employee who is no longer with LANL. As of the submittal of this NOD response, the original photographs have not been located. If the photographs are located color copies of the photographs will be transmitted to NMED.

NMED Comment

2. *Ecological risk at the site is not addressed in the VCM Plan. The Permittees must assess ecological risk from uptake of residual contaminants through plants into the food chain using LANL ecological screening levels (ESLs) for contaminants or sampling results from vegetation removed from the site. Results of ecological risk can be presented in the VCM Completion Report.*

LANL Response

2. Results of ecological risk screening assessment will be presented in the VCM Completion Report for SWMU 21-011(k).

SPECIFIC COMMENTS

NMED Comment

1. ***Section 1.2 Regulatory History, Page 4***

Table 1.2-2 Regulatory Activity for SWMU 21-011(k).

The above referenced Table is incomplete as submitted, missing plan submittals, and NMED and the Permittees correspondence. Please update the Table to accurately reflect the regulatory activity for SWMU 21-011 (k).

LANL Response

1. Table 1.2-1, presented below, has been updated to reflect plan submittals and NMED and the Permittees correspondence.

Table 1.2-1
Regulatory Activity for SWMU 21-011(k)

Date	Activity	Document
1988	Sampling	1994 TA-21 OU RFI Phase Report 1C (LANL 1994, 31591.1)
1991	LANL TA-21 RFI Work Plan	1991 TA-21 Operable Unit RFI Work Plan for Environmental Restoration (LANL 1991, 07528.1)
1992-93	RFI Site Characterization	1994 Addendum to TA-21 Phase Reports 1B and 1C (LANL 1994, 52350.1)
1996/1997	Interim Action	1996 Interim Action Plan for PRS 21-011(k) (LANL 1996, 54790.2); 1997 Interim Action Report for PRS 21-011(k) (LANL 1997, 55648.2)
2001	VCM Implementation Approach for SWMU 21-011(k)	Communication Record (LANL 2002, 70217)
2002	Submittal of VCM Plan for SWMU 21-011(k) at TA-21	"Voluntary Corrective Measures Plan for Solid Waste Management Unit (SWMU) 21-011(k) at Technical Area (TA) 21," LA-UR-02-2218, (LANL 2002, 73085.2)
2002	NMED Issues Comments on SWMU 21-011(k) VCM Plan	Notice of Technical Incompleteness, VCM Plan for SWMU 21-011(k), (NMED 2002, 73201)
2002	Submittal of Revision 1 of the VCM Plan for SWMU 21-011(k) at TA-21	"Voluntary Corrective Measures Plan for Solid Waste Management Unit (SWMU) 21-011(k) at Technical Area (TA) 21, Revision 1" LA-UR-02-3807, (LANL 2002, 73654.2)
2002	Withdrawal of Revision 1 of the VCM Plan for SWMU 21-011(k) at TA-21	Withdrawal Letter (LANL 2002, 73605)
2002	Submittal of Revision 2 of the VCM Plan for SWMU 21-011(k) at TA-21	"Voluntary Corrective Measures Plan for Solid Waste Management Unit (SWMU) 21-011(k) at Technical Area (TA) 21, Revision 2" LA-UR-02-6797, (LANL 2002, 73722)
2002	Submittal of Request for "No Longer Contained In" determination for soil, tuff, and sediment at SWMU 21-011(k), at TA-21	Letter Requesting No Longer Contained in Determination, (LANL 2002, 73721)
2002	NMED Issues No Longer Contained-In Determination for material to be excavated from SWMU 21-011(k), TA-21	Approval letter from NMED, (NMED 2002, 73720)
2002	Submittal of VCM Confirmation Sampling Notification	Sampling Notification Letter, ER2002-0797, (LANL 2002, 73723)
2002	Submittal of offsite analytical laboratory data to validate the proposed screening method to be used during the VCM at SWMU 21-011(k)	Communication Record, ER2002-0800, (LANL 2002, 73725)
2002	NMED issues Notice of Deficiency on SWMU 21-011(k) VCM Plan	Notice of Deficiency, VCM Plan for SWMU 21-011(k), (NMED 2002, 73724)

NMED Comment

2. *Section 1.3 Rationale for Proposed Corrective Measure, Page 4*

LANL Statement: "Consequently, the trail-user land use scenario is proposed for this VCM (LANL 2001, 70217) and used to screen soil and sediment areas with potentially elevated radionuclide concentration exceeding the acceptable human health dose level (15 mrem/yr)."

A dose of 15 mrem/yr may be considered acceptable to the Permittees; however, NMED does not evaluate human health based on dose per year. NMED evaluates risk to human health based on lifetime carcinogenic risk. Please revise the above statement to indicate that a dose of 15 mrem/yr. is acceptable to the Permittees, but may not be acceptable to NMED.

In order to determine if the proposed VCM could be considered a final remedy the risk assessment must contain an estimate of dose and risk over time for a residential receptor based on the starting residual level of radionuclides in soil being equivalent to the target goals and demonstrating how many years would be required for the risk to reach no further action (NFA) criteria of 10^{-5} excess risk for a residential receptor.

LANL Response

2. LANL recognizes that NMED has an interest in receiving information on radionuclides present at corrective action sites. For this reason, LANL voluntarily provides NMED with the information in this NOD Response for SWMU 21-011(k) that it provides to DOE pursuant to DOE Orders. However, NMED's requested response exceeds the agency's authority under the New Mexico Hazardous Waste Act. LANL is subject to DOE's authority under the Atomic Energy Act for radioactive materials at corrective action sites, and declines to revise the text as requested.

NMED Comment

3. *Section 1.3-1 Present-day dose vs. time for trail-user scenario at SWMU 21-011(k), Page 5*

LANL Statement: "This remedial approach is a cost-effective and proactive remedial alternative, and is preferred over no action, fencing of the site, and/or stabilization and placement in an on-site containment cell."

The VCM Plan submitted to NMED in April 2000 (LA-UR-02-2218) and deemed technically deficient (NMED letter dated May 15, 2000) stated in Section 1.3, page 6, "The estimated cost savings of onsite stabilization compared to transportation and disposal at Area G is expected to be approximately $2 million because onsite stabilization eliminates the costs associated with the coordination and implementation of transporting low level contaminated waste over public roadways, through public areas, and disposal at Area G." The current plan does not demonstrate that removal and disposal at Area G will result in a cost savings. In addition, the current proposed remedial method (removal and off-site disposal) requires contaminated material to be transported through the town of Los Alamos. Also, the cost estimate provided in the current revision of the VCM Plan Appendix B (VCM Checklist and Fact Sheet), Page B-5 is the same fact sheet as previously submitted to NMED. Please explain in more detail the benefits of the selected remedial alternative.

LANL Response

3. As stated in the September 17, 2002 correspondence "Withdrawal of Revision 1 of the VCM plan for SWMU 21-011(k), at Technical Areas 21" ER2002-0643, "Subsequent to the submittal of the VCM plan to NMED-HWB, the decision to stabilize contaminated material in place was revisited based on a much reduced volume of contaminated soil identified in the field as needing remediation as well as identifying a lower rate for disposal costs. As a result, the cost of excavation and disposal of the contaminated material was virtually the same as the cost for onsite stabilization. At the same time the Department of Energy (DOE) underscored its goal of minimizing the number of ER Project sites that will require long-term stewardship. As a result, the LANL ER Project and the DOE Los Alamos Site Office determined that the excavation and disposal of radioactively contaminated material from SWMU 21-011(k) at Area G at TA-54 is more in keeping with current cost efficiencies and long-term property management strategies."

   As stated in the referenced correspondence pre-VCM field activities refined the original estimate of 1500 yd^3 of material requiring removal to approximately 560 yd^3. After submission of the July 2002 VCM plan to NMED a bulk disposal rate was negotiated with Area G at TA-54, which greatly reduced the cost of disposal. Therefore, the reduced volume estimate and lower disposal cost made the cost of excavation and disposal at Area G essentially identical to those that would have been incurred for excavation, stabilization, and on-site disposal while significantly reducing long-term stewardship requirements. This approach was validated by members of the public and the Northern New Mexico Citizens Advisory Board (NNMCAB) during a site tour in 2002 when DOE and ER Project staff were reminded of DOE's stated goal of limiting DOE's "footprint" at LANL, which is inline with the current selected remedial alternative.

NMED Comment

4. ***3.0 Basis for Cleanup Levels, Page 16***

   LANL Statement: "By comparison, the calculated dose to a hypothetical recreational trail user following implementation of the proposed excavation and disposal of 500 yd^3 of contaminated material with concentrations of Cs-137 greater than 150pCi/g and approximately 60 yd^3 of contaminated sediment in the western drainage with Am-241 concentrations greater than 170 pCi/g is between 3 and 4 mrem/yr or about 1/4 the criterion of 15 mrem/yr for the free-release of real property (DOE 2000, 67489)."

   Please explain why the selected remedy is preferred over stabilization in place. Stabilization in place, prior to installation of the engineered cover, was estimated to provide between 2 and 3 mrem/yr or 1/5 the Department of Energy (DOE) criterion of 15 mrem/yr for free-release of real property, whereas the selected remedy is estimated to provide between 3 and 4 mrem/yr or 1/4 the DOE criterion. Also, please provide risk estimates for each remedy proposed.

LANL Response

4. The discussion regarding the preference of the selected remedy is included in our response to specific comment number 3 above. The primary reason for the increase in dose following the implentation of the preferred remedy is that the amount of material requiring removal to meet the cleanup criteria (approximately 560 yd^3) is substantially less than the 1500-yd^3 estimate used in the RESRAD model calculations presented in previous versions of the VCM plan for SWMU 21-011(k). RESRAD results using 1500 yd^3 equated to a lower overall site wide residual concentration remaining after implementation of excavation, solidification, and placement in an on-site stabilization cell. Based on

RESRAD results using 560 yd^3, the selected remedy presented in Revision 2 of the VCM plan is shown to be protective of human health and the environment based on current and projected future land use.

Risk estimates for a remedy other than the proposed remedy have not been completed. A full screening assessment, based on dose, will be included in the VCM Completion Report for SWMU 21-011(k), consistent with DOE Orders.

NMED Comment

5. ***3.0 Basis for Cleanup Levels, Page 16***

LANL Statement: "The total dose rate is projected to decline to less than 2 mrem/yr within approximately 30 years after excavation due solely to the decay of Cs-137, thereby decreasing the dose within 1/8 the time without VCM implementation. "

The above statement is confusing; please clarify the estimated risk after 30 years with and without implementation of the proposed VCM activities.

LANL Response

5. The text has been modified as presented below, please note the $1/8^{th}$ was a carryover from the original VCM plan, by comparing the time required to reach 2 mrem/yr on Figures 1.3-1 and 3.0-1 the correct fraction is $1/3^{rd}$.

The total dose rate is projected to decline to less than 2 mrem/yr within approximately 30 years after excavation due solely to the decay of Cs-137. This is approximately 1/3 the time that would be required to reach 2 mrem/yr without the source reduction achieved through implementation of the VCM.

NMED Comment

6. ***3.0 Basis for Cleanup Levels, Page 16***

LANL Statement: "Figure 3.0-1 is a dose versus time plot produced by RESRAD 6.1 (Appendix F, Exhibit F.C) for the recreational trail user following implementation of the proposed excavation and disposal of 50yd^3 of contaminated material with concentrations of Cs-137 greater than 150pCi/g . . . "

Based on information provided in Section 1.1 Purpose and Scope, page I of the VCM Plan, approximately 500 yd^3 of contaminated soil, tuff, and sediment, and approximately 60 yd^3 of contaminated sediment are proposed for removal during the VCM activities. Please correct the above statement to reflect actual amount of material planned for removal during the proposed VCM activities.

LANL Response

6. The text has been corrected to read "disposal of 560 yd^3 of contaminated material..."

Attachment 2 to this NOD response includes the RESRAD output results for the recreational trail user following implementation of the VCM at SWMU 21-011(k). The RESRAD results included in Exhibit F2.2 of Revision 2 of the VCM Plan were from a previous version of the VCM plan.

NMED Comment

7. ***3.0 Basis for Cleanup Levels, Page 17***

LANL Statement: "The mixture derived concentration guideline (DCGL) (Appendix F) for soil is satisfied when the sum of ratios or the radionuclides present is less than or equal to 1. Based on site average concentrations current dose at SMWU 21-011 (k) is 7.3 mrem/yr for a recreational trail-user scenario, well below the 15 mrem/yr dose-based criteria."

Although a calculated dose of 7.3 mrem/yr may be a legitimate dose to DOE, it does not satisfy NMED requirements. NMED requires risk to be calculated for each radionuclide present, the risk for individual radionuclides can then be summed to determine total risk at the site. Estimates of excess risk corresponding to the estimated doses should be included; the excess risk should be estimated for a 30-year exposure for the trail-user and for the residential scenario where that scenario is considered. The trail-user scenario adequately estimates current potential exposure, but in order to determine if the proposed VCM could be considered a final remedy the risk assessment must contain an estimate of dose and risk over time for a residential receptor based on the starting residual level of radionuclides in soil being equivalent to the target goals and demonstrating how many years would be required for the risk to reach NFA criteria of 10^{-5} excess risk for a residential receptor.

LANL Response

7. See response to Specific Comment #2.

NMED Comment

8. ***4.1 Conceptual Model, Page 19***

LANL Statement: "The SWMU is vegetated, and portions of it are covered with plant litter, thereby minimizing any contaminant transport via wind and fugitive dust."

Based on communication between the Permittees and NMED, the site had been cleared of vegetation during the summer of 2002 in preparation for solidification activities that were proposed to NMED in prior submittals of the VCM Plan. Please clarify or revise the above statement to reflect actual site conditions.

LANL Response

8. The text has been modified to state the following: "During the summer of 2002 the woody vegetation from the SWMU was removed in anticipation of VCM activities. Grasses and plant litter remain over much of the site which help minimize contaminant transport via wind and fugitive dust."

NMED Comment

9. ***4.3 Remedial Approach, Page 21***

LANL Statement: "Site preparation activities will include clearing and grubbing of vegetation in areas to be excavated; set-up of site trailers; survey and staking of area to be excavated; construction of site support zones; installation of sanitary facilities; tree removal and chipping . . . "

Based on communication between the Permittees and NMED, the site had been cleared of vegetation, grubbed, and the trees removed and chipped during the summer of 2002 in preparation for

solidification activities that were proposed to NMED in the prior submittals of the VCM Plan. In addition, the following paragraphs in section 4.3 of the VCM Plan detail site clearing activities. The above statement is confusing to the reader; please revise or remove the statement to reflect actual site conditions. If clearing and grubbing have in fact been successfully completed, state that clearing activities have already been conducted and provide the details of such activities.

LANL Response

9. Section 4.3 of the text has been updated to reflect current conditions as follows:

4.3 Remedial Approach

Following the readiness review, mobilization and site preparation for remedial activities commenced. Mobilization activities included the delivery of site trailers, materials, and heavy equipment. Site preparation activities included clearing and grubbing of vegetation in areas to be excavated; set-up of site trailers; survey and staking of areas to be excavated; construction of site support zones; installation of sanitary facilities; tree removal and chipping; improvement and extension of the existing haul road; fence removal; installation of temporary fencing; and installation of stormwater BMPs.

Tree trunks over 8 in. in diameter were cut into nominal 15-ft lengths for subsequent use as stormwater run-on and runoff control diversion barriers. Prior to clearing and grubbing, on-site vegetation was sampled for waste characterization purposes as described in detail in Section 6.0. The material was cleared and stored in rolloff containers. After receipt and review of waste characterization results the material will be disposed of at Area G at TA-54. The drainline from the northern fence line of the two holding tanks (structures 21-112 and -113) to the outfall at the southern end of the SWMU has been removed. This 4-in. diameter, cast iron drainline extended 80 ft from the south side of the North Perimeter Road to a discharge point just below the canyon rim. The soil above the cast iron drainline was excavated and the drainline removed. The drainline excavation trench was field screened using a gamma instrument and PG-2 detector in the same manner being followed for guiding the soil removal. Samples were collected immediately below the removed line and following collection of confirmation samples, the trench was backfilled. Based on soil screening results some soil removal and additional sampling will be required along the section of the drainline that formerly ran under the road. Once that work is accomplished the road will be repaired as described in Section 5.

During field activities, the Laboratory is monitoring worker exposure to radionuclide-contaminated soil at SWMU 21-011(k) based on the requirements of the site-specific health and safety plan (SSHASP). The two high-volume air samplers proposed in the previous version of this VCM plan are not being used. Upon further review of the project, Laboratory Air Quality Group personnel determined that high-volume air samples located in close proximity to the site, (i.e., across the DP Canyon drainage channel to the north) would not detect contamination present in suspended particulates from the VCM, because 1) once suspended, the particulates travel a much further distance before being deposited on the ground, and 2) the high-volume samplers will not collect an aliquot of sample sufficient for analysis in a short time period. In lieu of the high-volume samplers, the Laboratory is monitoring exposure to members of the public during remediation of 21-011(k) by use of existing airnet stations. The Laboratory operates four airnet stations near the Los Alamos Airport and DP Road (Airnet stations: 9 - Los Alamos Airport, 68 - Airport Road, 62 - Crossroads Bible Church, and 69 - DP Road West Entrance). Airnet station 72 is just south of the site and is also being operated during the VCM. Airnet station 69 was shut down at the end of December 2002. These stations are downwind of SWMU 21-011(k) and in the predominant wind direction and will be used to monitor potential exposure to the public from field activities at 21-011k. The data collected from these stations during the implementation of the VCM will be reported in the VCM Completion Report for SWMU 21-011(k).

The Air Quality Group personnel conducted a new source review for the SWMU 21-011(k) VCM to determine if a new air sampling station is required by National Emissions Standards for Hazardous Air Pollutants (NESHAPs) as adopted by 20.2.78 of the New Mexico Administrative Code (NMAC), and LANL Air Quality Group criteria. The soil characterization data for radionuclides was used with the appropriate release factors, as described in Appendix D of 40 CFR Part 61, to calculate an emissions estimate for excavating, transporting and treating the contaminated material onsite (1500 yd^3). This calculation was conducted prior to the decision to excavate the material and transport it to Area G at TA-54 for disposal and before the total volume estimate had been refined. Therefore, with the change in the remediation approach, the current volume estimate is lowered to 560 yd^3. The calculated emission estimate represents a conservative estimate of the potential effective dose equivalent. Dose assessments from the emissions estimates were calculated using CAP88, an EPA-approved dispersion-modeling program. Based on the previous modeling results, the potential effective dose equivalent from excavation and transport of the material to Area G at TA-54 (560 yd^3 of contaminated soil) to the nearest receptor along State Road 502 (based on predominant wind direction) would conservatively be 0.07 mrem/yr (based on the original 1500 yds^3), which is below the monitoring threshold of 0.1 mrem/yr specified in Title 40 of the Code of Federal Regulations (40 CFR) Part 61, Subpart H (Radionuclide-NESHAPs).

Areas of the site with concentrations above 150 pCi/g Cs-137 and 170 pCi/g Am-241 have been surveyed and staked for excavation based on an initial walkover radiation survey conducted prior to the start of excavation. These areas showed excellent correlation to those shown in Figure 3.0-2. As these areas are excavated, real-time radiological screening combined with real-time mapping of gross gamma radiation is being used to determine whether enough media has been removed to achieve the established clean-up level. Excavated soil, sediment, and tuff are being staged on site within the bermed stockpile areas and covered with plastic sheeting. Silt fences, silt dikes, and/or straw wattles are being used to control run-on and runoff as described in the Storm Water Pollution Prevention Plan for 21-011(k) (LANL 2002, 73189). As a BMP, soil/sediment currently located near the northern SWMU boundary and along the western and eastern edges of SWMU 21-011(k) with Cs-137 concentrations just below the target clean-up level is being excavated first and staged on site. Confirmation sampling and a radiological survey of the entire site will be conducted prior to recontouring and placement of the vegetative cover over the site in accordance with Section 5.0, Confirmation Surveys and Sampling.

NMED Comment

10. ***4.3 Remedial Approach, Page 22***

LANL Statement: "Roll off containers will be bought on site and the excavated material will be loaded into the containers with a front-end loader. Trucks will then be used to transport the full rolloff containers to Area G at TA-54."

Excavated material must be sampled and managed in accordance with the NMED letter entitled "Contained-In Determination for Solid Waste Management Unit (SWMU) 21 -011 (k), Technical Area 21" dated November 25, 2002.

LANL Response

10. The text has been updated to present current conditions as follows:

As the excavation process proceeds, the contaminated material is being placed in individual stockpiles from the various excavation areas until all of the material with Cs-137 concentrations greater than 150 pCi/g and material in the western drainage with Am-241 concentrations greater than 170 pCi/g have

been excavated. All stockpile areas are in level easily-accessible portions of the site. In accordance with the No Longer Contained-In determination received from NMED on November 25, 2002, each 100 yd^3 of excavated material will be sampled for Appendix VIII volatile organic compounds (VOCs), the results reviewed with NMED prior to disposal of the soil at Area G at TA-54, and the results included in the VCM Completion Report for SWMU 21-011(k). After receipt and review of the VOC results with NMED, rolloff containers will be brought on site and the excavated material will be placed into the containers using a front-end loader. Trucks will then be used to transport the full rolloff containers to Area G at TA-54. The trucks and rolloff containers will be surveyed by Health, Safety, and Radiation Protection (HSR-1) Radiological Control Technicians (RCTs) prior to being released from the site. To ensure efficient disposal at Area G, all waste shipping paperwork will be compiled in advance of transport.

NMED Comment

11. ***5.2 Confirmation Surveys and Sampling of Soil Removal Area, page 25***

LANL Statement: "Upon completion of the excavation and removal activities, but before restoration occurs, confirmation samples will be collected at a rate of at least one from each area where 25 yd of contaminated material has been removed. At least one surface sample will be collected from each discrete excavated area, even if the area is smaller than 25 yd2. A minimum of one surface sample per 500 yd' of area not requiring excavation will be collected at random... Samples will be analyzed by gamma spectroscopy for Cs-137 and by alpha spectroscopy for Am-241 and isotopic Pu, and for Sr-90 to confirm the excavated areas meet the requirements of DOE order 5400.5. A minimum of one sample from each excavated area will be collected from the surface to a depth of approximately 12 in. In areas greater than 25 m^2 at least one sample per 25 m^2 will be collected. "

The proposed plan for confirmatory sampling is not clear. Based on the above-referenced text it is unclear to NMED if the proposed sampling frequency is adequate to determine total risk of residual contaminants left at the site following excavation and removal activities. Please revise or clarify, with consistent units, the proposed confirmatory sampling plan.

SWMU 21-011(k) is listed on the Facility operating permit, and based on historical records RCRA-regulated constituents are present at the site. NMED is concerned that the proposed sampling suite may not be adequate to address all potential contaminants that may be present at the site due to historical releases from the outfall. Based on Table H-3 (page H-7 of the VCM Plan), barium, cadmium, calcium, chromium, cobalt, nickel, selenium, sodium, vanadium, mercury, and other RCRA-regulated constituents outlined in the "contained in" request (submitted to NMED by the Permittees on November 5, 2002) were detected at low levels in waste characterization and sampling results for discrete sampling intervals. The confirmation sampling does not include sampling for inorganic constituents. Please provide rationale for not including inorganic constituents in the confirmatory sampling suite or revise the suite to include inorganic constituents in the confirmatory sampling plan. Since the activities proposed in the VCM plan are intended to be a final remedy, it is essential that the nature and extent of all potential contaminants of concern, in addition to radionuclides, be fully evaluated.

LANL Response

11. The text has been modified as follows:

"Confirmation that cleanup goals have been met will be made through collection of samples from both remediated (soil removal) areas and site-wide unremediated areas. Sampling frequencies are different for each type of excavated area. In each discrete remediated area, a minimum of one surface (0- to

12-in.) confirmation sample will be collected regardless of the area's size. For remediated areas larger than 25 m^2, samples will be collected at a rate of one per every 25 m^2. Unremediated areas will be sampled at a rate of one surface sample per every 500 m^2. Samples will be analyzed by gamma spectroscopy for Cs-137 and by alpha spectroscopy for Am-241,isotopic Pu, and Sr-90 to confirm the excavated areas meet the requirements of DOE order 5400.5."

Rational for not including inorganic constituents in the confirmatory sampling suite at SWMU 21-011(k)

In March 2001 samples were collected during the pre-VCM site and waste characterization effort (Appendix H of the VCM Plan). During a February 26, 2001 meeting with NMED, 11 locations at SWMU 21-011(k) were selected for the collection of site and waste characterization samples. The sample locations were based on gross gamma radiation results from the in situ gamma spectroscopy survey conducted at the site in November 2000, which identified areas of high (> 100,000 counts pre minute (cpm)), medium (betwwen 50,000 and 100,000 cpm), and low (< 50,000 cpm) gross gamma activity. Five sample locations were selected within areas of the site with high gamma activity, 4 sample locations were selected within areas with medium gamma activity, and 2 sample locations were selected within areas with low gamma activity based on the assumption that areas at SWMU 21-011(k) with the measured highest gamma activity and portions of areas with medium gamma activity would be addressed by the VCM and would also be the most likely location of any non-radioactive hazardous constituents present at the site. NMED recommended that in addition to the waste characterization samples, a minimum of one discrete sample should be collected from each of the 11 sample locations for site characterization purposes and analyzed for a full suite of analytes which included: perchlorates, gamma spectroscopy, isotopic plutonium, strontium-90, TAL metals, TCLP metals, TCLP VOCs, TCLP SVOCs, pesticides, PCBs, VOCs (via Encore), cesium-137, amercium-241, and gross alpha, beta, and gamma radiation.

Wherever possible, two discrete site characterization samples were collected from different depth intervals. Discrete samples were collected from two depths at seven of the eleven sample locations. Frozen tuff and snow present at the four other sample locations prevented the collection of additional depth samples. As documented in an August 14, 2001 ER Project Communication Record from Paula Bertino to Vickie Maranville of NMED-HWB, the results of this sampling effort and the 1996 confirmation sampling data were presented to NMED during a July 30, 2001 meeting (LANL 2001, 70217). Analytical results from the pre-VCM characterization sampling effort indicated that some inorganic constituents (barium, cadmium, calcium, chromium, cobalt, nickel, selenium, sodium, vanadium, mercury) were detected at concentrations above their respective background levels, primarily in waste characterization composite samples at locations with high and medium measured gross gamma activity (Appendix H of the VCM Plan). As discussed during the July 30, 2001 meeting between the LANL ER Project and NMED-HWB staff and in all previous versions of the VCM plan, mercury was the only inorganic chemical detected above its background level in three composite waste characterization samples, at three different locations, all with high measured gross gamma activity that will be removed during the VCM (Appendix H of the VCM plan). None of the inorganic chemicals detected above background showed a clear trend that would be indicative of further site contamination. In addition, none of the inorganic chemicals detected exceeds its respective screening action level (SAL) and therefore are below any cleanup level that would be derived for the site. The pre-VCM site characterization results confirmed that contamination from relatively short-lived radionuclides, (primarily Cs-137 and Am-241) are the drivers for the VCM at SWMU 21-011(k).

NMED Comment

12. ***7.0 PROPOSED SCHEDULE AND UNCERTAINTIES, Page 29***

LANL Statement: "The VCM Completion Report will be prepared and submitted to NMED Hazardous Waste Bureau (HWB) by the end of fiscal year 2003."

Based on the current schedule provided in the VCM Plan, submittal of the VCM Completion Report by the end of fiscal year 2003 is not acceptable to NMED. The VCM Completion Report must be submitted within 90-days of completion of field activities. Based on the schedule provided in the VCM Plan, the VCM Completion Report must be submitted on or before July 18, 2003. Should the schedule change, the actual submittal date may vary based on the final completion of the field activities, but should not be longer than 90-days after completion of field activities.

LANL Response

12. The VCM completion report will be submitted to NMED-HWB within 90-days of completion of field activities.

NMED Comment

13. ***Table 7.0-1 VCM Field Work Schedule, Page 29***

Please revise the above-referenced Table to reflect actual site conditions (i.e., start date for field activities, and report submittal date).

LANL Response

13. The schedule has been updated and is presented below.

Please note the laboratory holiday shutdown is not included in the total approximate working days, the schedule is weather dependent, and the duration of field activities has been increased due to winter site conditions and additional sampling and waste management activities required by the No Longer Contained In determination.

Table 7.0-1
VCM Field Work Schedule

Activity	Workday Duration	Start	Finish
Submit VCM plan to NMED	**N/A**	**N/A**	**TBD**
Readiness review/mobilization/pre-excavation radiological survey	15 days	November 14, 2002	November 29, 2002
Site preparation	6 days	November 14, 2002	November 20, 2002
Excavation, confirmation sampling, and post-excavation radiological survey	84 days	November 21, 2002	February 14, 2003
Review/Transmit VOC results	60 days	February 17, 2003	April 15, 2003
Waste management/disposal	60 days	February 17, 2003	April 15, 2003
Site restoration and final radiological survey	10 days	April 15, 2003	April 25, 2003
Demobilization	7 days	April 28, 2003	May 2, 2003
Approximate VCM working days	96 days	November 11, 2002	April 29, 2003
VCM Completion Report Submittal	NA	NA	August 1, 2003

TBD – to be determined

NMED Comment

14. ***A-1.0 ACRONYMS, Page A-I***

HRMB no longer exists, and is not used in the VCM Plan. Please replace HRMB with Hazardous Waste Bureau (HWB), which is used in the VCM Plan.

LANL Response

14. The acronym HRMB has been removed from the acronym list.

NMED Comment

15. ***A-2.0 GLOSSARY, Page A-3***

LANL Statement: "DOE Order 5400.5, Elevated Activity Criterion... are given in DOE/CH-8901 "

Please provide a copy of DOE/CH-8901 to NMED for review.

LANL Response

15. DOE Order 5400.5 can be found at the following universal resource locator:

www.nirs.org/radrecycle/54005.pdf

Attachment 3 to this NOD includes the requested information taken from the "Manual for Implementing Residual Radiactive Material Guidelines Using RESRAD, Version 5.0." The information from this

reference is included because finding DOE/CH-8901 within DOE Order 5400.5 is very difficult and when the guidance is downloaded, the formulas do not print out correctly.

NMED Comment

18. ***Appendix B, VCM Checklist and Fact Sheet, Page B-5***

The Estimated Cost and Schedule provided on page B-5 is incorrect. Please correct the typographical errors (the proposed action is a VCM not VCA) and revise the cost to reflect actual proposed activities at the site. The Cost and Schedule provided are identical to the Cost and Schedule provided as part of the Revision I of the VCM plan that was submitted in July 2002 and subsequently withdrawn.

LANL Response

18. The text has been modified to change all references to VCA to VCM. The cost for disposal of the approximate 560 yd^3 of soil, sediment, and tuff at Area G at TA-54 is $100,000 based on the negotiated disposal rate. As provided in the response to specific comment 13 the VCM began in November 2002 and will be completed by May 2003 based on the current schedule.

NMED Comment

19. ***Appendix E, Estimated Cost, Page E-1***

Appendix E should be revised to reflect proposed excavation and removal activities for the site. The estimate cost schedule provided is similar to the schedule provided for stabilization (VCM Plan Revision 1, dated July 2002 and referenced by LA-UR-02-3807). In addition, the proposed cost ($1.4 million) is not the same as the proposed cost outlined in page B-5 of this VCM Plan. Page B-5 states the total cost, which would include subcontractor, analytical, and disposal costs would be approximately $2.2 million, not $1.4 that is stated on page E-1. Please correct the inaccuracies and provide a revised cost estimate for excavation and removal.

LANL Response

19. Appendix E has been revised as follows:

Note: The $1.4 million referenced is the projected cost from completion of the plan through the VCM Completion Report. The entire project is budgeted at $2.2 million

APPENDIX E: ESTIMATED COSTS

Estimated Cost

Estimated Cost

Based on current resource estimates, the anticipated subcontractor costs and analytical costs of this VCM are approximately $2.2 million.

Schedule

The fieldwork portion of this VCM began in November FY02 and is anticipated to be completed in May 2003. The fieldwork includes soil, sediment, and tuff removal, confirmatory sample collection and analysis, radiation surveys, waste management, and site restoration including an engineered cover.

Attachment 1

Maps Displaying Colorimetric Scale from the

VCM Plan for SWMU 21-011(k), Revision 2

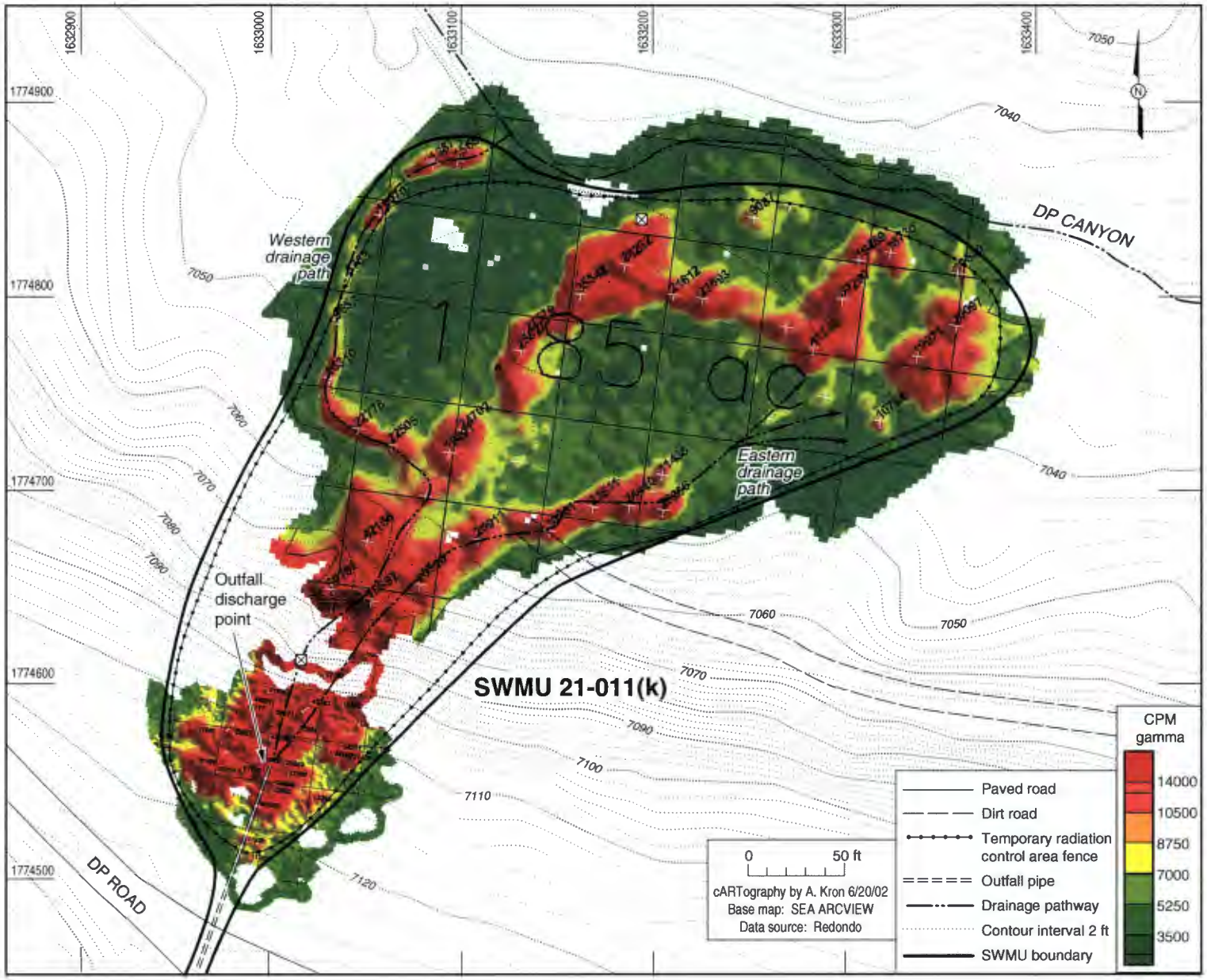


Figure 2.2-3 July 2000 Chemrad gross gamma survey results at SWMU 21-011(k)

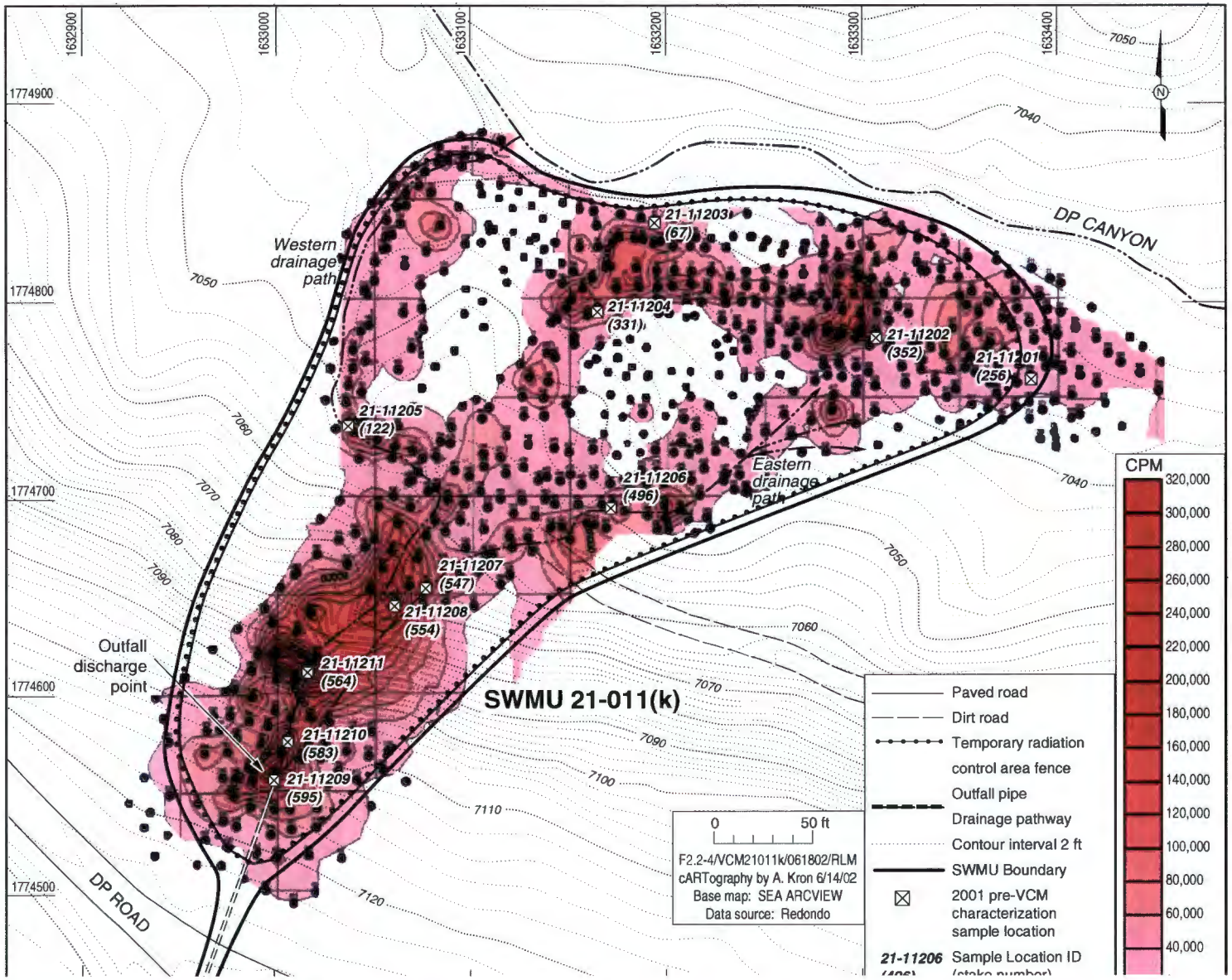


Figure 2.2-4 November 2000 in situ gamma survey results and March 2001 pre-VCM characterization sample locations at SWMU 21-011(k)

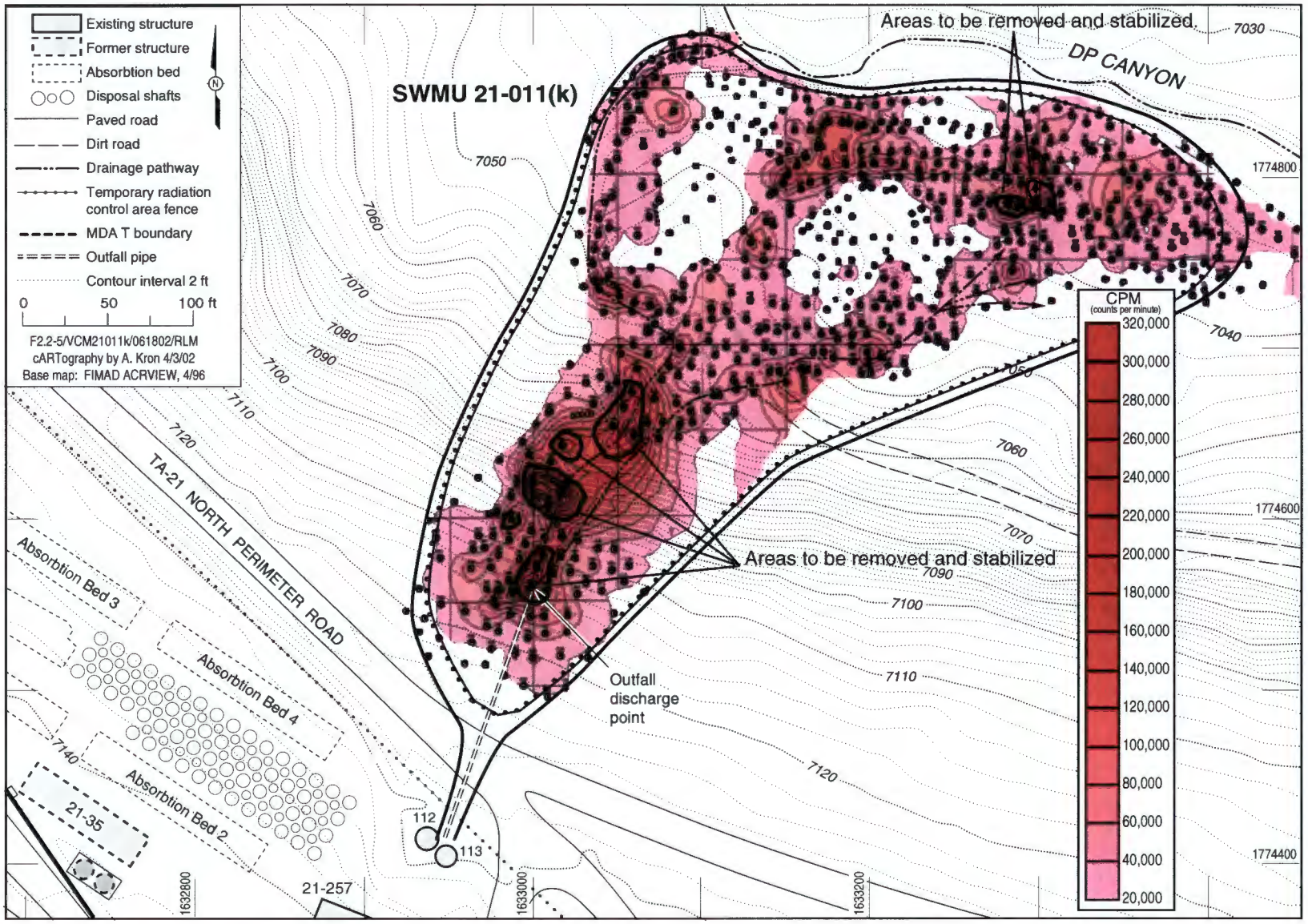


Figure 3.0-2 November 2000 in situ gross gamma survey results at SWMU 21-011(k) with circled areas planned for removal

Attachment 2

RESRAD Summary Report for the Recreational Trail-User Scenario

Following Implementation of the VCM

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentration w/removal of 500 yd^3
File : TUHME21011kw_remov_500y.RAD

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

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

Current Menu	Parameter	Value	Default	Name
B-1	Dose conversion factors for inhalation, mrem/pCi			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Am-241	4.440E-01	4.440E-01	DCF2(2)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(3)
B-1	H-	6.400E-08	6.400E-08	DCF2(4)
B-1	Np-237+	5.400E-01	5.400E-01	DCF2(5)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(6)
B-1	Pb-210+D	2.320E-02	2.320E-02	DCF2(7)
B-1	Pu-238	3.920E-01	3.920E-01	DCF2(8)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(9)
B-1	Ra-226+D	8.600E-03	8.600E-03	DCF2(10)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(11)
B-1	Th-229+D	2.160E+00	2.160E+00	DCF2(12)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(13)
B-1	U-233	1.350E-01	1.350E-01	DCF2(14)
B-1	U-234	1.320E-01	1.320E-01	DCF2(15)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(16)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(17)
D-1	Dose conversion factors for ingestion, mrem/pCi			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Am-241	3.640E-03	3.640E-03	DCF3(2)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(3)
D-1	H-3	6.400E-08	6.400E-08	DCF3(4)
D-1	Np-237+D	4.440E-03	4.440E-03	DCF3(5)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(6)
D-1	Pb-210+D	7.270E-03	7.270E-03	DCF3(7)
D-1	Pu-238	3.200E-03	3.200E-03	DCF3(8)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(9)
D-1	Ra-226+D	1.330E-03	1.330E-03	DCF3(10)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(11)
D-1	Th-229+D	4.030E-03	4.030E-03	DCF3(12)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(13)
D-1	U-233	2.890E-04	2.890E-04	DCF3(14)
D-1	U-234	2.830E-04	2.830E-04	DCF3(15)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(16)
D-1	U-238+D	2.690E-04	2.690E-04	DCF3(17)
D-34	Food transfer factors			
D-34	Ac-227+Dplant/soil concentration ratio, dimensionless2.500E-03 2.500E-03 RTF(1,1)			
D-34	Ac-227+Dbeef/livestock-intake ratio, (pCi/kg)/(pCi/d)2.000E-05 2.000E-05 RTF(1,2)			
D-34	Ac-227+Dmilk/livestock-intake ratio, (pCi/L)/(pCi/d) 2.000E-05 2.000E-05 RTF(1,3)			
D-34				
D-34	Am-241	plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03 RTF(2,1)
D-34	Am-241	beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05 RTF(2,2)
D-34	Am-241	milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06 RTF(2,3)
D-34				
D-34	Cs-137+D	plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02 RTF(3,1)
D-34	Cs-137+D	beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02 RTF(3,2)
D-34	Cs-137+D	milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03 RTF(3,3)

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

	Current Menu	Parameter	Value	Default	Name
D-34	H-3	plant/soil concentration ratio, dimensionless	4.800E+00	4.800E+00	RTF(4,1)
D-34	H-3	beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.200E-02	1.200E-02	RTF(4,2)
D-34	H-3	milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-02	1.000E-02	RTF(4,3)
D-34					
D-34	Np-237+D	plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(5,1)
D-34	Np-237+D	beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,2)
D-34	Np-237+D	milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(5,3)
D-34					
D-34	Pa-231	plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(6,1)
D-34	Pa-231	beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(6,2)
D-34	Pa-231	milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)
D-34					
D-34	Pb-210+D	plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(7,1)
D-34	Pb-210+D	beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(7,2)
D-34	Pb-210+D	milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(7,3)
D-34					
D-34	Pu-238	plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Pu-238	beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(8,2)
D-34	Pu-238	milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(8,3)
D-34					
D-34	Pu-239	plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(9,1)
D-34	Pu-239	beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(9,2)
D-34	Pu-239	milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(9,3)
D-34					
D-34	Ra-226+D	plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(10,1)
D-34	Ra-226+D	beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(10,2)
D-34	Ra-226+D	milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(10,3)
D-34					
D-34	Sr-90+D	plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(11,1)
D-34	Sr-90+D	beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(11,2)
D-34	Sr-90+D	milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(11,3)
D-34	Th-229+D	plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(12,1)
D-34	Th-229+D	beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(12,2)
D-34	Th-229+D	milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(12,3)
D-34					
D-34	Th-230	plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(13,1)
D-34	Th-230	beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(13,2)
D-34	Th-230	milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(13,3)
D-34					
D-34	U-233	plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(14,1)
D-34	U-233	beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(14,2)
D-34	U-233	milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(14,3)
D-34					
D-34	U-234	plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(15,1)
D-34	U-234	beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(15,2)
D-34	U-234	milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(15,3)
D-34					

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

0	Menu	Parameter	Current Parameter Value	Default	Name
D-34	U-235+D	plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(16,1)
D-34	U-235+D	beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(16,2)
D-34	U-235+D	milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(16,3)
D-34					
D-34	U-238+D	plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(17,1)
D-34	U-238+D	beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(17,2)
D-34	U-238+D	milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(17,3)
D-5	Bioaccumulation factors, fresh water, L/kg:				
D-5	Ac-227+D	fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D	crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5					
D-5	Am-241	fish	3.000E+01	3.000E+01	BIOFAC(2,1)
D-5	Am-241	crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(2,2)
D-5					
D-5	Cs-137+D	fish	2.000E+03	2.000E+03	BIOFAC(3,1)
D-5	Cs-137+D	crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5					
D-5	H-3	fish	1.000E+00	1.000E+00	BIOFAC(4,1)
D-5	H-3	crustacea and mollusks	1.000E+00	1.000E+00	BIOFAC(4,2)
D-5					
D-5	Np-237+D	fish	3.000E+01	3.000E+01	BIOFAC(5,1)
D-5	Np-237+D	crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(5,2)
D-5					
D-5	Pa-231	fish	1.000E+01	1.000E+01	BIOFAC(6,1)
D-5	Pa-231	crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(6,2)
D-5					
D-5	Pb-210+D	fish	3.000E+02	3.000E+02	BIOFAC(7,1)
D-5	Pb-210+D	crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(7,2)
D-5					
D-5	Pu-238	fish	3.000E+01	3.000E+01	BIOFAC(8,1)
D-5	Pu-238	crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(8,2)
D-5					
D-5	Pu-239	fish	3.000E+01	3.000E+01	BIOFAC(9,1)
D-5	Pu-239	crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(9,2)
D-5					
D-5	Ra-226+D	fish	5.000E+01	5.000E+01	BIOFAC(10,1)
D-5	Ra-226+D	crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(10,2)
D-5					
D-5	Sr-90+D	fish	6.000E+01	6.000E+01	BIOFAC(11,1)
D-5	Sr-90+D	crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(11,2)
D-5					
D-5	Th-229+D	fish	1.000E+02	1.000E+02	BIOFAC(12,1)
D-5	Th-229+D	crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(12,2)
D-5					
D-5	Th-230	fish	1.000E+02	1.000E+02	BIOFAC(13,1)
D-5	Th-230	crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(13,2)
D-5					
D-5	U-233	fish	1.000E+01	1.000E+01	BIOFAC(14,1)
D-5	U-233	crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(14,2)

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

Menu		Parameter	Current Parameter Value	Default	Name
D-5	U-234	fish	1.000E+01	1.000E+01	BIOFAC(15,1)
D-5	U-234	crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(15,2)
D-5					
D-5	U-235+D	fish	1.000E+01	1.000E+01	BIOFAC(16,1)
D-5	U-235+D	crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(16,2)
D-5					
D-5	U-238+D	fish	1.000E+01	1.000E+01	BIOFAC(17,1)
D-5	U-238+D	crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(17,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Used by RESRAD Default (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.000E+04	1.000E+04	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	THICK0
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	2.500E+01	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	TI
R011	Times for calculations (yr)	1.000E+01	1.000E+00	T(2)
R011	Times for calculations (yr)	3.000E+01	3.000E+00	T(3)
R011	Times for calculations (yr)	6.000E+01	1.000E+01	T(4)
R011	Times for calculations (yr)	9.000E+01	3.000E+01	T(5)
R011	Times for calculations (yr)	1.200E+02	1.000E+02	T(6)
R011	Times for calculations (yr)	2.000E+02	3.000E+02	T(7)
R011	Times for calculations (yr)	not used	1.000E+03	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	T(10)
R012	Initial principal radionuclide (pCi/g): Am-241	5.000E+00	0.000E+00	S1(2)
R012	Initial principal radionuclide (pCi/g): Cs-137	5.600E+01	0.000E+00	S1(3)
R012	Initial principal radionuclide (pCi/g): Pu-238	5.000E-01	0.000E+00	S1(8)
R012	Initial principal radionuclide (pCi/g): Pu-239	1.000E+01	0.000E+00	S1(9)
R012	Initial principal radionuclide (pCi/g): Sr-90	1.300E+01	0.000E+00	S1(11)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	W1(2)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	W1(3)
R012	Concentration in groundwater (pCi/L): Pu-238	not used	0.000E+00	W1(8)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	W1(9)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	W1(11)
R013	Cover depth (m)	0.000E+00	0.000E+00	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	BCZ
R013	Average annual wind speed (m/sec)	3.000E+00	2.000E+00	WIND
R013	Humidity in air (g/m**3)	5.500E+00	8.000E+00	HUMID
R013	Evapotranspiration coefficient	9.990E-01	5.000E-01	EVAPTR
R013	Precipitation (m/yr)	3.500E-01	1.000E+00	PRECIP
R013	Irrigation (m/yr)	0.000E+00	2.000E-01	RI
R013	Irrigation mode	overhead	overhead	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	HCSZ

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Used by RESRAD Default (If different from user input)	Parameter Name
R014	Saturated zone hydraulic gradient	not used	2.000E-02	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	VWT
R014	Well pump intake depth (m below water table)	not used	1.000E+01	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	UW
R015	Number of unsaturated zone strata	not used	1	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	HCUZ(1)
R016	Distribution coefficients for Am-241			
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.636E-06
	ALEACH(2)			
R016	Solubility constant	0.000E+00	0.000E+00	not used
	SOLUBK(2)			
R016	Distribution coefficients for Cs-137			
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.332E-08
	ALEACH(3)			
R016	Solubility constant	0.000E+00	0.000E+00	not used
	SOLUBK(3)			
R016	Distribution coefficients for Pu-238			
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.666E-08
	ALEACH(8)			
R016	Solubility constant	0.000E+00	0.000E+00	not used
	SOLUBK(8)			
R016	Distribution coefficients for Pu-239			
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.666E-08
	ALEACH(9)			
R016	Solubility constant	0.000E+00	0.000E+00	not used
	SOLUBK(9)			
R016	Distribution coefficients for Sr-90			
R016	Contaminated zone (cm**3/g)	3.000E+01	3.000E+01	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	not used	3.000E+01	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	not used	3.000E+01	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.097E-06
	ALEACH(11)			
R016	Solubility constant	0.000E+00	0.000E+00	not used
	SOLUBK(11)			

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Used by RESRAD Default (If different from user input)	Parameter Name	
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	DCNUCC(1)	
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	DCNUCU(1,1)	
R016	Saturated zone (cm**3/g)	not used	2.000E+01	DCNUCS(1)	
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.636E-06	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter H-3				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	DCNUCC(4)	
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	DCNUCU(4,1)	
R016	Saturated zone (cm**3/g)	not used	0.000E+00	DCNUCS(4)	
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.000E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	DCNUCU(5,1)	
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	DCNUCS(5)	
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.624E-07	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	DCNUCC(6)	
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	DCNUCU(6,1)	
R016	Saturated zone (cm**3/g)	not used	5.000E+01	DCNUCS(6)	
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.862E-06	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	DCNUCC(7)	
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	DCNUCU(7,1)	
R016	Saturated zone (cm**3/g)	not used	1.000E+02	DCNUCS(7)	
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.321E-07	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	DCNUCC(10)	
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	DCNUCU(10,1)	
R016	Saturated zone (cm**3/g)	not used	7.000E+01	DCNUCS(10)	
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.331E-06	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	DCNUCC(12)	
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	DCNUCU(12,1)	
R016	Saturated zone (cm**3/g)	not used	6.000E+04	DCNUCS(12)	
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.556E-09	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)

Site-Specific Parameter Summary (continued)

Menu	Parameter	Input	Default (If different from user input)	Name	
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	DCNUCC(13)	
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	DCNUCU(13,1)	
R016	Saturated zone (cm**3/g)	not used	6.000E+04	DCNUCS(13)	
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.556E-09	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	DCNUCC(14)	
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	DCNUCU(14,1)	
R016	Saturated zone (cm**3/g)	not used	5.000E+01	DCNUCS(14)	
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.862E-06	ALEACH(14)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(14)
R016	Distribution coefficients for daughter U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	DCNUCC(15)	
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	DCNUCU(15,1)	
R016	Saturated zone (cm**3/g)	not used	5.000E+01	DCNUCS(15)	
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.862E-06	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for daughter U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	DCNUCC(16)	
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	DCNUCU(16,1)	
R016	Saturated zone (cm**3/g)	not used	5.000E+01	DCNUCS(16)	
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.862E-06	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R016	Distribution coefficients for daughter U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	DCNUCC(17)	
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	DCNUCU(17,1)	
R016	Saturated zone (cm**3/g)	not used	5.000E+01	DCNUCS(17)	
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.862E-06	ALEACH(17)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(17)
R017	Inhalation rate (m**3/yr)	1.400E+04	8.400E+03	INHALR	
R017	Mass loading for inhalation (g/m**3)	2.000E-05	1.000E-04	MLINH	
R017	Exposure duration	3.000E+01	3.000E+01	ED	
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	SHF3	
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	SHF1	
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	FIND	
R017	Fraction of time spent outdoors (on site)	1.600E-02	2.500E-01	FOTD	
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

Site-Specific Parameter Summary (continued)

Menu	Parameter	Input	Default (If different from user input)	Name
R017	Radii of shape factor array (used if FS = -1):			
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:			
R017	Ring 1	not used	1.000E+00	FRACA(1)
R017	Ring 2	not used	2.732E-01	FRACA(2)
R017	Ring 3	not used	0.000E+00	FRACA(3)
R017	Ring 4	not used	0.000E+00	FRACA(4)
R017	Ring 5	not used	0.000E+00	FRACA(5)
R017	Ring 6	not used	0.000E+00	FRACA(6)
R017	Ring 7	not used	0.000E+00	FRACA(7)
R017	Ring 8	not used	0.000E+00	FRACA(8)
R017	Ring 9	not used	0.000E+00	FRACA(9)
R017	Ring 10	not used	0.000E+00	FRACA(10)
R017	Ring 11	not used	0.000E+00	FRACA(11)
R017	Ring 12	not used	0.000E+00	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	DIET(6)
R018	Soil ingestion rate (g/yr)	5.870E+02	3.650E+01	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	FDW
R018	Contamination fraction of household water	not used	1.000E+00	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	FR9
R018	Contamination fraction of plant food	not used -1	FPLANT	
R018	Contamination fraction of meat	not used -1	FMEAT	
R018	Contamination fraction of milk	not used -1	FMILK	
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	LSI

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Used by RESRAD Default (If different from user input)	Parameter Name
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	DM
R019	Depth of roots (m)	not used	9.000E-01	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	8.894E+01	CO2F
STOR	Storage times of contaminated foodstuffs (days):			
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	TPCV

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Used by RESRAD Default (If different from user input)	Parameter Name
R021	Total porosity of the building foundation	not used	1.000E-01	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):			
R021	in cover material	not used	2.000E-06	DIFCV
R021	in foundation material	not used	3.000E-07	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	HRM
R021	Building interior area factor	not used	0.000E+00	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	EMANA(2)
TITL	Number of graphical time points	32	---	NPTS
TITL	Maximum number of integration points for dose	17	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean conc w/r
File : TUHME21011kw_remov_500y.RAD

Contaminated Zone Dimensions	Initial Soil Concentrations, pCi/g	
Area: 10000.00 square meters	Am-241	5.000E+00
Thickness: 2.00 meters	Cs-137	5.600E+01
Cover Depth: 0.00 meters	Pu-238	5.000E-01
	Pu-239	1.000E+01
	Sr-90	1.300E+01

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 1.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+01	3.000E+01	6.000E+01	9.000E+01	1.200E+02	2.000E+02
TDOSE(t):	3.402E+00	2.805E+00	1.952E+00	1.222E+00	8.532E-01	6.645E-01	4.922E-01
M(t): 2.268E-01	1.870E-01	1.301E-01	8.150E-02	5.688E-02	4.430E-02	3.281E-02	

Maximum TDOSE(t): 3.402E+00 mrem/yr at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Am-241	3.390E-03	0.0010	1.463E-03	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.708E-01	0.0502
Cs-137	2.827E+00	0.8309	1.165E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.600E-02	0.0076
Pu-238	1.192E-06	0.0000	1.288E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.497E-0	0.0044
Pu-239	4.532E-05	0.0000	2.830E-03	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.325E-01	0.0977
Sr-90	4.750E-03	0.0014	1.110E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.846E-02	0.0054
Total	2.835E+00	0.8333	4.434E-03	0.0013	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.627E-01	0.1654

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.757E-01	0.0516
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	2.853E+00	0.8385
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.510E-02	0.0044
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.353E-01	0.0986
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	2.322E-02	0.0068
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	3.402E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Am-241	3.336E-03	0.0012	1.440E-03	0.0005	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.681E-01	0.0599
Cs-137	2.244E+00	0.8000	9.246E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.063E-02	0.0074
Pu-238	1.101E-06	0.0000	1.190E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.383E-02	0.0049
Pu-239	4.531E-05	0.0000	2.829E-03	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.324E-01	0.1185
Sr-90	3.744E-03	0.0013	8.750E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.455E-02	0.0052
Total	2.251E+00	0.8025	4.398E-03	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.495E-01	0.1959

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.728E-01	0.0616
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	2.264E+00	0.8073
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.395E-02	0.0050
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	3.353E-01	0.1195
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	1.830E-02	0.0065
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.805E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Am-241	3.231E-03	0.0017	1.394E-03	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.628E-01	0.0834
Cs-137	1.414E+00	0.7241	5.825E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.300E-02	0.0067
Pu-238	9.404E-07	0.0000	1.016E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.181E-02	0.0060
Pu-239	4.529E-05	0.0000	2.827E-03	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.322E-01	0.1702
Sr-90	2.326E-03	0.0012	5.435E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.038E-03	0.0046
Total	1.419E+00	0.7269	4.329E-03	0.0022	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.288E-01	0.2709

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
0 Water Dependent Pathways

0 Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.674E-01	0.0857
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	1.427E+00	0.7307
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.191E-02	0.0061
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	3.351E-01	0.1716
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	1.137E-02	0.0058
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	1.952E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 6.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Am-241	3.080E-03	0.0025	1.329E-03	0.0011	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.551E-01	0.1269
Cs-137	7.068E-01	0.5781	2.912E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.499E-03	0.0053
Pu-238	7.422E-07	0.0000	8.017E-05	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.318E-03	0.0076
Pu-239	4.525E-05	0.0000	2.825E-03	0.0023	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.319E-01	0.2715
Sr-90	1.139E-03	0.0009	2.661E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.425E-03	0.0036
Total	7.110E-01	0.5816	4.237E-03	0.0035	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.072E-01	0.4149

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 = 6.000E+01 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.595E-01	0.1305
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	7.133E-01	0.5834
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	9.399E-03	0.0077
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	3.348E-01	0.2738
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	5.566E-03	0.0046
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	1.222E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 9.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Am-241	2.935E-03	0.0034	1.266E-03	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.478E-01	0.1732
Cs-137	3.534E-01	0.4142	1.456E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.249E-03	0.0038
Pu-238	5.859E-07	0.0000	6.326E-05	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.352E-03	0.0086
Pu-239	4.522E-05	0.0001	2.823E-03	0.0033	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.316E-01	0.3887
Sr-90	5.574E-04	0.0007	1.303E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.166E-03	0.0025
Total	3.569E-01	0.4183	4.153E-03	0.0049	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.922E-01	0.5768

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 9.000E+01 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.520E-01	0.1781
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.566E-01	0.4180
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	7.416E-03	0.0087
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	3.345E-01	0.3920
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	2.725E-03	0.0032
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.532E-01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.200E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	2.798E-03	0.0042	1.206E-03	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.408E-01	0.2119
Cs-137	1.767E-01	0.2659	7.281E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.625E-03	0.0024
Pu-238	4.627E-07	0.0000	4.991E-05	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.801E-03	0.0087
Pu-239	4.518E-05	0.0001	2.820E-03	0.0042	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.313E-01	0.4986
Sr-90	2.729E-04	0.0004	6.378E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.061E-03	0.0016
Total	1.798E-01	0.2706	4.077E-03	0.0061	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.806E-01	0.7233

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.200E+02 years
Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.448E-01	0.2179
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	1.783E-01	0.2683
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	5.851E-03	0.0088
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	3.342E-01	0.5029
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	1.334E-03	0.0020
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.645E-01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Am-241	2.462E-03	0.0050	1.061E-03	0.0022	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.238E-01	0.2516
Cs-137	2.783E-02	0.0565	1.147E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.559E-04	0.0005
Pu-238	2.472E-07	0.0000	2.654E-05	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.083E-03	0.0063
Pu-239	4.509E-05	0.0001	2.814E-03	0.0057	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.306E-01	0.6717
Sr-90	4.064E-05	0.0001	9.497E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.579E-04	0.0003
Total	3.037E-02	0.0617	3.901E-03	0.0079	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.579E-01	0.9304

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.000E+02 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.274E-01	0.2588
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	2.808E-02	0.0571
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	3.110E-03	0.0063
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	3.334E-01	0.6775
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	1.987E-04	0.0004
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.922E-01	1.0000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Branch Fraction*	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+01	3.000E+01	6.000E+01	9.000E+01	1.200E+02	2.000E+02
Am-241	Am-241	1.000E+00	3.513E-02	3.457E-02	3.348E-02	3.190E-02	3.040E-02	2.896E-02	2.547E-02
Am-241	Np-237	1.000E+00	9.506E-09	1.981E-07	5.662E-07	1.097E-06	1.602E-06	2.084E-06	3.260E-06
Am-241	U-233	1.000E+00	6.666E-16	2.195E-13	1.831E-12	7.090E-12	1.561E-11	2.725E-11	7.240E-11
Am-241	Th-229	1.000E+00	3.538E-19	1.635E-15	3.966E-14	3.056E-13	1.010E-12	2.354E-12	1.049E-11
Am-241	§DSR(j)	3.513E-02	3.457E-02	3.348E-02	3.190E-02	3.040E-02	2.897E-02	2.547E-02	
0Cs-137	Cs-137	1.000E+00	5.095E-02	4.044E-02	2.547E-02	1.274E-02	6.368E-03	3.184E-03	5.015E-04
0Pu-238	Pu-238	1.000E+00	3.020E-02	2.790E-02	2.382E-02	1.880E-02	1.483E-02	1.170E-02	6.220E-03
Pu-238	U-234	1.000E+00	3.890E-09	7.859E-08	2.114E-07	3.751E-07	5.042E-07	6.060E-07	7.843E-07
Pu-238	Th-230	1.000E+00	2.284E-14	7.369E-12	5.903E-11	2.156E-10	4.490E-10	7.431E-10	1.734E-09
Pu-238	Ra-226	1.000E+00	8.336E-17	3.791E-13	8.903E-12	6.545E-11	2.068E-10	4.616E-10	1.847E-09
Pu-238	Pb-210	1.000E+00	1.946E-19	1.102E-14	6.737E-13	8.475E-12	3.506E-11	9.236E-11	4.678E-10
Pu-238	§DSR(j)	3.020E-02	2.790E-02	2.382E-02	1.880E-02	1.483E-02	1.170E-02	6.220E-03	
0Pu-239	Pu-239	1.000E+00	3.353E-02	3.353E-02	3.351E-02	3.348E-02	3.345E-02	3.342E-02	3.334E-02
Pu-239	U-235	1.000E+00	6.953E-12	1.460E-10	4.239E-10	8.405E-10	1.257E-09	1.673E-09	2.780E-09
Pu-239	Pa-231	1.000E+00	3.588E-16	1.187E-13	1.001E-12	3.935E-12	8.801E-12	1.559E-11	4.311E-11
Pu-239	Ac-227	1.000E+00	4.776E-18	2.055E-14	4.350E-13	2.797E-12	7.902E-12	1.606E-11	5.341E-11
Pu-239	§DSR(j)	3.353E-02	3.353E-02	3.351E-02	3.348E-02	3.345E-02	3.342E-02	3.334E-02	
0Sr-90	Sr-90	1.000E+00	1.786E-03	1.408E-03	8.745E-04	4.282E-04	2.096E-04	1.026E-04	1.528E-05

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
§ is used to indicate summation; the Greek sigma is not included in this font.
The DSR includes contributions from associated (half-life <= 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 1.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+01	3.000E+01	6.000E+01	9.000E+01	1.200E+02	2.000E+02
Am-241	4.270E+02	4.339E+02	4.481E+02	4.702E+02	4.935E+02	5.178E+02	5.889E+02
Cs-137	2.944E+02	3.709E+02	5.888E+02	1.178E+03	2.355E+03	4.711E+03	2.991E+04
Pu-238	4.968E+02	5.376E+02	6.296E+02	7.980E+02	1.011E+03	1.282E+03	2.411E+03
Pu-239	4.473E+02	4.474E+02	4.477E+02	4.481E+02	4.485E+02	4.488E+02	4.499E+02
Sr-90	8.398E+03	1.065E+04	1.715E+04	3.503E+04	7.156E+04	1.462E+05	9.816E+05

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean conc w/r
File : TUHME21011kw_remov_500y.RAD

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide	Initial (i)	tmin (pCi/g)	DSR(i,tmin) (years)	G(i,tmin)	DSR(i,tmax)	G(i,tmax)
Am-241	5.000E+00	0.000E+00	3.513E-02	4.270E+02	3.513E-02	4.270E+02
Cs-137	5.600E+01	0.000E+00	5.095E-02	2.944E+02	5.095E-02	2.944E+02
Pu-238	5.000E-01	0.000E+00	3.020E-02	4.968E+02	3.020E-02	4.968E+02
Pu-239	1.000E+01	0.000E+00	3.353E-02	4.473E+02	3.353E-02	4.473E+02
Sr-90	1.300E+01	0.000E+00	1.786E-03	8.398E+03	1.786E-03	8.398E+03

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

0Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+01	3.000E+01	6.000E+01	9.000E+01	1.200E+02	2.000E+02
Am-241	Am-241	1.000E+00	1.757E-01	1.728E-01	1.674E-01	1.595E-01	1.520E-01	1.448E-01	1.273E-01
Np-237	Am-241	1.000E+00	4.753E-08	9.903E-07	2.831E-06	5.483E-06	8.010E-06	1.042E-05	1.630E-05
U-233	Am-241	1.000E+00	3.333E-15	1.097E-12	9.155E-12	3.545E-11	7.807E-11	1.363E-10	3.620E-10
Th-229	Am-241	1.000E+00	1.769E-18	8.176E-15	1.983E-13	1.528E-12	5.050E-12	1.177E-11	5.246E-11
Cs-137	Cs-137	1.000E+00	2.853E+00	2.264E+00	1.427E+00	7.133E-01	3.566E-01	1.783E-01	2.808E-02
Pu-238	Pu-238	1.000E+00	1.510E-02	1.395E-02	1.191E-02	9.399E-03	7.415E-03	5.851E-03	3.110E-03
U-234	Pu-238	1.000E+00	1.945E-09	3.929E-08	1.057E-07	1.875E-07	2.521E-07	3.030E-07	3.921E-07
Th-230	Pu-238	1.000E+00	1.142E-14	3.685E-12	2.951E-11	1.078E-10	2.245E-10	3.715E-10	8.672E-10
Ra-226	Pu-238	1.000E+00	4.168E-17	1.896E-13	4.451E-12	3.273E-11	1.034E-10	2.308E-10	9.233E-10
Pb-210	Pu-238	1.000E+00	9.730E-20	5.509E-15	3.368E-13	4.238E-12	1.753E-11	4.618E-11	2.339E-10
Pu-239	Pu-239	1.000E+00	3.353E-01	3.353E-01	3.351E-01	3.348E-01	3.345E-01	3.342E-01	3.334E-01
U-235	Pu-239	1.000E+00	6.953E-11	1.460E-09	4.239E-09	8.405E-09	1.257E-08	1.673E-08	2.780E-08
Pa-231	Pu-239	1.000E+00	3.588E-15	1.187E-12	1.001E-11	3.935E-11	8.801E-11	1.559E-10	4.311E-10
Ac-227	Pu-239	1.000E+00	4.776E-17	2.055E-13	4.350E-12	2.797E-11	7.902E-11	1.606E-10	5.341E-10
Sr-90	Sr-90	1.000E+00	2.322E-02	1.830E-02	1.137E-02	5.566E-03	2.725E-03	1.334E-03	1.987E-04

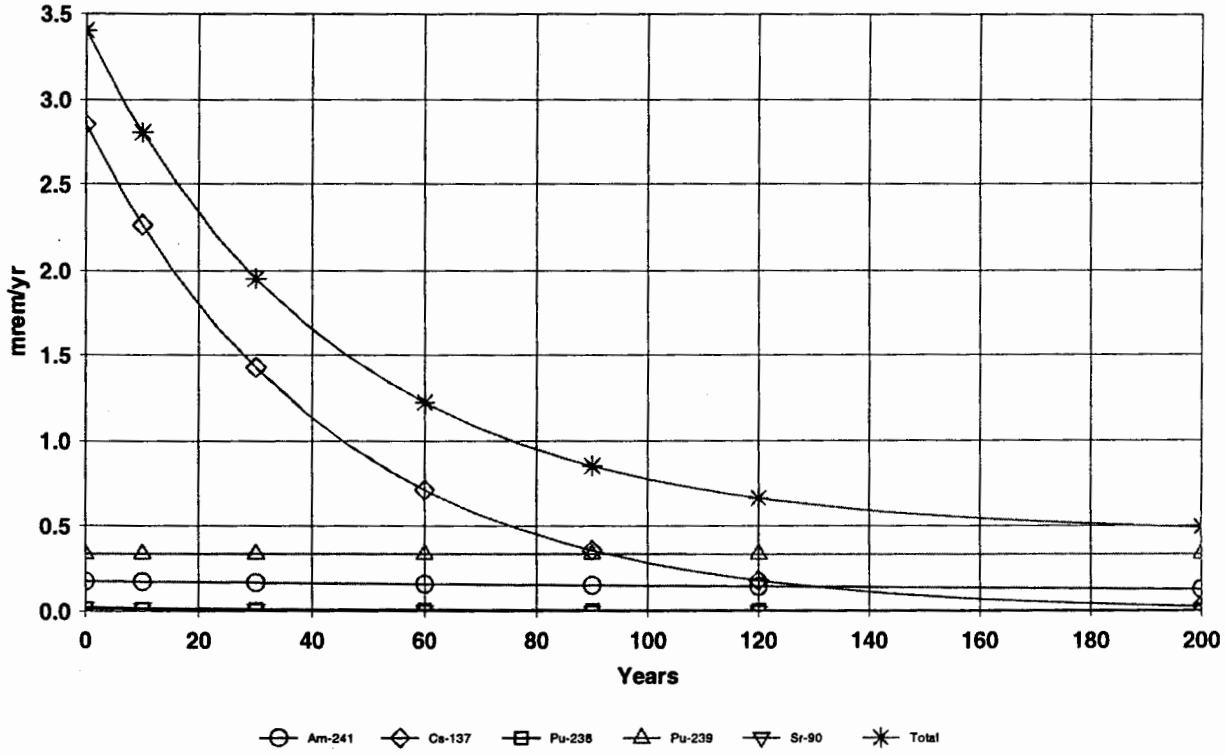
BRF(i) is the branch fraction of the parent nuclide.
§ is used to indicate summation; the Greek sigma is not included in this font.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+01	3.000E+01	6.000E+01	9.000E+01	1.200E+02	2.000E+02
Am-241	Am-241	1.000E+00	5.000E+00	4.920E+00	4.764E+00	4.540E+00	4.326E+00	4.122E+00	3.625E+00
Np-237	Am-241	1.000E+00	0.000E+00	1.607E-05	4.743E-05	9.263E-05	1.357E-04	1.767E-04	2.769E-04
U-233	Am-241	1.000E+00	0.000E+00	3.522E-10	3.136E-09	1.235E-08	2.734E-08	4.785E-08	1.275E-07
Th-229	Am-241	1.000E+00	0.000E+00	1.110E-13	2.971E-12	2.347E-11	7.822E-11	1.831E-10	8.202E-10
Cs-137	Cs-137	1.000E+00	5.600E+01	4.445E+01	2.800E+01	1.400E+01	7.000E+00	3.500E+00	5.512E-01
Pu-238	Pu-238	1.000E+00	5.000E-01	4.620E-01	3.945E-01	3.113E-01	2.456E-01	1.938E-01	1.030E-01
U-234	Pu-238	1.000E+00	0.000E+00	1.363E-05	3.786E-05	6.772E-05	9.128E-05	1.099E-04	1.424E-04
Th-230	Pu-238	1.000E+00	0.000E+00	6.215E-10	5.313E-09	1.973E-08	4.131E-08	6.856E-08	1.605E-07
Ra-226	Pu-238	1.000E+00	0.000E+00	9.024E-13	2.339E-11	1.763E-10	5.615E-10	1.259E-09	5.060E-09
Pb-210	Pu-238	1.000E+00	0.000E+00	6.624E-14	4.625E-12	6.013E-11	2.515E-10	6.660E-10	3.394E-09
Pu-239	Pu-239	1.000E+00	1.000E+01	9.997E+00	9.991E+00	9.983E+00	9.974E+00	9.965E+00	9.942E+00
U-235	Pu-239	1.000E+00	0.000E+00	9.847E-08	2.953E-07	5.904E-07	8.852E-07	1.180E-06	1.964E-06
Pa-231	Pu-239	1.000E+00	0.000E+00	1.042E-11	9.372E-11	3.747E-10	8.426E-10	1.497E-09	4.153E-09
Ac-227	Pu-239	1.000E+00	0.000E+00	1.023E-12	2.388E-11	1.574E-10	4.481E-10	9.142E-10	3.054E-09
Sr-90	Sr-90	1.000E+00	1.300E+01	1.025E+01	6.365E+00	3.116E+00	1.526E+00	7.469E-01	1.112E-01

BRF(i) is the branch fraction of the parent nuclide.
§ is used to indicate summation; the Greek sigma is not included in this font.
RESCALC.EXE execution time = 2.33 seconds

DOSE: All Nuclides Summed, All Pathways Summed



TUHME21011kw_remov_500y.RAD 10/18/2002 07:28 Includes All Pathways

Attachment 3

Procedure for Calculating Hot Spot Limits contained in DOE/CH-8901

taken from the "Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD, Version 5.0."

Distribution Category UC-902

ANL/EAD/LD-2

Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD, Version 5.0

Working Draft for Comment

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Office of Environmental Restoration

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$G_i(t)$ = single-radionuclide, time-dependent soil guideline for the ith principal radionuclide in a uniformly contaminated zone (pCi/g).

If the area of elevated contamination is inhomogeneous, one of two approaches may be used: (1) the area may be treated as if it were homogeneous with a concentration $\hat{S}_i(0)/3$, where $\hat{S}_i(0)$ is the peak concentration of the ith principal radionuclide in a sample from within the area of elevated contamination, or (2) the area may be divided into subzones by using the same procedure that is used for an inhomogeneous contaminated zone.

When inhomogeneous release criteria are used, Equation 3.12 must be satisfied for every area of inhomogeneous contamination; in addition, Equation 3.3 must be satisfied for any region within the homogeneous portion of the contaminated zone.

3.3.2 Hot Spot Criterion for Field Application

Hot spots are small areas that have levels of residual radioactive material that are considerably above the levels in the surrounding area. The derivation of remedial action criteria generally assumes homogeneous contamination of large areas (several hundred square meters or more), and the derived concentration guide is stated in terms of concentrations averaged over an area of 100 m^2. Because of this averaging process, hot spots can exist within these 100-m^2 areas that contain concentrations of radionuclides that are significantly higher than the authorized limit. Therefore, the presence of hot spots could potentially pose a greater risk of exposure to individuals using the site than the risk associated with homogeneous contamination. To ensure that individuals are adequately protected and to ensure that the ALARA process is satisfied, the following hot spot criterion must be applied, along with the general criterion for homogeneous contamination. The hot spot criterion for field application is

$$M^{**} \equiv \sum_i S_i^*/G_i^{**} \leq 1 \ , \tag{3.16}$$

where

M^{**} = hot spot mixture sum for field use (dimensionless),

S_i^* = measured concentration of the ith principal radionuclide in the hot spot (pCi/g), and

G_i^{**} = single-radionuclide soil guideline for the ith principal radionuclide in the hot spot (pCi/g).

The measured hot spot concentrations S_i^* are the peak concentrations if the hot spot area is 1 m^2 or less, or the average concentrations if the hot spot area is larger than 1 m^2.

The formula for single-radionuclide, hot spot soil guidelines is

$$G_i^{**} = G_i(t_m) \times (100/A)^{1/2} , \tag{3.17}$$

where

$G_i(t_m)$ = as defined for Equation 3.4,

A = area of hot spot (m^2), and

$(100/A)^{1/2}$ = hot spot multiplication factor.

Equations 3.15 and 3.16 apply to hot spots with areas of 25 m^2 or less. For larger hot spot areas, the homogeneous release criterion is sufficient. An area of A = 1 m^2 is used in Equation 3.16 if the actual hot spot area is less than 1 m^2. The average radionuclide concentrations for any 100-m^2 area must always comply with the homogeneous release criterion, irrespective of hot spot criteria.

For general field applications, it is recommended that the ranges of hot spot multiplication factors provided in Table 3.2 be used. The hot spot guideline for radionuclide i is calculated for each specific site by Equation 3.16. The term $G_i(t_m)$ in Equation 3.16 can be substituted by G_i, the authorized limit at a specific site for the ith principal radionuclide.

The authorized limit is considered adequate to protect the public for areas larger than 25 m^2; hence, no special hot spot limits are required for areas larger than 25 m^2.

TABLE 3.2 Ranges for Hot Spot Multiplication Factors

Range	Factor (multiple of authorized limit)
<1 m^2	10[a]
1 - <3 m^2	6
3 - <10 m^2	3
10 - 25 m^2	2

[a] Areas less than 1 m^2 are to be averaged over a 1-m^2 area, and that average shall not exceed 10 times the authorized limit.

Averaging of hot spots less than or equal to 25 m^2 should be done only over the local hot spot area.

Every reasonable effort should be made to identify and remove any source that has a radionuclide concentration exceeding 30 times the authorized limit, irrespective of area.