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June 29, 2001
Project No. 5427F-01

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Kaiser Aluminum & Chemical Corporation
Final Status Survey Report
Adjacent Land Area
Tulsa, Oklahoma Facility

Dear Sir or Madame:

On behalf of Kaiser Aluminum & Chemical Corporation (Kaiser), we are herewith submitting the above-referenced report. If you have any questions concerning the enclosed document, please contact Mr. J. W. (Bill) Vinzant, Kaiser's Manager of Environmental Affairs at (225) 231-5116.

Respectfully submitted,

Alan J. Shuckrow, Ph.D.
Senior Manager

AJS:cak

Enclosure

cc: J. Buckley, U.S. Nuclear Regulatory Commission
L. Carson II, U.S. Nuclear Regulatory Commission
J. W. Vinzant, Kaiser

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NMSS01 Public

Final Status Survey Report

Adjacent Land Area
Tulsa, Oklahoma Facility

Kaiser Aluminum & Chemical Corporation
Baton Rouge, Louisiana

Project No. 5427F
July 2001

Earth Sciences Consultants, Inc.

Providing Environmental Consulting Services Since 1979

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Baton Rouge, Louisiana

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Final Status Survey Report
Adjacent Land Area
Kaiser Aluminum & Chemical Corporation
Tulsa, Oklahoma

1.0 Background Information

The subject facility, located at 7311 East 41st Street in Tulsa, Oklahoma (Figure 1-1), was built by the Standard Magnesium Corporation (SMC) in the early to mid-1950s and currently is owned by Kaiser Aluminum & Chemical Corporation (Kaiser). Historical operations at the facility included the smelting and manufacture of magnesium anodes. To facilitate these operations, SMC obtained a source materials license (C-4012) from the Atomic Energy Commission (AEC) in March 1958 to recycle magnesium alloy aircraft scrap with up to 4 percent thorium content. This license was renewed and amended several times and superceded by License No. STB-472 in 1961. In 1968, STB-472 was amended to also authorize possession and processing of uranium-bearing materials, but there is no record that uranium materials ever were received on site. Thorium alloy material comprised only a fraction of the total magnesium refined on site. Kaiser purchased the facility in 1964 and magnesium operations continued to around 1977. Aluminum replaced magnesium (circa 1977) in smelting and anode manufacture, and the plant continued operating until the 1997-1998 time frame. However, the radiological license was terminated in 1971 by the AEC at Kaiser's request. Magnesium-thorium alloy reprocessing had been halted at that time for more than a year.

As a result of smelting and manufacturing operations, a metallic dross generated as a waste product was conveyed to disposal ponds (retention and reserve ponds) located north of the manufacturing complex. Some of the dross contained thorium.

Over time, certain portions of the original SMC property were transferred to other entities. Consequently, some contamination existed on property adjacent to current Kaiser property boundaries. The Nuclear Regulatory Commission (NRC) detected surface contamination around the site in 1993 and, subsequently, in off-site areas adjacent to the pond parcel. Although no human health risk was reported from either on-site or off-site contamination, the area was placed on the NRC's Site Decommissioning Management Plan. Characterizations of the pond area and areas adjacent to the south and east property boundaries subsequently were performed in accordance with procedures described in NUREG/CR-5849. Predecommissioning conditions of the adjacent land property are summarized in reports by ADA

Consultants, Inc. (ADA), March 1999; ADA, undated; B. Koh & Associates, Inc. (B. Koh), May 1998; and B. Koh, November 1999; and depicted in Figure 1-2.

These extensive characterization activities, conducted since 1994, established the presence of Th-228, Th-230, and Th-232 in dross/soil residues on and adjacent to the Kaiser property. No elevated uranium was detected. Th-228 and Th-232 were determined to be in secular equilibrium. In addition, a ratio of Th-230 to (Th-228 + Th-232)/2 of 3.5 was established from characterization data.

Kaiser prepared and submitted to the NRC an Adjacent Land Remediation Plan. This plan was approved by the NRC on April 4, 2000. Kaiser conducted off-site remediation activities from October 2000 through May 2001. Contamination of the adjacent properties was found to occur at the ground surface and to depths of up to 15 feet. The extent of the contamination was limited to the following properties: Union Pacific Railroad right-of-way; northwest corner of Specific Systems (formerly Unarco) property; along Fulton Creek on the Beejay, Inc. property; north of the North Extrusion Building; north of the Smalley Equipment property; and adjacent to the Red Man Pipe & Supply Company (Red Man) (formerly Premier) property. Contamination also was found along the north side of East 41st Street, between the roadway and the Kaiser building. In addition, contamination was found south of Kaiser's flux building, outside the retention pond property fence, and on Kaiser property between the building and the Union Pacific Railroad property. Remediation was performed in these areas to achieve unrestricted release of the adjacent land areas.

During the course of the adjacent land remediation project, a buried spillway structure was uncovered southwest of the retention pond. Although this lies primarily on the pond parcel, its southern extremity extends onto the Union Pacific Railroad right-of-way. Decommissioning of the entire buried structure will be included in a future decommissioning effort.

Field surveys were performed to guide remediation activities that, in this case, primarily involved excavating affected soil and moving it onto Kaiser's property. The final status survey was performed following completion of remediation/excavation in each discrete affected survey grid to demonstrate that radiological conditions satisfy criteria for unrestricted release. Following successful remediation, excavations were backfilled.

2.0 Site Information

2.1 Site Description

The Kaiser Tulsa, Oklahoma facility is located in an area of light industry (Figure 1-1). The site is roughly triangular shaped; bounded to the south by East 41st Street, to the west by the Skelly Bypass (Interstate 44), and to the east by the Broken Arrow Expressway. The site is transected from west to east by Union Pacific Railroad tracks and right-of-way (Figure 1-2) which constitutes a large portion of the adjacent land remediation project. In addition to the railroad property, land east of the site bordering Specific Systems and Red Man Pipe and Supply Company property and a small strip of land north of East 41st Street make up the adjacent land remediated.

Undisturbed soils in the Adjacent Land Area consisted of 8 to 12 inches of dark brown to black topsoil underlain by a 10 to 18 inch deep zone which transitioned from black to brown soil. The brown colorization was maintained through the next 18 to 90 inches. Soils containing dross were visually distinguishable from other soils based on color. Soil containing dross usually contained gravel- to sand-sized material which was a dull gray color and usually contrasted with the brown to black soil.

2.2 Site Conditions at the Time of Final Survey

A drawing of the Adjacent Land Area to be remediated (Figure 1-2) was prepared prior to remediation to locate and identify the affected areas. The prior characterization sampling was performed by taking four equal distance core samples in each 10-meter-by-10-meter section of the Adjacent Land Area. These 10-meter-by-10-meter sections are referred to as the characterization grids and are included in Figure 1-2. The characterization grids were numbered 1 through 174. The core samples were identified by the characterization grid number followed by the letter A, B, C, or D representing the quadrant of the characterization grid in which the core was centered, as presented below.

A	**B**
C	**D**

N ↑

Underground utilities were marked with flags and paint along the ground. The grass and other vegetation was mowed prior to beginning remediation and the properties were surveyed by a professional surveyor (Professional Surveying, Inc.).

2.3 Identity of Contaminants and Release Criteria

Radionuclides detected at the Kaiser site and Adjacent Land Area are the thorium isotopes Th-232, Th-230, and Th-228. Thorium is derived from parent ores of naturally occurring Th and uranium (U). Uranium is not known on site, either by process knowledge or soil/waste analysis. Naturally occurring Th includes the Th isotopes Th-232 and Th-228 in secular equilibrium. Secular equilibrium occurs when a parent isotope (Th-232, $t_{1/2} = 1.405 \times 10^{10}$ years) has a half life ($t_{1/2}$) much longer than the half lives of progeny isotopes (in this case, Th-228, $t_{1/2} = 1.913$ years), meaning the activity of Th-228 is to equal the activity of Th-232. Th-230 is a progeny of the naturally occurring U decay chain that has been identified on the Kaiser site and adjacent land, separate from the members of the U decay chain above it.

A Maximum Average Concentration (MAC) for unrestricted release of natural Th in soil was established by the NRC, as given in Reference 6. The value was established at 10 picocuries per gram (ρCi/g) of natural Th (Th-232 + Th-228), absent Th-230, above natural background. The equivalent limit for Th-230 without Th-232 + Th-228 would be 14 ρCi/g, above natural background. Therefore, for a combination of Th isotopes the unity rule applies and, collectively, the MAC can be calculated from the following:

$$((C_{Th-232} + C_{Th-228})/10) + (C_{Th-230})/14 \leq 1$$

where

C_{Th} = net Th isotope concentration in soil (ρCi/g).

A mean ratio of 3.5-to-1 for Th-230-to-((Th-232 + Th-228)/2) in dross at the Kaiser site was derived from analytical data as described in Appendix A of Reference 7, Adjacent Land Remediation Plan for Kaiser Aluminum & Chemical Corporation, Tulsa, Oklahoma. Using this mean ratio, the unity rule is satisfied when Th-232 + Th-228 does not exceed 4.4 ρCi/g above background when averaged over the survey unit. The release criteria for open land areas were established in Reference 7 and are as follows:

- MACs are at or below 4.4 ρCi/g above background of Th-232 + Th-228, based on a 100-square-meter (m^2) grid. (Given secular equilibrium between Th-232 and Th-228, this equates to 2.2 ρCi/g Th-232 above background.)
- Reasonable efforts were made to identify and remove elevated areas that may exceed the average guideline by greater than a factor of $(100/A)^{1/2}$ where A is the elevated area (less than 100 m^2) in m^2. The residual activity level of any location may not exceed 13.2 ρCi/g above background of Th-232 + Th-228.

- Exposure rates do not exceed 10 micro-Roentgen (μR/hr) above background at 1 meter above the surface after the excavated areas have been backfilled. Exposure rates are to be averaged over 100-m^2 grid areas. Maximum exposure rates over any discrete area of less than 100 m^2 may not exceed 20 μR/hr above background.

On the basis of the mean activity ratio between the Th isotopes and the surface fixed and removable contamination limit criterion for the Th isotopes, surface and removable contamination release criteria for the site were derived in Appendix B of Reference 7. Release criteria are in units of α disintegration per minute (dpm) per 100 square centimeters (cm^2) and are listed below.

Average Surface (Fixed or Total) Contamination	230 dpm
Maximum Surface (Fixed or Total) Contamination	700 dpm
Removable (Smearable) Contamination	As Low As Reasonably Achievable (ALARA)

3.0 Final Status Survey Overview

3.1 Survey Objectives

The purpose of the final status survey was to demonstrate that the radiological conditions at the land area adjacent to Kaiser's Tulsa, Oklahoma facility meet release criteria established in the approved decommissioning plan and that the area can, therefore, be released from restrictions for future use without radiological controls. Specific objectives of the survey were to show that:

A. Surface Activity of Structures

- Average total surface activity levels are at or below guideline values established for the site as detailed in Section 2.3.
- Areas of residual activity exceeding the average surface activity guideline value, known as elevated areas, may be acceptable, providing the activity levels are less than approximately three times the average guideline value, as detailed in Section 2.3, when averaged over a surface area of 100 cm^2 and provided the average level within a 1-m^2 area containing the elevated area is within the average surface activity guideline value.
- Reasonable efforts have been made to clean up removable activity and removable activity in any 100-cm^2 area is ALARA, e.g., 20 α dpm/100cm^2.

B. Volume Activity of Soil

- Average activity concentrations are at or below the guideline value as established in Section 2.3, based on a 100-m^2 grid.
- Reasonable efforts have been made to identify and remove elevated areas that may exceed the average guideline by greater than a factor of $(100/A)^{1/2}$ where A is the area (less than 100 m^2) of the elevated area in square meters, and provided the activity level does not exceed three times the guideline value established in Section 2.3.

C. Exposure Rate

- Exposure rates do not exceed 10 μR/hr above background at 1 meter above the surface after excavated areas have been backfilled. Exposure rates are to be averaged over 100-m^2 grid areas. Maximum exposure rates over any discrete area of less than 100 m^2 may not exceed 20 μR/hr above background.

3.2 Organization and Responsibilities

Remediation activities were performed by a team composed of qualified personnel, as presented in Figure 3-1. Descriptions of the individuals responsible for the data presented in this report are provided below. Samples of soil were analyzed by Outreach Laboratory of Broken Arrow, Oklahoma.

3.2.1 Project Manager (Kaiser)

Mr. J. William Vinzant served as the Kaiser Project Manager (PM) for the Adjacent Land Area remediation project with overall responsibility for planning and management of the remediation activities. Mr. Vinzant was responsible for ensuring that remediation activities met the established environmental, health and safety (H&S), and quality assurance (QA) requirements, technical performance, and budgeting and scheduling criteria.

3.2.2 Site Administrator (Kaiser)

Kaiser designated Mr. S. Paul Handa as the Site Administrator (SA) for the Adjacent Land Area remediation project with overall responsibility for on-site planning and management of the remediation activities. As an agent for the PM, the SA observed remediation activities to ensure that they met established environmental, H&S, and QA requirements, technical performance, and budgeting and scheduling criteria. The SA provided coordination and communication with adjacent landowners and the railroad. The SA had authority to make necessary changes to the contractor's work, to stop any activity, and conduct site orientation activities with visitors to the site.

3.2.3 Health Physics Technician (Earth Sciences)

The Health Physics Technician (HPT) served as the single point of contact for all radiological decisions and direction regarding both day-to-day remediation activities and the final status survey. The HPT reported to Kaiser's PM for administrative activities and QA guidance.

3.2.4 QA Coordinator (Earth Sciences)

The QA Coordinator (QAC) had the delegated responsibility and authority to assure that QA objectives were met. In regard to remediation and final survey activities, QAC responsibilities included overseeing that the appropriate quality management, policy, training, and verification controls were present. Additional QAC responsibilities included review of all data generated by field surveys and analytical analyses in support of the final status survey.

3.2.5 Radiation Safety Officer (Kaiser)

The Radiation Safety Officer (RSO) was responsible for the radiological H&S of certain work activities involving radioactive materials. In addition, the Kaiser RSO reviewed implementation and documentation of all work activities involving radioactive materials.

3.3 Instrumentation

Direct measurements of fixed (total) alpha and beta/gamma contamination were performed with a gas proportional detector coupled with a dual scaler instrument. Results were converted from net counts per minute (cpm) to dpm/100cm^2 by dividing by the appropriate detector efficiency in counts per disintegration (cpd) and the probe area correction factor of probe area in cm^2 divided by 100.

Table 3-1 presents the Minimum Detectable Activity (MDA) calculation of direct measurement and scanning instruments used for structural surfaces survey activities at Kaiser's Tulsa, Oklahoma facility adjacent land areas. These instruments satisfy the goal of achieving MDA values between 25 and 75 percent of the release criteria for direct measurements. Alternate scanning or fixed measurement techniques were used to improve the detection limit (e.g., increased fixed measurement count times).

MDA for direct measurement instrumentation was calculated using the NUREG/CR-5849 formula that accounts for both Type I and Type II errors (i.e., elimination of false negatives and false positives to the 95 percent confidence level):

$$MDA = [2.71 + 4.65(B_k * t)^{1/2}]/(t * E * A/100)$$

where:

B_k = background rate in cpm,
t = counting time in minutes,
E = detector efficiency in cpd, and
A = active probe area of the detector in cm^2.

For structural surface scanning instruments, the MDA was also calculated using a formula from NUREG/CR-5849:

$$MDA = (3 * B_k)(E * A/100)$$

where:

B_k = background count rate in cpm,
E = detector efficiency in cpd, and
A = active probe of the detector in cm^2.

Scans of soil (land areas) were performed with 2-inch-by-2-inch sodium iodine (NaI) detectors coupled with scaler type instruments. When scanning soil, the Minimum Detectable Concentration (MDC) was estimated using methodology provided in Reference 8, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) and is detailed for increasing values of background in Table 3-2.

Exposure rate surveys were performed with micro-Roentgen (micro-R) meters containing a 1-inch-by-1-inch NaI scintillation detector. Since scintillation detectors are energy dependent, calibration for the site specific gamma energy spectrum was accomplished by comparing the instrument response to that of a pressurized ionization chamber at different locations on the site. Guidance provided in Attachment 6 of Reference 9 was used to cross calibrate the micro-R meters used. The cross calibration is detailed in Appendix A.

3.4 Survey Procedures

Surveys were planned and implemented in accordance with NUREG/CR-5849. Survey procedures are summarized in this section. Site procedures are detailed in the Kaiser Tulsa, Oklahoma Facility Health Physics Manual (HPM), Reference 9.

3.4.1 Area Classification

For purposes of establishing sampling and measurement frequency and pattern, the site initially was divided into affected and unaffected areas, based on characterization activities (References 2 through 5) which also were used to construct Figure 1-2. Grids with colored segments were classified as affected. Remaining white grids were classified as unaffected.

As remediation proceeded, additional land areas were classified, based upon additional core sampling and analyses of the new cores, as well as analyses of archived cores from previous characterization activities. Results are presented in Figure 3-2 and Table 3-3, which represent the final classification of the adjacent land areas.

3.4.2 Reference Grids

A grid system was implemented to permit referencing sample results and field measurements during characterization of the site. The grid system utilized a 10-meter-by-10-meter grid or rectangles of 100 m^2. This existing grid base was used to the maximum possible extent during remediation and final status survey activities.

The affected adjacent land areas of the site were subdivided into final survey units in accordance with NUREG/CR-5849, i.e., contiguous areas that have similar radiological characteristics for which a separate decision was made as to whether the unit meets the release acceptance criteria. Since all of the affected areas identified during characterization have low-level activity concentrations, contiguous areas identified in the remediation contractor's work schedule were used as the initial basis for survey unit delineation. These areas were selected based on required construction protocols for discrete areas. Survey units are described by the 10-meter-by-10-meter characterization grids that they encompass and, where applicable, the adjacent company property they occupy. In addition, the final survey units, numbered 1 through 7, were further subdivided based on conditions encountered once remediation had begun. For example, Survey Unit 5 was subdivided into Survey Units 5A and 5B. The survey units are divided according to property lines as follows and are presented in Figures 3-3 and 3-4:

- Survey Unit 1 – Part of Beejay, Inc. property and the Red Man property
- Survey Unit 2 – Specific Systems property
- Survey Unit 3 – South side of the Kaiser Flux Building
- Survey Unit 4 – Part of the Union Pacific Railroad right-of-way outside of 25 feet of center line of tracks
- Survey Unit 5 – Part of the Beejay, Inc. property, adjacent to Fulton Creek
- Survey Unit 6 – City of Tulsa, East 41st Street right-of-way
- Survey Unit 7 – Part of the Union Pacific Railroad right-of-way inside of 25 feet of center line of tracks

Where concrete, asphalt, railbed, and/or ballast, pass through open land (soil) grids, a 1-meter-by-1-meter grid was established for conducting structural surface surveys in accordance with NUREG/CR-5849.

3.4.3 Surface Scans

3.4.3.1 Soil Surface Scans

One hundred percent of the affected area soil surfaces were scanned for gamma radiation to identify locations of elevated residual surface and shallow activity. The scanning technique entailed walking each grid at scanning speeds no greater than 0.5 meter per second, and moving the detector back and forth across the path being walked. Audible indication was used to identify elevated areas. Areas where elevated activity was detected were removed. Surveys covered 100 percent of both the bottom and sides of excavations. In addition, at least 10 percent of unaffected land lying within 10 meters of the affected area was also scanned.

3.4.3.2 Structural Surface Scans

One hundred percent of structural surfaces contained within affected areas, such as concrete and railroad tracks were scanned for alpha, beta, and/or gamma radiations. Wherever surfaces were relatively flat and accessible (e.g., the concrete spillway surface), scanning for alpha and beta/gamma radiation was performed. The railroad tracks, because of their obtuse physical surfaces were scanned for gamma radiation. Scanning speeds were one detector width per second for alpha and beta/gamma scans performed with a gas-filled detector and 0.5 meters per second for gamma scans. Audible indication was used to identify elevated areas.

3.4.4 Surface Activity Measurements

Areas where concrete, asphalt, railbed, and/or ballast pass through affected open land grids were gridded in a pattern as directed by NUREG/CR-5849. Structural surfaces where the scan detection sensitivity for the Th isotopes were demonstrated to be less than or equal to 25 percent of the guideline level were surveyed at 2-meter-by-2-meter grids. Those areas where the scan detection sensitivity criteria was not met were surveyed at 1-meter-by-1-meter grids. Surface activity measurements included:

- A scan for alpha and beta/gamma activity to identify elevated areas within a grid.
- A fixed count of the highest surveyed area within a grid to determine the fixed (total) contamination level in dpm/100 cm^2.
- A smear sample to access removable activity in dpm/100 cm^2.

3.4.5 Exposure Rate Measurements

Gamma exposure rate measurements were taken after an excavation has been backfilled. At least four measurements were taken per 100-m^2 grid, near midpoints along the diagonals between the center and corners. Gamma exposure rate readings were taken at 1 meter above the soil surface. Gamma exposure rate readings also were taken over at least 10 percent of adjacent unaffected survey grids. For structural surfaces, exposure rates were taken at 1 meter above sample points, where applicable.

3.4.6 Soil Sampling

3.4.6.1 Surface

Surface samples of soil (0 to 15 cm) were systematically collected from each survey unit at a minimum of four equidistant points per 100 m^2 of surface area. The surface area included excavation walls (sides) as well as the bottom surface. Figure 3-3 depicts the approximate extent of excavations within each survey unit. Samples in addition to the four per 100 m^2 of surface area were taken in survey units that had high background levels or where additional soil activity concentration data was desired.

3.4.6.2 Subsurface

To supplement existing characterization data, core samples were taken four per 100-m^2 area in all areas adjacent to affected areas and/or areas within characterization grids that did not have existing core or surface samples. The core samples were taken with a geoprobe drilling apparatus producing an approximately 4-foot length by one-and-one-quarter-inch-diameter core. Cores were scanned in a low background area with a 2-inch-by-2-inch NaI detector. The highest 1-foot segment then was forwarded to the laboratory for Th-232 identification and quantification by gamma spectroscopy analysis. Results of the core analyses were used to finalize the final affected/unaffected grid delineation and, in cases where only part of a characterization grid was excavated, used to supplement the final status survey data for the survey unit. In addition, archived cores from previous characterization activities that were not previously analyzed were scanned and the highest surveyed 1-foot segment sent to a laboratory for gamma spectroscopy analysis. All the additional core sampling and analyses, and the analyses results for affected/unaffected area delineation and final status survey data, were performed in accordance with agreement with the NRC (Reference 10).

3.4.7 Special Measurements and Samples

Composite samples were taken of final status surface samples and of core samples. Specifically, sub-samples of core samples were taken to make seven composite samples. None of the composite samples

contained more than 10 core samples. The seven composite samples were analyzed by alpha and gamma spectroscopy. In addition, a composite of each of the seven major survey units (1 through 7) final status surface samples was taken. These composites were submitted for alpha spectroscopy analysis. Composite sampling and alpha spectroscopy analyses were performed in agreement with the NRC (Reference 10). The results of the alpha spectroscopy analyses were used to confirm the activity ratio of Th-230 to ((Th-232 + Th-228)/2) of 3.5. The results are presented in Table 3-4.

3.5 Background Level Determinations

3.5.1 Soil

During previous characterization activities (Reference 4), one on-site and one off-site area each were sampled for background radioactivity levels in soil. Thirty 4-foot-long core samples were taken and analyzed at both locations. Every 6-inch segment of the cores was analyzed by gamma spectroscopy for Th-232 activity concentration. Results of all the samples at all the depth intervals are presented in Table 3-5. The average Th-232 activity concentration for each 6-inch depth interval was calculated. Values range from 0.99 to 1.24 ρCi/g, with an overall average concentration of 1.1 ρCi/g. Since final status surface samples were taken from the sides (walls) of excavations as well as the bottom of excavations, they represent soil at various depths. Therefore, the overall average of 1.1 ρCi/g representative of all depths was subtracted from final status soil samples.

3.5.2 Structure Surfaces

Background levels also were established for structure surfaces encountered within soil grids including surfaces paved with concrete or asphalt, railroad ties, and rail and ballast. Structure surface background levels were established by performing surveys on similar unaffected surfaces off site and/or upwind of the site, using the same instruments/detectors used to do final surveys. The number of background readings required was determined using the guidance provided in NUREG/CR-5849. Structure surface background levels were not subtracted from final status surveys of structural surfaces. Table 3-6 presents the structure surface background data.

3.5.3 Gross Gamma Background

Ambient background due to gamma radiation was determined for all survey instruments/detectors used to perform surveys on site. For the 2-inch-by-2-inch NaI detectors used to survey soil areas, the ambient background in cpm was determined at contact with the soil surface and at 1 meter above the soil surface. For the micro-R meter used to measure exposure rates at 1 meter above backfilled excavation soil

surfaces, the ambient background in μR/hr was determined at 1 meter above the soil surface. Measurements were performed on the soil between the site administration building and 41st Street. The data is presented in Table 3-7. This data was confirmed by taking measurements at another off-site location approximately one-half mile from the site.

3.6 Sample Analysis

Soil samples were analyzed by gamma spectroscopy to determine Th-232 concentration in ρCi/g. Soil samples were counted as received from the field and represent the activity concentration remaining in the adjacent land area. The Th-232 activity was inferred from the activity of one of its secular equilibrium progeny Actinium-228. From the measured Th-232 activity concentration, 1.1 ρCi/g background was subtracted. From the net Th-232 activity concentration, the Th-228 activity concentration was calculated by multiplying by 1 based on secular equilibrium between Th-232 and Th-228. Likewise, the Th-230 activity concentration was calculated by multiplying the net Th-232 activity concentration by 3.5. The 3.5 ratio of Th-230 to ((Th-232 + Th-228)/2) activity was calculated from the alpha spectroscopy analyses of 24 site samples of impacted soil and soil-like material, as detailed in Appendix A of Reference 7. Based on the unity calculation detailed in Section 2.3, the acceptance criteria for average activity concentration of soil is met if the net Th-232 activity concentration is $\leq$2.2 ρCi/g.

Smear samples were analyzed for removable contamination on site by counting for alpha and beta/gamma activity using a zinc sulfide scintallation detector and dual scaler instrument. The resulting cpm alpha and cpm beta/gamma were converted to dpm/100cm^2 by dividing the resulting net cpm by the appropriate detector efficiency in cpd. Smear samples are assumed to represent the removable activity on the 100-cm^2 area swiped.

3.7 Data Interpretation

The following parameters for soil activity concentration, structure surface fixed and removable contamination, and exposure rates were calculated for comparison to the appropriate acceptance criteria:

1. Average – the average activity for soil (areas of 100 m^2), for exposure rate (areas of 100 m^2), and for surface activity (areas of 1 m^2), was calculated as follows:

$$\bar{x} = (1/n_s)\sum_{i=1}^{n_s} x_i$$

2. Weighted Average – if any of the results was greater than the release criteria but less than the allowable elevated area criteria (3 times guideline value for fixed surface activity, $[100/A]^{1/2}$ times the guideline value, up to a value of 3 times, for soil activity concentration) a weighted average was calculated as follows:

$$\bar{x}_w = (1/n_s)\sum_{i=1}^{n_s} x_i \left[1 - \sum_{k=1}^{n_k} A_k\right] + \sum_{k=1}^{n_k} y_k A_k$$

If either of the averages exceeded the acceptance criteria, additional remediation was required and follow-up measurements were performed to verify the effectiveness of the actions. When the averages were below the guideline values, the results were evaluated to determine if the data for each survey unit provided a 95 percent confidence level, and the true mean activity level met the release criteria as follows:

1. The standard deviation of the data for the survey unit was calculated as follows:

$$s_x = \sqrt{\frac{\left[\sum_{i=1}^{n}\left(\bar{x} - x_i\right)^2\right]}{n-1}}$$

2. The average of the data for the survey unit was calculated using the equation above.

3. The 95 percent CL statistic μ_α was calculated for the data as follows:

$$\mu_\alpha = \bar{x} + t_{1-\alpha,df}\frac{s_x}{\sqrt{n}}$$

If there were areas of elevated activity in the survey unit, the weighted average for each grid with an elevated activity was included as one of the results (x_i) used in the calculation of the average and the standard deviation for the whole survey unit used in the μ_α calculation.

3.8 Records

All samples and original survey data have been archived at Kaiser's Tulsa, Oklahoma facility.

3.9 QA/Quality Control

Appendix B contains a summary of data generated from QA/quality control (QC) samples submitted with the final status soil samples. Appendix C contains results of the daily QC checks for field survey instrument used during the implementation of the final status survey.

4.0 Survey Findings and Results

4.1 Background Levels

Site background for soil, structural surfaces, and ambient gamma radiation was determined as detailed in Section 3.5. Results are presented in Tables 3-5, 3-6, and 3-7.

4.2 Building Surveys

4.2.1 Railroad Tracks (Table 4-A and Figure 4-A)

4.2.1.1 Scans

Railroad tracks traversing affected and unaffected grids were scanned using a 2-inch-by-2-inch NaI detector. Gross gamma scans were performed in lieu of alpha/beta scans due to the obtuse physical geometry of the railroad tracks and ballast. Gross gamma scans of the railroad tracks detected levels at background.

4.2.1.2 Surface Activity Measurements

Table 4-A lists results of fixed count time surface activity measurements. The measurements were taken as illustrated in Figure 4-A: one every 10 1-meter-by-1-meter grid in unaffected areas and one every five 1-meter-by-1-meter grid in affected areas. Sample density was selected based on the low probability of contamination on the railroad tracks. A total of 200 fixed-point measurements were taken in the railroad track areas. All were less than the acceptance criteria.

4.2.1.3 Removable Activity Measurements

Table 4-A lists results of the fixed count time surface activity measurements. Measurements were taken as illustrated in Figure 4-A; one every 10 1-meter-by-1-meter grid in unaffected areas and one every five 1-meter-by-1-meter grid in affected areas. A total of 200 smear samples were taken in the railroad track areas. All smear count results were less than the acceptance criteria.

4.2.1.4 Exposure Rates

Exposure rates were taken at 1 meter above the railroad tracks, as part of the open land area surveys in grids that included the railroad tracks.

4.2.2 Spillway (Table 4B and Figure 4-11)

4.2.2.1 Scans

Scans of the spillway surface indicated surface activity levels approaching background.

4.2.2.2 Surface Activity Measurements

Table 4-B lists results of the fixed count time surface activity measurements taken one per 1-meter-by-1-meter grid. A total of 10 fixed-point measurements (Figure 4-11) were taken in the spillway area and all were less than the acceptance criteria.

4.2.2.3 Removable Activity Measurements

Table 4-B lists results of the removable activity measurements taken one per 1-meter-by-1-meter grid. A total of 10 smears (Figure 4-11) were taken in the spillway area and all were less than the acceptance criteria.

4.2.2.4 Exposure Rates

Exposure rate measurements were taken 1 meter above the spillway surface. Due to the proximity of the retention pond area and the excavations, none of the measurement locations satisfied the acceptance criteria. The spillway area will be addressed during subsequent decommissioning of the site.

4.3 Ground Surveys

4.3.1 Survey Unit 1 (Table 4-1 and Figure 4-1)

4.3.1.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, revealed several areas of elevated contact gamma radiation. These areas subsequently were remediated, resurveyed, and found to be absent of elevated reading. The areas in question were located in Grids 52-55 and 59 (Figure 4-1).

4.3.1.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-1. Net exposure rates averaged 1 μR/hr with a standard deviation of 2 μR/hr.

4.3.1.3 Thorium Concentrations in Soil

Table 4-1 contains analytical results of surface and core samples. Thirty-six samples were taken and all concentrations were less than the acceptance criteria (Figure 4-1). The average net concentration of Th-232 for Survey Unit 1 was 0.108 ρCi/g with a standard deviation of 0.214 ρCi/g.

4.3.2 Survey Unit 2A (Table 4-2 and Figure 4-2)

4.3.2.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. However, scans of adjacent areas, not previously identified as affected areas, revealed areas of elevated contact gamma radiation, suggesting soil contamination. The identified area was not contiguous, due to layers of asphalt and gravel, and, therefore, a separate subunit, 2B, was created to address the condition.

4.3.2.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-2. Net exposure rates were an average of 1 μR/hr with a standard deviation of 0 μR/hr.

4.3.2.3 Thorium Concentrations in Soil

Table 4-2 lists results of surface and core samples taken. Six samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-2). The average net concentration of Th-232 for Survey Unit 2A was 0.00 ρCi/g with a standard deviation of 0.00 ρCi/g.

4.3.3 Survey Unit 2B (Table 4-3 and Figure 4-3)

4.3.3.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not detect any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.3.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-3. Net exposure rates were an average of 5 μR/hr with a standard deviation of 1 μR/hr.

4.3.3.3 Thorium Concentrations in Soil

Table 4-3 lists analytical results of surface and core samples. Six samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-3). The average net concentration of Th-232 for Survey Unit 2B was 0.00 ρCi/g with a standard deviation of 0.00 ρCi/g.

4.3.4 Survey Unit 2C (Table 4-4 and Figure 4-4)

4.3.4.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.4.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-4. Net exposure rates were an average of 8 μR/hr with a standard deviation of 1 μR/hr.

4.3.4.3 Thorium Concentrations in Soil

Table 4-4 lists analytical results for surface and core samples taken. Six samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-4). The average net concentration of Th-232 for Survey Unit 2C was 0.00 ρCi/g with a standard deviation of 0.00 ρCi/g.

4.3.5 Survey Unit 2D (Table 4-5 and Figure 4-5)

4.3.5.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did identify areas of elevated contact gamma radiation, suggesting residual soil contamination. Those areas subsequently were excavated and surveyed per the approved plan.

4.3.5.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-5. Net exposure rates averaged 1μR/hr with a standard deviation of 1 μR/hr.

4.3.5.3 Thorium Concentrations in Soil

Table 4-5 lists analytical results for surface and core samples. Twenty-two samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-5). The average net concentration of Th-232 for Survey Unit 2D was 0.190 ρCi/g with a standard deviation of 0.354 ρCi/g.

4.3.6 Survey Unit 2E (Table 4-6 and Figure 4-6)

4.3.6.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.6.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-6. Net exposure rates were an average of 1 μR/hr with a standard deviation of 1μR/hr.

4.3.6.3 Thorium Concentrations in Soil

Table 4-6 lists analytical results for surface and core samples. Seven samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-6). The average net concentration of Th-232 for Survey Unit 2E was 0.050 ρCi/g with a standard deviation of 0.132 ρCi/g.

4.3.7 Survey Unit 2F (Table 4-7 and Figure 4-7)

4.3.7.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did identify areas of elevated contact gamma radiation, suggesting residual soil contamination. Those areas subsequently were excavated and surveyed per the approved plan.

4.3.7.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-7. Net exposure rates averaged 6μR/hr with a standard deviation of 2 μR/hr.

4.3.7.3 Thorium Concentrations in Soil

Table 4-7 lists analytical results for surface and core samples taken. Fifty-eight samples were taken in the survey unit and all but two were less than the acceptance criteria (Figure 4-7). The average net concentration of Th-232 for Survey Unit 2F was 0.351 ρCi/g with a standard deviation of 0.953 ρCi/g. For those samples that exceeded the acceptance criteria, a weighted average calculation was performed to ensure that the unit met release criteria.

4.3.8 Survey Unit 3 (Table 4-8 and Figure 4-8)

4.3.8.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.8.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-8. Net exposure rates averaged 1 μR/hr with a standard deviation of 1 μR/hr.

4.3.8.3 Thorium Concentrations in Soil

Table 4-8 lists the results of surface and core samples taken. Seventeen samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-8). The average net concentration of Th-232 for Survey Unit 3 was 0.063 ρCi/g with a standard deviation of 0.109 ρCi/g.

4.3.9 Survey Unit 4A (Table 4-9 and Figure 4-9)

4.3.9.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.9.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-9. Net exposure rates were averaged 1 μR/hr with a standard deviation of 0 μR/hr.

4.3.9.3 Thorium Concentrations in Soil

Table 4-9 lists analytical results for surface and core samples. Four samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-9). The average net concentration of Th-232 for Survey Unit 4A was 0.058 ρCi/g with a standard deviation of 0.115 ρCi/g.

4.3.10 Survey Unit 4B (Table 4-10 and Figure 4-10)

4.3.10.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.10.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-10. Net exposure rates averaged 1 μR/hr with a standard deviation of 0 μR/hr

4.3.10.3 Thorium Concentrations in Soil

Table 4-10 lists analytical results for surface and core samples. Four samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-10). The average net concentration of Th-232 for Survey Unit 4B was 0.113 ρCi/g with a standard deviation of 0.090 ρCi/g.

4.3.11 Survey Unit 4C (Table 4-11 and Figure 4-11)

4.3.11.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.11.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-11. Net exposure rates averaged 1 μR/hr with a standard deviation of 0 μR/hr.

4.3.11.3 Thorium Concentrations in Soil

Table 4-11 lists analytical results for surface and core samples taken. Eight samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-11). The average net concentration of Th-232 for Survey Unit 4C was 0.074 ρCi/g with a standard deviation of 0.126 ρCi/g.

4.3.12 Survey Unit 4D (Table 4-12 and Figure 4-12)

4.3.12.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.12.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-12. Net exposure rates averaged 13 μR/hr with a standard deviation of 5 μR/hr. Only four of the 28 sample locations satisfied the acceptance criteria. Radiation being emitted by throated material on Kaiser property did not permit accurate exposure rate readings from soil in the survey unit. aterial on site will be addressed during future decommissioning activities.

4.3.12.3 Thorium Concentrations in Soil

Table 4-12 lists analytical results of surface samples. Twenty-eight samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-12). The average net concentration of Th-232 for Survey Unit 4D was 0.161 ρCi/g with a standard deviation of 0.378 ρCi/g.

4.3.13 Survey Unit 4E (Table 4-13 and Figure 4-13)

4.3.13.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.13.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-13. Net exposure rates averaged 1 μR/hr with a standard deviation of 1 μR/hr.

4.3.13.3 Thorium Concentrations in Soil

Table 4-13 lists analytical results for surface and core samples. Thirty-two samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-13). The average net concentration of Th-232 for Survey Unit 4E was 0.116 ρCi/g with a standard deviation of 0.336 ρCi/g.

4.3.14 Survey Unit 4F (Table 4-14 and Figure 4-14)

4.3.14.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.14.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-14. Net exposure rates averaged -1 μR/hr with a standard deviation of 1 μR/hr.

4.3.14.3 Thorium Concentrations in Soil

Table 4-14 lists analytical results for surface and core samples. Four samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-14). The average net concentration of Th-232 for Survey Unit 4F was 0.335 ρCi/g with a standard deviation of 0.534 ρCi/g

4.3.15 Survey Unit 4G (Table 4-15 and Figure 4-15)

4.3.15.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, revealed several areas of elevated contact gamma radiation, suggesting residual soil contamination. These areas subsequently were remediated and resurveyed. Additional areas that were located were partial areas of Grids 116-120 and 154-156.

4.3.15.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-15. Net exposure rates averaged -1 μR/hr with a standard deviation of 1μR/hr.

4.3.15.3 Thorium Concentrations in Soil

Table 4-15 lists analytical results of surface samples. Twenty-eight samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-15). The average net concentration of Th-232 for Survey Unit 4G was 0.047 ρCi/g with a standard deviation of 0.084 ρCi/g.

4.3.16 Survey Unit 4H (Table 4-16 and Figure 4-16)

4.3.16.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, identified several areas of elevated contact gamma radiation, suggesting residual soil contamination. These areas subsequently were remediated and resurveyed. Additional areas that were located were partial areas of Grids 129, 130, and 132.

4.3.16.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-16. Net exposure rates averaged 3 μR/hr with a standard deviation of 2 μR/hr.

4.3.16.3 Thorium Concentrations in Soil

Table 4-16 lists analytical results for surface samples. Eight samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-16). The average net concentration of Th-232 for Survey Unit 4H was 0.00 ρCi/g with a standard deviation of 0.00 ρCi/g.

4.3.17 Survey Unit 4I (Table 4-17 and Figure 4-17)

4.3.17.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.17.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-17. Net exposure rates averaged 1 μR/hr with a standard deviation of 1 μR/hr.

4.3.17.3 Thorium Concentrations in Soil

Table 4-17 lists analytical results for surface and core samples. Twenty-two samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-17). The average net concentration of Th-232 for Survey Unit 4I was 0.136 ρCi/g with a standard deviation 0.204 ρCi/g

4.3.18 Survey Unit 4J (Table 4-18 and Figure 4-18)

Survey Unit 4J was identified (subsequent to development of the remediation plan) through analysis of cores that were taken during characterization studies.

4.3.18.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.18.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-18. Net exposure rates averaged -2 μR/hr with a standard deviation of 0 μR/hr.

4.3.18.3 Thorium Concentrations in Soil

Table 4-18 lists analytical results for surface and core samples. Four samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-18). The average net concentration of Th-232 for Survey Unit 4J was 0.00 ρCi/g with a standard deviation of 0.00 ρCi/g.

4.3.19 Survey Unit 4K (Table 4-19 and Figure 4-19)

Survey Unit 4K was identified during the installation of a drain line.

4.3.19.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.19.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-19. Net exposure rates averaged -2 μR/hr with a standard deviation of 1 μR/hr.

4.3.19.3 Thorium Concentrations in Soil

Table 4-19 lists analytical results for surface and core samples. Two samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-19). The average net concentration of Th-232 for Survey Unit 4K was 0.185 ρCi/g with a standard deviation of 0.262 ρCi/g.

4.3.20 Survey Unit 4L (Table 4-20 and Figure 4-20)

4.3.20.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, identified several areas of elevated contact gamma radiation, suggesting residual soil contamination. These areas, located in Grids 192, 193, and 198, subsequently were remediated and resurveyed

4.3.20.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-20. Net exposure rates averaged 1 μR/hr with a standard deviation of 1 μR/hr.

4.3.20.3 Thorium Concentrations in Soil

Table 4-20 lists analytical results for surface samples. Fifteen samples were taken in the survey unit and all but one were less than the acceptance criteria (Figure 4-20). The average net concentration of Th-232 for Survey Unit 4L was 0.613 ρCi/g with a standard deviation of 0.761 ρCi/g. For the sample that exceeded the acceptance criteria, a weighted average calculation was performed to ensure that the unit met release criteria.

4.3.21 Survey Unit 4M (Table 4-21 and Figure 4-21)

4.3.21.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.21.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-21. Net exposure rates averaged 0 μR/hr with a standard deviation of 1 μR/hr.

4.3.21.3 Thorium Concentrations in Soil

Table 4-21 lists analytical results for surface and core samples. Twenty-two samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-21). The average net concentration of Th-232 for Survey Unit 4M was 0.144 ρCi/g with a standard deviation of 0.327 ρCi/g.

4.3.22 Survey Unit 5A (Table 4-22 and Figure 4-22)

4.3.22.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.22.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-22. Net exposure rates averaged 1 μR/hr with a standard deviation of 1 μR/hr.

4.3.22.3 Thorium Concentrations in Soil

Table 4-22 lists analytical results for surface and core samples. Twelve samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-22). The average net concentration of Th-232 for Survey Unit 5A was 0.488 ρCi/g with a standard deviation of 0.481 ρCi/g.

4.3.23 Survey Unit 5B (Table 4-23 and Figure 4-23)

4.3.23.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.23.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-23. Net exposure rates averaged 1 μR/hr with a standard deviation of 0 μR/hr.

4.3.23.3 Thorium Concentrations in Soil

Table 4-23 lists analytical results for surface and core samples. Ten samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-23). The average net concentration of Th-232 for Survey Unit 5B was 0.076 ρCi/g with a standard deviation of 0.172 ρCi/g.

4.3.24 Survey Unit 6A (Table 4-24 and Figure 4-24)

4.3.24.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. However, scans of adjacent areas, not previously identified as affected areas, identified areas of elevated contact gamma radiation suggesting soil contamination. The areas subsequently were remediated and resurveyed.

4.3.24.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-24. Net exposure rates averaged 0 μR/hr with a standard deviation of 0 μR/hr.

4.3.24.3 Thorium Concentrations in Soil

Table 4-24 lists analytical results for surface and core samples. Twelve samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-24). The average net concentration of Th-232 for Survey Unit 6A was 0.265 ρCi/g with a standard deviation of 0.445 ρCi/g.

4.3.25 Survey Unit 6B (Table 4-25 and Figure 4-25)

4.3.25.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination

4.3.25.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-25. Net exposure rates averaged 1 μR/hr with a standard deviation of 1 μR/hr.

4.3.25.3 Thorium Concentrations in Soil

Table 4-25 lists analytical results for surface and core samples. Twenty samples were taken in the survey unit and all but one, in Grid 163, were less than the acceptance criteria (Figure 4-25). The average net concentration of Th-232 for Survey Unit 6B was 0.402 ρCi/g with a standard deviation of 0.722 ρCi/g. A weighted average calculation demonstrated that the survey unit met the acceptance criteria.

4.3.26 Survey Unit 6C (Table 4-26 and Figure 4-26)

4.3.26.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.26.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-26. Net exposure rates averaged 0 μR/hr with a standard deviation of 0 μR/hr.

4.3.26.3 Thorium Concentrations in Soil

Table 4-26 lists analytical results for surface and core samples. Four samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-26). The average net concentration of Th-232 for Survey Unit 6C was 0.065 ρCi/g with a standard deviation of 0.082 ρCi/g.

4.3.27 Survey Unit 7A (Table 4-27 and Figure 4-27)

4.3.27.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, identified several areas of elevated contact gamma radiation, suggesting residual soil contamination. These areas, located in Grids 70, 73, 75, 77, 78, 80, 82, and parts of 116-120, subsequently were remediated and resurveyed.

4.3.27.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-27. Net exposure rates averaged 1 μR/hr with a standard deviation of 2 μR/hr. Radiation being emitted by throated material on Kaiser property did not permit accurate exposure rate readings through the survey unit. Therefore, analytical results were used to determine if remediation activities were successful.

4.3.27.3 Thorium Concentrations in Soil

Table 4-27 lists analytical results for surface samples. One-hundred-eight samples were taken in the survey unit and all but one were less than the acceptance criteria (Figure 4-27). The average net concentration of Th-232 for Survey Unit 7A was 0.261 ρCi/g with a standard deviation of 0.516 ρCi/g. For the sample that was over, a weighted average calculation was performed to ensure that the unit passed.

4.3.28 Survey Unit 7B (Table 4-28 and Figure 4-28)

4.3.28.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, identified several areas of elevated contact gamma radiation, suggesting residual soil contamination. These areas, located in Grid 87 and parts of Grids 87, 129, 130, and 132, subsequently were remediated and resurveyed.

4.3.28.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-28. Net exposure rates averaged 1 μR/hr with a standard deviation of 0 μR/hr.

4.3.28.3 Thorium Concentrations in Soil

Table 4-28 lists analytical results for surface samples taken. Thirty-eight samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-28). The average net concentration of Th-232 for Survey Unit 7B was 0.098 ρCi/g with a standard deviation of 0.267 ρCi/g.

4.3.29 Survey Unit 7C (Table 4-29 and Figure 4-29)

4.3.29.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, identified several areas of elevated contact gamma radiation, suggesting residual soil contamination. These areas, located in Grids 89, 97, and 98 and parts of 91 and 92, were subsequently remediated and resurveyed.

4.3.29.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-29. Net exposure rates averaged 1 μR/hr with a standard deviation of 0 μR/hr.

4.3.29.3 Thorium Concentrations in Soil

Table 4-29 lists analytical results for surface samples. Fifty-two samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-29). The average net concentration of Th-232 for Survey Unit 7C was 0.166 ρCi/g with a standard deviation of 0.405 ρCi/g.

4.3.30 Survey Unit 7D (Table 4-30 and Figure 4-30)

4.3.30.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.30.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-30. Net exposure rates averaged 1 μR/hr with a standard deviation of 1 μR/hr.

4.3.30.3 Thorium Concentrations in Soil

Table 4-30 lists analytical results for surface and core samples. Six samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-30). The average net concentration of Th-232 for Survey Unit 7D was 0.381 ρCi/g with a standard deviation of 0.336 ρCi/g.

4.3.31 Survey Unit 7E (Table 4-31 and Figure 4-31)

4.3.31.1 Scans

A 100-percent scan of the excavation bottom and sidewalls did not identify any areas of elevated contact gamma radiation, suggesting that no residual soil contamination remained. Scans of adjacent areas, not previously identified as affected areas, did not identify any areas of elevated contact gamma radiation, suggesting no residual soil contamination.

4.3.31.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-31. Net exposure rates averaged 1 μR/hr with a standard deviation of 1 μR/hr.

4.3.31.3 Thorium Concentrations in Soil

Table 4-31 lists analytical results for surface and core samples. Six samples were taken in the survey unit and all were less than the acceptance criteria (Figure 4-31). The average net concentration of Th-232 for Survey Unit 7E was 0.476 ρCi/g with a standard deviation of 0.747 ρCi/g.

4.3.32 Unaffected Areas (Table 4-32)

4.3.32.1 Scans

Scans of core samples were performed in accordance with Ref. 9, ESC/HPM 3-6 Gross Gamma Surveys of Soil Cores. Analytical results led to the reclassification of seven areas. The areas that were reclassified were discussed as part of the survey unit to which they were included

4.3.32.2 Exposure Rates

Net exposure rate measurements are presented in Table 4-32. Net exposure rates averaged 1 μR/hr with a standard deviation of 2 μR/hr.

4.3.32.3 Thorium Concentrations in Soil

Table 4-32 lists analytical results for core samples. A total of 313 samples were taken in the unaffected areas and all were less than the acceptance criteria. (Figure 4-32). The average net concentration of Th-232 for the unaffected areas was 0.153 ρCi/g with a standard deviation of 0.084 ρCi/g.

5.0 Summary

All the survey units meet the acceptance criteria for unrestricted release. The overall average net Th-232 activity concentration remaining in the affected areas is 0.194 ρCi/g. This average concentration, calculated from weighted (based on the land area represented) final status survey data, is less than 10 percent of the net Th-232 activity concentration acceptance criteria for unrestricted release.

6.0 References

1. NUREG/CR-5849, Manual for Conducting Radiological Surveys in Support of License Termination (June 1992).

2. B. Koh & Associates, Inc., May 1998, Characterization Survey, Kaiser Aluminum and Chemical Corporation, Tulsa, Oklahoma, Rev 0.

3. B. Koh & Associates, Inc, November 1999, Supplementary Radiological Characterization Survey, Kaiser Aluminum & Chemical Corporation, Tulsa, Oklahoma, Revision 1.

4. Scott, L. Max, Ph.D., CHP, March 1999, Adjacent Land Characterization, Kaiser Aluminum Specialty Products, Appendix A, Estimate of Volume of Off-Site Contaminated Soil, Adjacent Land Characterization Report, ADA Consultants, Inc., Baton Rouge, LA.

5. Scott, L. Max, Ph.D., CHP, Addendum to Adjacent Land Characterization, ADA Consultants, Inc. Baton Rouge, LA.

6. NRC, October 23, 1981, 46 FR 52061, Branch Technical Position, Disposal or Onsite Storage of Thorium and Uranium Waste from Past Operations.

7. Kaiser, July 1999, Adjacent Land Remediation Plan for Kaiser Aluminum & Chemical Corporation, Tulsa, Oklahoma, Tulsa, OK.

8. NUREG/CR-1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Rev. 1 (August 2000).

9. Kaiser Tulsa, Oklahoma Site Health Physics Manual.

10. NRC Memorandum, January 29, 2001, Meeting Report for the January 16 – 17, 2001, Meeting with Kaiser.

11. Earth Sciences, October 2000, Final Status Survey Plan, Adjacent land Area, Tulsa, Oklahoma, Kaiser Aluminum & Chemical Corporation, Baton Rouge, Louisiana.

Tables

Table 3-1
Instrumentation
Kaiser Adjacent Land Remediation

Instrument Type	Probe	B background (cpm)	t count time (min)	E efficiency (cpd)	A probe area (cm^2)	t_c time constant (min)	MDA	75 % of Criteria	25% of Criteria
							($dpm/100cm^2$)		
Smear Count	Model 43-10-1 (α)	0.2	5	0.228	20	N/A	6	15	5
Smear Count	Model 43-10-1 (β)	50	5	0.154	20	N/A	99	15	5
Direct Measurement	Model 43-68 (α)	2	1	0.128	126	N/A	58	175	58
Direct Measurement	Model 43-68 (β)	60	1	0.212	126	N/A	145	175	58
Scanning	Model 43-68 (α)	2	N/A	0.128	126	N/A	37	175	58
Scanning	Model 43-68 (β)	60	N/A	0.212	126	N/A	674	175	58

Notes:
B = Background count rate (cpm).
cpm = Counts per minute.
min = Minutes.
cpd = Counts per disintegration.
cm^2 = Square centimeters.
MDA = Minimum detectable activity.
dpm = Disintegrations per minute.
N/A = Not applicable.

All survey measurements detailed in this table were based on the detection of α radiation.

Table 3-2
MDC Values for Increasing Background
Kaiser Adjacent Land Remediation

Measurement	Instrument Type Unshielded	B BKG (cpm)	I scan time (sec)	p surveyor E (-)	E_i instrument E (cpm / uR/h)	d'	s_i (counts)	MDCR (ncpm)	$MDCR_s$ (cpm)	Scan MDC (uR/h)	CF (pCi/g / uR/h)	Scan MDC (pCi/g)
Scanning for Th-232	2" x 2" NaI	3000	1	0.5	830	1.380	10	585	828	1.00	0.99	1.0
Scanning for Th-232	2" x 2" NaI	5000	1	0.5	830	1.380	13	756	1069	1.29	0.99	1.3
Scanning for Th-232	2" x 2" NaI	7000	1	0.5	830	1.380	15	894	1265	1.52	0.99	1.5
Scanning for Th-232	2" x 2" NaI	9000	1	0.5	830	1.380	17	1014	1434	1.73	0.99	1.7
Scanning for Th-232	2" x 2" NaI	11000	1	0.5	830	1.380	19	1121	1585	1.91	0.99	1.9
Scanning for Th-232	2" x 2" NaI	13000	1	0.5	830	1.380	20	1219	1724	2.08	0.99	2.1
Scanning for Th-232	2" x 2" NaI	15000	1	0.5	830	1.380	22	1309	1851	2.23	0.99	2.2
Scanning for Th-232	2" x 2" NaI	16000	1	0.5	830	1.380	23	1352	1912	2.30	0.99	2.3
Scanning for Th-232	2" x 2" NaI	17000	1	0.5	830	1.380	23	1394	1971	2.37	0.99	2.3
Scanning for Th-232	2" x 2" NaI	18000	1	0.5	830	1.380	24	1434	2028	2.44	0.99	2.4
Scanning for Th-232	2" x 2" NaI	19000	1	0.5	830	1.380	25	1473	2084	2.51	0.99	2.5
Scanning for Th-232	2" x 2" NaI	20000	1	0.5	830	1.380	25	1512	2138	2.58	0.99	2.5
Scanning for Th-232	2" x 2" NaI	21000	1	0.5	830	1.380	26	1549	2191	2.64	0.99	2.6

Notes:
B = background count rate (cpm).
cpm = counts per minute.
i = scan time interval.
p = surveyor effeciency (ranges from 0.5 to 0.75).
e_i = instrument efficiency (from Table 6.7 of MARSSIM).
d' = value selected from Table 6.5 of MARSSIM.
s_i = minimal number of net source counts.
MDCR = minimum detectable count rate.
$MDCR_s$ = surveyor MDCR.
MDC = minimum detectable concentration.
CF = conversion factor (developed from MARSSIM).
ncpm = net counts per minute.
pCi/g = pico curies per gram.
mR/h = micro-Roentgen per hour.

Table 3-3
Affected/Unaffected Area Classification
Kaiser Adjacent Land Remediation

Characterization Grid Number	NUREG-5849 Status	Status Basis	Comments
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27	Unaffected	4 cores < AC	
28			
29			
30	Unaffected	4 cores < AC	
31	Unaffected	4 cores < AC	Unaffected
32	Unaffected	4 cores < AC	Unaffected
33			
34	Unaffected	4 cores < AC	Unaffected
35			
36	Unaffected	4 cores < AC	Unaffected
37			
38	Unaffected	4 cores < AC	Unaffected
39			
40			
41			
42			
43			
44			
45			

Table 3-3
Affected/Unaffected Area Classification
Kaiser Adjacent Land Remediation

Characterization Grid Number	NUREG-5849 Status	Status Basis	Comments
46	Unaffected	4 cores < AC	Unaffected
47			
48	Unaffected	4 cores < AC	Unaffected
49	Unaffected	4 cores < AC	Unaffected
50	Unaffected	4 cores < AC	Unaffected
51	Unaffected	4 cores < AC	Unaffected
52			
53			
54			
55			
56			
57			
58			
59			
60			
61			
62	Unaffected	3 cores < AC	Unaffected
63			
64	Unaffected	4 cores < AC	Unaffected
65	Unaffected	4 cores < AC	Unaffected
66	Unaffected	4 cores < AC	Unaffected
67	Unaffected	3 cores < AC	Unaffected
68			
69	Unaffected	4 cores < AC	Unaffected
70			
71	Unaffected	4 cores < AC	Unaffected
72			
73			
74			
75			
76			
77			
78			
79			
80			
81			
82			
83	Unaffected	4 cores < AC	Unaffected
84			
85			
86			
87			
88			
89			
90			

Table 3-3
Affected/Unaffected Area Classification
Kaiser Adjacent Land Remediation

Characterization Grid Number	NUREG-5849 Status	Status Basis	Comments
91			
92			
93			
94			
95			
96			
97			
98			
99			
100			
101			
102			
103			
104			
105			
106			
107	Unaffected	4 cores < AC	Unaffected
108	Unaffected	4 cores < AC	Unaffected
109	Unaffected	4 cores < AC	Unaffected
110	Unaffected	4 cores < AC	Unaffected
111			
112	Unaffected	4 cores < AC	Unaffected
113	Unaffected	4 cores < AC	Unaffected
114	Unaffected	4 cores < AC	Unaffected
115	Unaffected	4 cores < AC	Unaffected
116			
117			
118			
119			
120			
121			
122			
123			
124			
125	Unaffected	4 cores < AC	Unaffected
126	Unaffected	4 cores < AC	Unaffected
127			
128	Unaffected	1 core < AC	Grid area is 5 m^2
129			
130			
131			
132			
133			
134			
135			

Table 3-3
Affected/Unaffected Area Classification
Kaiser Adjacent Land Remediation

Characterization Grid Number	NUREG-5849 Status	Status Basis	Comments
136			
137			
138	Unaffected	4 cores < AC	Unaffected
139	Unaffected	4 cores < AC	Unaffected
140	Unaffected	4 cores < AC	Unaffected
141	Unaffected	4 cores < AC	Unaffected
142	Unaffected	4 cores < AC	Unaffected
143	Unaffected	4 cores < AC	Unaffected
144	Unaffected	4 cores < AC	Unaffected
145	Unaffected	4 cores < AC	Unaffected
146	Unaffected	4 cores < AC	Unaffected
147	Unaffected	4 cores < AC	Unaffected
148	Unaffected	4 cores < AC	Unaffected
149	Unaffected	4 cores < AC	Unaffected
150			
151	Unaffected	5 cores < AC	Unaffected
152			
153	Unaffected	4 cores < AC	Unaffected
154			
155			
156			
157			
158			
160	Unaffected	1 core < AC	Grid area is 5 m^2
161			
162			
163			
164			
165			
166			
167			
168	Unaffected	3 cores < AC	Unaffected
169			
170			
171	Unaffected	4 soil samples < AC	Unaffected
172	Unaffected	4 cores < AC	Unaffected
173	Unaffected	4 cores < AC	Unaffected
174	Unaffected	4 cores < AC	Unaffected
175			
176			
177	Unaffected	1 core < AC	Grid area is 5 m^2
178	Unaffected	1 core < AC	Grid area is 5 m^2
179			
180	Unaffected	4 cores < AC	Unaffected
181	Unaffected	2 cores < AC	Unaffected

Table 3-3
Affected/Unaffected Area Classification
Kaiser Adjacent Land Remediation

Characterization Grid Number	NUREG-5849 Status	Status Basis	Comments
182	Unaffected	4 cores < AC	Unaffected
183	Unaffected	4 cores < AC	Unaffected
184	Unaffected	4 cores < AC	Unaffected
185	Unaffected	4 cores < AC	Unaffected
186	Unaffected	4 cores < AC	Unaffected
187	Unaffected	4 cores < AC	Unaffected
188	Unaffected	4 cores < AC	Unaffected
189			
190			
191			
192			
193			
194	Unaffected	3 cores < AC	Unaffected
195	Unaffected	4 cores < AC	Unaffected
196	Unaffected	4 cores < AC	Unaffected
197	Unaffected	4 cores < AC	Unaffected
198			
199	Unaffected	4 cores < AC	Unaffected
200	Unaffected	2 cores < AC	Grid area is 6 m^2
201	Unaffected	1 core < AC	Grid area is < 5 m^2
202	Unaffected	4 cores < AC	Unaffected
203	Unaffected	4 cores < AC	Unaffected
204	Unaffected	4 cores < AC	Unaffected
205	Unaffected	4 cores < AC	Unaffected
207	Unaffected	4 soil samples < AC	Unaffected
208	Unaffected	4 cores < AC	Unaffected
209			
210			
211	Unaffected	4 cores < AC	Unaffected
212	Unaffected	4 cores < AC	Unaffected
213			
214	Unaffected	4 cores < AC	Unaffected
215			
216			
217	Unaffected	4 cores < AC	Unaffected
218	Unaffected	4 soil samples < AC	Unaffected
219	Unaffected	4 soil samples < AC	Unaffected

Notes:
All grids not marked as "Unaffected" are "Affected."
AC = Acceptance criteria.

Table 3-4
Alpha Spectroscopy Results
Kaiser Adjacent Land Remediation

Sample Number	Gamma Th-232 Analytical Results (pCi/g)	(+/-) error (pCi/g)	Alpha Th-232 Analytical Results (pCi/g)	(+/-) error (pCi/g)	Alpha Th-230 Analytical Results (pCi/g)	(+/-) error (pCi/g)	Alpha Th-228 Analytical Results (pCi/g)	(+/-) error (pCi/g)	Ratio of Gamma to Alpha Th-232	Ratio of Alpha 230/232	Ratio of Alpha 228/232
500-COMP-SU1	1.48E+00	1.47E-01	1.49E+00	2.41E-01	2.52E+00	3.53E-01	1.35E+00	2.31E-01	0.99	1.69	0.91
501-COMP-SU2	1.28E+00	2.34E-01	4.40E-01	1.17E-01	9.45E-01	1.70E-01	4.43E-01	1.16E-01	2.91	2.15	1.01
502-COMP-SU3	1.06E+00	1.04E-01	7.54E-01	1.69E-01	1.26E+00	2.20E-01	6.23E-01	1.60E-01	1.41	1.67	0.83
503-COMP-SU4	1.10E+00	1.48E-01	7.24E-01	1.60E-01	1.64E+00	2.40E-01	7.46E-01	1.62E-01	1.52	2.27	1.03
504-COMP-SU5	1.37E+00	1.77E-01	6.50E-01	2.82E-01	1.36E+00	3.91E-01	7.27E-01	3.15E-01	2.11	2.09	1.12
505-COMP-SU6	9.59E-01	1.95E-01	8.78E-01	1.91E-01	2.59E+00	3.61E-01	5.45E-01	1.56E-01	1.09	2.95	0.62
506-COMP-SU7	6.40E-01	9.90E-02	8.29E-01	1.86E-01	1.87E+00	2.69E-01	7.61E-01	1.92E-01	0.77	2.26	0.92
650-FS-COMP	9.29E-01	1.23E-01	9.21E-01	1.78E-01	2.91E-01	1.06E-01	1.06E+00	2.01E-01	1.01	0.32	1.15
687-COMP	1.12E+00	1.48E-01	1.19E+00	2.81E-01	3.06E+00	4.38E-01	9.36E-01	2.50E-01	0.94	2.57	0.79
688-COMP	1.01E+00	1.17E-01	9.39E-01	2.23E-01	1.88E+00	3.10E-01	8.23E-01	2.03E-01	1.08	2.00	0.88
735-COMP	1.31E+00	1.55E-01	8.92E-01	1.87E-01	2.49E+00	3.44E-01	6.67E-01	1.65E-01	1.47	2.79	0.75
736-COMP	6.45E-01	1.18E-01	5.95E-01	1.70E-01	1.07E+00	2.17E-01	5.62E-01	1.83E-01	1.08	1.80	0.94
737-COMP	1.14E+00	1.43E-01	2.74E+00	3.51E-01	6.49E+00	5.35E-01	2.49E+00	3.34E-01	0.42	2.37	0.91
738-COMP	1.13E+00	2.16E-01	1.27E+00	2.33E-01	2.74E+00	3.43E-01	2.32E-01	1.19E-01	0.89	2.16	0.18
								AVERAGE	1.26	2.08	0.86
								STD DEV	0.62	0.63	0.24

Table 3-5
Soil Background
Kaiser Adjacent Land Remediation

Location[1]	Length[2]	Depth 0" - 6"	6" - 12"	12" - 18"	18" - 24"	24" - 30"	30" - 36"	36" - 42"	42" - 48"	
1	46"	0.98	0.92	1.47	1.35	1.49	1.24	1.09		
2	36"	0.80	1.34	1.24	1.16	1.01	0.67			
3	40"	0.35	0.66	0.57	0.81	0.77	0.76			
4	37"	0.61	1.06	1.07	1.08	1.50	1.16			
5	43"	0.90	0.94	0.81	0.90	1.11	0.98	0.79		
6	39"	0.95	0.84	1.29	1.36	1.46	0.99			
7	40"	0.70	1.18	1.26	1.30	1.33	1.50			
8	41"	1.24	1.33	1.07	1.25	1.63	1.41			
9	38"	0.86	0.82	0.93	1.03	1.27	1.02			
10	37"	0.57	0.47	0.94	0.49	1.18	0.38			
11	41"	0.97	1.07	1.26	1.47	1.32	2.04			
12	39"	0.96	1.21	1.48	1.32	1.63	1.42			
13	42"	1.31	1.09	1.43	1.16	1.27	1.42	0.96		
14	46"	1.13	0.87	0.75	0.89	1.16	1.26	0.96		
15	36"	1.11	1.27	0.99	1.48	1.42	0.56			
16	34"	0.53	0.97	1.25	0.91	1.49				
17	38"	0.91	0.80	1.22	1.52	1.31	1.16			
18	38"	0.60	1.04	0.86	0.92	0.81				
19	40"	0.36	0.57	0.70	0.66	0.60	0.84			
20	41"	1.38	1.25	1.42	1.41	2.06	1.13			
21	39"	1.25	1.25	0.97	1.03	1.30	1.21			
22	40"	1.07	1.43	1.36	1.51	1.63	1.47			
23	46"	1.08	1.22	1.03	1.43	1.54	1.31	1.45		
24	33"	0.85	0.79	1.28	1.35	1.41				
25	46"	0.56	1.18	0.86	1.05	1.18	0.93	0.94		
26	42"	1.47	0.88	1.23	1.02	1.62	1.03	0.74		
27	42"	1.24	0.98	1.06	1.56	1.37	1.38	0.74		
28	44"	1.18	1.46	1.37	0.79	2.32	0.87	1.08		
29	39"	0.90	0.87	0.98	0.90	0.97	1.12			
30	41"	1.25	1.37	1.50	1.22	1.46	1.50			
31	42"	1.33	0.97	1.52	1.62	1.49	1.72	0.47		
32	46"	1.36	1.37	1.27	1.29	1.43	1.32	1.18		
33	46"	0.92	0.67	0.85	0.94	0.84	1.25	0.97		
34	46"	1.12	1.17	1.06	1.45	1.37	1.21	1.31		
35	42"	1.07	0.89	1.04	1.13	1.25	1.22	0.74		
36	38"	0.41	0.57	0.96	0.64	0.70	0.55			
37	46"	0.86	1.09	0.91	1.28	1.12	0.95	0.99		
38	39"	1.02	1.39	1.22	1.32	1.25	0.89			
39	46"	0.70	1.37	1.46	1.01	1.03	0.82	1.02		
40	46"	1.13	1.01	1.20	0.86	1.17	1.11	1.26		
41	41"	0.92	0.91	1.20	1.19	1.39	1.36			
42	33"	0.90	1.04	1.00	1.19	0.87				
43	46"	0.96	1.12	1.09	1.02	1.18	1.21	1.21		
44	34"	1.29	1.45	1.88	1.59	1.20				
45	46"	1.23	0.95	0.54	0.73	0.64	1.04	0.79		
46	36"	0.58	0.98	1.32	0.99	1.13	0.46			
47	39"	0.63	1.00	1.45	2.25	1.02	1.10			
48	40"	1.10	1.01	1.30	1.62	1.37	1.61			
49	28"	0.99	1.27	1.19	1.22					
50	26"	0.97	1.26	1.20	1.31					
51	46"	1.72	1.16	1.16	1.38	1.19	1.26	0.84		
52	46"	1.63	1.50	1.07	1.25	1.31	1.14	1.06		
53	46"	1.29	1.28	0.86	1.20	1.29	1.61	1.32		
54	46"	1.24	0.82	0.78	0.57	0.93	0.86	0.95		
55	46"	1.31	1.29	1.12	1.18	0.89	0.84	0.99		
56	46"	1.17	0.65	0.92	1.14	0.96	0.90	0.96		
57	46"	0.96	1.10	0.64	0.70	1.26	0.87	0.99		
58	46"	1.04	1.20	0.71	0.60	0.79	0.82	0.77		
59	46"	0.96	1.32	1.24	1.29	0.85	1.16	1.02		
60	46"	1.00	1.08	0.96	1.08	1.38	1.07	1.20		**Total**
Count		60	60	60	60	58	53	29		380
Average		1.00	1.07	1.11	1.16	1.24	1.12	0.99		1.10
Minimum		0.35	0.47	0.54	0.49	0.60	0.38	0.47		0.35
Maximum		1.72	1.50	1.88	2.25	2.32	2.04	1.45		2.32
Median		0.99	1.08	1.11	1.19	1.27	1.13	0.99		1.11
Standard Deviation		0.29	0.24	0.26	0.32	0.32	0.32	0.21		0.30
Level Bound (95% CL)		1.06	1.12	1.17	1.22	1.31	1.19	1.06		1.13
Average + 20%		1.20	1.28	1.34	1.39	1.49	1.34	1.19		1.33
$t_{95\%,df}$		1.672	1.672	1.672	1.672	1.673	1.676	1.701		1.650
n_B		6	4	4	5	5	6	3		5

Notes:
All measurements are for Th-232 (pCi/g).
[1]When there are no length units, the core represents a depth of 0 to 4 feet.
[2]Length is the actual length of the recovered core from a 4-foot increment.

Table 3-6
Structure Surface Background
Kaiser Adjacent Land Remediation

	1		2		3		4		5		6	
	Asphalt		Concrete		Large Ballast		Railroad Rail		Railroad Tie		Small Ballast	
	Alpha (cpm)	Beta (cpm)	Alpha (cpm)	Beta (cpm)	Alpha (cpm)	Beta (cpm)	Alpha (cpm)	Beta (cpm)	Alpha (cpm)	Beta (cpm)	Alpha (cpm)	Beta (cpm)
1	4	275	21	460	3	743	9	197	10	194	6	232
2	6	283	12	429	6	699	15	198	12	208	9	247
3	1	275	13	440	6	675	11	209	13	206	5	249
4	7	305	17	439	5	750	13	222	3	214	3	256
5	2	261	17	387	8	725	8	205	6	209	4	217
6	8	225	0	351	4	761	11	203	7	184	6	262
7	4	299	20	382	9	744	15	219	6	238	6	248
8	11	286	19	380	4	720	15	183	8	189	9	225
9	8	266	11	351	12	681	10	201	8	225	4	230
10	8	256	18	390	5	651	14	197	13	265	9	230
Average:	6	273	15	401	6	715	12	203	9	213	6	240
Stnd Dev.:	3	23	6	39	3	37	3	11	3	24	2	15
Minimum:	1	225	0	351	3	651	8	183	3	184	3	217
Maximum:	11	305	21	460	12	761	15	222	13	265	9	262
Median:	7	275	17	389	6	723	12	202	8	209	6	240
n_B	23	1	15	1	16	0	4	0	13	1	11	0

1 - Asphalt 1 through 5 were taken in the parking area west of Building 2. Asphalt 6 through 10 were taken in the parking area of Building 8.
2 - Concrete walkway west of Building 2.
3 - Large-sized ballast, granite looking, taken on the Union Pacific Railway, 20 meters past the 1/2 mile marker.
4 - Rail of the Union Pacific Railway, 20 meters past the 1/2 mile marker (west of Kaiser property).
5 - Ties of the Union Pacific Railway, 20 meters past the 1/2 mile marker (west of Kaiser property).
6 - Small-sized ballast, taken on the Union Pacific Railway, 20 meters past the 1/2 mile marker (west of Kaiser property).

Table 3-7
Gross Gamma Background
Kaiser Adjacent Land Remediation

	A	B	C	D	E
	Model 44-10C (75473 /81084) On Contact (cpm)	**Model 44-10C (75473 /81084) @ 1 meter (cpm)**	**Model 19 (104630) @ 1 meter (mR/hr)**	**Model 44-10C (75448/ 112016) On Contact (cpm)**	**Model 44-10C (75448/ 112016) @ 1 meter (cpm)**
1	3529	3345	10	2877	2606
2	3582	3402	9	2842	2594
3	3467	3302	10	2949	2783
4	3501	3367	9	2901	2745
5	3489	3379	9	2814	2489
6	3565	3509	10	2834	2748
7	3383	3207	9	2812	2745
8	3509	3366	10	3087	2988
9	3370	3211	9	2945	2814
10	3605	3412	9	2825	2638
Average:	3500	3350	9	2889	2715
Stnd dev.:	78	91	1	86	140
Minimum:	3370	3207	9	2812	2489
Maximum:	3605	3509	10	3087	2988
Median:	3505	3367	9	2860	2745
n_B	0	0	0	0	0

A - Gross Gamma count rate on contact with ground, measured unshielded 2-inch-by-2-inch NaI detector #81084
B - Gross Gamma count rate at 1 meter above ground, measured unshielded 2-inch-by-2-inch NaI detector #81084
C - Gross Gamma exposure rate at 1 meter above ground, as measured with an unshielded 1-inch-by-1-inch NaI detector
D - Gross Gamma count rate on contact with ground, measured unshielded 2-inch-by-2-inch NaI detector #112016
E - Gross Gamma count rate at 1 meter above ground, measured unshielded 2-inch-by-2-inch NaI detector #112016

Table 3-8
PIC Calibration Check
Kaiser Adjacent Land Remediation

Kaiser Ludlum Model 3 SN 13203		KOH Bicron MREM SN B709J		KOH Ludlum Model 19 SN 156479		Scott Ludlum Model 3-97 SN 48469		Morton Ludlum Model 12 SN 20854		ESC @ 1 meter Ludlum Model 19 SN 104630		ESC on contact Ludlum Model 19 SN 104630	
µR/hr	Scale	µR/hr	Scale	µR/hr	Scale	µR/hr	Scale	µR/hr	Scale	µR/hr	Scale	µR/hr	Scale
120	10x	65	1x	120	250	110	10x	150	100x	120	250	90	250
230	10x	110	1x	200	250	170	10x	260	100x	160	250	120	250
3	10x	45	1x	75	250	80	10x	100	100x	70	250	70	250
25	1x	9	.1x	18	25	18	1x	28	10x	20	25	27	25
35	1x	10	.1x	23	50	27	1x	40	100x	25	50	17	50
20	1x	7	.1x	15	25	15	1x	22	10x	18	25	19	25
10	1x	4	.1x	8	25	8	1x	10	10x	10	25	11	25

Table 4-A
Surface Activity Measurements
Railroad Tracks
Kaiser Adjacent Land Remediation

Surface Location		Media	Activity (dpm/100 cm^2)											
			Total						Removable					
			Alpha			Beta			Alpha			Beta		
Charact. Grid	RR Track Location	Type	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA
64	1A	T	50	48	58	588	226	145	-1	0	6	130	106	99
64	4B	T	50	48	58	509	214	145	4	15	6	-32	85	99
64	7C	R	37	43	58	445	205	145	8	22	6	227	117	99
65	11A	R	31	41	58	502	213	145	-1	0	6	97	103	99
65	14B	T	19	34	58	554	221	145	-1	0	6	-6	89	99
65	17C	T	37	43	58	651	234	145	-1	0	6	149	109	99
66	21A	R	43	46	58	554	221	145	4	15	6	162	110	99
66	24B	T	50	48	58	580	225	145	4	15	6	188	113	99
66	27C	R	37	43	58	565	222	145	4	15	6	117	105	99
67	31A	T	19	34	58	520	216	145	8	22	6	58	98	99
67	34B	T	25	38	58	554	221	145	8	22	6	26	94	99
67	37C	R	43	46	58	565	222	145	12	27	6	52	97	99
68	41A	T	12	31	58	457	207	145	4	15	6	117	105	99
68	44B	T	25	38	58	603	228	145	8	22	6	-6	89	99
68	47C	T	37	43	58	565	222	145	-1	0	6	45	96	99
69	51A	T	0	22	58	502	213	145	4	15	6	182	112	99
69	54B	R	25	38	58	475	209	145	8	22	6	240	119	99
69	57C	T	19	34	58	483	211	145	4	15	6	227	117	99
70	61A	R	25	38	58	547	220	145	-1	0	6	234	118	99
70	64B	R	99	65	58	588	226	145	8	22	6	292	124	99
70	67C	T	31	41	58	580	225	145	4	15	6	-13	88	99
71	71A	T	25	38	58	509	214	145	12	27	6	52	97	99
71	74B	T	50	48	58	618	230	145	8	22	6	45	96	99
71	77C	R	105	67	58	775	250	145	4	15	6	58	98	99
72	81A	T	50	48	58	723	244	145	-1	0	6	39	95	99
72	82C	R	25	38	58	535	218	145	8	22	6	52	97	99
72	84B	T	37	43	58	760	248	145	8	22	6	-32	85	99
72	86A	T	12	31	58	595	227	145	4	15	6	117	105	99
72	87C	R	37	43	58	693	240	145	4	15	6	58	98	99
72	89B	T	25	38	58	584	225	145	8	22	6	45	96	99

Table 4-A
Surface Activity Measurements
Railroad Tracks
Kaiser Adjacent Land Remediation

Surface Location			Activity (dpm/100 cm^2)											
			Total						Removable					
			Alpha			Beta			Alpha			Beta		
Charact. Grid	RR Track Location	Media Type	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA
73	91A	R	12	31	58	824	256	145	8	22	6	117	105	99
73	92C	T	19	34	58	221	167	145	4	15	6	-6	89	99
73	94B	R	19	34	58	629	231	145	-1	0	6	299	125	99
73	96B	T	25	38	58	678	238	145	8	22	6	58	98	99
73	97C	T	37	43	58	562	222	145	8	22	6	13	92	99
73	99B	R	19	34	58	674	237	145	12	27	6	19	93	99
74	101A	T	37	43	58	584	225	145	12	27	6	45	96	99
74	102C	T	31	41	58	580	225	145	8	22	6	26	94	99
74	104B	T	37	43	58	636	232	145	4	15	6	26	94	99
74	106A	T	25	38	58	517	215	145	8	22	6	-45	83	99
74	107C	T	43	46	58	741	246	145	8	22	6	84	101	99
74	109B	T	37	43	58	636	232	145	4	15	6	71	99	99
75	111A	R	43	46	58	689	239	145	8	22	6	117	105	99
75	112C	T	19	34	58	591	226	145	8	22	6	188	113	99
75	114B	T	50	48	58	651	234	145	4	15	6	149	109	99
75	116A	T	37	43	58	854	260	145	-1	0	6	143	108	99
75	117C	R	43	46	58	685	239	145	8	22	6	182	112	99
75	119B	T	50	48	58	711	242	145	4	15	6	162	110	99
76	121A	T	99	65	58	633	232	145	12	27	6	169	111	99
76	122C	T	37	43	58	820	256	145	12	27	6	188	113	99
76	124B	R	37	43	58	591	226	145	4	15	6	292	124	99
76	126A	T	12	31	58	883	263	145	-1	0	6	318	127	99
76	127C	T	25	38	58	659	235	145	8	22	6	-13	88	99
76	129B	T	50	48	58	580	225	145	4	15	6	-26	86	99
77	131A	T	99	65	58	726	244	145	8	22	6	-32	85	99
77	132C	R	56	51	58	880	263	145	12	27	6	39	95	99
77	134B	T	43	46	58	640	233	145	-1	0	6	52	97	99
77	136A	R	62	53	58	678	238	145	-1	0	6	45	96	99
77	137C	T	37	43	58	854	260	145	4	15	6	117	105	99
77	139B	T	25	38	58	580	225	145	17	31	6	84	101	99

Table 4-A
Surface Activity Measurements
Railroad Tracks
Kaiser Adjacent Land Remediation

Surface Location			Activity (dpm/100 cm^2)											
			Total						Removable					
			Alpha			Beta			Alpha			Beta		
Charact. Grid	RR Track Location	Media Type	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA
78	141A	R	56	51	58	681	238	145	8	22	6	91	102	99
78	142C	T	68	55	58	760	248	145	4	15	6	-26	86	99
78	144B	T	37	43	58	606	228	145	4	15	6	-13	88	99
78	146A	R	19	34	58	831	257	145	-1	0	6	240	119	99
78	147C	R	50	48	58	749	247	145	4	15	6	39	95	99
78	149B	T	50	48	58	565	222	145	8	22	6	-162	64	99
79	151A	T	6	27	58	745	246	145	25	38	6	39	95	99
79	152C	T	37	43	58	854	260	145	17	31	6	32	94	99
79	154B	T	12	31	58	674	237	145	4	15	6	-26	86	99
79	156A	R	74	57	58	734	245	145	8	22	6	-39	84	99
79	157C	T	87	61	58	883	263	145	8	22	6	162	110	99
79	159B	T	25	38	58	595	227	145	8	22	6	-97	75	99
80	161A	T	99	65	58	955	272	145	4	15	6	227	117	99
80	162C	R	62	53	58	906	266	145	-1	0	6	169	111	99
80	164B	T	31	41	58	1295	309	145	-1	0	6	-13	88	99
80	166A	T	12	31	58	1625	340	145	8	22	6	32	94	99
80	167C	T	50	48	58	940	270	145	8	22	6	156	109	99
80	169B	T	37	43	58	1093	287	145	4	15	6	39	95	99
81	171A	T	50	48	58	839	258	145	-1	0	6	221	117	99
81	172C	R	56	51	58	902	266	145	8	22	6	162	110	99
81	174B	R	50	48	58	1265	305	145	4	15	6	292	124	99
81	176A	T	50	48	58	1194	298	145	4	15	6	234	118	99
81	177C	T	37	43	58	1093	287	145	8	22	6	52	97	99
81	179B	R	43	46	58	880	263	145	8	22	6	156	109	99
82	181A	T	56	51	58	1183	297	145	8	22	6	32	94	99
82	182C	R	87	61	58	865	261	145	4	15	6	-39	84	99
82	184B	T	43	46	58	947	271	145	8	22	6	247	119	99
82	186A	T	50	48	58	1052	283	145	4	15	6	162	110	99
82	187C	R	74	57	58	895	265	145	8	22	6	240	119	99
82	189B	T	37	43	58	857	260	145	4	15	6	26	94	99

Table 4-A
Surface Activity Measurements
Railroad Tracks
Kaiser Adjacent Land Remediation

Surface Location			Activity (dpm/100 cm^2)											
			Total						Removable					
			Alpha			Beta			Alpha			Beta		
Charact. Grid	RR Track Location	Media Type	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA
83	191A	T	19	34	58	1063	284	145	4	15	6	-6	89	99
83	192C	R	37	43	58	651	234	145	4	15	6	-26	86	99
83	194C	T	50	48	58	876	263	145	8	22	6	39	95	99
83	196A	R	12	31	58	752	247	145	12	27	6	91	102	99
83	197C	T	37	43	58	902	266	145	8	22	6	26	94	99
83	199B	R	50	48	58	569	223	145	4	15	6	13	92	99
84	201A	T	62	53	58	943	270	145	8	22	6	110	104	99
84	202C	T	74	57	58	872	262	145	8	22	6	234	118	99
84	204B	T	62	53	58	1104	289	145	4	15	6	84	101	99
84	206A	R	62	53	58	670	237	145	8	22	6	78	100	99
84	207C	R	50	48	58	595	227	145	17	31	6	91	102	99
84	209B	T	25	38	58	917	267	145	8	22	6	104	103	99
85	211A	T	37	43	58	850	259	145	4	15	6	104	103	99
85	212C	R	37	43	58	887	264	145	17	31	6	45	96	99
85	214B	T	105	67	58	1153	294	145	8	22	6	19	93	99
85	216A	T	56	51	58	917	267	145	4	15	6	52	97	99
85	217C	R	19	34	58	775	250	145	4	15	6	26	94	99
85	219B	T	74	57	58	947	271	145	4	15	6	32	94	99
86	221A	T	19	34	58	891	264	145	8	22	6	0	90	99
86	222C	T	37	43	58	958	272	145	12	27	6	0	90	99
86	224B	T	6	27	58	962	273	145	12	27	6	-26	86	99
86	226A	T	37	43	58	1142	293	145	4	15	6	39	95	99
86	227C	T	50	48	58	1022	279	145	4	15	6	45	96	99
86	229B	R	19	34	58	835	258	145	8	22	6	247	119	99
87	231A	R	56	51	58	883	263	145	8	22	6	97	103	99
87	232C	T	25	38	58	895	265	145	8	22	6	-6	89	99
87	234B	T	31	41	58	869	262	145	12	27	6	71	99	99
87	236A	T	37	43	58	648	234	145	4	15	6	65	99	99
87	237C	R	12	31	58	794	253	145	-1	0	6	26	94	99
87	239B	T	50	48	58	711	242	145	8	22	6	19	93	99

Table 4-A
Surface Activity Measurements
Railroad Tracks
Kaiser Adjacent Land Remediation

Surface Location			Activity (dpm/100 cm^2)											
			Total						Removable					
			Alpha			Beta			Alpha			Beta		
Charact. Grid	RR Track Location	Media Type	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA
88	241A	T	81	59	58	749	247	145	8	22	6	39	95	99
88	242C	T	12	31	58	730	245	145	4	15	6	32	94	99
88	244B	T	37	43	58	910	267	145	8	22	6	39	95	99
88	246A	T	50	48	58	779	251	145	8	22	6	19	93	99
88	247C	R	25	38	58	891	264	145	8	22	6	52	97	99
88	249B	T	56	51	58	940	270	145	8	22	6	45	96	99
89	251A	T	50	48	58	580	225	145	8	22	6	58	98	99
89	252C	T	12	31	58	824	256	145	8	22	6	26	94	99
89	254B	R	56	51	58	711	242	145	4	15	6	26	94	99
89	256A	T	50	48	58	666	236	145	4	15	6	26	94	99
89	257C	T	62	53	58	880	263	145	4	15	6	13	92	99
89	259B	T	31	41	58	779	251	145	8	22	6	6	91	99
90	261A	R	19	34	58	839	258	145	12	27	6	110	104	99
90	262C	R	37	43	58	906	266	145	4	15	6	253	120	99
90	264B	T	50	48	58	786	252	145	4	15	6	253	120	99
90	266A	T	25	38	58	869	262	145	4	15	6	208	115	99
90	267C	R	37	43	58	708	242	145	4	15	6	195	114	99
90	269B	T	31	41	58	565	222	145	8	22	6	169	111	99
97	271A	T	50	48	58	584	225	145	8	22	6	208	115	99
97	272C	R	56	51	58	854	260	145	8	22	6	0	90	99
97	274B	R	19	34	58	651	234	145	4	15	6	91	102	99
97	276A	T	25	38	58	584	225	145	8	22	6	78	100	99
97	277C	T	74	57	58	606	228	145	4	15	6	117	105	99
97	279B	R	50	48	58	902	266	145	8	22	6	45	96	99
98	281A	R	25	38	58	854	260	145	8	22	6	58	98	99
98	282C	T	31	41	58	906	266	145	8	22	6	-84	77	99
98	284B	T	37	43	58	1198	298	145	8	22	6	221	117	99
98	286A	T	56	51	58	1007	278	145	4	15	6	292	124	99
98	287C	T	37	43	58	970	273	145	4	15	6	169	111	99
98	289B	T	62	53	58	805	254	145	8	22	6	136	107	99

Table 4-A
Surface Activity Measurements
Railroad Tracks
Kaiser Adjacent Land Remediation

Surface Location			Activity (dpm/100 cm^2)											
			Total						Removable					
			Alpha			Beta			Alpha			Beta		
Charact. Grid	RR Track Location	Media Type	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA
99	291A	R	43	46	58	745	246	145	8	22	6	162	110	99
99	292C	R	74	57	58	749	247	145	4	15	6	-6	89	99
99	294B	T	50	48	58	565	222	145	8	22	6	45	96	99
99	296A	R	12	31	58	771	250	145	12	27	6	234	118	99
99	297C	T	37	43	58	805	254	145	4	15	6	286	123	99
99	299B	T	105	67	58	771	250	145	4	15	6	39	95	99
105	301A	R	50	48	58	846	259	145	4	15	6	19	93	99
105	302C	T	25	38	58	812	255	145	4	15	6	45	96	99
105	304B	T	81	59	58	835	258	145	4	15	6	52	97	99
105	306A	T	56	51	58	902	266	145	4	15	6	26	94	99
105	307C	T	19	34	58	943	270	145	8	22	6	97	103	99
105	309B	T	74	57	58	846	259	145	4	15	6	97	103	99
127	311A	T	50	48	58	565	222	145	4	15	6	45	96	99
127	312C	R	25	38	58	494	212	145	4	15	6	234	118	99
127	314B	T	19	34	58	842	259	145	8	22	6	-6	89	99
127	316A	T	50	48	58	906	266	145	4	15	6	240	119	99
127	317C	T	19	34	58	970	273	145	8	22	6	247	119	99
127	319B	T	25	38	58	846	259	145	8	22	6	110	104	99
135	321A	T	25	38	58	509	214	145	4	15	6	58	98	99
135	322C	R	74	57	58	547	220	145	8	22	6	39	95	99
135	324B	R	50	48	58	445	205	145	4	15	6	117	105	99
135	326A	T	81	59	58	749	247	145	8	22	6	117	105	99
135	327C	R	56	51	58	902	266	145	-1	0	6	45	96	99
135	329B	T	19	34	58	468	208	145	4	15	6	13	92	99
188	331A	T	50	48	58	910	267	145	-1	0	6	52	97	99
188	334B	T	37	43	58	842	259	145	4	15	6	91	102	99
188	337C	R	25	38	58	820	256	145	4	15	6	32	94	99
187	341A	T	31	41	58	771	250	145	4	15	6	-13	88	99
187	344B	R	43	46	58	704	241	145	4	15	6	162	110	99
187	347C	R	43	46	58	730	245	145	4	15	6	130	106	99

Table 4-A
Surface Activity Measurements
Railroad Tracks
Kaiser Adjacent Land Remediation

Surface Location			Activity (dpm/100 cm^2)											
			Total						Removable					
			Alpha			Beta			Alpha			Beta		
Charact. Grid	RR Track Location	Media Type	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA
186	351A	T	37	43	58	928	269	145	8	22	6	6	91	99
186	354B	T	50	48	58	925	268	145	8	22	6	117	105	99
186	357C	R	56	51	58	940	270	145	17	31	6	91	102	99
185	361A	T	37	43	58	943	270	145	4	15	6	32	94	99
185	364B	R	31	41	58	771	250	145	-1	0	6	-26	86	99
185	367C	T	31	41	58	850	259	145	4	15	6	-6	89	99
184	371A	T	31	41	58	887	264	145	8	22	6	45	96	99
184	374B	R	43	46	58	737	245	145	4	15	6	221	117	99
184	377C	R	25	38	58	854	260	145	8	22	6	39	95	99
207	381A	T	37	43	58	913	267	145	4	15	6	-39	84	99
207	384B	R	37	43	58	704	241	145	17	31	6	32	94	99
207	387C	T	43	46	58	895	265	145	8	22	6	110	104	99
206	391A	R	31	41	58	850	259	145	-1	0	6	26	94	99
206	392C	R	31	41	58	891	264	145	4	15	6	58	98	99
206	394B	T	56	51	58	850	259	145	8	22	6	130	106	99
206	396A	R	62	53	58	745	246	145	12	27	6	97	103	99
206	397C	T	62	53	58	812	255	145	-1	0	6	97	103	99
206	399B	T	62	53	58	891	264	145	8	22	6	-32	85	99
205	401A	R	50	48	58	805	254	145	-1	0	6	162	110	99
205	404B	R	31	41	58	846	259	145	12	27	6	26	94	99
205	407C	R	37	43	58	816	255	145	12	27	6	6	91	99
			4.18E+01			7.72E+02			5.91E+00			8.48E+01	Average	
Degrees of Freedom:		200	2.06E+01			1.86E+02			4.20E+00			9.02E+01	Std Deviation	
			0.00E+00			2.21E+02			-8.77E-01			-1.62E+02	Minimum	
			1.05E+02			1.62E+03			2.54E+01			3.18E+02	Maximum	
t value*			3.72E+01			7.75E+02			7.89E+00			5.19E+01	Median	
1.656			4.42E+01			7.94E+02			6.40E+00			9.53E+01	m_s 95%CL	
1.977			4.47E+01			7.98E+02			6.50E+00			9.74E+01	m_s 97.5%CL	

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

(1). Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-B
Surface Activity Measurements
Spillway
Kaiser Adjacent Land Remediation

Surface Location	(2) Media Type	Net Exposure Rate µR/hr	Activity (dpm/100cm^2)											
			Total						Removable					
			Alpha			Beta			Alpha			Beta		
			Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA	Act.	(1) Uncert.	MDA
1	Conc.	351	205	91	58	1782	355	145	4	9	6	-26	86	99
2	Conc.	351	136	75	58	1569	335	145	4	15	6	0	90	99
3	Conc.	380	99	65	58	1610	339	145	-1	0	6	52	97	99
4	Conc.	391	136	75	58	1745	351	145	8	22	6	-13	88	99
5	Conc.	391	174	84	58	1602	338	145	-1	0	6	58	98	99
6	Conc.	411	236	97	58	1655	343	145	-1	0	6	45	96	99
7	Conc.	411	186	87	58	1632	341	145	-1	0	6	45	96	99
8	Conc.	476	149	78	58	1898	365	145	4	15	6	65	99	99
9	Conc.	411	192	88	58	1546	333	145	8	22	6	-39	84	99
10	Conc.	320	167	82	58	1119	290	145	-1	0	6	-26	86	99
		389	1.68E+02			1.62E+03			2.19E+00			1.62E+01	Average	
Degrees of Freedom: 9		43	3.94E+01			2.05E+02			3.61E+00			4.06E+01	Std Deviation	
		320	9.92E+01			1.12E+03			-8.77E-01			-3.90E+01	Minimum	
		476	2.36E+02			1.90E+03			7.89E+00			6.49E+01	Maximum	
t value*		391	1.71E+02			1.62E+03			1.32E+00			2.27E+01	Median	
1.833		414	1.91E+02			1.73E+03			4.29E+00			3.98E+01	μ_α 95%CL	
2.262		420	1.96E+02			1.76E+03			4.78E+00			4.53E+01	μ_α 97.5%CL	

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

(1). Uncertainty represents the 95 percent confidence level, 2σ.

(2). Conc. = Concrete spillway.

Table 4-1
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 1

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
52A	FS	5.32E-01	0.00E+00	1.10E-01	3.88E-01	0.00	2	
52B	CS	1.02E+00	0.00E+00	1.58E-01	4.53E-01	0.00	1	
52C	FS	1.56E+00	4.60E-01	1.31E-01	2.34E-01	0.21	1	
52D	CS	6.19E-01	0.00E+00	9.80E-02	3.33E-01	0.00	-2	
53A	FS	1.16E+00	6.00E-02	1.33E-01	5.21E-01	0.03	4	
53B	CS	5.60E-01	0.00E+00	5.60E-01	5.19E-01	0.00	-1	
53C	FS	6.05E-01	0.00E+00	9.20E-02	2.77E-01	0.00	4	
53D	CS	6.41E-01	0.00E+00	7.20E-02	2.80E-01	0.00	-1	
54A	FS	8.35E-01	0.00E+00	1.00E-01	2.32E-01	0.00	4	
54B	CS	1.18E+00	8.00E-02	1.61E-01	3.61E-01	0.04	-1	
54C	FS	8.17E-01	0.00E+00	9.40E-02	2.24E-01	0.00	4	
54D	CS	9.63E-01	0.00E+00	1.35E-01	3.94E-01	0.00	-1	
55A	FS	7.96E-01	0.00E+00	9.30E-02	1.77E-01	0.00	4	
55B	FS	6.63E-01	0.00E+00	1.08E-01	2.98E-01	0.00	-1	
55C	FS	1.31E+00	2.10E-01	1.54E-01	3.53E-01	0.09	5	
55D	CS	9.30E-01	0.00E+00	8.20E-02	3.25E-01	0.00	1	
57A	FS	1.17E+00	7.00E-02	1.57E-01	4.39E-01	0.03	3	
57B	FS	1.27E+00	1.70E-01	1.38E-01	2.39E-01	0.08	1	
57C	FS	1.38E+00	2.80E-01	1.29E-01	4.01E-01	0.13	1	
57D	FS	9.51E-01	0.00E+00	9.90E-02	1.96E-01	0.00	1	
58A	FS	9.95E-01	0.00E+00	1.37E-01	4.13E-01	0.00	1	
58B	FS	1.28E+00	1.80E-01	8.40E-02	2.39E-01	0.08	1	
58C	FS	1.66E+00	5.60E-01	8.00E-02	1.83E-01	0.25	1	
58D	FS	1.42E+00	3.20E-01	7.00E-02	3.03E-01	0.14	1	
59A	FS	7.26E-01	0.00E+00	1.12E-01	2.44E-01	0.00	1	
59B	FS	6.99E-01	0.00E+00	7.70E-02	3.45E-01	0.00	-1	
59C	CS	6.75E-01	0.00E+00	1.78E-01	3.36E-01	0.00	-2	
59D	CS	8.04E-01	0.00E+00	1.24E-01	3.79E-01	0.00	-2	
60A	FS	9.34E-01	0.00E+00	1.18E-01	3.92E-01	0.00	-2	
60B	FS	8.21E-01	0.00E+00	1.13E-01	4.47E-01	0.00	-2	
60C	FS	5.63E-01	0.00E+00	1.04E-01	3.81E-01	0.00	1	
60D	FS	7.66E-01	0.00E+00	7.00E-02	3.57E-01	0.00	1	
166A	FS	2.03E+00	9.30E-01	6.40E-02	1.40E-01	0.42	1	
166B	FS	1.67E+00	5.70E-01	6.10E-02	1.08E-01	0.26	-2	
166C	CS	9.05E-01	0.00E+00	1.24E-01	3.79E-01	0.00	-2	
166D	CS	7.08E-01	0.00E+00	7.60E-02	2.34E-01	0.00	-2	
Degrees of Freedom:	35	9.89E-01	1.08E-01			0.05	1	Average
		3.65E-01	2.14E-01			0.10	2	Std Deviation
		5.32E-01	0.00E+00			0.00	-2	Minimum
		2.03E+00	9.30E-01			0.42	5	Maximum
t value*		9.18E-01	0.00E+00			0.00	1	Median
1.690		1.09E+00	1.68E-01			0.08	1	μ_α 95%CL
2.031		1.11E+00	1.80E-01			0.08	1	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.
CS = Core sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-2
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 2A

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
33A-1	FS	7.62E-01	0.00E+00	1.17E-01	2.94E-01	0.00	1	
33A-2	FS	3.92E-01	0.00E+00	8.70E-02	3.84E-01	0.00	1	
33B	CS	1.02E+00	0.00E+00	1.19E-01	3.93E-01	0.00	1	
33C-1	FS	8.26E-01	0.00E+00	1.32E-01	2.00E-01	0.00	1	
33C-2	FS	6.21E-01	0.00E+00	1.14E-01	4.10E-01	0.00	1	
33D	CS	8.17E-01	0.00E+00	1.20E-01	3.99E-01	0.00	1	
Degrees of Freedom:	5	7.40E-01	0.00E+00			0.00	1	Average
		2.13E-01	0.00E+00			0.00	0	Std Deviation
		3.92E-01	0.00E+00			0.00	1	Minimum
		1.02E+00	0.00E+00			0.00	1	Maximum
t value*		7.90E-01	0.00E+00			0.00	1	Median
2.015		9.15E-01	0.00E+00			0.00	1	μ_α 95%CL
2.571		9.64E-01	0.00E+00			0.00	1	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.

Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.

FS = Final soil sample.

CS = Core sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.

Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.

The average and standard deviation of unity is calculated for each final survey grid.

Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.

The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.

Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-3
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 2B

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
35A-1	FS	7.13E-01	0.00E+00	1.00E-01	3.46E-01	0.00	6	
35A-2	FS	6.79E-01	0.00E+00	1.12E-01	2.28E-01	0.00	4	
35B	CS	9.13E-01	0.00E+00	1.94E-01	3.84E-01	0.00	6	
35C-1	FS	7.44E-01	0.00E+00	6.90E-02	2.03E-01	0.00	4	
35C-2	FS	5.08E-01	0.00E+00	6.30E-02	2.24E-01	0.00	4	
35D	CS	1.07E+00	0.00E+00	1.85E-01	3.58E-01	0.00	6	
Degrees of Freedom:	5	7.71E-01	0.00E+00			0.00	5	Average
		1.96E-01	0.00E+00			0.00	1	Std Deviation
		5.08E-01	0.00E+00			0.00	4	Minimum
		1.07E+00	0.00E+00			0.00	6	Maximum
t value*		7.29E-01	0.00E+00			0.00	5	Median
2.015		9.32E-01	0.00E+00			0.00	6	μ_α 95%CL
2.571		9.76E-01	0.00E+00			0.00	6	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.

Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.

FS = Final soil sample.

CS = Core sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.

Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.

The average and standard deviation of unity is calculated for each final survey grid.

Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.

The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.

Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-4
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 2C

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
37A	FS	8.07E-01	0.00E+00	7.20E-02	2.59E-01	0.00	6	
37B	CS	8.45E-01	0.00E+00	1.26E-01	4.00E-01	0.00	8	
37C-1	FS	4.18E-01	0.00E+00	1.03E-01	3.44E-01	0.00	9	
37C-2	FS	7.67E-01	0.00E+00	8.90E-02	3.98E-01	0.00	9	
37C-3	FS	5.73E-01	0.00E+00	8.50E-02	2.17E-01	0.00	9	
37D	CS	8.56E-01	0.00E+00	1.29E-01	3.00E-01	0.00	8	
Degrees of Freedom:	5	7.11E-01	0.00E+00			0.00	8	Average
		1.77E-01	0.00E+00			0.00	1	Std Deviation
		4.18E-01	0.00E+00			0.00	6	Minimum
		8.56E-01	0.00E+00			0.00	9	Maximum
t value*		7.87E-01	0.00E+00			0.00	9	Median
2.015		8.56E-01	0.00E+00			0.00	9	μ_α 95%CL
2.571		8.97E-01	0.00E+00			0.00	9	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.
CS = Core sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.

Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.

The average and standard deviation of unity is calculated for each final survey grid.

Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.

The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.

Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-5
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 2D

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
24B	FS	1.05E+00	0.00E+00	1.49E-01	5.61E-01	0.00	2	
24C	FS	1.40E+00	3.00E-01	1.72E-01	4.66E-01	0.14	2	
24E	FS	1.56E+00	4.60E-01	1.93E-01	5.19E-01	0.21	3	
24F	FS	1.40E+00	3.00E-01	2.29E-01	5.69E-01	0.14	1	
24G	FS	1.19E+00	9.00E-02	1.51E-01	5.59E-01	0.04	2	
24H	FS	9.59E-01	0.00E+00	1.92E-01	4.50E-01	0.00	2	
94B	FS	1.10E+00	0.00E+00	1.55E-01	5.04E-01	0.00	1	
124A	FS	1.03E+00	0.00E+00	1.42E-01	4.72E-01	0.00	1	
124B	FS	1.11E+00	1.00E-02	1.87E-01	4.00E-01	0.00	1	
124C	FS	7.75E-01	0.00E+00	1.17E-01	4.89E-01	0.00	1	
124D	FS	1.06E+00	0.00E+00	1.46E-01	4.50E-01	0.00	1	
134A	CS	1.57E+00	4.70E-01	2.25E-01	3.76E-01	0.21	0	
134B	CS	2.48E+00	1.38E+00	2.28E-01	4.06E-01	0.62	0	
134C	CS	8.75E-01	0.00E+00	1.21E-01	4.68E-01	0.00	0	
134D	CS	2.04E+00	9.40E-01	1.85E-01	5.34E-01	0.42	1	
136B	FS	8.64E-01	0.00E+00	1.46E-01	5.64E-01	0.00	2	
179A	FS	6.87E-01	0.00E+00	1.02E-01	4.73E-01	0.00	1	
179B	FS	1.20E+00	1.00E-01	2.17E-01	4.33E-01	0.04	1	
137A	FS	1.11E+00	1.00E-02	1.87E-01	3.65E-01	0.00	1	
137B	FS	1.22E+00	1.20E-01	2.12E-01	3.76E-01	0.05	1	
137C	FS	1.09E+00	0.00E+00	1.62E-01	4.28E-01	0.00	1	
137D	FS	7.35E-01	0.00E+00	9.50E-02	3.98E-01	0.00	1	
Degrees of Freedom:	21	1.20E+00	1.90E-01			0.09	1	Average
		4.22E-01	3.54E-01			0.16	1	Std Deviation
		6.87E-01	0.00E+00			0.00	0	Minimum
		2.48E+00	1.38E+00			0.62	3	Maximum
t value*		1.11E+00	5.00E-03			0.00	1	Median
1.721		1.36E+00	3.20E-01			0.14	1	μ_α 95%CL
2.080		1.39E+00	3.47E-01			0.16	2	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.

Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.

FS = Final soil sample.

CS = Core sample.

Calculations:

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.

Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.

The average and standard deviation of unity is calculated for each final survey grid.

Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.

The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.

Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-6
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 2E

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
47A	CS	7.59E-01	0.00E+00	1.39E-01	4.24E-01	0.00	3	
47B	CS	7.16E-01	0.00E+00	1.30E-01	4.87E-01	0.00	1	
47C-1	FS	4.30E-01	0.00E+00	1.15E-01	3.30E-01	0.00	0	
47C-2	FS	BDL	0.00E+00	BDL	4.83E-01	0.00	0	
47C-3	FS	5.45E-01	0.00E+00	9.30E-02	3.61E-01	0.00	1	
47C-4	FS	4.91E-01	0.00E+00	8.20E-02	2.41E-01	0.00	0	
47D	CS	1.45E+00	3.50E-01	1.51E-01	4.15E-01	0.16	1	
Degrees of Freedom:	6	7.32E-01	5.00E-02			0.02	1	Average
		3.74E-01	1.32E-01			0.06	1	Std Deviation
		4.30E-01	0.00E+00			0.00	0	Minimum
		1.45E+00	3.50E-01			0.16	3	Maximum
t value*		6.31E-01	0.00E+00			0.00	1	Median
1.943		1.01E+00	1.47E-01			0.07	2	μ_α 95%CL
2.447		1.08E+00	1.72E-01			0.08	2	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.

Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.

CS = Core sample.

FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.

Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.

The average and standard deviation of unity is calculated for each final survey grid.

Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.

The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.

Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-7
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 2F

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)
39A	FS	9.47E-01	0.00E+00	1.24E-01	3.70E-01	0.00	8
39B	FS	1.19E+00	9.00E-02	1.61E-01	3.91E-01	0.04	8
39C	FS	1.06E+00	0.00E+00	1.44E-01	3.97E-01	0.00	6
39D	FS	1.19E+00	9.00E-02	1.40E-01	4.77E-01	0.04	9
40A	FS	7.41E-01	0.00E+00	1.05E-01	4.57E-01	0.00	8
40B	FS	8.27E-01	0.00E+00	9.20E-02	2.77E-01	0.00	8
40C	FS	7.94E-01	0.00E+00	1.21E+00	4.23E+00	0.00	8
40D	FS	9.28E-01	0.00E+00	1.54E-01	5.28E-01	0.00	7
40E	FS	8.23E-01	0.00E+00	1.00E-01	3.78E-01	0.00	7
40F	FS	1.37E+00	2.70E-01	1.47E-01	3.78E-01	0.12	8
40G	FS	1.35E+00	2.50E-01	1.90E-01	5.30E-01	0.11	6
40H	FS	9.98E-01	0.00E+00	1.08E-01	4.57E-01	0.00	10
41A	FS	3.04E+00	1.94E+00	1.49E-01	3.99E-01	0.87	6
41B	FS	7.10E-01	0.00E+00	1.15E-01	4.55E-01	0.00	6
41C	FS	7.91E-01	0.00E+00	1.28E-01	5.14E-01	0.00	8
41D	FS	9.86E-01	0.00E+00	8.60E-02	3.11E-01	0.00	6
41E	FS	1.37E+00	2.70E-01	1.34E-01	4.11E-01	0.12	7
41F	FS	2.76E+00	1.66E+00	2.03E-01	4.74E-01	0.75	7
41G	FS	7.78E-01	0.00E+00	1.01E-01	3.73E-01	0.00	6
41H	FS	8.85E-01	0.00E+00	1.54E-01	5.06E-01	0.00	6
41I	FS	6.89E-01	0.00E+00	1.35E-01	4.54E-01	0.00	7
42A	FS	8.58E-01	0.00E+00	1.20E-01	4.83E-01	0.00	6
42B	FS	7.76E-01	0.00E+00	1.65E-01	4.51E-01	0.00	8
42C	FS	1.01E+00	0.00E+00	1.42E-01	4.72E-01	0.00	8
42D	FS	1.09E+00	0.00E+00	1.33E-01	4.47E-01	0.00	9
43A	FS	1.02E+00	0.00E+00	1.30E-01	2.91E-01	0.00	7
43B	CS	8.98E-01	0.00E+00	1.25E-01	3.51E-01	0.00	6
43C	FS	1.12E+00	2.00E-02	1.31E-01	4.22E-01	0.01	6
43D	FS	9.83E-01	0.00E+00	2.08E-01	3.98E-01	0.00	6
63A	FS	9.22E-01	0.00E+00	1.25E-01	5.06E-01	0.00	7
63B	FS	9.18E-01	0.00E+00	1.59E-01	3.40E-01	0.00	7
63C	CS	9.42E-01	0.00E+00	9.50E-02	3.04E-01	0.00	7
63D	CS	1.08E+00	0.00E+00	1.15E-01	4.09E-01	0.00	7
44A	FS	1.87E+00	7.70E-01	1.75E-01	4.42E-01	0.35	6
44B	FS	1.18E+00	8.00E-02	9.80E-02	2.90E-01	0.04	6
44C	FS	2.30E+00	1.20E+00	1.82E-01	3.56E-01	0.54	4
44D	FS	9.76E-01	0.00E+00	1.20E-01	4.72E-01	0.00	5
44E	FS	8.96E-01	0.00E+00	9.20E-02	3.09E-01	0.00	5
44F	FS	1.18E+00	8.00E-02	1.28E-01	3.68E-01	0.04	4
44M	FS	1.31E+00	2.10E-01	1.43E-01	4.46E-01	0.09	6
44G	FS	8.03E-01	0.00E+00	1.44E-01	4.58E-01	0.00	6
44H	FS	9.44E-01	0.00E+00	1.18E-01	3.95E-01	0.00	6
44I	FS	1.14E+00	4.00E-02	1.29E-01	3.49E-01	0.02	5
44J	FS	1.11E+00	1.00E-02	1.68E-01	4.46E-01	0.00	5
44K	FS	8.91E-01	0.00E+00	9.70E-02	3.03E-01	0.00	5
44L	FS	1.18E+00	8.00E-02	1.33E-01	3.80E-01	0.04	5

Table 4-7
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 2F

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
45A	FS	1.03E+00	0.00E+00	1.58E-01	5.69E-01	0.00	4	
45B	FS	1.06E+00	0.00E+00	1.99E-01	5.06E-01	0.00	4	
45C	FS	2.00E+00	9.00E-01	1.84E-01	4.60E-01	0.41	4	
45D	FS	1.32E+00	2.20E-01	1.62E-01	5.54E-01	0.10	3	
45E	FS	1.00E+00	0.00E+00	1.85E-01	3.88E-01	0.00	3	
45F	FS	2.19E+00	1.09E+00	1.50E-01	4.86E-01	0.49	3	
45G	FS	1.06E+00	0.00E+00	8.30E-02	2.58E-01	0.00	2	
45H	FS	6.27E+00	5.17E+00	2.73E-01	3.37E-01	2.33	2	
46A-1	CS	5.56E+00	4.46E+00	2.82E-01	3.99E-01	2.01	4	
46A-2	CS	1.25E+00	1.50E-01	1.62E-01	3.64E-01	0.07	4	
46C	CS	1.23E+00	1.30E-01	1.14E-01	4.16E-01	0.06	2	
Wgt. Avg. Final Survey Grid 45:		2.26E+00	1.18E+00			0.53		
Degrees of Freedom:	57	1.34E+00	3.51E-01			0.16	6	Average
		1.00E+00	9.53E-01			0.43	2	Std Deviation
		6.89E-01	0.00E+00			0.00	2	Minimum
		6.27E+00	5.17E+00			2.33	10	Maximum
t value*		1.05E+00	0.00E+00			0.00	6	Median
1.673		1.56E+00	5.60E-01			0.25	6	μ_α 95%CL
2.003		1.61E+00	6.02E-01			0.27	6	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.

Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.

FS = Final soil sample.

CS = Core sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.

Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.

The average and standard deviation of unity is calculated for each final survey grid.

Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.

The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.

Weighted Average = ($20m^2/100m^2$) x elevated measurement + ($80m^2/100m^2$) x average of unelevated measurements

FS Grid 2F-9 contained an elevated area of 20m2 with Th-232 activity concentration = 5.92 pCi/g.

Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-8
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 3

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
20C	FS	1.45E+00	3.50E-01	1.37E-01	0.43	0.16	2	
21A	FS	1.23E+00	1.30E-01	1.15E-01	0.40	0.06	2	
21B	FS	1.05E+00	0.00E+00	9.00E-02	0.34	0.00	2	
22A	FS	1.23E+00	1.30E-01	1.50E-01	0.60	0.06	1	
22B	FS	1.06E+00	0.00E+00	1.90E-01	0.45	0.00	2	
22C	FS	1.16E+00	6.00E-02	2.06E-01	0.32	0.03	1	
22D	FS	8.86E-01	0.00E+00	1.17E-01	0.41	0.00	2	
23A	FS	8.22E-01	0.00E+00	1.24E-01	0.34	0.00	1	
23B	FS	9.19E-01	0.00E+00	1.75E-01	0.64	0.00	1	
23C	FS	8.15E-01	0.00E+00	1.34E-01	0.52	0.00	1	
23D	FS	8.97E-01	0.00E+00	1.15E-01	0.29	0.00	2	
23E	FS	1.21E+00	1.10E-01	1.89E-01	0.48	0.05	1	
23F	FS	7.51E-01	0.00E+00	2.01E-01	0.52	0.00	1	
24A	FS	9.45E-01	0.00E+00	1.63E-01	0.43	0.00	2	
24D	FS	8.33E-01	0.00E+00	1.72E-01	0.45	0.00	1	
93B	FS	8.18E-01	0.00E+00	1.26E-01	0.52	0.00	1	
94A	FS	1.39E+00	2.90E-01	2.18E-01	0.46	0.13	2	
Degrees of Freedom:	16	1.03E+00	6.29E-02			0.03	1	Average
		2.16E-01	1.09E-01			0.05	1	Std Deviation
		7.51E-01	0.00E+00			0.00	1	Minimum
		1.45E+00	3.50E-01			0.16	2	Maximum
t value*		9.45E-01	0.00E+00			0.00	1	Median
1.746		1.12E+00	1.09E-01			0.05	2	μ_α 95%CL
2.120		1.14E+00	1.19E-01			0.05	2	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-9
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 4A

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
29A	FS	9.87E-01	0.00E+00	1.38E-01	3.35E-01	0.00	1	
29B	FS	1.06E+00	0.00E+00	6.50E-02	2.36E-01	0.00	1	
28A	FS	9.58E-01	0.00E+00	1.09E-01	2.98E-01	0.00	1	
28B	FS	1.33E+00	2.30E-01	9.10E-02	2.41E-01	0.10	1	
Degrees of Freedom:	3	1.08E+00	5.75E-02			0.03	1	Average
		1.70E-01	1.15E-01			0.05	0	Std Deviation
		9.58E-01	0.00E+00			0.00	1	Minimum
		1.33E+00	2.30E-01			0.10	1	Maximum
t value*		1.02E+00	0.00E+00			0.00	1	Median
2.353		1.28E+00	1.93E-01			0.09	1	μ_α 95%CL
3.182		1.35E+00	2.40E-01			0.11	1	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-10
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 4B

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
26A	FS	1.29E+00	1.90E-01	8.50E-02	2.79E-01	0.09	1	
26B	FS	1.18E+00	8.00E-02	1.52E-01	3.76E-01	0.04	1	
25A	FS	1.05E+00	0.00E+00	1.12E-01	4.53E-01	0.00	1	
25B	FS	1.28E+00	1.80E-01	1.95E-01	3.61E-01	0.08	1	
Degrees of Freedom:	3	1.20E+00	1.13E-01			0.05	1	Average
		1.12E-01	9.00E-02			0.04	0	Std Deviation
		1.05E+00	0.00E+00			0.00	1	Minimum
		1.29E+00	1.90E-01			0.09	1	Maximum
t value*		1.23E+00	1.30E-01			0.06	1	Median
2.353		1.33E+00	2.18E-01			0.10	1	μ_α 95%CL
3.182		1.38E+00	2.56E-01			0.12	1	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.

Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.

FS = Final soil sample.

Th-230 is calculated using the measured ratio of 3.5 to 1 of Th-230 to Th-232. Therefore, Th-230 = Th 232 * 3.5.

Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.

The average and standard deviation of net exposure rate is calculated for each grid.

Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.

The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.

Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-11
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 4C

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
1A	FS	1.43E+00	3.30E-01	2.12E-01	4.76E-01	0.15	1	
1B	FS	1.12E+00	2.00E-02	1.58E-01	4.95E-01	0.01	1	
2A	FS	1.10E+00	0.00E+00	1.43E-01	2.64E-01	0.00	1	
2B	FS	9.41E-01	0.00E+00	1.16E-01	3.73E-01	0.00	1	
3A	FS	1.31E+00	2.10E-01	1.76E-01	3.50E-01	0.09	1	
3B	FS	8.71E-01	0.00E+00	1.39E-01	3.12E-01	0.00	1	
4A	FS	1.04E+00	0.00E+00	1.41E-01	4.08E-01	0.00	1	
4B	FS	1.13E+00	3.00E-02	1.73E-01	3.91E-01	0.01	1	
Degrees of Freedom:	7	1.12E+00	7.38E-02			0.03	1	Average
		1.82E-01	1.26E-01			0.06	0	Std Deviation
		8.71E-01	0.00E+00			0.00	1	Minimum
		1.43E+00	3.30E-01			0.15	1	Maximum
t value*		1.11E+00	1.00E-02			0.00	1	Median
1.895		1.24E+00	1.58E-01			0.07	1	μ_α 95%CL
2.365		1.27E+00	1.79E-01			0.08	1	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-12
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 4D

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (mR/hr)	
5A	FS	8.37E-01	0.00E+00	1.28E-01	5.24E-01	0.00	21	
5B	FS	8.33E-01	0.00E+00	1.35E-01	5.04E-01	0.00	21	
6A	FS	9.58E-01	0.00E+00	1.98E-01	3.56E-01	0.00	21	
6B	FS	9.94E-01	0.00E+00	1.20E-01	3.20E-01	0.00	17	
7A	FS	9.36E-01	0.00E+00	1.66E-01	5.55E-01	0.00	11	
7B	FS	1.21E+00	1.10E-01	1.65E-01	2.98E-01	0.05	11	
8A	FS	1.06E+00	0.00E+00	3.28E-01	3.28E-01	0.00	11	
8B	FS	2.96E+00	1.86E+00	5.57E-01	5.57E-01	0.84	11	
9A	FS	1.45E+00	3.50E-01	1.44E-01	4.79E-01	0.16	11	
9B	FS	1.38E+00	2.80E-01	1.88E-01	4.04E-01	0.13	11	
10A	FS	1.42E+00	3.20E-01	1.38E-01	4.47E-01	0.14	15	
10B	FS	1.67E+00	5.70E-01	1.58E-01	4.93E-01	0.26	15	
11A	FS	9.65E-01	0.00E+00	1.03E-01	2.68E-01	0.00	15	
11B	FS	1.04E+00	0.00E+00	2.14E-01	4.10E-01	0.00	15	
12A	FS	1.12E+00	2.00E-02	2.11E-01	3.51E-01	0.01	15	
12B	FS	1.04E+00	0.00E+00	1.82E-01	3.76E-01	0.00	15	
13A	FS	9.87E-01	0.00E+00	1.74E-01	3.72E-01	0.00	15	
13B	FS	1.27E+00	1.70E-01	1.27E-01	4.55E-01	0.08	15	
14A	FS	1.75E+00	6.50E-01	1.50E-01	3.68E-01	0.29	15	
14B	FS	8.43E-01	0.00E+00	1.10E-01	4.33E-01	0.00	11	
15A	FS	7.72E-01	0.00E+00	7.60E-02	2.45E-01	0.00	11	
15B	FS	8.53E-01	0.00E+00	9.80E-02	3.46E-01	0.00	11	
16A	FS	6.14E-01	0.00E+00	1.10E-01	5.03E-01	0.00	11	
16B	FS	8.50E-01	0.00E+00	1.10E-01	4.18E-01	0.00	11	
17A	FS	1.29E+00	1.90E-01	1.89E-01	3.85E-01	0.09	9	
17B	FS	1.09E+00	0.00E+00	1.86E-01	3.75E-01	0.00	7	
18A	FS	7.31E-01	0.00E+00	1.87E-01	4.79E-01	0.00	4	
18B	FS	7.12E-01	0.00E+00	1.02E-01	3.83E-01	0.00	1	
Degrees of Freedom:	27	1.13E+00	1.61E-01			0.07	13	Average
		4.56E-01	3.78E-01			0.17	5	Std Deviation
		6.14E-01	0.00E+00			0.00	1	Minimum
		2.96E+00	1.86E+00			0.84	21	Maximum
t value*		1.02E+00	0.00E+00			0.00	11	Median
1.703		1.28E+00	2.83E-01			0.13	14	m_a 95%CL
2.052		1.31E+00	3.08E-01			0.14	15	m_a 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and m_a (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-13
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 4E

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
19A	FS	1.21E+00	1.10E-01	2.25E-01	4.94E-01	0.05	2	
19B	FS	1.15E+00	5.00E-02	1.44E-01	4.64E-01	0.02	2	
19C	FS	6.16E-01	0.00E+00	1.42E-01	4.66E-01	0.00	2	
19D	FS	1.02E+00	0.00E+00	1.68E-01	4.07E-01	0.00	3	
20A	FS	9.93E-01	0.00E+00	1.47E-01	3.85E-01	0.00	2	
20B	FS	7.51E-01	0.00E+00	1.07E-01	4.04E-01	0.00	1	
20E	FS	9.40E-01	0.00E+00	1.84E-01	5.74E-01	0.00	2	
20D	FS	9.40E-01	0.00E+00	1.28E-01	4.36E-01	0.00	1	
20F	FS	8.98E-01	0.00E+00	1.79E-01	4.68E-01	0.00	1	
21C	FS	9.33E-01	0.00E+00	9.40E-02	2.80E-01	0.00	2	
21D	FS	1.52E+00	4.20E-01	2.27E-01	4.64E-01	0.19	2	
90C	CS	8.80E-01	0.00E+00	1.39E-01	5.18E-01	0.00	2	
91A	FS	1.08E+00	0.00E+00	1.52E-01	5.03E-01	0.00	2	
91B	FS	7.51E-01	0.00E+00	1.31E-01	4.21E-01	0.00	1	
92A	FS	9.23E-01	0.00E+00	1.52E-01	3.19E-01	0.00	1	
92B	FS	6.65E-01	0.00E+00	1.11E-01	4.41E-01	0.00	1	
92D	FS	8.15E-01	0.00E+00	1.18E-01	4.09E-01	0.00	1	
93A	FS	7.47E-01	0.00E+00	7.40E-02	3.22E-01	0.00	1	
93C	FS	8.99E-01	0.00E+00	1.93E-01	5.00E-01	0.00	2	
93D	FS	7.76E-01	0.00E+00	1.08E-01	3.24E-01	0.00	1	
94C	FS	1.16E+00	6.00E-02	1.94E-01	4.31E-01	0.03	1	
94D	FS	1.21E+00	1.10E-01	1.62E-01	4.79E-01	0.05	0	
100A	FS	9.90E-01	0.00E+00	1.12E-01	3.09E-01	0.00	1	
100B	FS	1.15E+00	5.00E-02	1.89E-01	3.36E-01	0.02	1	
133A	FS	1.30E+00	2.00E-01	1.90E-01	3.60E-01	0.09	1	
133B	FS	1.03E+00	0.00E+00	1.23E-01	4.15E-01	0.00	1	
133D	FS	8.63E-01	0.00E+00	1.35E-01	3.00E-01	0.00	1	
136A	FS	9.16E-01	0.00E+00	1.56E-01	4.47E-01	0.00	1	
136C	FS	8.91E-01	0.00E+00	1.27E-01	4.54E-01	0.00	1	
136D	FS	9.06E-01	0.00E+00	1.37E-01	4.69E-01	0.00	2	
179C	CS	2.51E+00	1.41E+00	1.87E-01	5.10E-01	0.63	1	
179D	CS	2.40E+00	1.30E+00	2.10E-01	3.59E-01	0.59	0	
Degrees of Freedom:	31	1.06E+00	1.16E-01			0.05	1	Average
		4.13E-01	3.36E-01			0.15	1	Std Deviation
		6.16E-01	0.00E+00			0.00	0	Minimum
		2.51E+00	1.41E+00			0.63	3	Maximum
t value*		9.37E-01	0.00E+00			0.00	1	Median
1.70		1.18E+00	2.17E-01			0.10	2	μ_α 95%CL
2.04		1.21E+00	2.37E-01			0.11	2	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.
CS = Core sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-14
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 4F

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
152A	FS	2.22E+00	1.12E+00	1.71E-01	4.88E-01	0.50	0	
152B	FS	8.88E-01	0.00E+00	1.33E-01	4.69E-01	0.00	-1	
152C	FS	1.32E+00	2.20E-01	2.00E-01	5.08E-01	0.10	-1	
152D	FS	1.01E+00	0.00E+00	1.00E-01	4.51E-01	0.00	0	
Degrees of Freedom:	3	1.36E+00	3.35E-01			0.15	-1	Average
		6.02E-01	5.34E-01			0.24	1	Std Deviation
		8.88E-01	0.00E+00			0.00	-1	Minimum
		2.22E+00	1.12E+00			0.50	0	Maximum
t value*		1.17E+00	1.10E-01			0.05	-1	Median
2.353		2.07E+00	9.63E-01			0.43	0	μ_α 95%CL
3.182		2.32E+00	1.18E+00			0.53	0	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.

Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.

FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.

Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.

The average and standard deviation of unity is calculated for each final survey grid.

Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.

The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.

Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-15
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 4G

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
120C	FS	1.41E+00	3.10E-01	1.72E-01	4.54E-01	0.14	-1	
120D	FS	1.11E+00	1.00E-02	1.70E-01	4.14E-01	0.00	-2	
121C	FS	1.02E+00	0.00E+00	1.18E-01	4.42E-01	0.00	-1	
121D	FS	1.00E+00	0.00E+00	9.10E-02	2.39E-01	0.00	-1	
116C	FS	1.06E+00	0.00E+00	1.37E-01	3.96E-01	0.00	0	
116D	FS	1.29E+00	1.90E-01	1.44E-01	3.97E-01	0.09	0	
117C	FS	1.23E+00	1.30E-01	1.58E-01	5.22E-01	0.06	-1	
117D	FS	1.24E+00	1.40E-01	1.42E-01	5.21E-01	0.06	-1	
118C	FS	8.94E-01	0.00E+00	1.16E-01	3.58E-01	0.00	0	
118D	FS	9.76E-01	0.00E+00	1.47E-01	5.28E-01	0.00	-1	
119C	FS	1.12E+00	2.00E-02	1.51E-01	4.68E-01	0.01	-2	
119D	FS	9.95E-01	0.00E+00	1.18E-01	3.53E-01	0.00	-1	
154A	FS	9.36E-01	0.00E+00	1.13E-01	3.76E-01	0.00	0	
154B	FS	1.12E+00	2.00E-02	1.48E-01	3.99E-01	0.01	-1	
154C	FS	1.36E+00	2.60E-01	3.00E-01	6.70E-01	0.12	-1	
154D	FS	7.00E-01	0.00E+00	1.32E-01	4.96E-01	0.00	0	
155A	FS	9.03E-01	0.00E+00	2.21E-01	5.78E-01	0.00	0	
155B	FS	9.31E-01	0.00E+00	1.23E-01	2.95E-01	0.00	0	
155C	FS	6.68E-01	0.00E+00	1.03E-01	4.05E-01	0.00	0	
155D	FS	1.01E+00	0.00E+00	1.35E-01	3.71E-01	0.00	-1	
156A	FS	1.15E+00	5.00E-02	1.53E-01	6.58E-01	0.02	-2	
156B	FS	1.17E+00	7.00E-02	1.92E-01	4.17E-01	0.03	-1	
156C	FS	7.88E-01	0.00E+00	1.46E-01	5.60E-01	0.00	0	
156D	FS	9.68E-01	0.00E+00	1.50E-01	4.46E-01	0.00	0	
122C	FS	1.13E+00	3.00E-02	1.50E-01	5.63E-01	0.01	-1	
122D	FS	1.19E+00	9.00E-02	2.18E-01	5.49E-01	0.04	-1	
123C	FS	1.06E+00	0.00E+00	1.27E-01	4.40E-01	0.00	-1	
123D	FS	9.96E-01	0.00E+00	1.23E-01	3.89E-01	0.00	-1	
Degrees of Freedom:	27	1.05E+00	4.71E-02			0.02	-1	Average
		1.77E-01	8.42E-02			0.04	1	Std Deviation
		6.68E-01	0.00E+00			0.00	-2	Minimum
		1.41E+00	3.10E-01			0.14	0	Maximum
t value*		1.04E+00	0.00E+00			0.00	-1	Median
1.703		1.11E+00	7.42E-02			0.03	-1	μ_α 95%CL
2.052		1.12E+00	7.98E-02			0.04	0	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-16
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 4H

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
129C	FS	9.59E-01	0.00E+00	1.39E-01	2.97E-01	0.00	2	
129D	FS	9.51E-01	0.00E+00	1.30E-01	4.13E-01	0.00	6	
130C	FS	1.09E+00	0.00E+00	1.48E-01	4.64E-01	0.00	6	
130D	FS	1.05E+00	0.00E+00	1.03E-01	3.53E-01	0.00	2	
131C	FS	9.53E-01	0.00E+00	1.53E-01	2.88E-01	0.00	1	
131D	FS	9.31E-01	0.00E+00	9.90E-02	2.78E-01	0.00	1	
132C	FS	9.53E-01	0.00E+00	6.20E-02	2.80E-01	0.00	1	
132D	FS	6.68E-01	0.00E+00	1.15E-01	3.81E-01	0.00	1	
Degrees of Freedom:	7	9.44E-01	0.00E+00			0.00	3	Average
		1.25E-01	0.00E+00			0.00	2	Std Deviation
		6.68E-01	0.00E+00			0.00	1	Minimum
		1.09E+00	0.00E+00			0.00	6	Maximum
t value*		9.53E-01	0.00E+00			0.00	2	Median
1.895		1.03E+00	0.00E+00			0.00	4	μ_α 95%CL
2.365		1.05E+00	0.00E+00			0.00	4	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-17
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 4I

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
95C	FS	8.30E-01	0.00E+00	9.30E-02	3.47E-01	0.00	1	
95D	FS	1.14E+00	4.00E-02	1.22E-01	2.38E-01	0.02	1	
96E	FS	1.20E+00	1.00E-01	1.32E-01	5.11E-01	0.04	2	
96F	FS	1.42E+00	3.20E-01	2.11E-01	4.47E-01	0.14	1	
96G	FS	9.32E-01	0.00E+00	1.34E-01	4.50E-01	0.00	1	
101A	FS	1.30E+00	2.00E-01	1.84E-01	2.68E-01	0.09	1	
101B	FS	8.29E-01	0.00E+00	1.22E-01	1.88E-01	0.00	1	
101C	FS	1.07E+00	0.00E+00	1.31E-01	4.09E-01	0.00	2	
101D	FS	1.06E+00	0.00E+00	1.76E-01	4.60E-01	0.00	1	
101E	FS	9.41E-01	0.00E+00	1.37E-01	4.32E-01	0.00	1	
101F	FS	1.60E+00	5.00E-01	1.56E-01	3.93E-01	0.23	1	
101G	FS	1.50E+00	4.00E-01	1.95E-01	4.23E-01	0.18	0	
101H	FS	1.05E+00	0.00E+00	1.79E-01	5.01E-01	0.00	1	
101I	FS	8.40E-01	0.00E+00	1.47E-01	5.16E-01	0.00	2	
101J	FS	1.46E+00	3.60E-01	2.08E-01	4.70E-01	0.16	1	
102A	FS	1.02E+00	0.00E+00	1.54E-01	4.37E-01	0.00	1	
102B	FS	7.46E-01	0.00E+00	2.33E-01	4.83E-01	0.00	2	
102C	FS	1.21E+00	1.10E-01	1.20E-01	2.95E-01	0.05	1	
102D	FS	1.31E+00	2.10E-01	1.55E-01	4.13E-01	0.09	1	
103C	FS	1.12E+00	2.00E-02	2.81E-01	3.33E-01	0.01	2	
103D	FS	4.42E-01	0.00E+00	1.36E-01	5.56E-01	0.00	1	
104C	FS	1.83E+00	7.30E-01	1.97E-01	2.75E-01	0.33	2	
Degrees of Freedom:	21	1.13E+00	1.36E-01			0.06	1	Average
		3.16E-01	2.04E-01			0.09	1	Std Deviation
		4.42E-01	0.00E+00			0.00	0	Minimum
		1.83E+00	7.30E-01			0.33	2	Maximum
t value*		1.10E+00	1.00E-02			0.00	1	Median
1.721		1.25E+00	2.11E-01			0.09	1	μ_α 95%CL
2.08		1.27E+00	2.27E-01			0.10	1	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.

Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.

The average and standard deviation of unity is calculated for each final survey grid.

Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-18
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 4J

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (mR/hr)	
150A	FS	8.29E-01	0.00E+00	2.73E-01	5.35E-01	0.00	-2	
150B	FS	9.48E-01	0.00E+00	1.29E-01	3.89E-01	0.00	-2	
150C	FS	1.02E+00	0.00E+00	2.42E-01	5.18E-01	0.00	-2	
150D	FS	3.73E-01	0.00E+00	1.00E-01	3.02E-01	0.00	-2	
Degrees of Freedom:	3	7.93E-01	0.00E+00			0.00	-2	Average
		2.91E-01	0.00E+00			0.00	0	Std Deviation
		3.73E-01	0.00E+00			0.00	-2	Minimum
		1.02E+00	0.00E+00			0.00	-2	Maximum
t value*		8.89E-01	0.00E+00			0.00	-2	Median
2.353		1.13E+00	0.00E+00			0.00	-2	μ_α 95%CL
3.182		1.25E+00	0.00E+00			0.00	-2	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-19
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 4K

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
111C	FS	8.62E-01	0.00E+00	9.40E-02	3.67E-01	0.00	-1	
111D	FS	1.47E+00	3.70E-01	2.66E-01	5.36E-01	0.17	-2	
Degrees of Freedom:	1	1.17E+00	1.85E-01			0.08	-2	Average
		4.30E-01	2.62E-01			0.12	1	Std Deviation
		8.62E-01	0.00E+00			0.00	-2	Minimum
		1.47E+00	3.70E-01			0.17	-1	Maximum
t value*		1.17E+00	1.85E-01			0.08	-2	Median
6.314		3.09E+00	1.35E+00			0.61	2	μ_α 95%CL
12.706		5.03E+00	2.54E+00			1.14	5	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-20
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 4L

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
192C	FS	6.64E-01	0.00E+00	1.03E-01	3.85E-01	0.00	-1	
192D	FS	1.56E+00	4.59E-01	2.20E-01	5.18E-01	0.21	1	
193C	FS	1.44E+00	3.40E-01	2.39E-01	4.82E-01	0.15	1	
193D	FS	1.73E+00	6.30E-01	1.83E-01	6.06E-01	0.28	1	
193E	FS	1.45E+00	3.47E-01	1.24E-01	3.64E-01	0.27	0	
193F	FS	1.20E+00	1.02E-01	2.11E-01	4.60E-01	0.16	1	
193G	FS	1.46E+00	3.56E-01	1.42E-01	4.26E-01	0.27	0	
193H	FS	1.22E+00	1.21E-01	1.24E-01	2.96E-01	0.16	-1	
106D	FS	1.18E+00	8.10E-02	2.54E-01	5.55E-01	0.04	1	
106E	FS	1.28E+00	1.81E-01	1.58E-01	5.80E-01	0.08	0	
106F	FS	7.90E-01	0.00E+00	1.18E-01	3.21E-01	0.00	0	
198A	FS	1.53E+00	4.30E-01	1.64E-01	5.50E-01	0.19	1	
198B	FS	1.84E+00	7.40E-01	1.39E-01	4.20E-01	0.33	2	
198C	FS	3.76E+00	2.66E+00	2.38E-01	3.41E-01	1.20	3	
198D	FS	3.09E+00	1.99E+00	1.87E-01	3.85E-01	0.90	4	
Wgt. Avg of Grid 198:		2.48E+00	1.38E+00			0.62		
Degrees of Freedom:	15	1.67E+00	6.13E-01			0.30	1	Average
		8.10E-01	7.61E-01			0.33	1	Std Deviation
		6.64E-01	0.00E+00			0.00	-1	Minimum
		3.76E+00	2.66E+00			1.20	4	Maximum
t value*		1.45E+00	3.52E-01			0.20	1	Median
1.753		2.02E+00	9.47E-01			0.45	1	μ_α 95%CL
2.131		2.10E+00	1.02E+00			0.48	2	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-21
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 4M

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
209C	CS	1.16E+00	6.00E-02	2.14E+00	4.56E-01	0.03	1	
290D	FS	1.97E+00	8.67E-01	2.56E-01	5.42E-01	0.39	1	
210C	FS	7.79E-01	0.00E+00	1.24E-01	5.01E-01	0.00	0	
210D	FS	2.34E+00	1.24E+00	2.72E-01	6.62E-01	0.56	2	
210E	FS	9.51E-01	0.00E+00	1.37E-01	4.64E-01	0.00	1	
189C	FS	7.76E-01	0.00E+00	1.21E-01	2.93E-01	0.00	1	
189D	FS	9.88E-01	0.00E+00	1.43E-01	4.47E-01	0.00	1	
216A	FS	8.48E-01	0.00E+00	1.29E-01	4.36E-01	0.00	-1	
216B	FS	8.11E-01	0.00E+00	9.80E-02	2.22E-01	0.00	-1	
216C	FS	9.55E-01	0.00E+00	1.44E-01	5.38E-01	0.00	-1	
216D	FS	1.11E+00	1.40E-02	1.25E-01	4.68E-01	0.01	-1	
216E	FS	7.14E-01	0.00E+00	1.19E-01	4.32E-01	0.00	-1	
216F	FS	4.84E-01	0.00E+00	1.07E-01	3.97E-01	0.00	-1	
215A	FS	1.21E+00	1.10E-01	1.28E-01	4.94E-01	0.05	0	
215B	FS	1.04E+00	0.00E+00	1.48E-01	4.41E-01	0.00	-1	
215C	FS	1.38E+00	2.83E-01	1.32E-01	4.20E-01	0.13	0	
215D	FS	1.05E+00	0.00E+00	1.40E-01	3.54E-01	0.00	-1	
215E	FS	1.66E+00	5.63E-01	1.84E-01	5.60E-01	0.25	0	
213A	FS	1.08E+00	0.00E+00	1.28E-01	4.51E-01	0.00	-1	
213B	FS	5.13E-01	0.00E+00	9.40E-02	3.09E-01	0.00	0	
213C	CS	1.14E+00	4.00E-02	1.37E-01	3.92E-01	0.02	1	
213D	CS	7.52E-01	0.00E+00	1.76E-01	4.24E-01	0.00	1	
Degrees of Freedom:	21	1.08E+00	1.44E-01			0.07	0	Average
		4.42E-01	3.27E-01			0.15	1	Std Deviation
		4.84E-01	0.00E+00			0.00	-1	Minimum
		2.34E+00	1.24E+00			0.56	2	Maximum
t value*		1.01E+00	0.00E+00			0.00	0	Median
1.721		1.24E+00	2.64E-01			0.12	0	μ_α 95%CL
2.080		1.27E+00	2.90E-01			0.13	0	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
CS = Core sample.
FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-22
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 5A

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (mR/hr)	
56A	FS	2.14E+00	1.04E+00	1.88E-01	4.67E-01	0.47	2	
56B	CS	1.30E+00	2.00E-01	1.46E-01	3.07E-01	0.09	2	
56C	CS	1.62E+00	5.20E-01	1.76E-01	3.90E-01	0.23	2	
56D	CS	1.04E+00	0.00E+00	1.05E-01	3.46E-01	0.00	1	
169A	FS	2.05E+00	9.50E-01	1.03E-01	3.91E-01	0.43	1	
169B	FS	1.77E+00	6.70E-01	1.64E-01	4.81E-01	0.30	2	
169C	FS	2.36E+00	1.26E+00	2.37E-01	4.55E-01	0.57	1	
169D	FS	2.12E+00	1.02E+00	1.86E-01	4.17E-01	0.46	2	
170A	FS	6.94E-01	0.00E+00	1.16E-01	3.18E-01	0.00	0	
170B	CS	5.74E-01	0.00E+00	1.01E-01	3.55E-01	0.00	1	
170C	FS	1.30E+00	2.00E-01	1.29E-01	3.52E-01	0.09	1	
170D	FS	8.10E-01	0.00E+00	1.18E-01	3.62E-01	0.00	1	
Degrees of Freedom:	11	1.48E+00	4.88E-01			0.22	1	Average
		6.17E-01	4.81E-01			0.22	1	Std Deviation
		5.74E-01	0.00E+00			0.00	0	Minimum
		2.36E+00	1.26E+00			0.57	2	Maximum
t value*		1.46E+00	3.60E-01			0.16	1	Median
1.796		1.80E+00	7.38E-01			0.33	2	m_a 95%CL
2.201		1.87E+00	7.94E-01			0.36	2	m_a 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.

Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.

FS = Final soil sample.

CS = Core sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.

Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.

The average and standard deviation of unity is calculated for each final survey grid.

Finally, the average, standard deviation, median, and ma (95 and 97.5% confidence level) are calculated for the entire survey unit.

The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.

Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-23
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 5B

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
61A1	FS	7.42E-01	0.00E+00	1.93E-01	4.26E-01	0.00	1	
61A2	FS	9.14E-01	0.00E+00	1.32E-01	4.36E-01	0.00	1	
61B1	FS	9.24E-01	0.00E+00	1.43E-01	2.94E-01	0.00	1	
61B2	FS	6.95E-01	0.00E+00	1.09E-01	4.34E-01	0.00	1	
61C1	FS	8.32E-01	0.00E+00	9.80E-02	3.14E-01	0.00	1	
61C2	FS	4.83E-01	0.00E+00	2.10E-01	4.80E-01	0.00	1	
167A	CS	1.07E+00	0.00E+00	1.53E-01	6.69E-01	0.00	1	
167B	CS	1.02E+00	0.00E+00	2.06E-01	5.06E-01	0.00	1	
167C	CS	1.35E+00	2.50E-01	1.44E-01	3.83E-01	0.11	1	
167D	FS	1.61E+00	5.10E-01	1.40E-01	3.74E-01	0.23	1	
Degrees of Freedom:	9	9.64E-01	7.60E-02			0.03	1	Average
		3.26E-01	1.72E-01			0.08	0	Std Deviation
		4.83E-01	0.00E+00			0.00	1	Minimum
		1.61E+00	5.10E-01			0.23	1	Maximum
t value*		9.19E-01	0.00E+00			0.00	1	Median
1.833		1.15E+00	1.75E-01			0.08	1	μ_α 95%CL
2.262		1.20E+00	1.99E-01			0.09	1	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.
CS = Core sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-24
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 6A

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
157A	FS	2.66E+00	1.56E+00	1.80E-01	3.59E-01	0.70	0	
157B	FS	8.21E-01	0.00E+00	2.18E-01	5.22E-01	0.00	0	
157C	FS	1.57E+00	4.70E-01	1.46E-01	5.15E-01	0.21	0	
157D	FS	1.02E+00	0.00E+00	1.46E-01	3.80E-01	0.00	1	
158A	FS	1.46E+00	3.60E-01	1.28E-01	3.53E-01	0.16	0	
158B	FS	7.33E-01	0.00E+00	1.08E-01	3.72E-01	0.00	0	
158C	FS	7.71E-01	0.00E+00	1.18E-01	3.83E-01	0.00	0	
158D	FS	1.01E+00	0.00E+00	1.63E-01	3.68E-01	0.00	0	
175A	FS	8.70E-01	0.00E+00	2.56E-01	5.61E-01	0.00	0	
175B	FS	1.36E+00	2.60E-01	1.55E-01	4.85E-01	0.12	0	
175C	FS	1.49E+00	3.90E-01	1.51E-01	5.18E-01	0.18	0	
175D	FS	1.24E+00	1.40E-01	1.46E-01	4.10E-01	0.06	0	
Degrees of Freedom:	11	1.25E+00	2.65E-01			0.12	0	Average
		5.34E-01	4.45E-01			0.20	0	Std Deviation
		7.33E-01	0.00E+00			0.00	0	Minimum
		2.66E+00	1.56E+00			0.70	1	Maximum
t value*		1.13E+00	7.00E-02			0.03	0	Median
1.796		1.53E+00	4.96E-01			0.22	0	μ_α 95%CL
2.201		1.59E+00	5.48E-01			0.25	0	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-25
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 6B

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (mR/hr)	
161A	FS	8.59E-01	0.00E+00	1.08E-01	3.06E-01	0.00	1	
161B	FS	1.10E+00	0.00E+00	1.16E-01	4.13E-01	0.00	1	
161C	FS	1.14E+00	4.00E-02	1.92E-01	4.42E-01	0.02	1	
161D	FS	9.50E-01	0.00E+00	1.33E-01	4.25E-01	0.00	1	
162A	FS	1.14E+00	4.00E-02	1.29E-01	3.05E-01	0.02	2	
162B	FS	8.37E-01	0.00E+00	1.17E-01	4.56E-01	0.00	2	
162C	FS	8.54E-01	0.00E+00	1.27E-01	3.95E-01	0.00	2	
162D	FS	1.23E+00	1.30E-01	1.63E-01	3.14E-01	0.06	1	
163A	FS	8.78E-01	0.00E+00	1.35E-01	4.43E-01	0.00	1	
163B	FS	4.06E+00	2.96E+00	3.39E-01	4.37E-01	1.33	1	
163C	FS	9.74E-01	0.00E+00	1.58E-01	3.56E-01	0.00	1	
163D	FS	1.98E+00	8.80E-01	2.25E-01	4.41E-01	0.40	0	
164A	FS	2.46E+00	1.36E+00	1.78E-01	4.36E-01	0.61	1	
164B	FS	1.24E+00	1.40E-01	1.61E-01	3.94E-01	0.06	1	
164C	FS	9.35E-01	0.00E+00	1.65E-01	3.26E-01	0.00	0	
164D	FS	8.17E-01	0.00E+00	1.27E-01	4.12E-01	0.00	0	
165A	FS	2.30E+00	1.20E+00	2.52E-01	5.07E-01	0.54	1	
165B	FS	1.15E+00	5.00E-02	1.27E-01	4.70E-01	0.02	0	
165C	FS	1.81E+00	7.10E-01	1.68E-01	4.14E-01	0.32	0	
165D	FS	1.53E+00	4.30E-01	1.21E-01	3.64E-01	0.19	0	
Weighted Avg. of Grid 163:		1.50E+00	5.07E-01			2.28E-01		
Degrees of Freedom:	20	1.42E+00	4.02E-01			0.18	1	Average
		7.75E-01	7.22E-01			0.32	1	Std Deviation
		8.17E-01	0.00E+00			0.00	0	Minimum
		4.06E+00	2.96E+00			1.33	2	Maximum
t value*		1.14E+00	4.00E-02			0.02	1	Median
1.725		1.71E+00	6.74E-01			0.30	1	μ_α 95%CL
2.086		1.77E+00	7.31E-01			0.33	1	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.

Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.

The average and standard deviation of unity is calculated for each final survey grid.

Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.

The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.

Weighted Average = ($4m^2/50m^2$) x elevated measurement + ($46m^2/50m^2$) x average of unelevated measurements

Grid 163 contained an elevated area of $4m^2$ with Th-232 activity concentration = 4.06 pCi/g.

Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-26
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 6C

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
176A	FS	9.75E-01	0.00E+00	1.46E-01	4.53E-01	0.00	0	
176B	FS	1.27E+00	1.70E-01	1.99E-01	3.96E-01	0.08	0	
176C	FS	1.19E+00	9.00E-02	1.45E-01	4.16E-01	0.04	0	
176D	FS	9.25E-01	0.00E+00	1.50E-01	5.79E-01	0.00	0	
Degrees of Freedom:	3	1.09E+00	6.50E-02			0.03	0	Average
		1.66E-01	8.19E-02			0.04	0	Std Deviation
		9.25E-01	0.00E+00			0.00	0	Minimum
		1.27E+00	1.70E-01			0.08	0	Maximum
t value*		1.08E+00	4.50E-02			0.02	0	Median
2.353		1.29E+00	1.61E-01			0.07	0	μ_α 95%CL
3.182		1.35E+00	1.95E-01			0.09	0	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-27
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 7A

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)
26C	FS	7.97E-01	0.00E+00	1.33E-01	4.04E-01	0.00	0
26D	FS	2.73E+00	1.63E+00	1.70E-01	3.52E-01	0.73	0
25C	FS	2.19E+00	1.09E+00	1.94E-01	6.92E-01	0.49	1
25D	FS	8.02E-01	0.00E+00	1.47E-01	4.93E-01	0.00	1
28C	FS	7.44E-01	0.00E+00	7.80E-02	2.81E-01	0.00	1
28D	FS	9.53E-01	0.00E+00	1.11E-01	2.55E-01	0.00	1
29C	FS	9.76E-01	0.00E+00	1.34E-01	3.50E-01	0.00	1
29D	FS	1.08E+00	0.00E+00	1.00E-01	3.50E-01	0.00	2
1C	FS	1.80E+00	7.00E-01	1.56E-01	4.47E-01	0.32	1
1D	FS	1.43E+00	3.30E-01	1.95E-01	4.45E-01	0.15	1
2C	FS	2.16E+00	1.06E+00	2.02E-01	3.97E-01	0.48	1
2D	FS	8.14E-01	0.00E+00	7.20E-02	3.76E-01	0.00	1
3C	FS	1.03E+00	0.00E+00	9.90E-02	3.27E-01	0.00	1
3D	FS	1.33E+00	2.30E-01	2.22E-01	4.71E-01	0.10	1
4C	FS	1.16E+00	6.00E-02	1.35E-01	4.41E-01	0.03	1
4D	FS	7.16E-01	0.00E+00	1.03E-01	4.51E-01	0.00	1
5C	FS	2.46E+00	1.36E+00	2.24E-01	3.31E-01	0.61	1
5D	FS	1.04E+00	0.00E+00	1.24E-01	4.30E-01	0.00	2
6C	FS	9.03E-01	0.00E+00	1.22E-01	2.28E-01	0.00	1
6D	FS	1.04E+00	0.00E+00	1.79E-01	4.67E-01	0.00	0
7C	FS	8.65E-01	0.00E+00	9.20E-02	3.29E-01	0.00	1
7D	FS	1.19E+00	9.00E-02	1.70E-01	3.69E-01	0.04	1
8C	FS	1.07E+00	0.00E+00	1.60E-01	3.99E-01	0.00	0
8D	FS	3.10E+00	2.00E+00	2.22E-01	4.35E-01	0.90	0
9C	FS	6.77E-01	0.00E+00	1.36E-01	5.48E-01	0.00	1
9D	FS	1.62E+00	5.20E-01	2.26E-01	4.15E-01	0.23	1
10C	FS	3.48E+00	2.38E+00	2.13E-01	5.57E-01	1.07	1
10D	FS	9.90E-01	0.00E+00	1.61E-01	3.48E-01	0.00	1
11C	FS	1.95E+00	8.50E-01	2.46E-01	5.18E-01	0.38	1
11D	FS	1.89E+00	7.90E-01	1.63E-01	4.82E-01	0.36	0
12C	FS	5.41E-01	0.00E+00	9.20E-02	3.67E-01	0.00	0
12D	FS	5.23E-01	0.00E+00	1.22E-01	4.62E-01	0.00	1
13C	FS	9.19E-01	0.00E+00	1.20E-01	3.20E-01	0.00	1
13D	FS	9.35E-01	0.00E+00	8.90E-02	3.33E-01	0.00	1
111A	FS	1.38E+00	2.80E-01	2.09E-01	4.08E-01	0.13	0
111B	FS	1.06E+00	0.00E+00	1.17E-01	2.92E-01	0.00	0
116A	FS	1.06E+00	0.00E+00	1.34E-01	4.84E-01	0.00	1
116B	FS	9.94E-01	0.00E+00	2.33E-01	5.89E-01	0.00	0
117A	FS	1.15E+00	5.00E-02	1.00E-01	4.51E-01	0.02	0
117B	FS	1.05E+00	0.00E+00	2.19E-01	6.69E-01	0.00	0

Table 4-27
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 7A

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (µR/hr)
118A	FS	1.74E+00	6.40E-01	2.48E-01	5.29E-01	0.29	0
118B	FS	9.96E-01	0.00E+00	1.35E-01	2.85E-01	0.00	0
119A	FS	1.06E+00	0.00E+00	1.94E-01	5.84E-01	0.00	0
119B	FS	1.21E+00	1.10E-01	1.39E-01	3.75E-01	0.05	0
120A	FS	9.61E-01	0.00E+00	1.59E-01	4.09E-01	0.00	0
120B	FS	6.21E-01	0.00E+00	1.10E-01	3.98E-01	0.00	0
121A	FS	9.68E-01	0.00E+00	2.08E-01	4.18E-01	0.00	0
121B	FS	7.86E-01	0.00E+00	9.70E-02	3.43E-01	0.00	0
122A	FS	9.85E-01	0.00E+00	1.63E-01	5.42E-01	0.00	0
122B	FS	1.09E+00	0.00E+00	1.22E-01	5.18E-01	0.00	-1
123A	FS	8.16E-01	0.00E+00	1.20E-01	3.92E-01	0.00	0
123B	FS	8.65E-01	0.00E+00	1.70E-01	3.90E-01	0.00	0
68A	CS	1.33E+00	2.30E-01	1.63E-01	4.42E-01	0.10	0
68B	FS	1.72E+00	6.20E-01	1.54E-01	5.26E-01	0.28	0
68C	CS	1.11E+00	1.00E-02	1.48E-01	3.95E-01	0.00	-1
68D	CS	7.89E-01	0.00E+00	1.42E-01	4.83E-01	0.00	-1
72A	FS	*2.46E-01*	0.00E+00	6.00E-02	2.46E-01	0.00	1
72B	FS	5.10E-01	0.00E+00	1.11E-01	2.34E-01	0.00	1
72C	FS	1.77E+00	6.70E-01	1.35E-01	3.42E-01	0.30	-1
72D	FS	7.75E-01	0.00E+00	1.25E-01	4.99E-01	0.00	-1
70A	FS	2.09E+00	9.89E-01	1.53E-01	3.79E-01	0.15	1
70B	FS	1.14E+00	3.80E-02	1.73E-01	6.41E-01	0.06	1
70C	CS	8.91E-01	0.00E+00	1.48E-01	5.07E-01	0.05	-1
70D	CS	9.78E-01	0.00E+00	1.27E-01	3.37E-01	0.04	-1
73A	FS	*2.69E-01*	0.00E+00	7.30E-02	2.69E-01	0.00	1
73B	FS	5.71E-01	0.00E+00	1.09E-01	3.02E-01	0.00	1
73B-1	FS	3.09E+00	1.99E+00	2.33E-01	3.59E-01	0.90	1
73B-2	FS	1.82E+00	7.20E-01	1.32E-01	3.41E-01	0.32	1
73B-3	FS	5.72E-01	0.00E+00	1.19E-01	2.91E-01	0.00	1
73B-4	FS	4.43E-01	0.00E+00	9.50E-02	2.14E-01	0.00	1
73C	FS	2.78E+00	1.68E+00	1.39E-01	3.35E-01	0.76	-1
73D	FS	6.34E-01	0.00E+00	1.32E-01	4.18E-01	0.00	-1
74A	FS	3.95E-01	0.00E+00	9.50E-02	3.11E-01	0.00	1
74B	FS	5.83E-01	0.00E+00	9.50E-02	2.92E-01	0.00	1
74C	FS	1.71E+00	6.10E-01	1.69E-01	5.74E-01	0.27	-1
74D	FS	8.83E-01	0.00E+00	1.29E-01	3.57E-01	0.00	-1
75A	FS	2.31E+00	1.21E+00	1.46E-01	3.71E-01	0.54	1
75B	FS	1.73E+00	6.30E-01	1.31E-01	3.46E-01	0.28	1
75C	FS	1.12E+00	2.00E-02	1.10E-01	3.27E-01	0.01	-1
75D	FS	1.18E+00	8.00E-02	1.78E-01	3.18E-01	0.04	-1
76A	FS	6.34E-01	0.00E+00	2.50E-02	2.11E-01	0.00	1
76B	FS	1.92E+00	8.20E-01	1.27E-01	3.45E-01	0.37	1
76C	FS	1.21E+00	1.10E-01	1.52E-01	3.19E-01	0.05	-1
76D	FS	1.32E+00	2.20E-01	1.08E-01	4.13E-01	0.10	-1

Table 4-27
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 7A

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
77A	FS	2.97E-01	0.00E+00	8.30E-02	3.18E-01	0.00	1	
77B	FS	1.43E+00	3.30E-01	1.26E-01	2.33E-01	0.15	1	
77C	FS	1.25E+00	1.50E-01	1.49E-01	3.21E-01	0.07	-1	
77D	FS	7.53E-01	0.00E+00	1.14E-01	5.61E-01	0.00	-1	
78A	FS	3.19E+00	2.09E+00	3.03E-01	4.44E-01	0.94	1	
78B	FS	1.16E+00	6.00E-02	1.27E-01	3.93E-01	0.03	1	
78C	FS	1.27E+00	1.70E-01	2.29E-01	4.63E-01	0.08	-1	
78D	FS	1.02E+00	0.00E+00	1.46E-01	5.62E-01	0.00	-1	
79A	FS	6.52E-01	0.00E+00	8.90E-02	3.06E-01	0.00	1	
79B	FS	1.11E+00	1.00E-02	1.82E-01	4.16E-01	0.00	1	
79C	FS	8.30E-01	0.00E+00	1.60E-01	3.94E-01	0.00	-1	
79D	FS	1.02E+00	0.00E+00	1.22E-01	4.79E-01	0.00	-1	
80A	FS	7.01E-01	0.00E+00	4.00E-02	3.10E-01	0.00	1	
80B	FS	7.13E-01	0.00E+00	1.04E-01	3.91E-01	0.00	1	
80C	FS	7.70E-01	0.00E+00	1.19E-01	3.52E-01	0.00	-1	
80D	FS	9.99E-01	0.00E+00	1.96E-01	4.93E-01	0.00	-1	
81A	FS	9.77E-01	0.00E+00	8.20E-02	5.47E-01	0.00	0	
81B	FS	1.47E+00	3.70E-01	1.51E-01	3.16E-01	0.17	0	
81C	FS	7.28E-01	0.00E+00	9.80E-02	3.48E-01	0.00	6	
81D	FS	7.14E-01	0.00E+00	1.05E-01	3.37E-01	0.00	7	
82A	FS	1.15E+00	5.00E-02	1.50E-01	5.17E-01	0.02	7	
82B	FS	9.80E-01	0.00E+00	1.04E-01	3.27E-01	0.00	7	
82C	FS	9.41E-01	0.00E+00	1.15E-01	3.76E-01	0.00	7	
82D	FS	6.74E-01	0.00E+00	9.60E-02	3.78E-01	0.00	7	
Weighted Avg. of Grid 10		1.44E+00	3.80E-01			0.17		
Degrees of Freedom:	108	1.19E+00	2.61E-01			0.12	1	Average
		6.36E-01	5.16E-01			0.23	2	Std Deviation
		2.46E-01	0.00E+00			0.00	-1	Minimum
		3.48E+00	2.38E+00			1.07	7	Maximum
t value*		1.02E+00	0.00E+00			0.00	1	Median
1.661		1.29E+00	3.43E-01			0.15	1	μ_α 95%CL
1.984		1.31E+00	3.59E-01			0.16	1	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.
CS = Core sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Grid 10 contained an elevated area of $4m^2$ with Th-232 activity concentration = 3.48 pCi/g.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-28
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 7B

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
84A	FS	7.41E-01	0.00E+00	6.00E-02	2.25E-01	0.00	1	
84B	FS	9.26E-01	0.00E+00	1.17E-01	3.92E-01	0.00	2	
84C	FS	1.06E+00	0.00E+00	1.78E-01	4.28E-01	0.00	1	
84D	FS	9.99E-01	0.00E+00	1.21E-01	3.91E-01	0.00	1	
85A	FS	6.41E-01	0.00E+00	1.09E-01	4.33E-01	0.00	2	
85B	FS	7.81E-01	0.00E+00	1.36E-01	3.46E-01	0.00	2	
85C	FS	9.02E-01	0.00E+00	1.36E-01	4.34E-01	0.00	1	
85D	FS	8.63E-01	0.00E+00	1.25E-01	4.92E-01	0.00	1	
86A	FS	2.62E+00	1.52E+00	1.93E-01	4.30E-01	0.68	2	
86B	FS	1.28E+00	1.80E-01	1.28E-01	4.03E-01	0.08	2	
86C	FS	7.68E-01	0.00E+00	1.82E-01	3.57E-01	0.00	2	
86D	FS	1.04E+00	0.00E+00	1.24E-01	4.02E-01	0.00	1	
87A	FS	9.16E-01	0.00E+00	1.07E-01	3.58E-01	0.00	2	
87B	FS	1.12E+00	2.00E-02	1.81E-01	3.82E-01	0.01	1	
87C	FS	8.52E-01	0.00E+00	1.12E-01	4.20E-01	0.00	1	
87D	FS	1.03E+00	0.00E+00	1.46E-01	6.20E-01	0.00	1	
88A	FS	1.18E+00	8.00E-02	1.82E-01	3.35E-01	0.04	1	
88B	FS	8.81E-01	0.00E+00	1.51E-01	6.44E-01	0.00	1	
88C	FS	1.19E+00	9.00E-02	1.58E-01	6.01E-01	0.04	1	
88D	FS	1.56E+00	4.60E-01	2.78E-01	5.14E-01	0.21	1	
14C	FS	9.65E-01	0.00E+00	2.22E-01	3.72E-01	0.00	1	
14D	FS	1.57E+00	4.70E-01	1.60E-01	4.75E-01	0.21	1	
15C	FS	1.23E+00	1.30E-01	1.99E-01	4.30E-01	0.06	2	
15D	FS	1.43E+00	3.30E-01	1.62E-01	5.26E-01	0.15	2	
16C	FS	7.80E-01	0.00E+00	1.35E-01	5.15E-01	0.00	2	
16D	FS	1.25E+00	1.50E-01	1.29E-01	4.38E-01	0.07	2	
17C	FS	8.93E-01	0.00E+00	1.06E-01	3.35E-01	0.00	1	
17D	FS	9.91E-01	0.00E+00	1.72E-01	3.12E-01	0.00	1	
18C	FS	9.96E-01	0.00E+00	1.66E-01	6.26E-01	0.00	1	
18D	FS	8.08E-01	0.00E+00	1.08E-01	4.06E-01	0.00	1	
129A	FS	1.02E+00	0.00E+00	1.15E-01	1.89E-01	0.00	1	
129B	FS	8.72E-01	0.00E+00	1.44E-01	5.11E-01	0.00	1	
130A	FS	8.71E-01	0.00E+00	1.36E-01	4.61E-01	0.00	1	
130B	FS	8.69E-01	0.00E+00	1.32E-01	4.01E-01	0.00	1	
131A	FS	9.71E-01	0.00E+00	9.30E-02	3.36E-01	0.00	1	
131B	FS	1.33E+00	2.30E-01	1.68E-01	3.98E-01	0.10	1	
132A	FS	1.15E+00	5.00E-02	1.57E-01	2.72E-01	0.02	1	
132B	FS	9.11E-01	0.00E+00	8.40E-02	2.87E-01	0.00	1	
Degrees of Freedom:	37	1.06E+00	9.76E-02			4.39E-02	1	Average
		3.39E-01	2.67E-01			1.20E-01	0	Std Deviation
		6.41E-01	0.00E+00			0.00E+00	1	Minimum
		2.62E+00	1.52E+00			6.84E-01	2	Maximum
t value*		9.81E-01	0.00E+00			0.00E+00	1	Median
1.688		1.15E+00	1.71E-01			7.68E-02	1	μ_α 95%CL
2.027		1.17E+00	1.85E-01			8.34E-02	1	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-29
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 7C

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)
89A	FS	1.01E+00	0.00E+00	1.12E-01	3.33E-01	0.00	1
89B	FS	1.29E+00	1.90E-01	2.03E-01	4.12E-01	0.09	1
89C	FS	1.01E+00	0.00E+00	1.48E-01	4.07E-01	0.00	0
89D	FS	1.03E+00	0.00E+00	1.26E-01	5.58E-01	0.00	0
90A	FS	1.86E+00	7.60E-01	1.68E-01	4.70E-01	0.34	1
90B	FS	1.17E+00	7.00E-02	1.43E-01	3.04E-01	0.03	0
90D	FS	9.75E-01	0.00E+00	1.28E-01	3.02E-01	0.00	0
90E	FS	9.64E-01	0.00E+00	1.14E-01	3.94E-01	0.00	0
90F	FS	9.74E-01	0.00E+00	1.41E-01	3.84E-01	0.00	0
90G	FS	7.40E-01	0.00E+00	9.70E-02	3.99E-01	0.00	1
91C	FS	7.56E-01	0.00E+00	1.22E-01	3.97E-01	0.00	1
91D	FS	7.31E-01	0.00E+00	1.42E-01	5.18E-01	0.00	1
92C	FS	8.17E-01	0.00E+00	1.44E-01	4.88E-01	0.00	0
95A	FS	8.68E-01	0.00E+00	1.57E-01	4.12E-01	0.00	1
95B	FS	1.01E+00	0.00E+00	8.90E-02	2.60E-01	0.00	1
96A	FS	9.72E-01	0.00E+00	1.47E-01	4.54E-01	0.00	1
96B	FS	1.33E+00	2.30E-01	1.98E-01	3.67E-01	0.10	0
96C	FS	1.01E+00	0.00E+00	1.52E-01	4.53E-01	0.00	0
96D	FS	1.04E+00	0.00E+00	1.27E-01	5.15E-01	0.00	0
96H	FS	7.91E-01	0.00E+00	7.60E-02	4.06E-01	0.00	1
97A	FS	1.17E+00	7.00E-02	1.39E-01	3.93E-01	0.03	1
97B	FS	1.30E+00	2.00E-01	1.55E-01	5.32E-01	0.09	1
97C	FS	9.58E-01	0.00E+00	1.77E-01	4.44E-01	0.00	1
97D	FS	1.12E+00	2.00E-02	1.46E-01	4.87E-01	0.01	0
98A	CS	9.44E-01	0.00E+00	1.31E-01	4.56E-01	0.00	1
98B	FS	9.37E-01	0.00E+00	1.63E-01	4.05E-01	0.00	1
98C	FS	1.15E+00	5.00E-02	1.84E-01	3.99E-01	0.02	0
98D	FS	1.18E+00	8.00E-02	1.41E-01	4.66E-01	0.04	1
99A	FS	1.45E+00	3.50E-01	1.65E-01	6.00E-01	0.16	1
99B	FS	1.55E+00	4.50E-01	1.97E-01	4.43E-01	0.20	1
99C	FS	1.02E+00	0.00E+00	1.23E-01	4.68E-01	0.00	0
99D	FS	8.79E-01	0.00E+00	1.43E-01	5.24E-01	0.00	1
100C	FS	1.25E+00	1.50E-01	1.51E-01	4.21E-01	0.07	0
100D	FS	7.44E-01	0.00E+00	1.02E-01	4.55E-01	0.00	1
103A	FS	8.91E-01	0.00E+00	1.40E-01	3.24E-01	0.00	0
103B	FS	1.34E+00	2.40E-01	1.48E-01	4.06E-01	0.11	1
104A	FS	9.71E-01	0.00E+00	1.30E-01	4.97E-01	0.00	1
104B	FS	3.22E+00	2.12E+00	2.02E-01	3.99E-01	0.95	1
104D	FS	1.21E+00	1.10E-01	1.35E-01	3.29E-01	0.05	0
105A	FS	9.61E-01	0.00E+00	1.48E-01	6.20E-01	0.00	1
105B	FS	8.71E-01	0.00E+00	9.80E-02	4.11E-01	0.00	1
105C	FS	1.14E+00	4.00E-02	1.69E-01	5.31E-01	0.02	1
105D	FS	2.51E+00	1.41E+00	2.08E-01	3.29E-01	0.63	1

Table 4-29
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 7C

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
127A	FS	6.17E-01	0.00E+00	1.05E-01	3.12E-01	0.00	0	
127B	CS	1.12E+00	2.00E-02	1.03E-01	3.92E-01	0.01	0	
127C	FS	2.13E+00	1.03E+00	2.42E-01	4.09E-01	0.46	0	
127D	CS	6.99E-01	0.00E+00	1.04E-01	3.34E-01	0.00	0	
133C	FS	7.54E-01	0.00E+00	1.19E-01	3.37E-01	0.00	0	
135A	FS	1.05E+00	0.00E+00	1.79E-01	4.05E-01	0.00	1	
135B	FS	1.08E+00	0.00E+00	1.45E-01	6.21E-01	0.00	1	
135C	FS	6.34E-01	0.00E+00	1.25E-01	3.12E-01	0.00	0	
135D	FS	2.16E+00	1.06E+00	2.12E-01	3.37E-01	0.48	1	
Degrees of Freedom:	51	1.14E+00	1.66E-01			0.07	1	Average
		4.76E-01	4.05E-01			0.18	0	Std Deviation
		6.17E-01	0.00E+00			0.00	0	Minimum
		3.22E+00	2.12E+00			0.95	1	Maximum
t value*		1.01E+00	0.00E+00			0.00	1	Median
1.677		1.25E+00	2.61E-01			0.12	1	μ_α 95%CL
2.009		1.27E+00	2.79E-01			0.13	1	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.
CS = Core sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-30
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 7D

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
192A	FS	1.79E+00	6.94E-01	2.82E-01	5.15E-01	0.31	0	
192B	FS	1.34E+00	2.41E-01	1.86E-01	6.52E-01	0.11	1	
193A	FS	1.78E+00	6.75E-01	1.82E-01	4.45E-01	0.30	1	
193B	FS	6.76E-01	0.00E+00	7.90E-02	2.28E-01	0.00	1	
106A	FS	1.76E+00	6.63E-01	1.99E-01	6.23E-01	0.30	1	
106B	FS	1.11E+00	1.10E-02	1.22E-01	3.26E-01	0.00	0	
Degrees of Freedom:	5	1.41E+00	3.81E-01			0.17	1	Average
		4.56E-01	3.36E-01			0.15	1	Std Deviation
		6.76E-01	0.00E+00			0.00	0	Minimum
		1.79E+00	6.94E-01			0.31	1	Maximum
t value*		1.55E+00	4.52E-01			0.20	1	Median
2.015		1.78E+00	6.57E-01			0.30	1	μ_α 95%CL
2.571		1.89E+00	7.34E-01			0.33	1	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-31
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Survey Unit 7E

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit (pCi/g)	Unity (-)	Net Exposure Rate (μR/hr)	
209A	CS	4.94E-01	0.00E+00	1.19E+00		0.00	0	
209B	FS	1.39E+00	2.88E-01	1.59E-01	5.06E-01	0.13	1	
210A	FS	1.13E+00	3.10E-02	1.90E-01	3.29E-01	0.13	1	
210B	FS	7.51E-01	0.00E+00	1.77E-01	5.17E-01	0.12	0	
189A	FS	1.31E+00	2.05E-01	1.51E-01	5.89E-01	0.09	1	
189B	FS	1.94E+00	8.44E-01	1.98E-01	5.35E-01	0.38	1	
206D	CS	1.58E+00	4.80E-01	4.80E-01	3.49E-01	0.22	3	
206A	CS	3.55E+00	2.45E+00	2.45E+00	3.94E-01	1.10	3	
206B	CS	7.61E-01	0.00E+00	0.00E+00	5.83E-01	0.00	3	
Wgt. Avg. Final Survey Grid 206:		1.41E+00	4.61E-01			0.17		
Degrees of Freedom:	9	1.43E+00	4.76E-01			0.14	1	Average
		8.61E-01	7.47E-01			0.13	1	Std Deviation
		4.94E-01	0.00E+00			0.00	0	Minimum
		3.55E+00	2.45E+00			0.38	1	Maximum
t value*		1.31E+00	2.05E-01			0.12	1	Median
1.833		1.93E+00	9.09E-01			0.22	1	μ_α 95%CL
2.262		2.05E+00	1.01E+00			0.23	1	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
CS = Core sample.
FS = Final soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.

Table 4-32
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Unaffected Areas

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit	Conc. Th-232 (pCi/g)	Unity (-)	Net Exposure Rate (mR/hr)
27 D	CS	6.60E-01	1.20E-01	3.66E-01	0.00E+00	0.00	1
27 C	CS	1.06E+00	1.15E-01	3.05E-01	0.00E+00	0.00	1
27 A	CS	8.28E-01	1.15E-01	4.26E-01	0.00E+00	0.00	1
27 B	CS	1.34E+00	1.86E-01	4.22E-01	2.40E-01	0.11	1
30 C	CS	7.34E-01	1.10E-01	3.65E-01	0.00E+00	0.00	0
30 D	CS	1.08E+00	1.93E-01	5.02E-01	0.00E+00	0.00	0
30 B	CS	8.14E-01	1.43E+00	3.90E-01	0.00E+00	0.00	0
30 A	CS	1.33E+00	2.15E-01	4.31E-01	2.32E-01	0.10	0
31 C	CS	1.15E+00	2.29E-01	5.28E-01	5.10E-02	0.02	0
31 D	CS	1.04E+00	1.35E-01	3.56E-01	0.00E+00	0.00	0
31 B	CS	7.12E-01	1.18E-01	4.22E-01	0.00E+00	0.00	0
31 A	CS	7.51E-01	1.48E-01	2.67E-01	0.00E+00	0.00	0
32 A	CS	6.74E-01	1.16E-01	3.92E-01	0.00E+00	0.00	1
32 B	CS	7.27E-01	1.51E-01	3.76E-01	0.00E+00	0.00	1
32 C	CS	3.10E+00	2.86E-01	5.03E-01	2.00E+00	0.90	1
32 D	CS	1.02E+00	1.47E-01	5.33E-01	0.00E+00	0.00	1
34 A	CS	7.94E-01	1.33E-01	4.93E-01	0.00E+00	0.00	2
34 B	CS	1.43E+00	1.48E-01	3.11E-01	3.30E-01	0.15	2
34 C	CS	9.97E-01	9.40E-02	3.33E-01	0.00E+00	0.00	1
34 D	CS	8.76E-01	1.23E-01	3.44E-01	0.00E+00	0.00	1
36 B	CS	6.54E-01	1.20E-01	3.44E-01	0.00E+00	0.00	6
36 D	CS	7.17E-01	1.25E-01	4.24E-01	0.00E+00	0.00	4
36 C	CS	1.07E+00	1.31E-01	3.73E-01	0.00E+00	0.00	4
36 A	CS	8.74E-01	1.49E-01	2.99E-01	0.00E+00	0.00	6
38 A	CS	8.21E-01	1.77E-01	5.24E-01	0.00E+00	0.00	6
38 B	CS	9.13E-01	1.15E-01	3.89E-01	0.00E+00	0.00	8
38 C	CS	8.42E-01	1.79E-01	3.51E-01	0.00E+00	0.00	6
38 D	CS	7.15E-01	1.14E-01	4.15E-01	0.00E+00	0.00	6
46 A	CS	1.25E+00	1.62E-01	3.64E-01	1.50E-01	0.07	4
46 B	CS	1.82E+00	1.70E-01	6.48E-01	7.16E-01	0.32	3
46 C	CS	1.23E+00	1.14E-01	4.16E-01	1.27E-01	0.06	0
46 D	CS	8.17E-01	1.36E-01	4.87E-01	0.00E+00	0.00	-1
48 B	CS	2.56E+00	1.79E-01	4.93E-01	1.46E+00	0.66	0
48 A	CS	7.33E-01	1.67E-01	5.07E-01	0.00E+00	0.00	1
48 C	CS	8.80E-01	1.12E-01	4.02E-01	0.00E+00	0.00	-1
48 D	CS	1.28E+00	1.33E-01	4.00E-01	1.79E-01	0.08	-1
49 A	CS	1.57E+00	1.68E-01	2.83E-01	4.65E-01	0.21	0
49 B	CS	2.29E-01	7.30E-02	2.19E-01	0.00E+00	0.00	0
49 C	CS	1.91E+00	1.82E-01	5.51E-01	8.12E-01	0.37	-1
49 D	CS	BDL	BDL	2.01E-01	BDL	BDL	-1
50 A	CS	7.36E-01	9.70E-02	3.49E-01	0.00E+00	0.00	1
50 B	CS	4.00E-01	9.20E-02	2.90E-01	0.00E+00	0.00	0
50 D	CS	6.59E-01	1.00E-01	3.19E-01	0.00E+00	0.00	-1
50 C	CS	6.96E-01	1.12E-01	4.01E-01	0.00E+00	0.00	-1

Table 4-32
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Unaffected Areas

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit	Conc. Th-232 (pCi/g)	Unity (-)	Net Exposure Rate (mR/hr)
51 C	CS	8.03E-01	1.08E-01	4.09E-01	0.00E+00	0.00	1
51 B	CS	1.10E+00	1.36E-01	3.05E-01	0.00E+00	0.00	-1
51 A	CS	9.86E-01	1.73E-01	3.27E-01	0.00E+00	0.00	1
51 D	CS	5.15E-01	1.06E-01	4.04E-01	0.00E+00	0.00	-1
62 A	CS	1.37E+00	1.83E-01	3.76E-01	2.72E-01	0.12	1
62 B97	CS	2.77E+00	2.25E-01	5.25E-01	1.67E+00	0.75	1
62 B99	CS	7.46E-01	8.40E-02	4.38E-01	0.00E+00	0.00	1
64 C	CS	8.64E-01	1.60E-01	4.61E-01	0.00E+00	0.00	0
64 A	CS	1.74E+00	1.66E-01	2.50E-01	6.35E-01	0.29	-1
64 B	CS	9.07E-01	1.48E-01	3.61E-01	0.00E+00	0.00	0
64 D	CS	8.49E-01	1.03E-01	1.90E-01	0.00E+00	0.00	0
65 C	CS	9.89E-01	1.45E-01	4.92E-01	0.00E+00	0.00	-1
65 D	CS	1.78E+00	1.68E-01	3.93E-01	6.82E-01	0.31	-1
65 A	CS	8.15E-01	1.55E-01	5.45E-01	0.00E+00	0.00	-1
65 B	CS	6.79E-01	1.33E-01	4.53E-01	0.00E+00	0.00	-1
66 B	CS	6.19E-01	1.04E-01	4.98E-01	0.00E+00	0.00	-1
66 A	CS	8.01E-01	1.44E-01	3.43E-01	0.00E+00	0.00	-1
66 D	CS	1.02E+00	1.71E-01	3.17E-01	0.00E+00	0.00	-1
66 C	CS	8.76E-01	1.09E-01	3.58E-01	0.00E+00	0.00	-1
67 A	CS	8.89E-01	1.26E-01	3.69E-01	0.00E+00	0.00	-1
67 B	CS	1.01E+00	1.41E-01	4.25E-01	0.00E+00	0.00	-1
67 C	CS	7.23E-01	1.34E-01	4.14E-01	0.00E+00	0.00	-1
69 D	CS	1.12E+00	1.64E-01	3.98E-01	1.80E-02	0.01	0
69 C	CS	1.32E+00	7.60E-02	3.23E-01	2.19E-01	0.10	0
69 B	CS	1.07E+00	2.08E-01	4.54E-01	0.00E+00	0.00	-1
69 A	CS	2.46E+00	1.64E-01	4.23E-01	1.36E+00	0.61	-1
71 D	CS	2.75E+00	2.71E-01	5.44E-01	1.65E+00	0.74	0
71 A	CS	7.26E-01	1.61E-01	2.27E-01	0.00E+00	0.00	1
71 B	CS	8.84E-01	1.50E-01	3.26E-01	0.00E+00	0.00	1
71 C	CS	2.72E+00	2.62E-01	4.48E-01	1.62E+00	0.73	0
83 D	CS	8.71E-01	1.91E-01	5.05E-01	0.00E+00	0.00	0
83 B	CS	1.36E+00	1.98E-01	3.62E-01	2.64E-01	0.12	1
83 C	CS	1.27E+00	1.69E-01	3.68E-01	1.74E-01	0.08	-1
83 A	CS	1.72E+00	2.08E-01	4.44E-01	6.17E-01	0.28	0
107 C	CS	6.97E-01	1.32E-01	4.66E-01	0.00E+00	0.00	0
107 B	CS	9.41E-01	1.49E-01	4.63E-01	0.00E+00	0.00	-1
107 A	CS	1.17E+00	1.31E-01	5.13E-01	6.60E-02	0.03	-1
107 D	CS	9.35E-01	1.31E-01	4.87E-01	0.00E+00	0.00	0
107 D	CS	9.07E-01	2.37E-01	5.31E-01	0.00E+00	0.00	0
108 B	CS	7.00E-01	1.10E-01	3.64E-01	0.00E+00	0.00	0
108 A	CS	9.64E-01	1.53E-01	4.35E-01	0.00E+00	0.00	-1
108 C	CS	8.71E-01	1.20E-01	3.06E-01	0.00E+00	0.00	-1
109 B	CS	9.19E-01	2.05E-01	5.33E-01	0.00E+00	0.00	-1
109 A	CS	9.01E-01	2.01E-01	3.76E-01	0.00E+00	0.00	-1

Table 4-32
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Unaffected Areas

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit	Conc. Th-232 (pCi/g)	Unity (-)	Net Exposure Rate (mR/hr)
109 C	CS	9.95E-01	1.84E-01	4.70E-01	0.00E+00	0.00	-1
109 D	CS	1.46E+00	2.21E-01	3.62E-01	3.61E-01	0.16	-1
110 D	CS	1.05E+00	1.48E-01	5.29E-01	0.00E+00	0.00	0
110 C	CS	1.01E+00	1.37E-01	4.89E-01	0.00E+00	0.00	0
110 A	CS	1.77E+00	2.38E-01	5.37E-01	6.65E-01	0.30	0
110 B	CS	1.16E+00	2.17E-01	5.49E-01	6.00E-02	0.03	0
112 A	CS	1.00E+00	1.35E-01	4.03E-01	0.00E+00	0.00	0
112 C	CS	1.49E+00	1.53E-01	5.07E-01	3.91E-01	0.18	0
112 D	CS	1.10E+00	2.20E-01	4.25E-01	0.00E+00	0.00	0
112 B	CS	6.02E-01	1.19E-01	5.44E-01	0.00E+00	0.00	0
113 D	CS	8.95E-01	1.25E-01	3.15E-01	0.00E+00	0.00	0
113 A	CS	6.19E-01	1.30E-01	4.80E-01	0.00E+00	0.00	0
113 C	CS	1.09E+00	2.18E-01	4.18E-01	0.00E+00	0.00	0
113 B	CS	9.94E-01	1.43E-01	4.77E-01	0.00E+00	0.00	0
114 A	CS	7.44E-01	8.80E-02	2.59E-01	0.00E+00	0.00	0
114 B	CS	7.31E-01	1.37E-01	5.73E-01	0.00E+00	0.00	1
114 C	CS	9.61E-01	1.42E-01	5.28E-01	0.00E+00	0.00	-1
114 D	CS	9.30E-01	1.39E-01	4.30E-01	0.00E+00	0.00	0
115 A	CS	1.02E+00	1.81E-01	4.76E-01	0.00E+00	0.00	0
115 B	CS	1.08E+00	1.20E-01	3.04E-01	0.00E+00	0.00	0
115 C	CS	1.11E+00	1.85E-01	3.53E-01	1.40E-02	0.01	0
115 D	CS	8.14E-01	1.30E-01	4.71E-01	0.00E+00	0.00	0
125 B	CS	9.31E-01	1.26E-01	2.01E-01	0.00E+00	0.00	1
125 C	CS	1.13E+00	1.33E-01	4.13E-01	3.20E-02	0.01	1
125 D	CS	1.50E+00	1.94E-01	4.44E-01	3.99E-01	0.18	1
125 A	CS	8.10E-01	1.40E-01	4.69E-01	0.00E+00	0.00	1
126 A	CS	6.90E-01	1.09E-01	3.88E-01	0.00E+00	0.00	6
126 B	CS	1.06E+00	2.02E-01	4.76E-01	0.00E+00	0.00	2
126 D	CS	8.00E-01	1.91E-01	4.04E-01	0.00E+00	0.00	1
126 C	CS	7.36E-01	1.39E-01	5.47E-01	0.00E+00	0.00	7
128 A	CS	1.12E+00	1.16E-01	2.61E-01	2.10E-02	0.01	2
138 A	CS	2.39E+00	1.79E-01	4.61E-01	1.29E+00	0.58	0
138 C	CS	9.78E-01	1.77E-01	3.84E-01	0.00E+00	0.00	0
138 D	CS	1.01E+00	1.33E-01	2.25E-01	0.00E+00	0.00	0
138 B	CS	3.36E-01	9.70E-02	3.92E-01	0.00E+00	0.00	0
139 D	CS	7.95E-01	1.01E-01	3.78E-01	0.00E+00	0.00	1
139 C	CS	8.12E-01	1.26E-01	4.10E-01	0.00E+00	0.00	1
139 A	CS	2.91E+00	1.99E-01	4.50E-01	1.81E+00	0.81	1
139 B	CS	9.14E-01	1.26E-01	4.26E-01	0.00E+00	0.00	1
140 C	CS	8.11E-01	1.83E-01	4.12E-01	0.00E+00	0.00	1
140 A	CS	9.40E-01	1.11E-01	3.22E-01	0.00E+00	0.00	1
140 B	CS	8.14E-01	1.18E-01	4.80E-01	0.00E+00	0.00	1
140 D	CS	1.01E+00	1.27E-01	4.59E-01	0.00E+00	0.00	1

Table 4-32
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Unaffected Areas

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit	Conc. Th-232 (pCi/g)	Unity (-)	Net Exposure Rate (mR/hr)
141 D	CS	9.59E-01	1.27E-01	4.05E-01	0.00E+00	0.00	1
141 B	CS	1.02E+00	1.29E-01	3.93E-01	0.00E+00	0.00	2
141 C	CS	6.03E-01	1.39E-01	3.01E-01	0.00E+00	0.00	2
141 A	CS	ND	ND	6.60E-01	ND	ND	1
142 C	CS	6.90E-01	1.25E-01	4.07E-01	0.00E+00	0.00	2
142 A	CS	7.94E-01	1.07E-01	3.07E-01	0.00E+00	0.00	3
142 B	CS	1.65E+00	1.81E-01	4.12E-01	5.52E-01	0.25	3
142 D	CS	1.27E+00	1.83E-01	4.65E-01	1.69E-01	0.08	3
143 B	CS	1.17E+00	1.69E-01	4.40E-01	7.30E-02	0.03	3
143 D	CS	9.33E-01	1.98E-01	4.99E-01	0.00E+00	0.00	2
143 A	CS	9.01E-01	1.23E-01	3.10E-01	0.00E+00	0.00	6
143 C	CS	1.09E+00	1.34E-01	2.92E-01	0.00E+00	0.00	3
144 A	CS	2.25E+00	1.80E-01	4.11E-01	1.15E+00	0.52	6
144 C	CS	1.13E+00	1.91E-01	4.63E-01	3.20E-02	0.01	6
144 D	CS	7.89E-01	1.17E-01	3.79E-01	0.00E+00	0.00	2
144 B99	CS	ND	ND	4.76E-01	ND	ND	2
145 C	CS	1.81E+00	1.66E-01	3.25E-01	7.08E-01	0.32	6
145 B	CS	1.02E+00	1.40E-01	3.65E-01	0.00E+00	0.00	1
145 D	CS	5.69E-01	1.60E-01	3.65E-01	0.00E+00	0.00	2
145 A	CS	8.67E-01	1.21E-01	3.23E-01	0.00E+00	0.00	6
146 C	CS	1.03E+00	1.46E-01	4.30E-01	0.00E+00	0.00	6
146 A	CS	1.12E+00	1.27E-01	8.80E-02	2.20E-02	0.01	6
146 D	CS	6.52E-01	1.16E-01	3.92E-01	0.00E+00	0.00	1
146 B	CS	6.07E-01	1.16E-01	3.63E-01	0.00E+00	0.00	2
147 C	CS	1.67E+00	1.41E-01	3.00E+00	5.68E-01	0.26	6
147 D	CS	1.42E+00	2.13E-01	4.26E-01	3.17E-01	0.14	6
147 A	CS	2.76E+00	2.22E-01	5.01E-01	1.66E+00	0.75	6
147 B	CS	7.59E-01	1.13E-01	3.75E-01	0.00E+00	0.00	6
148 C	CS	1.05E+00	1.55E-01	3.83E-01	0.00E+00	0.00	0
148 D	CS	9.92E-01	1.60E-01	3.78E-01	0.00E+00	0.00	-1
148 B	CS	1.03E+00	1.33E-01	5.22E-01	0.00E+00	0.00	-1
148 A	CS	1.02E+00	1.95E-01	4.09E-01	0.00E+00	0.00	-1
149 C	CS	9.66E-01	1.24E-01	4.52E-01	0.00E+00	0.00	0
149 D	CS	8.46E-01	1.42E-01	4.90E-01	0.00E+00	0.00	0
149 B	CS	6.32E-01	1.14E-01	5.73E-01	0.00E+00	0.00	0
149 A	CS	9.08E-01	9.50E-02	4.01E-01	0.00E+00	0.00	0
151 C	CS	1.01E+00	2.14E-01	3.94E-01	0.00E+00	0.00	0
151 A	CS	9.96E-01	1.28E-01	4.73E-01	0.00E+00	0.00	-1
151 D	CS	3.05E+00	2.05E-01	3.75E-01	1.95E+00	0.88	-1
151 F	CS	1.85E+00	1.83E-01	5.65E-01	7.49E-01	0.34	-1
151 B	CS	1.11E+00	1.65E-01	5.34E-01	1.30E-02	0.01	-1
153 D	CS	1.53E+00	1.53E-01	5.44E-01	4.31E-01	0.19	-1
153 C	CS	5.32E-01	1.20E-01	3.91E-01	0.00E+00	0.00	0

Table 4-32
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Unaffected Areas

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit	Conc. Th-232 (pCi/g)	Unity (-)	Net Exposure Rate (mR/hr)
153 B	CS	1.71E+00	2.09E-01	3.97E-01	6.11E-01	0.27	0
153 A	CS	1.19E+00	1.50E-01	4.05E-01	9.20E-02	0.04	0
160 A	CS	2.38E+00	1.89E-01	5.86E-01	1.28E+00	0.58	1
168 C	CS	1.14E+00	1.85E-01	3.17E-01	3.80E-02	0.02	2
168 D	CS	1.19E+00	1.47E-01	4.96E-01	8.90E-02	0.04	2
168 B	CS	8.72E-01	8.80E-02	2.75E-01	0.00E+00	0.00	1
171 C	SS	1.70E+00	1.32E-01	4.55E-01	6.00E-01	0.27	1
171 D	SS	8.87E-01	1.03E-01	3.70E-01	0.00E+00	0.00	1
171 A	SS	3.62E-01	8.70E-02	3.40E-01	0.00E+00	0.00	1
171 B	SS	3.14E+00	2.47E-01	6.34E-01	2.04E+00	0.92	1
172 C	CS	9.62E-01	1.94E-01	3.45E-01	0.00E+00	0.00	0
172 B	CS	7.89E-01	1.17E-01	3.42E-01	0.00E+00	0.00	1
172 D	CS	9.75E-01	1.84E-01	5.03E-01	0.00E+00	0.00	-1
172 A	CS	4.36E-01	1.12E-01	3.90E-01	0.00E+00	0.00	-1
173 D	CS	1.03E+00	1.36E-01	4.22E-01	0.00E+00	0.00	-1
173 A	CS	7.77E-01	1.89E-01	4.15E-01	0.00E+00	0.00	0
173 B	CS	7.25E-01	1.28E-01	4.42E-01	0.00E+00	0.00	-2
173 C	CS	7.68E-01	1.01E-01	3.59E-01	0.00E+00	0.00	-2
174 A	CS	1.09E+00	2.12E-01	3.78E-01	0.00E+00	0.00	-2
174 B	CS	8.13E-01	1.25E-01	4.18E-01	0.00E+00	0.00	-1
174 C	CS	1.02E+00	1.97E-01	3.05E-01	0.00E+00	0.00	0
174 D	CS	8.84E-01	1.30E-01	3.51E-01	0.00E+00	0.00	-2
177	CS	9.61E-01	1.59E-01	3.66E-01	0.00E+00	0.00	1
178	CS	8.05E-01	1.51E-01	3.83E-01	0.00E+00	0.00	1
180 A	CS	9.77E-01	2.03E-01	4.44E-01	0.00E+00	0.00	0
180 B	CS	2.90E-01	1.02E-01	3.14E-01	0.00E+00	0.00	0
180 C	CS	7.60E-01	1.08E-01	3.81E-01	0.00E+00	0.00	0
180 D	CS	1.12E+00	1.82E-01	3.94E-01	1.70E-02	0.01	0
181 A	CS	4.13E-01	8.10E-02	2.52E-01	0.00E+00	0.00	0
181 B	CS	3.94E-01	7.50E-02	1.60E-01	0.00E+00	0.00	0
182 A	CS	7.55E-01	1.16E-01	3.75E-01	0.00E+00	0.00	0
182 B	CS	8.61E-01	1.01E-01	3.80E-01	0.00E+00	0.00	0
182 C	CS	2.57E-01	6.10E-02	3.14E-01	0.00E+00	0.00	0
182 D	CS	6.07E-01	1.07E-01	3.55E-01	0.00E+00	0.00	0
183 A	CS	8.34E-01	1.64E-01	2.96E-01	0.00E+00	0.00	0
183 B	CS	6.66E-01	8.90E-02	2.66E-01	0.00E+00	0.00	0
183 C	CS	7.33E-01	1.22E-01	3.97E-01	0.00E+00	0.00	0
183 D	CS	2.19E+00	1.83E-01	5.10E-01	1.09E+00	0.49	0
184 A	CS	1.14E+00	1.26E-01	4.47E-01	3.70E-02	0.02	0
184 B	CS	9.27E-01	1.11E-01	3.42E-01	0.00E+00	0.00	0
184 C	CS	1.10E+00	1.20E-01	4.03E-01	3.00E-03	0.00	0
184 D	CS	1.14E+00	1.76E-01	4.03E-01	4.10E-02	0.02	0

Table 4-32
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Unaffected Areas

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit	Conc. Th-232 (pCi/g)	Unity (-)	Net Exposure Rate (mR/hr)
185 A	CS	8.33E-01	1.07E-01	4.13E-01	0.00E+00	0.00	1
185 B	CS	7.32E-01	1.29E-01	4.96E-01	0.00E+00	0.00	1
185 C	CS	8.32E-01	1.96E-01	4.94E-01	0.00E+00	0.00	0
185 D	CS	6.84E-01	9.10E-02	2.45E-01	0.00E+00	0.00	0
186 A	CS	8.25E-01	1.06E-01	3.49E-01	0.00E+00	0.00	0
186 B	CS	1.07E+00	2.14E-01	3.93E-01	0.00E+00	0.00	1
186 C	CS	5.48E-01	1.32E-01	4.96E-01	0.00E+00	0.00	1
186 D	CS	5.91E-01	1.34E-01	4.17E-01	0.00E+00	0.00	1
187 A	CS	9.23E-01	1.87E-01	3.64E-01	0.00E+00	0.00	1
187 B	CS	8.64E-01	1.22E-01	3.91E-01	0.00E+00	0.00	1
187 C	CS	8.53E-01	1.70E-01	4.48E-01	0.00E+00	0.00	1
187 D	CS	6.94E-01	1.30E-01	2.34E-01	0.00E+00	0.00	1
188 A	CS	8.43E-01	1.20E-01	3.78E-01	0.00E+00	0.00	0
188 B	CS	1.16E+00	1.91E-01	4.99E-01	5.70E-02	0.03	0
188 C	CS	8.42E-01	1.39E-01	5.06E-01	0.00E+00	0.00	0
188 D	CS	5.61E-01	1.05E-01	3.58E-01	0.00E+00	0.00	1
190 A	CS	8.24E-01	1.67E-01	4.22E-01	0.00E+00	0.00	1
190 B	CS	1.38E+00	1.54E-01	4.69E-01	2.76E-01	0.12	1
190 C	CS	1.01E+00	1.41E-01	3.64E-01	0.00E+00	0.00	1
190 D	CS	1.56E+00	1.59E-01	4.98E-01	4.55E-01	0.20	1
191 A	CS	8.55E-01	1.34E-01	4.78E-01	0.00E+00	0.00	1
191 B	CS	9.41E-01	1.17E-01	3.46E-01	0.00E+00	0.00	0
191 C	CS	1.38E+00	1.67E-01	3.52E-01	2.84E-01	0.13	0
191 D	CS	1.49E+00	1.46E-01	4.93E-01	3.89E-01	0.18	-1
194 C	CS	9.01E-01	1.45E-01	3.19E-01	0.00E+00	0.00	-1
194 B	CS	8.86E-01	1.15E-01	3.40E-01	0.00E+00	0.00	-1
194 D	CS	1.28E+00	2.06E-01	3.95E-01	1.76E-01	0.08	-1
194 C	CS	7.88E-01	1.77E-01	4.56E-01	0.00E+00	0.00	-1
195 D	CS	1.04E+00	1.45E-01	3.28E-01	0.00E+00	0.00	-1
195 C	CS	8.70E-01	8.30E-02	3.54E-01	0.00E+00	0.00	-1
195 B	CS	5.47E-01	1.50E-01	5.19E-01	0.00E+00	0.00	-1
195 A	CS	6.47E-01	1.24E-01	4.17E-01	0.00E+00	0.00	-1
196 A	CS	2.00E+00	2.32E-01	4.54E-01	8.96E-01	0.40	-1
196 C	CS	1.58E+00	2.46E-01	5.34E-01	4.81E-01	0.22	-1
196 B	CS	1.14E+00	1.60E-01	4.65E-01	4.20E-02	0.02	-1
196 D	CS	1.53E+00	1.61E-01	4.36E-01	4.29E-01	0.19	-1
197 A	CS	2.13E+00	1.68E-01	5.07E-01	1.03E+00	0.46	0
197 B	CS	2.29E+00	1.89E-01	3.96E-01	1.19E+00	0.53	-1
197 C	CS	2.09E+00	2.10E-01	3.56E-01	9.86E-01	0.44	-1
197 D	CS	1.85E+00	1.41E-01	4.00E-01	7.54E-01	0.34	-1
199 A	CS	1.36E+00	2.15E-01	5.04E-01	2.57E-01	0.12	0
199 C	CS	1.91E+00	1.68E-01	5.30E-01	8.10E-01	0.36	0
199 D	CS	1.88E+00	1.75E-01	7.47E-01	7.80E-01	0.35	0
199 B	CS	1.01E+00	1.41E-01	4.62E-01	0.00E+00	0.00	0
200 A	CS	8.17E-01	1.29E-01	4.59E-01	0.00E+00	0.00	0
200 B	CS	2.94E+00	2.06E-01	5.48E-01	1.84E+00	0.83	0

Table 4-32
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Unaffected Areas

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit	Conc. Th-232 (pCi/g)	Unity (-)	Net Exposure Rate (mR/hr)
201	CS	2.37E+00	2.06E-01	6.35E-01	1.27E+00	0.57	0
202 A	CS	9.19E-01	1.12E-01	3.52E-01	0.00E+00	0.00	0
202 B	CS	7.54E-01	1.10E-01	3.36E-01	0.00E+00	0.00	0
202 C	CS	7.59E-01	1.75E-01	5.11E-01	0.00E+00	0.00	0
202 D	CS	1.02E+00	1.49E-01	4.00E-01	0.00E+00	0.00	1
203 B	CS	1.19E+00	1.55E-01	4.18E-01	8.70E-02	0.04	1
203 C	CS	9.86E-01	1.37E-01	4.05E-01	0.00E+00	0.00	1
203 D	CS	8.95E-01	1.67E-01	4.13E-01	0.00E+00	0.00	1
203 A	CS	9.88E-01	1.67E-01	4.18E-01	0.00E+00	0.00	1
204 A	CS	9.42E-01	1.22E-01	4.68E-01	0.00E+00	0.00	2
204 B	CS	7.64E-01	1.61E-01	3.99E-01	0.00E+00	0.00	2
204 C	CS	8.04E-01	8.90E-02	3.17E-01	0.00E+00	0.00	2
204 D	CS	6.25E-01	1.25E-01	4.67E-01	0.00E+00	0.00	3
205 A	CS	8.57E-01	1.37E-01	6.10E-01	0.00E+00	0.00	3
205 C	CS	1.04E+00	2.04E-01	4.90E-01	0.00E+00	0.00	2
205 B	CS	9.69E-01	1.43E-01	5.33E-01	0.00E+00	0.00	3
205 D	CS	8.90E-01	1.46E-01	5.45E-01	0.00E+00	0.00	3
207 A	CS	8.11E-01	1.30E-01	4.69E-01	0.00E+00	0.00	2
207 B	CS	1.04E+00	1.04E-01	3.25E-01	0.00E+00	0.00	3
207 C	CS	1.44E+00	1.50E-01	3.74E-01	3.40E-01	0.15	2
207 D	CS	2.17E+00	4.02E-01	4.75E-01	1.07E+00	0.48	3
208 A	CS	1.31E+00	1.47E-01	3.98E-01	2.13E-01	0.10	1
208 B	CS	1.09E+00	1.36E-01	4.34E-01	0.00E+00	0.00	1
208 D	CS	1.19E+00	1.20E-01	4.16E-01	8.80E-02	0.04	1
208 C	CS	1.26E+00	1.43E-01	4.99E-01	1.62E-01	0.07	1
211 A	CS	1.46E-01	1.53E-01	4.65E-01	0.00E+00	0.00	0
211 B	CS	8.42E-01	1.21E-01	2.91E-01	0.00E+00	0.00	0
211 C	CS	7.37E-01	1.19E-01	4.15E-01	0.00E+00	0.00	0
211 D	CS	2.08E+00	1.82E-01	4.15E-01	9.81E-01	0.44	0
212 A	CS	1.54E+00	2.16E-01	5.04E-01	4.44E-01	0.20	0
212 B	CS	5.81E-01	1.21E-01	3.15E-01	0.00E+00	0.00	0
212 C	CS	1.25E+00	1.52E-01	4.56E-01	1.52E-01	0.07	0
212 D	CS	6.12E-01	9.30E-02	2.36E-01	0.00E+00	0.00	0
214 A	CS	9.52E-01	1.56E-01	4.24E-01	0.00E+00	0.00	0
214 B	CS	6.69E-01	9.90E-02	2.84E-01	0.00E+00	0.00	0
214 C	CS	6.39E-01	1.32E-01	3.38E-01	0.00E+00	0.00	0
214 D	CS	4.86E-01	1.10E-01	3.36E-01	0.00E+00	0.00	0
218 A	SS	6.18E-01	1.69E-01	3.60E-01	0.00E+00	0.00	0
218 B	SS	6.25E-01	1.24E-01	3.27E-01	0.00E+00	0.00	0
218 C	SS	6.83E-01	1.19E-01	2.84E-01	0.00E+00	0.00	0
218 D	SS	6.34E-01	1.37E-01	4.33E-01	0.00E+00	0.00	1
219 A	SS	6.97E-01	1.17E-01	3.38E-01	0.00E+00	0.00	1
219 B	SS	5.56E-01	1.04E-01	3.71E-01	0.00E+00	0.00	1

Table 4-32
Exposure Rates and Soil Concentrations
Kaiser Adjacent Land Remediation Unaffected Areas

Sample Location	Sample Type	Analytical Results Gross Conc. Th-232 (pCi/g)	Uncert. (+/- pCi/g)	Detection Limit	Conc. Th-232 (pCi/g)	Unity (-)	Net Exposure Rate (mR/hr)	
219 C	SS	4.41E-01	1.03E-01	4.59E-01	0.00E+00	0.00	1	
219 D	SS	6.11E-01	1.26E-01	4.17E-01	0.00E+00	0.00	1	
217 A	CS	1.61E+00	1.60E-01	4.36E-01	5.13E-01	0.23	0	
217 B	CS	5.75E-01	1.29E-01	3.96E-01	0.00E+00	0.00	0	
217 C	CS	5.89E-01	1.42E-01	4.64E-01	0.00E+00	0.00	1	
217 D	CS	8.00E-01	3.20E-02	3.32E-01	0.00E+00	0.00	1	
Degrees of Freedom:	310	1.06E+00	1.53E-01			0.07	1	Average
		5.16E-01	8.38E-02			0.18	2	Std Deviation
		1.46E-01	3.20E-02			0.00	-2	Minimum
		3.14E+00	1.43E+00			0.92	8	Maximum
t value*		9.31E-01	1.41E-01			0.00	0	Median
1.658		1.11E+00	1.61E-01			0.09	1	μ_α 95%CL
1.98		1.12E+00	1.62E-01			0.10	1	μ_α 97.5%CL

*Look up value from Table 1 in Appendix B of NUREG/CR-5849.

Notes: Background value of 1.1 pCi/g Th-232 subtracted from Gross Th-232 result.
Background value of 9 μR/hr subtracted from Gross Exposure Rate measurements.
CS = Core sample.
SS = Soil sample.

Th-232 is calculated using the analytical data and correcting for background. The measured background value is 1.1 pCi/g Th-232.
Unity is calculated by summing the fractions of Th-232, Th-228, and Th-230 activity concentrations divided by their respective acceptance criteria, i.e., Th-232 + Th-228 / 10 pCi/g + Th-230 / 14 pCi/g.
The average and standard deviation of unity is calculated for each final survey grid.
Finally, the average, standard deviation, median, and μ_α (95 and 97.5% confidence level) are calculated for the entire survey unit.
The average and standard deviation calculation for the entire survey unit include the weighted average calculated for any grids that contain elevated areas.
Uncertainty represents the 95 percent confidence level, 2σ.