

Final Status Survey Report Volume III– Pond Parcel Excavation Backfill Units

**Survey Units Kaiser – FSSB – 001
Through Kaiser – FSSB - 009**

Prepared For:



**Kaiser Aluminum & Chemical Corporation
Thorium Remediation Project
Tulsa, Oklahoma Facility**

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**Executive Summary
Final Status Survey Report
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation**

Penn Environmental & Remediation, Inc. (Penn E&R) has been retained by the Kaiser Aluminum & Chemical Corporation (Kaiser) to provide radiological final status survey technical support for the remediation of its Kaiser Aluminum Specialty Products facility (Tulsa, Oklahoma facility) located at 7311 East 41st Street in Tulsa, Oklahoma. The remediation of radiologically impacted portions of the Tulsa, Oklahoma facility has been authorized by the Nuclear Regulatory Commission (NRC) via approval of the site-specific Decommissioning Plan (DP) (June 2001, Rev. May 2003, September 2003, May 2005, and September 2005) and Decommissioning Plan Addendum (DPA) (May 2002, Rev. May 2003) for the facility. The DP and DPA were designed to address the remediation of thorium dross and contaminated soil known to be present at the Tulsa, Oklahoma facility (Thorium Remediation Project).

The DP addresses the remediation of the impacted portions of the 14-acre "Pond Parcel" at the Tulsa, Oklahoma facility and the DPA addresses the approximate 3.5-acre "Former Operational Area" (FOA). The remediation alternative chosen for the Pond Parcel requires excavating material with a net Th-232 activity concentration greater than the Derived Concentration Guideline Level (DCGL_w) of 3.0 pCi/g, based on a dose limit of 25 mrem/yr. Material with net Th-232 activity concentrations greater than the Derived Cutoff Concentration Level (DCCL) of 31.1 net pCi/g Th-232 is being segregated and disposed off site as exempt material at the U.S. Ecology Grand View, Idaho facility. Material with activity concentrations less than 31.1 net pCi/g Th-232 (Below Criteria Material or BCM) is being used as backfill in the Pond Parcel excavation. A layer of clean imported borrow material (minimum thickness of 10 feet) obtained from an off site source is being placed over the BCM and graded in a manner to direct drainage away from the site, after which the site will be revegetated. At the time of preparation of this report, approximately 93 percent of the impacted portion of the Pond Parcel has been remediated.

Remediation activities for the FOA were similar to those implemented for the Pond Parcel with the exception of the excavations being backfilled with clean imported borrow material. At the time of preparation of this **Final Status Survey Report**, the remediation of the impacted portions of the FOA had been completed.

Final status surveys for the Thorium Remediation Project consist of three distinct elements: (1) surveys of the "open land areas" of the site including the excavation bottom surface soils for the Pond Parcel and FOA; (2) surveys of BCM placed in the Pond Parcel excavations; and (3) surveys of structural surfaces. Final status surveys are completed

prior to the backfilling of any Pond Parcel or FOA remediation excavation and during/following the placement of BCM in the Pond Parcel. The survey unit acceptance criteria developed in the DP are applicable to the entire site. Thus, if each survey unit meets the acceptance criteria, the dose for the entire site will be less than the release criteria of 25 mrem/yr.

Pond Parcel Excavation Bottom and FOA Excavation Final Status Surveys

Final status surveys associated with the Pond Parcel and FOA excavation bottoms are conducted through a progression of Class 1 survey units. Survey units typically consist of excavation bottom surface soil and associated side walls, elevated soil areas (if left in-place), and embedded structures (if encountered and left in-place). The final status survey of excavation bottom survey units typically consists of a gross gamma scan of the exposed surface soil of the unit and systematic soil sampling. Additional scanning and soil sampling are included for each elevated measurement comparison (EMC) performed for elevated areas left in-place. Embedded structures (typically small pipes and concrete) are surveyed for total alpha contamination (when possible) and removable alpha contamination.

Compliance with survey unit acceptance criteria is demonstrated by comparison of the average residual contamination for each survey element (excavation bottom soil, elevated areas, and embedded structures) to the appropriate acceptance criteria value and a sum of fractions for each survey unit is also calculated. The sum of fractions is a very conservative assessment of the survey unit. Summing the fractions ensures the survey unit and the entire site will be a small fraction of 25 mrem/yr (the release criterion) when the actual as-left dose assessment is complete. Systematic final status survey data are also evaluated using the Wilcoxon Rank Sum Test procedure.

A total of 30 Pond Parcel excavation bottom survey units are anticipated for the Thorium Remediation Project. Final status surveying and reporting have been completed for 24 of the 30 Pond Parcel excavation bottom survey units. Volume I of this **Final Status Survey Report** documents the final status survey results for Survey Units Kaiser-FSS-001 through Kaiser-FSS-024. One of the 24 excavation bottom survey units (Kaiser-FSS-001) consisted of an embedded structure encountered (a buried concrete spillway) during the removal of radiologically impacted soil. A summary of the final status survey results by survey unit is provided below in Table 1.

Of the 6 remaining open land area survey units for the pond parcel (Survey Units Kaiser-FSS-025 through Kaiser-FSS-030) it should be noted that remediation and final status survey sampling have been completed for 4 of those units (Kaiser-FSS-027 through Kaiser-FSS-030). Soil screening values and/or analytical laboratory results for all systematic soil samples for each survey unit were below the DCGL_w. In addition, no elevated areas were left in-place, therefore, no elevated measurement comparisons will be required for these units. Kaiser anticipates that the remediation and final status survey sampling results for Survey Units Kaiser-FSS-025 and Kaiser-FSS-026 will also meet the DP acceptance criteria. The results of the final status surveys for the remaining 6 Pond

Parcel excavation bottom survey units will be documented in an addendum to this Final Status Survey Report to be submitted at the end of the remediation project.

Table 1 – Pond Parcel Excavation Final Status Survey Summary by Survey Unit

Survey Unit	Surface Area (m ²)	No. of Systematic Samples Collected	Systematic Sample Exceedance of DCGL Value	WRS Test Criterion Met	Elevated Area(s) Present	Embedded Structure(s) Present	Total Sum of Fractions	Survey Unit Meets DP Acceptance Criteria
Kaiser-FSS-001*	84.5	36	YES	YES	YES	N/A	0.99	YES
Kaiser-FSS-002	126.5	9	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-003	80	9	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-004	107	9	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-005	35	9	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-006	2,670	12	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-007	1,182	16	NO	YES	NO	YES	0.04	YES
Kaiser-FSS-008	424	9	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-009	1,000	9	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-010	986	10	NO	YES	NO	YES	0.00	YES
Kaiser-FSS-011	2,400	12	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-012	2,460	12	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-013	1,320	10	NO	YES	YES	YES	0.38	YES
Kaiser-FSS-014	1,892	10	NO	YES	YES	YES	0.67	YES
Kaiser-FSS-015	1,997	10	NO	YES	NO	YES	0.18	YES
Kaiser-FSS-016	2,484	14	NO	YES	YES	NO	0.79	YES
Kaiser-FSS-017	2,230	17	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-018	1,582	10	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-019	1,582	10	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-020	1,570	9	NO	YES	YES	NO	0.19	YES
Kaiser-FSS-021	1,985	9	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-022	1,840	9	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-023	1,750	10	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-024	1,454	10	NO	YES	NO	NO	0.00	YES

* Survey Unit Kaiser- FSS-001 is the buried concrete spillway structure. The other pond parcel survey units are defined as open land areas.

Final status surveying and reporting have been completed for all 9 FOA excavation survey units. Volume II of this Final Status Survey Report documents the final status survey results for Survey Units Kaiser-FSSFOA-001 through Kaiser-FSSFOA-009. Three of the nine FOA excavation survey units consisted only of embedded structures (retaining walls) that were encountered during the removal of radiologically impacted

soil located adjacent to the structures. A summary of the final status survey results by survey unit is provided below in Table 2.

Table 2 – FOA Excavation Final Status Survey Summary by Survey Unit

Survey Unit	Surface Area (m ²)	No. of Systematic Samples Collected	Systematic Sample Exceedance of DCGL Value	WRS Test Criterion Met	Elevated Area(s) Present	Embedded Structure(s) Present	Total Sum of Fractions	Survey Unit Meets DP Acceptance Criteria
Kaiser-FSSFOA-001	228	9	NO	YES	NO	NO	0.00	YES
Kaiser-FSSFOA-002	49	9	NO	YES	NO	NO	0.00	YES
Kaiser-FSSFOA-003*	35	21	NO	YES	NO	N/A	0.16	YES
Kaiser-FSSFOA-004	84	10	NO	YES	NO	YES	0.15	YES
Kaiser-FSSFOA-005	1,320	9	NO	YES	NO	YES	0.03	YES
Kaiser-FSSFOA-006	2,550	13	NO	YES	YES	YES	0.59	YES
Kaiser-FSSFOA-007*	81.5	18	NO	YES	NO	N/A	0.07	YES
Kaiser-FSSFOA-008*	9.3	14	NO	YES	NO	N/A	0.09	YES
Kaiser-FSSFOA-009	19.5	10	NO	YES	NO	NO	0.00	YES

* Survey unit consists of a structure (cinderblock or concrete retaining wall) encountered during the removal of radiologically impacted soil.

Pond Parcel Excavation Backfill Units (BCM) Final Status Surveys

As with the Pond Parcel excavation bottoms, final status surveys associated with the Pond Parcel excavation backfill units (BCM) are conducted through a progression of Class 1 survey units. Typically a unit of BCM is placed in a portion(s) of a pond parcel excavation bottom(s) associated with a defined excavation bottom final status survey unit(s). Backfill units are completed through the placement of typically four to eight continuous layers (2-foot compacted lift depth) of BCM in a defined area. The final status survey of excavation backfill units consists of a gross gamma scan of each placed 2-foot lift of BCM and systematic soil core sampling upon completion of the BCM unit. Compliance with survey unit acceptance criteria is demonstrated by comparison of the average residual contamination for the survey unit to the appropriate acceptance criteria value. Systematic soil core sampling data are also evaluated using the Wilcoxon Rank Sum Test procedure.

A total of 15 Pond Parcel excavation backfill survey units are anticipated for the Thorium Remediation Project. Final status surveying and reporting have been completed for 9 of the 15 Pond Parcel excavation backfill survey units. **Volume III** of this **Final Status Survey Report** documents the final status survey results for Survey Units Kaiser-FSSB-001 through Kaiser-FSSB-009. A summary of the final status survey results by survey unit is provided below in Table 3.

Of the six remaining BCM survey units for the pond parcel (Survey Units Kaiser-FSSB-010 through Kaiser-FSSB-015), it should be noted that the placement of BCM and final status survey sampling have been completed for three of those units (Kaiser-FSSB-010 through Kaiser-FSSB-012). Soil screening values and/or analytical laboratory results for all systematic core samples for each survey unit were below the DCCL. Kaiser anticipates that the final status survey sampling results for Survey Units Kaiser-FSSB-013 through Kaiser-FSSB-015 will also meet the DP acceptance criteria. The results of the final status surveys for the remaining six Pond Parcel backfill survey units will be documented in an addendum to this Final Status Survey Report to be submitted at the end of the remediation project.

Table 3 – Pond Parcel Excavation Backfill Final Status Survey Summary by Survey Unit

Survey Unit	Base Surface Area (m ²)	No. of Systematic Soil Cores	No. of Systematic Soil Core Composite Samples	Systematic Soil Core Sample Exceedance of DCCL Value	WRS Test Criterion Met	Elevated Area(s) Present	Survey Unit Meets DP Acceptance Criteria
Kaiser-FSSB-001	2,220	11	28	NO	YES	NO	YES
Kaiser-FSSB-002	2,405	12	17	NO	YES	NO	YES
Kaiser-FSSB-003	1,709	11	37	NO	YES	NO	YES
Kaiser-FSSB-004	1,647	9	33	NO	YES	NO	YES
Kaiser-FSSB-005	1,716	9	34	NO	YES	NO	YES
Kaiser-FSSB-006	2,177	12	44	NO	YES	NO	YES
Kaiser-FSSB-007	1,381	9	44	NO	YES	NO	YES
Kaiser-FSSB-008	1,431	9	45	NO	YES	NO	YES
Kaiser-FSSB-009	1,840	9	20	NO	YES	NO	YES

Bounding As-Left Condition Final Dose Assessment

A bounding as-left condition dose assessment based on the maximum activity concentration of the BCM and minimum clean soil cover requirement has been completed for the Thorium Remediation Project. The resulting maximum dose is 1.33 mrem/yr. At the conclusion of the Thorium Remediation Project, the actual activity concentrations and the actual dimensions of the cover could be used to reassess the final dose. Since the activity concentrations will be less than bounding values used and the dimensions of the cover will be at least what were used, the resulting dose would be less than 1.33 mrem/yr.

**Final Status Survey Report
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Tulsa, Oklahoma Facility
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1.0 ROAD MAP – VOLUMES I THROUGH III

Penn Environmental & Remediation, Inc. (Penn E&R) has been retained by the Kaiser Aluminum & Chemical Corporation (Kaiser) to provide radiological final status survey technical support for the remediation of its Kaiser Aluminum Specialty Products facility (Tulsa, Oklahoma facility) located at 7311 East 41st Street in Tulsa, Oklahoma (Figure 1). The remediation of radiologically impacted portions of the Tulsa, Oklahoma facility has been authorized by the Nuclear Regulatory Commission (NRC) via approval of the site-specific Decommissioning Plan (DP) (June 2001, Rev. May 2003, September 2003, May 2005, and September 2005) and Decommissioning Plan Addendum (DPA) (May 2002, Rev. May 2003) for the facility. The DP and DPA were designed to address the remediation of thorium dross and contaminated soil known to be present at the Tulsa, Oklahoma facility (Thorium Remediation Project). The DP and DPA specify the procedures to safely decommission the Tulsa, Oklahoma facility and meet the NRC requirements for unrestricted use: residual radioactivity distinguishable from background will not result in a total effective dose equivalent (TEDE) to an average member of a critical group (resident farmer) that exceeds 25 millirem per year (mrem/yr). Additionally, implementation of the DP and the DPA will reduce residual radioactivity to levels that are as low as reasonably achievable (ALARA).

The final status survey technical approach authorized by the NRC (Chapter 14.0 of the DP and DPA) includes the protocols and guidance provided in NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (USEPA, December 1997) to demonstrate compliance with the DP and DPA release criteria. A copy of the most recent version (September 2005) of Chapter 14.0 is presented as an appendix to the Final Status Survey Report.

This Road Map was written to provide the reader with relevant background information related to the DP and DPA, a historical operations perspective for the site, as well as an overview of current site remediation and associated final status survey activities.

1.1 Decommissioning Plan and Decommissioning Plan Addendum

The DP addresses the remediation of the impacted portions of the 14-acre "Pond Parcel" at the Tulsa, Oklahoma facility and the DPA addresses the approximate 3.5-acre "Former Operational Area". The Pond Parcel has been divided into three parts: the non-impacted former Freshwater Pond area to the west (approximately 4 acres); the impacted

Retention Pond/Reserve Pond area to the east (approximately 9 acres); and the impacted area adjacent to the Flux Building and paved area (approximately 1 acre) (Figure 2).

The Former Operational Area (FOA) is principally a triangular parcel of land north of 41st Street and south of the Union Pacific Railroad right-of-way, on which plant processes and operations occurred. None of the original buildings which housed magnesium-thorium alloy processing, existed on site at the onset of the Thorium Remediation Project. The Flux Building, located to the northeast of the triangular parcel, is part of the FOA (Figure 2).

1.2 Historical Operations Perspective

The Standard Magnesium Corporation (SMC) built the Tulsa, Oklahoma facility in Tulsa, Oklahoma in the early to mid-1950s to manufacture magnesium products. SMC received a source materials license (C-4012) from the Atomic Energy Commission in March 1958 to receive possession and title to magnesium-thorium alloy (a thorium metal) with up to 4 percent thorium content for processing. Historical operations at the facility included the smelting of scrap magnesium alloy for the production of anodes. Scrap magnesium-thorium alloy was smelted, along with other magnesium materials, to recover the magnesium. Thorium alloy material comprised a small fraction of the total magnesium refined on site. Licensed operations involving the recovery of magnesium-thorium alloy began in 1958 and continued through 1968. Kaiser purchased the facility in 1964. Magnesium refining operations continued at the facility until approximately 1985. Aluminum then replaced magnesium in smelting and anode manufacture, and the plant continued operating until the 1997-1998 time frame.

License C-4012 was superseded by License STB-472 in November 1961. License STB-472 was amended in June 1968 to add uranium to the list of authorized materials, but there is no record that uranium-bearing materials were ever received on site. The license was terminated in 1971 by the AEC at Kaiser's request. At that time, Kaiser stated that it had not processed magnesium-thorium alloy in the past year.

The scrap magnesium alloy refining process consisted of placing the material into large melting pots, heating the material until molten, and then siphoning off the pure magnesium. Impurities from the mixture, including thorium, separated from the magnesium. This residue material was removed, allowed to cool, and crushed. The crushed material was returned to the heating pots for a second recovery process. Once refined, the metallic dross residue material was crushed and disposed on site.

The quantity of licensed material SMC and later Kaiser were authorized to possess at one time was periodically amended, but generally was limited to 30,000 pounds of magnesium-thorium alloy containing no more than 4 percent thorium. Records documenting the quantity of licensed material present at the site are not available.

1.3 Site Remediation

The site has been divided into two remediation areas: the Pond Parcel area where the dross residues were stored and the FOA where the site structures were located. These two areas and the planned/completed remedial activities are described in the following sections.

1.3.1 Pond Parcel Description and Remediation

Extensive site characterization activities were conducted within the 14-acre land area of the facility known as the Pond Parcel. These characterization activities indicated the presence of residual radioactive material within a 10-acre portion of the Pond Parcel. The radioactive material identified within this portion of land was a thorium-bearing dross containing the isotopes thorium-232 (Th-232), thorium-230 (Th-230), and thorium-228 (Th-228). 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-232+Th-228)/2) of 3.5 was calculated based on characterization data.

As previously mentioned, the impacted portion of the parcel contains the Retention Pond and former Reserve Pond area. The non-impacted portion of the Pond Parcel contains the former Freshwater Pond area. The DP was written to address the remediation of the Pond Parcel land area. The impacted Pond Parcel land area is bounded by the south fence line, the former Freshwater Pond embankment on the west, Fulton Creek ditch on the north, and the east fence line. A central feature of this area is the Retention Pond and associated embankments.

Thorium-bearing dross was also present on land adjacent to current Kaiser Property along the east and south fence lines and represented the margins of the impacted material. Per an NRC-approved remediation plan, Kaiser remediated this "adjacent land" by excavation and storing impacted soil within the Pond Parcel. Kaiser conducted the adjacent land remediation project (ALRP) during the period of October 2000 through May 2001. Impacted soil generated during the ALRP was considered part of the on-site decommissioning. In a letter dated March 7, 2002, the NRC provided Kaiser with a determination that the remediated adjacent properties met the criteria for unrestricted release.

The remediation alternative chosen for the Pond Parcel requires excavating material with a net Th-232 activity concentration greater than the Derived Concentration Guideline Level (DCGL_w) of 3.0 pCi/g, based on a dose limit of 25 mrem/yr. Material with net Th-232 activity concentrations greater than the Derived Cutoff Concentration Level (DCCL) of 31.1 net pCi/g Th-232 is being segregated and disposed off site as exempt material at the U.S. Ecology Grand View Idaho facility. Material with activity concentrations less than 31.1 net pCi/g Th-232 (Below Criteria Material or BCM) is being used as backfill in the Pond Parcel excavation. A layer of clean imported borrow material (minimum thickness of 10 feet) obtained from an off-site source is being placed

over the BCM and graded in a manner to direct drainage away from the site, after which the site will be revegetated.

At the time of preparation of this report, approximately 93 percent of the impacted portion of the Pond Parcel has been remediated. The remediated portion of the Pond Parcel has been excavated to depths up to 15 to 20 feet and to an average depth estimated at 14 feet across most of the Retention and Reserve ponds. At the end of the Thorium Remediation Project, approximately 4,000,000 cubic feet (ft³) of clean off-site soil will have been used to backfill the Pond Parcel excavations.

1.3.2 Former Operational Area (FOA) Description and Remediation

The DP identified the potential for radioactive material beneath several paved areas and building floor surfaces of the FOA. This determination was based upon an interpretation of historical data and/or observations made during the ALRP. As a result, a limited Additional Site Characterization Activities (ASCA) effort was conducted in the FOA during mid-2001. The objective of the ASCA was to determine if thorium-bearing dross/radioactive material was present beneath these areas of concern. Soil data obtained during the ASCA indicated the presence of residual radioactive material beneath several concrete-paved surfaces at relatively shallow depths. The presence of this material beneath the surfaces was most likely the result of historical grading activities.

A Historical Site Assessment (HSA) was then performed during late 2001 for the FOA. The HSA was conducted as the first step toward decommissioning the FOA at the Tulsa, Oklahoma facility. The objective of the HSA was to compile as much historical information as possible for the facility and, using the MARSSIM guidelines, categorize the land areas and structures of the FOA of the facility as either impacted or non-impacted. None of the original buildings which housed magnesium-thorium alloy processing existed on site at the time of the HSA. With the exception of the Flux Building, there were no buildings in the FOA of the facility classified as impacted in the HSA. The Flux Building was initially classified as an impacted structure due to past and current uses of the building to house and process soil core and surface samples. Land areas initially classified as impacted included the land areas beneath the Maintenance Building, the Crusher Building, the Crusher Addition Building, the North Extrusion Building, the Warehouse Building, and the former Smelter Building, as well as concrete paved areas completed post-1958 (Figure 2).

The results of the HSA (Appendix A of the DPA) were used to design radiological survey efforts for the structures and land areas of the FOA. The recommended radiological extended scoping (non-impacted structures) and characterization (impacted land areas) survey efforts were described in a work plan prepared by Earth Sciences Consultants, Inc. (December 2001). The primary objective of the extended scoping survey of the six existing site structures were to verify their initial classification as non-impacted in the HSA. The primary objectives of the characterization survey of the impacted land areas were to determine the nature and extent of residual radioactive materials within the FOA and collect sufficient data to support evaluation of remedial alternatives and technologies

for the impacted land areas of the FOA. The radiological survey efforts were completed during the months of January and February 2002. Results of the radiological surveys are presented in Chapter 4.0 of the DPA.

Based on the results of the survey effort, select land areas of the FOA were identified for remediation. These areas include the following:

- A portion of the land area beneath the former Warehouse Building (Survey Unit Kaiser-FSSFOA-005).
- A portion of the land area beneath the former Crusher Building (Survey Unit Kaiser-FSSFOA-006).
- The land area beneath a "built-up" dock area located immediately west of the former Crusher Building (Survey Unit Kaiser-FSSFOA-005).
- The land area beneath a built-up dock area located immediately west of the former Maintenance Building (Survey Unit Kaiser-FSSFOA-004).
- A portion of the land area beneath a paved concrete surface situated northwest of the former Maintenance Building, northeast of the former North Extrusion Building, and south of the Union Pacific Railroad right-of-way (Survey Unit Kaiser-FSSFOA-001).
- A portion of the land area along a concrete retaining wall situated at the southeastern corner of the former Maintenance Building (Survey Unit Kaiser-FSSFOA-002).
- A portion of the land area beneath a paved concrete surface situated to the north of the former Warehouse Building (Survey Unit Kaiser-FSSFOA-005).
- A portion of the land area beneath a paved concrete surface situated north of 41st Street and the former Crusher Building, south of the UPRR right-of-way, and west of the areas remediated during the ALRP (Survey Unit Kaiser-FSSFOA-006).

Kaiser completed select pre-decommissioning activities prior to undertaking the Thorium Remediation Project. The most significant pre-decommissioning activity was the demolition of several of the non-impacted FOA structures to facilitate the excavation of impacted material located beneath floor slabs. Non-impacted structures that were demolished included the Warehouse Building, the Crusher Building, and Crusher Addition Building. The Flux Building was demolished during the Thorium Remediation Project following the completion of a final status survey of the structure and NRC approval (August 1, 2005 NRC letter from John T. Buckley to Bill Vinzant). The demolished materials were disposed as construction debris off-site at a local permitted facility. The concrete floor slabs and paved surface concrete were removed in sections. The underside of each section of concrete was mechanically cleaned to remove loose soil and clearance surveyed based on the guidance of NRC FC 83-23. In addition, relative to the disposal of the cleared concrete slabs in a local permitted facility, the State of Oklahoma specified that contamination levels shall not be different than background.

At the time of preparation of this Final Status Survey report, the remediation of the impacted portions of the FOA had been completed. Remediation activities for the FOA consisted of the excavation of material with a net Th-232 activity concentration greater than the DCGL_w of 3.0 pCi/g and the backfill of the excavations with clean imported borrow material. The excavated material was transported to the Pond Parcel where material with net Th-232 activity concentrations greater than the DCCL of 31.1 pCi/g was segregated on site and disposed off site as exempt material at the U.S. Ecology Grand View Idaho facility. BCM (material with net activity concentrations below 31.1 pCi/g Th-232) was placed in the Pond Parcel excavation as backfill. At the end of the decommissioning project, the backfilled excavations located within the FOA will be final graded and vegetated to minimize soil erosion and promote positive site drainage.

1.4 Final Status Surveys and Reporting

Final status surveys for the Thorium Remediation Project consists of three distinct elements: (1) surveys of the "open land areas" of the site including the excavation bottom surface soils for the Pond Parcel and FOA; (2) surveys of BCM placed in the Pond Parcel excavations; and (3) surveys of structural surfaces. Final status surveys are completed prior to the backfilling of any Pond Parcel or FOA remediation excavation and during/following the placement of BCM in the Pond Parcel. The survey unit acceptance criteria developed in the DP are applicable to the entire site. Thus, if each survey unit meets the acceptance criteria, the dose for the entire site will be less than the release criteria of 25 mrem/yr.

The Final Status Survey Report is being submitted to NRC to address the survey units completed to date for the Thorium Remediation Project. The layout of this submittal is as follows:

- Volume I – Pond Parcel Excavation Bottom Survey Units
- Volume II – Former Operational Area Excavation Survey Units
- Volume III – Pond Parcel Backfill (BCM) Survey Units

Each volume of the Final Status Survey Report contains individual sub-reports that provide final status survey results for a particular survey unit. Each volume also contains independent chapters describing the specific type and/or area of survey, applicable acceptance criteria and survey protocols, and a summary of survey results as well as supporting figures, tables, and attachments.

1.4.1 Pond Parcel and FOA Excavation Bottom Surveys and Reporting

Final status surveys associated with the Pond Parcel and FOA excavation bottoms are conducted through a progression of Class 1 survey units. Survey units typically consist of excavation bottom surface soil and associated side walls, elevated soil areas (if left in-place), and embedded structures (if encountered and left in-place). The final status survey of excavation bottom survey units typically consists of a gross gamma scan of the exposed surface soil of the unit and systematic soil sampling. Additional scanning and

soil sampling are included for each elevated measurement comparison (EMC) performed for elevated areas left in-place. Embedded structures (typically small pipes and concrete) are surveyed for total alpha contamination (when possible) and removable alpha contamination.

Compliance with survey unit acceptance criteria is demonstrated by comparison of the average residual contamination for each survey element (excavation bottom soil, elevated areas, and embedded structures) to the appropriate acceptance criteria value and a sum of fractions for each survey unit is also calculated. The sum of fractions is a very conservative assessment of the survey unit. Summing the fractions ensures the survey unit and the entire site will be a small fraction of 25 mrem/yr (the release criterion) when the actual as-left dose assessment is complete. Systematic final status survey data are also evaluated using the Wilcoxon Rank Sum Test procedure.

A total of 30 Pond Parcel excavation bottom survey units are anticipated for the Thorium Remediation Project. Final status surveying and reporting have been completed for 24 of the 30 Pond Parcel excavation bottom survey units. **Volume I** of this **Final Status Survey Report** documents the final status survey results for Survey Units Kaiser-FSS-001 through Kaiser-FSS-024. One of the 24 excavation bottom survey units (Kaiser-FSS-001) consisted of an embedded structure encountered (a buried concrete spillway) during the removal of radiologically impacted soil. A discussion of the appropriate survey unit acceptance criteria and surveying protocol for the Pond Parcel excavation bottom survey units is also presented in **Volume I** of this **Final Status Survey Report**. The results of the final status surveys for the remaining 6 Pond Parcel excavation bottom survey units will be documented in an addendum to this Final Status Survey Report to be submitted at the end of the remediation project.

Final status surveying and reporting have been completed for all 9 FOA excavation survey units. **Volume II** of this **Final Status Survey Report** documents the final status survey results for Survey Units Kaiser-FSSFOA-001 through Kaiser-FSSFOA-009. Three of the 9 FOA excavation survey units consisted only of embedded structures (retaining walls) that were encountered during the removal of radiologically impacted soil located adjacent to the structures. A discussion of the appropriate survey unit acceptance criteria and surveying protocol for the FOA excavation survey units is also presented in **Volume II** of this **Final Status Survey Report**.

1.4.2 Pond Parcel Excavation Backfill Units (BCM) Surveys and Reporting

As with the Pond Parcel excavation bottoms, final status surveys associated with the Pond Parcel excavation backfill units (BCM) are conducted through a progression of Class 1 survey units. Typically a unit of BCM is placed in a portion(s) of a pond parcel excavation bottom(s) associated with a defined excavation bottom final status survey unit(s). Backfill units are completed through the placement of typically four to eight continuous layers (2-foot compacted lift depth) of BCM in a defined area. The final status survey of excavation backfill units consists of a gross gamma scan of each placed 2-foot lift of BCM and systematic soil core sampling upon completion of the BCM unit.

Compliance with survey unit acceptance criteria is demonstrated by comparison of the average residual contamination for the survey unit to the appropriate acceptance criteria value. Systematic soil core sampling data are also evaluated using the Wilcoxon Rank Sum Test procedure.

A total of 15 Pond Parcel excavation backfill survey units are anticipated for the Thorium Remediation Project. Final status surveying and reporting have been completed for 9 of the 15 Pond Parcel excavation backfill survey units. **Volume III** of this **Final Status Survey Report** documents the final status survey results for Survey Units Kaiser-FSSB-001 through Kaiser-FSSB-009. A discussion of the appropriate survey unit acceptance criteria and surveying protocol for the Pond Parcel excavation backfill units is presented in **Volume III** of this **Final Status Survey Report**. The results of the final status surveys for the remaining 6 Pond Parcel excavation backfill survey units will be documented in an addendum to this **Final Status Survey Report** to be submitted at the end of the remediation project.

1.4.3 Final Status Survey QA Program

The final status survey QA program implemented for the Thorium Remediation Project includes QA functions that cover aspects of data collection, including both field radiation instrument surveys, and soil and smear sampling for laboratory analysis, through the preparation of the documentation of the results. Applicable field radiation instrument final status survey QA data for each survey unit is provided in **Appendix A** to **Volumes I through III** of this **Final Status Survey Report**. Analytical QA data for the final status surveys will be documented in an addendum to this **Final Status Survey Report** to be submitted at the end of the remediation project.

1.4.4 Documentation of As-Left Condition and the Completion of a Final Dose Assessment

A bounding dose assessment based on the maximum activity concentration and minimum soil cover requirement has been completed and is presented in **Appendix E** of **Volume III** of this **Final Status Survey Report**. The resulting maximum dose is 1.33 mrem/yr. At the conclusion of the Thorium Remediation Project, the actual activity concentrations and the actual dimensions of the cover could be used to reassess the final dose. Since the activity concentrations will be less than bounding values used and the dimensions of the cover will be at least what were used, the resulting dose would be less than 1.33 mrem/yr.

**Final Status Survey Report
Volume III - Pond Parcel Excavation Backfill Units
Survey Units Kaiser-FSSB-001 through Kaiser-FSSB-009
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation
March 22, 2006**

2.0 INTRODUCTION

This volume of the Final Status Survey Report presents the results of Pond Parcel excavation backfill unit final status survey activities completed as part of the Thorium Remediation Project at the Tulsa, Oklahoma facility (**Figure 1**). Final status surveys associated with the Pond Parcel backfill units are being conducted through a progression of Class 1 survey units. Typically a unit of Below Criteria Material or BCM (less than 31.1 net pCi/g Th-232 material) is placed in a portion(s) of a pond parcel excavation bottom(s) associated with a defined excavation bottom final status survey unit(s). Backfill units are completed through the placement of typically four to eight continuous layers (2-foot compacted lift depth) of BCM. The final status survey of excavation backfill units consists of a gross gamma scan of each placed 2-foot lift of BCM and systematic soil core sampling upon completion of the BCM unit.

A total of 15 Pond Parcel excavation backfill survey units are anticipated for the Thorium Remediation Project. Final status surveying and reporting have been completed for 9 of the 15 Pond Parcel excavation backfill survey units. This volume of the Final Status Survey Report documents the final status survey results for Survey Units Kaiser-FSSB-001 through Kaiser-FSSB-009 (**Figure 3**). Specifically, this volume of the report contains 9 individual sub-reports (BCM-001 through BCM-009), each documenting the final status survey results for a particular survey unit. The results of the final status surveys for the remaining 6 Pond Parcel excavation backfill survey units will be documented in an addendum to this Final Status Survey Report to be submitted at the end of the remediation project.

The remaining chapters of this volume presents the site release criteria for the Tulsa, Oklahoma facility and the acceptance criteria to be used to clear survey units (**Chapter 3.0**), an overview of the surveying protocol for the Pond Parcel excavation backfill survey units (**Chapter 4.0**), and a summary of findings relative to the final status survey of Pond Parcel excavation backfill Survey Units Kaiser-FSSB-001 through Kaiser-FSSB-009 (**Chapter 5.0**). Supporting appendices to this volume of the Final Status Survey Report include the following:

- **Appendix A** – Survey Instrument Quality Assurance/Quality Control (QA/QC) Documentation
- **Appendix B** – Chapter 14.0 of the Decommissioning Plan (September 2005 Revision)
- **Appendix C** – Evaluation of Survey Unit Analytical Results, Wilcoxon Rank Sum Test
- **Appendix D** – Onsite Cave Counter Calibration and Soil Sample Results
- **Appendix E** – Bounding As-Left Condition Final Dose Assessment

3.0 FINAL STATUS SURVEY ACCEPTANCE CRITERIA

3.1 Site Release Criteria and Survey Unit Acceptance Criteria

The site release criteria for the Kaiser Tulsa, Oklahoma facility, as presented in the DP are:

"The site will be remediated in accordance with decommissioning criteria of Subpart E, Radiological Criteria for License Termination of 10 CFR Part 20, Standards of Protection Against Radiation. Specifically, Subpart E, 10 CFR 20.1402, Radiological Criteria for Unrestricted Use, allows release of a site for unrestricted use if the residual radioactivity distinguishable from background results in a TEDE to an average member of the critical group that does not exceed 25 mrem/yr and the residual radioactivity has been reduced to levels that are ALARA."

In regards to acceptance criteria to be used to clear survey units the DP continues:

"Dose modeling is used to estimate the TEDE to the average member of the critical group (that group reasonably expected to receive the greatest exposure to residual radioactivity for any applicable circumstances). The concentration of residual radioactivity (per radionuclide) distinguishable from background that, if distributed uniformly throughout a survey unit, results in a TEDE of 25 mrem in 1 year to an average member of the critical group is the single-radionuclide DCGL_w."

Two factors complicate the application of DCGL_w acceptance criteria at the Kaiser Tulsa, Oklahoma facility. The first is the presence of multiple radionuclides, specifically, Th-232, Th-228 and Ra-228 from the thorium decay series and Th-230, Ra-226 and Pb-210 from the uranium decay series. Each radionuclide has a DCGL_w value corresponding to the 25 mrem TEDE criteria. When multiple radionuclides are present, compliance may be demonstrated by a sum of fractions calculation over the entire series of radionuclides or the use of a surrogate value to represent 25 mrem TEDE for the entire mix of radionuclides presents. The activity concentration of Th-232 in units of pCi/g has been established as the surrogate acceptance criteria for surveys of soil and soil-like material. Use of Th-232 as a surrogate for soil surveys is detailed in the DP. Likewise gross alpha activity has been established as the surrogate acceptance criteria for surveys of structural surfaces. The use of gross alpha as a surrogate for structure surveys is detailed in the Technical Addendum to the Decommissioning Plan and Addendum, Revised Structural Surface Acceptance Criteria (May 2005).

The second factor is the presence of three distinct survey elements onsite. In addition to the exposed surface soil of the excavated open land areas and surfaces of structures remaining onsite, a third survey element is present as a result of the remedy provided in the DP. In developing the remedial action plan, a derived cutoff concentration level (DCCL) of 31.1 net pCi/g Th-232 has been determined. This value represents the dividing line concentration between material which must be exported to an off-site disposal facility and material which can remain onsite under an unrestricted release scenario. The dose assessment presented in Chapter 5.0 of the DP demonstrates that unrestricted release dose levels can be achieved when material below the DCCL are returned to the excavation. The average concentration of BCM

remaining on site is termed in the DP as the Average Derived Concentration Level (ADCL_w). Dose-based criteria have been established for the Kaiser Tulsa, Oklahoma facility for three distinct survey elements: (1) surveys of the open land areas of the site including the FOA and the Pond Parcel excavation bottoms; (2) surveys of the Pond Parcel excavation backfill (BCM) units; and (3) surveys of structural surfaces.

Finally, for each survey element acceptance criteria there are additional criteria provided to address small areas of elevated activity calculated from area factors (AF) provided in the DP and the technical addendum to the DP. The elevated measurement comparison (EMC) criteria are referred to as DCGL_{EMC} values.

The inputs and assumptions used to derive element specific acceptance criteria are not the same, but rather are conservative for the specific survey element. The stand-alone acceptance criteria and key inputs/assumptions are:

- **Excavation Bottom Surface Soil DCGL_w** – 3.0 net pCi/g of Th-232 over the entire survey unit. Inputs/assumptions include 6-inch contaminated zone thickness and no cover.
- **Excavation Bottom Surface Soil DCGL_{EMC}** – 37.5 net pCi/g of Th-232 over 1 m². Additional values are provided for increasing survey areas. Inputs/assumptions are the same as excavation bottom surface soil except for area.
- **Below Criteria Material (BCM) DCCL** – 31.1 net pCi/g of Th-232 over the entire survey unit. Inputs/assumptions include a 3.31-meter contaminated zone thickness and minimum 3.05-meter (10 feet) clean layer of import borrow (soil) material.
- **Below Criteria Material (BCM) ADCL_{EMC}** – 87.5 net pCi/g of Th-232 over 1 m². Additional values are provided for increasing survey areas. Inputs/assumptions are the same as BCM except for area.
- **Structure Surface Total Contamination GA-DCGL** – 944 net dpm/100cm² gross alpha over 100 m². Inputs/assumptions include 100 m² of surface area and a removable fraction of 0.1.
- **Structure Surface Removable Contamination GA-DCGL** – 94.4 net dpm/100cm² gross alpha over 100 m². Inputs/assumptions are the same as structure surface total contamination.
- **Structure Surface Total Contamination GA-DCGL_{EMC}** – 92,700 net dpm/100cm² gross alpha over 1 m². Inputs/assumptions are the same as structure surface total contamination except for area.
- **Structure Surface Removable Contamination GA-DCGL_{EMC}** – 9,270 net dpm/100cm² gross alpha over 1 m². Additional values are provided for increasing survey areas. Inputs/assumptions are the same as structure surface total contamination except for area.

3.2 Open Land Area Acceptance Criteria

For surveys of the open land surface (excavation bottom and side walls) remaining after excavation of radiologically impacted material from the Pond Parcel and FOA, a surrogate net Th-232 activity concentration of 3.0 pCi/g is the applicable DCGL_w value. Table 3-1 presents area factors (based upon MARSSIM guidance) to be used for elevated measurement comparisons

(EMC) and to determine sampling requirements in situations where the scan instrument's minimum detectable concentration (MDC) is greater than the $DCGL_W$. The $DCGL_{EMC}$ values applicable to the open land areas of the site area are calculated by multiplying the $DCGL_W$ by the area factors presented in Table 3-1. $DCGL_{EMC}$ values are presented in Table 3-2.

$$DCGL_{EMC} = \text{Area Factor} * DCGL_W$$

Table 3-1 – Open Land Areas Area Factors

Area Factors									
Radio-nuclide	1 m ² (11 ft ²)	3 m ² (32 ft ²)	10 m ² (108 ft ²)	30 m ² (323 ft ²)	100 m ² (1,076 ft ²)	300 m ² (3,229 ft ²)	1,000 m ² (10,764 ft ²)	3,000 m ² (32,292 ft ²)	10,000 m ² (107,639 ft ²)
Th-232	12.5	6.2	3.2	2.3	1.8	1.5	1.1	1.0	1.0

Table 3-2 - $DCGL_{EMC}$ Values for Open Land Areas

$DCGL_{EMC}$ (pCi/g)									
Radio-nuclide	1 m ² (11 ft ²)	3 m ² (32 ft ²)	10 m ² (108 ft ²)	30 m ² (323 ft ²)	100 m ² (1,076 ft ²)	300 m ² (3,229 ft ²)	1,000 m ² (10,764 ft ²)	3,000 m ² (32,292 ft ²)	10,000 m ² (107,639 ft ²)
Th-232	37.5	18.6	9.6	6.9	5.4	4.5	3.3	3.0	3.0

3.3 Below Criteria Material (BCM) Acceptance Criteria

For surveys of the BCM placed in Pond Parcel excavations, a surrogate net Th-232 activity concentration of 31.1 pCi/g is the DCCL value. Table 3-1 presents area factors (based upon MARSSIM guidance) to be used for EMCs of open land areas and to determine sampling requirements in situations where the scan instrument's MDC is greater than the DCCL. (The use of the open land area areas factors is conservative for surveys of the BCM.) For the BCM used as Pond Parcel backfill, the ADCL value was multiplied by the area factors presented in Table 3-1. and the results are presented in Table 3-3.

$$ADCL_{EMC} = \text{Area Factor} * ADCL$$

However, since the BCM can be as high as 31.1 net pCi/g Th-232, the EMC is only applicable to concentrations exceeding 31.1 pCi/g Th-232 above background. The ADCL value of 7 pCi/g of Th-232 was conservatively used to establish elevated measurement criteria for BCM greater than 31.1 pCi/g Th-232 above background, to maintain the average concentration of the backfill material ALARA.

Table 3-3 - ADCL_{EMC} Values for Pond Parcel BCM Units

ADCL _{EMC} (pCi/g)									
Radio-nuclide	1 m ² (11 ft ²)	3 m ² (32 ft ²)	10 m ² (108 ft ²)	30 m ² (323 ft ²)	100 m ² (1,076 ft ²)	300 m ² (3,229 ft ²)	1,000 m ² (10,764 ft ²)	3,000 m ² (32,292 ft ²)	10,000 m ² (107,639 ft ²)
Th-232	87.5	43.4	22.4	16.1	12.6	10.5	7.7	7.0	7.0

3.4 Structures Acceptance Criteria

For surveys of structures remaining onsite, 944 dpm/100cm² of total alpha contamination is the applicable GA-DCGL value. Table 3-4 presents area factors (based on MARSSIM guidance) to be used for elevated measurement comparisons and to determine sampling requirements in situations where the scan instrument's MDC is greater than the GA-DCGL. The appropriate GA-DCGL_{EMC} values are calculated by multiplying the GA-DCGL by the area factors presented in Table 3-4 and the results are presented in Table 3-5.

$$\text{GA-DCGL}_{\text{EMC}} = \text{Area Factor} * \text{GA-DCGL}$$

Table 3-4 Structures Area Factors

Area Factors									
GA-DCGL	1 m ²	2 m ²	3 m ²	4 m ²	5 m ²	10 m ²	20 m ²	30 m ²	100 m ²
	98.2	49.2	32.9	24.7	19.8	9.91	4.97	3.32	1.00

Table 3-5 GA-DCGL_{EMC} Values Structures

DCGL _{EMC} (dpm/100cm ²)									
GA-DCGL	1 m ²	2 m ²	3 m ²	4 m ²	5 m ²	10 m ²	20 m ²	30 m ²	100 m ²
	9.27E+04	4.64E+04	3.10E+04	2.33E+04	1.87E+04	9.36E+03	4.69E+03	3.13E+03	9.44E+02

The criteria for total alpha contamination corresponds to 25 mrem/yr TEDE based on the assumption of less than 10% of the total contamination is removable. Compliance for structures is also demonstrated by taking smear samples of 100 cm² of surface area and comparison of the gross alpha count result to 10% of the applicable total contamination GA-DCGL.

3.5 Interim Sum of Fractions for Pond Parcel Excavation Bottom and FOA Excavation Surveys

The inputs and assumptions used to derive the DCCL value for BCM reflect the projected as-left condition of the site. This configuration is very conservative for all of the other survey elements since the DCGL derivation was based on no soil cover. When the layers of BCM and a minimum 10 foot clean cover are placed on top of the excavation surface soil and embedded structures, the dose from these survey elements are reduced to 0 mrem, since the great majority of exposure from these elements depends on direct contact or proximity to the element. Once the

final as-left configuration of the site has been determined through final status and land surveys, a final as-left dose assessment will be completed to demonstrate compliance with the DP release criteria of 25 mrem/yr TEDE.

Survey unit compliance is demonstrated by comparison of the average residual contamination for each survey element present to the appropriate acceptance criteria value and a sum of fractions for each survey unit is calculated. The sum of fractions is a very conservative assessment of the survey unit. Summing the fractions ensures the survey unit will be a small fraction of 25 mrem/yr (the release criteria) when the actual as-left dose assessment is complete. A bounding as-left condition dose assessment is included in **Volume III, Appendix E** of this Final Status Survey Report.

4.0 FINAL STATUS SURVEY PROTOCOL

4.1 Generic Survey Protocol

Survey units for the Thorium Remediation Project are evaluated to determine whether the average residual radioactivity concentration in a particular survey unit as a whole is below the applicable acceptance criterion concentration, i.e., the DCGL_w, GA-DCGL or DCCL. The final survey protocol uses both systematic grid sampling to determine this average radionuclide concentration in a survey unit in conjunction with scans to identify elevated areas of residual radioactivity. At least the minimum number of samples (N/2) is taken in each survey unit. Since the radionuclides of interest at the Tulsa, Oklahoma facility also occur naturally in background, survey unit final status survey data are compared to data from a reference area under what is known as a "two-sample test," or the Wilcoxon Rank Sum (WRS) Test. Application of the WRS Test procedure is described in Appendix C of this volume of the Final Status Survey Report.

When using the WRS Test, the minimum number of samples (N/2) is the number of samples required in the survey unit and in the reference background area. Hence "N" is the total number of samples required to complete the WRS Test. (Please note: N is often used to represent the number of samples in the survey unit or in the reference area also.) Paramount to determining the minimum number of samples is the determination of the relative shift, delta over sigma (Δ/σ). Delta is equal to the DCGL minus the lower-bound gray region (LBGR) value. The LBGR value is arbitrarily set at one-half the DCGL value to start the determination. Sigma is an estimate of the variability in a set of sample analysis results from a survey unit.

A random-start triangular pattern, or grid, is used in Class 1 and Class 2 survey units to locate the sample points. For Class 3 survey units, the samples are located randomly or at the discretion of the Data Manager. The distance between each sampling grid node, L , is determined by the following equation:

$$L = \sqrt{\frac{A}{0.866N}}$$

In the above equation, A is the survey unit area to be covered by the grid pattern and N (equal to $N/2$ for WRS testing) is the number of samples required for that survey unit. The random start point (X and Y coordinates) is selected using a random number generator ("RAND") function in the Microsoft computer application *Excel*®. Sample points are identified in the field by flags or other means using a global positioning system (or equivalent locating tool) to locate each grid node.

The routine method (of determining N) described above presumes that the actual scan MDC is less than or equal to the required scan MDC, i.e., there is sufficient scan sensitivity available to detect small areas of elevated activity. (The derivation of various scan MDCs is presented in Section 4.2.) For the infrequent situations where the actual scan MDC exceeds the required scan MDC (acceptance criteria for the survey unit), the alternate method for calculating the required number of samples N may be used. This alternate method is described in Section 5.5.2.4 of

MARSSIM and involves the calculation of an area factor corresponding to the actual scan MDC as follows:

$$AreaFactor = \frac{ScanMDC(actual)}{DCGL_w}$$

(Depending on the survey unit, *DCCL* or *GA-DCGL* is substituted for *DCGL_w* in the above equation.) The size of an area of elevated radioactivity corresponding to this area factor is interpolated from the appropriate area factor tables contained in **Chapter 3.0** and divided into the survey unit area to determine the alternate number of sample locations *N_i*. If *N_i* exceeds the value assigned to *N*, an alternate spacing *L_i* for the systematic sampling grid is calculated using the equation:

$$L_i = \sqrt{\frac{A}{0.866N_i}}$$

The corresponding height (*h*) of the equilateral triangle with side length equal to *L* (or *L_i*) is calculated using the following formula: $h = ((L^2 - (L/2)^2)^{1/2}$.

4.2 Final Status Survey Instrumentation

4.2.1 Soil Survey Instrumentation

The MARSSIM framework for determining the MDC for field instrument scanning activities is based on the premise that there are two stages of scanning. That is, surveyors do not make decisions on the basis of a single indication; rather, upon noting an increased number of counts, they pause briefly and then decide whether to move on or take further measurements. Thus, scanning consists of two components: continuous monitoring and stationary sampling. Accordingly, field instrument surveyor scan MDCs, *MDCR_s*, are calculated to control the occurrence of Type I (false negative) and Type II (false positive) errors using the following MARSSIM equation:

$$MDCR_s = \frac{MDCR}{\sqrt{p\varepsilon}}$$

where *MDCR* is the minimum detectable count rate (cpm), *p* is the surveyor efficiency (estimated in MARSSIM to be between 0.5 and 0.75; the value of 0.5 results in a more conservative *MDCR_s* calculation and, therefore, will be used), and *ε* is the instrument efficiency (cpm per $\mu R/hr$; Table 6.4 of NUREG-1507). In addition:

$$MDCR = s_i \left(\frac{60}{i} \right)$$

$$s_i = d' \sqrt{b_i}$$

where s_i (counts) is the minimal number of net source counts required for a specified level of performance for the counting interval i (seconds); d' is the index of sensitivity; and b_i is the number of background counts in the interval. Index of sensitivity d' values are listed in MARSSIM Table 6.5 based on the proportions for required true positive and tolerable false positive occurrence rates. The index of sensitivity value selected for initial use at the Kaiser, Tulsa facility is 1.38, corresponding to a true positive proportion of 0.95 and a false positive proportion of 0.60.

Typical calculated Th-232 scan MDCs for a survey instrument equipped with 2-inch x 2-inch NaI (2x2) detector using this MARSSIM two-stage scanning framework are summarized below in Table 4-1 for increasing background count rates.

Table 4-1 Typical Soil Scan MDCs for Th-232 Detection Using a 2 x 2 NaI Detector^a

Bkg (cpm)	i (sec)	P -	ϵ (cpm per $\mu\text{R/hr}$)	D' -	s_i (counts)	$MDCR$ (ncpm)	$MDCR_s$ (ncpm)	CF^b	Scan MDC ^c	
									$\mu\text{R/hr}$	pCi/g
5,000	1	0.5	830	1.38	13	756	1069	0.99	1.29	1.3
10,000					18	1069	1512		1.82	1.8

a. Th-232 in equilibrium with progeny uniformly distributed in a source thickness of 6 inches.

b. Conversion factor (pCi/g per $\mu\text{R/hr}$) taken from NUREG-1507, modeled using *MicroShield*. $CF = \text{Scan MDC (pCi/g)} / \text{Scan MDC (\mu R/hr)}$

c. $\text{Scan MDC (\mu R/hr)} = MDCR_s / \epsilon$ and $\text{Scan MDC (pCi/g)} = (MDCR_s / \epsilon) CF$

When scanning soil, the detector is held close to the ground (1 to 2 inches) and moved in a serpentine pattern. A scan rate of approximately 0.5 m per second is used reflecting the natural pace of the technician walking with the equipment swinging the detector a width of 1 meter in a serpentine pattern. Estimates of scan speed are provided for each soil survey unit for which the GPS/data logger system was used. The scan speed is estimated by dividing the total area surveyed by the number of 1 or 2 second interval gross gamma results recorded.

4.2.2 Structure Survey Instrumentation

Measurements of alpha activity are used to show compliance with the structural surface total and removable contamination acceptance criteria in units of dpm/100 cm². Scanning for gross alpha activity is used as part of final status surveys of structural surfaces to ensure elevated areas of activity are identified. In addition, static counts at predetermined sample points are used to assess total alpha contamination of structural surfaces. The following instrument is being used for the Thorium Remediation Project to survey structural surfaces:

Meter Manufacturer and Model	Detector Manufacturer and Model	Detector Type	Use
Ludlum 2221	Ludlum 43-68 Gas Proportional	Gas Proportional	Final status survey scans and static counts for total alpha contamination measurements

Structure survey instruments are evaluated and controlled to verify that MDCs of less than the DCGL_w for direct measurements and/or scanning measurements are routinely achieved. Field instrument scan MDCs are calculated to control the occurrence of Type I (false negative) and Type II (false positive) as discussed in the following subsections.

4.2.2.1 Alpha Scan

For a typical alpha background level of less than 3 cpm, the probability of detecting a single count while passing over the contaminated area is:

$$P(n \geq 1) = 1 - e^{\frac{-GE d}{60v}}$$

where:

- P(n ≥ 1) = probability of observing a single count,
- G = activity (dpm),
- E = 4π detector efficiency (cpd),
- d = width of detector in direction of scan (cm), and
- v = scan speed (cm/s).

The value of G is increased until the corresponding probability equaled the desired confidence level, e.g., 95 percent. Table 4-2 summarizes the calculation of alpha scan MDCs for the 4π detector alpha efficiencies of the instruments used. The resulting values of G (dpm) are significantly below the GA-DCGL value of 944 dpm/100cm².

Table 4-2 Typical Structure Scan MDCs for Gross Alpha Detection

G (dpm)	d (cm)	E (cpm)	v (cm/s)	P (-)
380	11.7	0.1618	3.90	0.95
550	11.7	0.1618	5.9	0.95
720	11.7	0.1618	7.80	0.95
1080	11.7	0.1618	11.7	0.95

4.2.2.2 Alpha Static Counts

Minimum counting times for static counts of total and removable contamination will be chosen to provide an MDC that is a fraction (25 to 75 percent) of the survey unit-specific acceptance criteria. MARSSIM equations have been modified to convert to units of dpm/100 cm². Count times are determined using the following equation. Static counting MDCs at a 95 percent confidence level are calculated using the following equation which is an expansion of NUREG-1507, Equation 6-7 (Strom & Stansbury, 1992):

$$MDC_{static} = \frac{3 + 3.29 \sqrt{B_r \cdot t_s \cdot (1 + \frac{t_s}{t_b})}}{t_s \cdot E_{tot} \cdot \frac{A}{100}}$$

where:

MDC_{static} = minimum detectable concentration level in dpm/100 cm²,

B_R = background count rate in counts per minute,

t_B = background count time in minutes,

t_s = sample count time in minutes,

A = detector probe physical (active) area in cm², and

E_{tot} = total detector efficiency for radionuclide emission of

= $E_i \times E_s$,

where:

E_i = 2π instrument efficiency in counts per disintegration (cpd) and

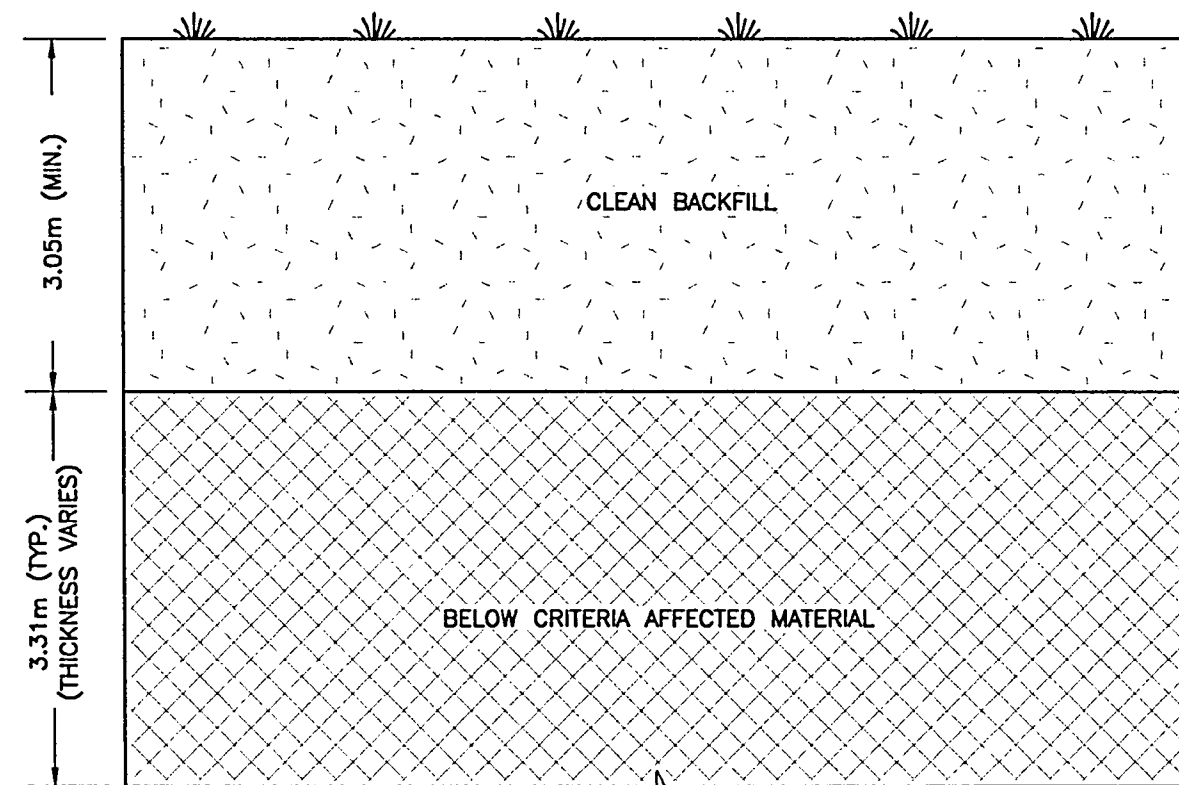
E_s = source (or surface contamination) efficiency.

Note: E_s values can be determined or the default values provided in NUREG-1507 can be used as follows: 0.25 for all alpha energies and beta maximum energies between 0.15 and 0.4 MeV, 0.5 for all beta maximum energies greater than 0.4 MeV.

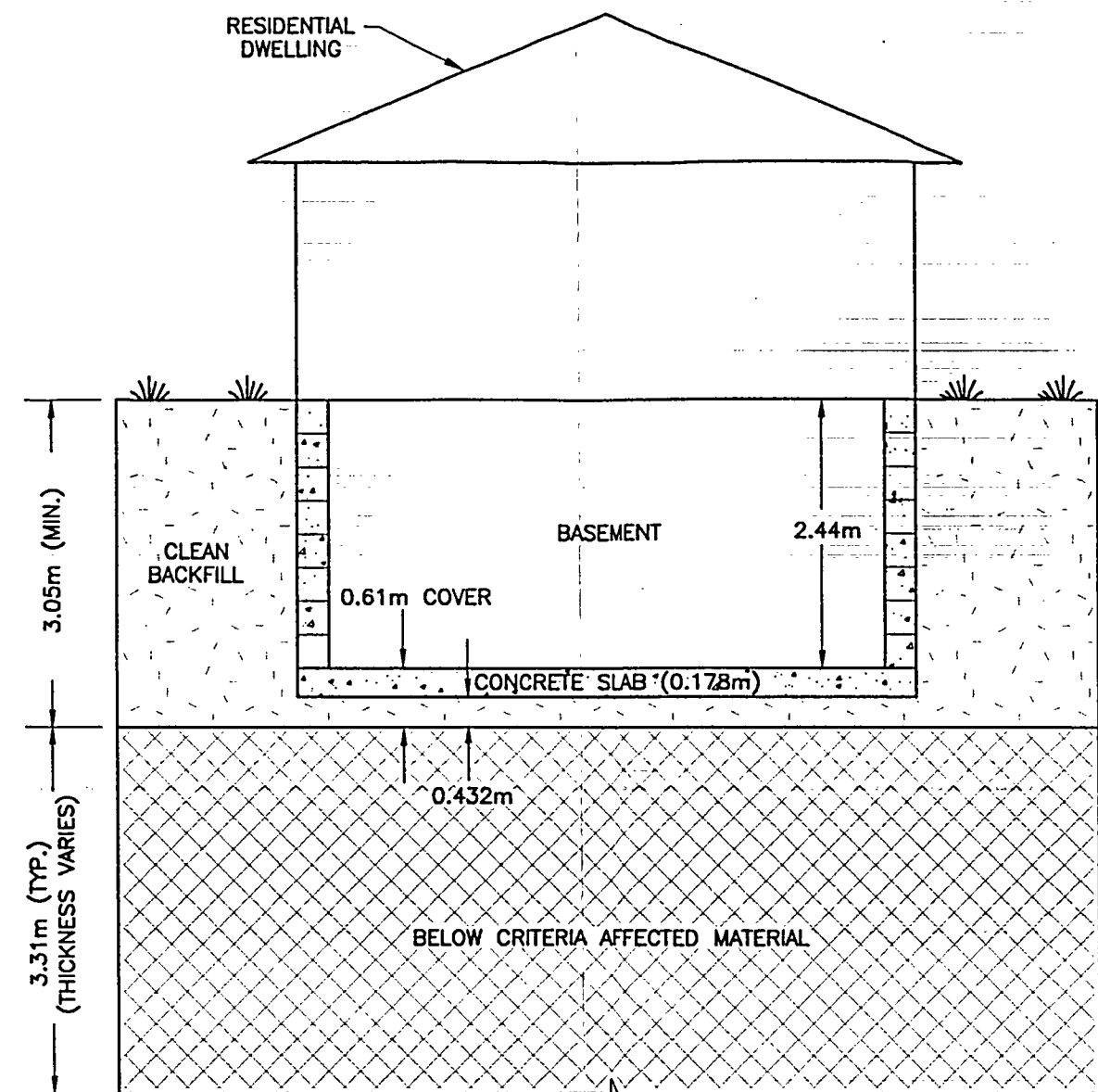
Table 4-3 contains example static alpha MDC calculation results for structural surfaces.

Table 4-3 Structural Surface Alpha Static MDC

Background Gross Alpha Count Rate (cpm)	Background Count Time (min)	Static Measurement Count Time (min)	Total Detector Efficiency	Detector Probe Area (cm ²)	Static MDC (dpm/100cm ²)
0.5	1	1	0.040	126	123
1.0	1	1	0.040	126	150
1.0	5	5	0.040	126	52.6
2.0	5	5	0.040	126	69.5



TYPICAL CROSS SECTION
THROUGH RESTORED SITE



TYPICAL CROSS SECTION THROUGH RESTORED SITE
WITH RESIDENTIAL DUAL SIMULATION SCENARIO
FOR DOSE MODELING

	THICKNESS (m)	DENSITY (g/cm ³)
COVER		
SOIL	4.32E-01	1.72E+00
CONCRETE	1.78E-01	2.35E+00
TOTAL*	6.10E-01	1.90E+00

*THE TOTAL COVER THICKNESS IS THE SUM OF THE CONCRETE SLAB AND THE CLEAN BACKFILL SOIL BENEATH THE DWELLING FOUNDATION.

THE TOTAL COVER DENSITY IS THE WEIGHTED AVERAGE OF THE CONCRETE AND THE SOIL DENSITIES

DRAWING NOT TO SCALE

FIGURE E-1
CONCEPTUAL MODEL FOR MODIFIED
DUAL SIMULATION EVALUATIONS

THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
BATON ROUGE, LOUISIANA

APPROVED *[Signature]* 3.17.06
CHECKED *[Signature]* 3.17.06
DRAWN DEB 03/16/06

DRAWING NUMBER

PA4072203



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4.3 Laboratory Analysis

Final status survey analytical laboratory services for the Thorium Remediation Project are being provided by Outreach Laboratory (Outreach) of Broken Arrow, Oklahoma. Final status survey samples consist of soil media samples and smear samples of removable alpha contamination.

Final status survey soil samples are analyzed for Th-232 activity concentration in units of pCi/g via gamma spectroscopy. The samples are counted by the laboratory as received, i.e., they are not dried and/or ground. The MDC value required for each gamma spectroscopy analysis is 25 percent of the release criteria for Th-232. Characterization survey results confirm that Th-232 is in secular equilibrium with its short-lived progeny Ac-228 and Th-228. Outreach infers Th-232 activity from the high energy/high yield gamma emitted by progeny of the thorium decay series, e.g., Actinium-228 (secular equilibrium progeny) high energy gamma line (911 keV). The Th-228 activity is calculated by multiplying the Th-232 activity by 1. The Th-230 activity is calculated by multiplying the Th-232 activity by 3.5.

The laboratory's analytical results are reported to include the activity, the 95 percent confidence level uncertainty (2-sigma error), and the MDC all in the same units of the sample analyzed.

To exclude the bias introduced when grouping analytical results containing "less than" values, the laboratory has been instructed to report observed counting data when reporting results that are below the critical level L_C (and thus "not detected") established for each analysis.

4.4 Open Land Area Survey Protocol

4.4.1 Minimum Number of Samples Determination

The estimate of sigma used for the Thorium Remediation Project is based on the standard deviation of the Th-232 activity measured in survey units during the ALRP final status survey (0.42). Using the DGCL_w value of 3.0 pCi/g of Th-232, Δ is equal to 3.0 - 1.5, or 1.5. Delta divided by the sigma of 0.42 results in a relative shift of 3.57 which is rounded to 3.5 for the purpose of determining the required number of samples. The corresponding minimum number of samples looked up in Table 5.3 of MARSSIM is 9.

4.4.2 Open Land Area Gross Gamma Scan Survey

Portable survey meters consisting of 2-inch by 2-inch sodium iodide (NaI) detectors (Ludlum Model 44-10) coupled with scaler instruments (Ludlum Model 2221) are used to perform gross gamma scans (to identify elevated areas). Typically, the portable survey meters are also coupled to a Global Positioning System (GPS) unit and a data logger to provide electronic downloads of coordinates and associated gross gamma count rates in units of counts per minute (cpm).

Per Section 5.3.3 of MARSSIM, scanning is used to identify locations within the survey unit that exceed the investigation level. For Class 1 survey units, the investigation level is the derived concentration guideline elevated measurement criteria (DCGLE_{EMC}) value for the area scanned. The DCGLE_{EMC} values applicable to the open land areas of the site are calculated by multiplying

the DCGL_W by the area factors presented in Chapter 3.0. DCGL_{EMC} values are also presented in Chapter 3.0.

The scan MDC and the scanning thresholds in measurement units of net counts per minute (ncpm) are calculated in accordance with MARSSIM and NUREG-1507. These values are summarized below in Table 4-5 for a maximum background of 50,000 cpm and increasing survey areas (A). The first line (A = 0.25 m²) is the default area used to demonstrate the calculation of scan MDC and the derivation of the conversion factor (CF in units of pCi/g or μ R/h) in NUREG-1507. However, surveys of an area this small are not applicable to final status, open land area surveys. The increasing areas presented in the table correspond to the approved area factors (DP) and result in scan thresholds for detection of both elevated areas (Fail DCGL_{EMC}) and complete survey units with activity concentration greater than the DCGL_W (Fail DCGL_W). The CF's for increasing areas were derived using the identical inputs of the NUREG-1507 derivation changing only the area.

In addition to the derived scan thresholds, scan data are evaluated against empirical data gathered in the field. For example, soil samples are collected at biased locations (highest scan count rate) and screened on site for Th-232 activity concentration corresponding to the high count rate. All of these factors (derived thresholds, empirical thresholds, and biased samples) are used to identify elevated areas and to release the survey unit for final sampling. The threshold values provided are theoretical, depend on counting geometry and other factors that cannot be controlled in the field, and are used to aid identifying elevated areas that may require additional remediation or application of the elevated measurement comparison.

Table 4-5 – Open Land Areas Scan MDC and Threshold Values

A Area (m ²)	DCGL _{EMC} (pCi/g)	B (cpm)	CF (pCi/g / μ R/h)	Scan MDC (pCi/g)	Fail DCGL _{EMC} (ncpm)	Fail DCGL _W (ncpm)
0.25	N/A	50,000	0.99	4.0	N/A	2,515
1	37.5	50,000	0.62	2.5	50,578	4,046
3	18.6	50,000	0.51	2.1	30,212	4,873
10	9.6	50,000	0.46	1.9	17,227	5,383
30	6.9	50,000	0.45	1.8	12,851	5,588
100	5.4	50,000	0.44	1.8	10,250	5,695
300	4.5	50,000	0.43	1.8	8,624	5,749
1000	3.3	50,000	0.43	1.8	6,360	5,782
3000	3.0	50,000	0.43	1.7	5,799	5,799

4.4.3 Open Land Area Soil Sampling

4.4.3.1 Systematic Final Status Survey Soil Sampling

Systematic soil samples are collected at locations determined through the use of a random start point and an equal-distant triangular grid in accordance with MARSSIM and the DP. Soil sample locations are demarcated in the field (using a GPS unit) and soil samples are collected at

the surface (0-6-inch depth interval) level using a clean, decontaminated sampling auger or sharpshooter shovel.

4.4.3.2 Additional Biased and EMC Evaluation Soil Sampling

In addition to the systematic samples used to determine the average Th-232 activity concentration in the survey unit, other soil samples may be taken within a survey unit to help demonstrate compliance. At the discretion of the surveyor, biased samples are taken at high scan rate locations to help determine scan survey results. In addition, if small areas of elevated activity are identified, additional soil samples are taken at biased locations to aid in the elevated measurement comparison for the area.

4.4.3.3 Use of the On Site Cave Counter

Certain soil samples, e.g., biased and/or EMC samples collected as part of the final status survey process are screened for Th-232 activity concentration using an on site cave counter. The on site cave counter for the Thorium Remediation Project consists of a 2-inch by 2-inch NaI Ludlum Model 44-10 detector coupled with a Ludlum Model 2221 Scaler/Ratemeter instrument, mounted inside a shielded box with room for a standard soil sample container to be placed on the face (bottom, non-wire connecting end) of the detector. Two detectors (numbered NaI # 4 and NaI #8) have been used as part of the counter. The detectors were calibrated annually off-site by a qualified vendor to verify their response to high energy photons. The detectors, including their use as part of the counter, are utilized to obtain gross gamma readings from soil samples in units of counts per minute (cpm). The detector response is checked daily when in use to a Cs-137 source. Documentation of the on site cave counter calibration and the calculation of Th-232 activity concentration, 95% confidence level uncertainty, and the MDC, are presented in Appendix D of this volume of the Final Status Survey Report.

4.5 Structure Survey Protocol

Permanent structures (destined to remain on site) encountered during the implementation of the Thorium Remediation Project can be classified by type. The first type is termed "embedded structures" and consists of small pipes and remnants of previous structures uncovered during excavation activities. These structures consist of very small surface areas (< 1 or 2 m^2) and will be buried with BCM and/or clean fill based on the final site configuration. Measurements of total alpha contamination and smear samples of removable alpha contamination are taken on these structures and reported with the open land area survey unit for which they reside. The second type of structure is the large surface area (approaching 100 m^2) structure such as a concrete retaining wall. This type of structure constitutes a separate survey unit and is surveyed as such.

4.5.1 Minimum Number of Samples Determination

The estimate of sigma used for the Thorium Remediation Project is based on the standard deviation of a set of total alpha contamination results from the final status survey of the Flux Building (Survey Unit FB-001 Floor Surface: 45.9). Since the gross alpha activity concentration

of 944 dpm/100cm² will be used as the DGCL-GA, Δ is equal to 944 - 472, or 472. Delta divided by the sigma of 45.9 results in a relative shift of 10.3. The minimum number of samples (looked up in Table 5.3 of MARSSIM) corresponding to alpha and beta error rates of 0.05 and a relative shift of 10.3 is 9.

4.5.2 Structure Surfaces Gross Alpha Scan Survey

Portable survey meters consisting of gas proportional detectors (Ludlum Model 43-68) coupled to alpha/beta scaler instruments (Ludlum Model 2360) are used wherever possible to perform scans (to identify elevated areas of alpha activity). Whenever the structure is too small or inaccessible for a gas proportional detector, surveys of gross gamma activity are performed using a 2-inch by 2-inch sodium iodide (NaI) detector (Ludlum Model 44-10) coupled with a scaler instrument (Ludlum Model 2221).

4.5.3 Systematic Measurements of Total and Removable Alpha Contamination

Systematic sample points are marked at locations determined through the use of a random start point and an equal-distant triangular grid in accordance with MARSSIM and the DP. Static measurements are taken at each sample point location to determine the total alpha contamination (in units of dpm/100cm²). Smear samples representing 100cm² areas are also collected at the same sample point location to assess removable alpha contamination (in units of dpm/100cm²). The smear samples are sent to Outreach for laboratory analysis.

For small embedded structures, static counts are taken to determine total alpha contamination (in units of dpm/100cm²) at biased locations (highest scan result) when possible. Smear samples representing 100 cm² areas are also collected at the same sample locations and counted for removable alpha contamination by Outreach. In areas such as the interiors of small diameter piping, the gas proportional detectors typically can not be used for static measurements; therefore, only smear samples are taken to assess the removable alpha contamination.

4.6 BCM Unit Survey Protocol

4.6.1 Minimum Number of Samples Determination

The estimate of sigma used for the Thorium Remediation Project is based on an estimate of the variance of Th-232 activity concentrations of core composite samples of 4.4. Using the DCCL value of 31.1 pCi/g of Th-232, and a LBGR of 31.1/2, Δ is equal to 31.1 - 15.55, or 15.55. Delta divided by the sigma of 4.4 results in a relative shift of 3.5. The corresponding minimum number of samples looked up in Table 5.3 of MARSSIM is 9.

4.6.2 BCM Unit Gross Gamma Scan Survey

Portable survey meters consisting of 2-inch by 2-inch sodium iodide (NaI) detectors (Ludlum Model 44-10) coupled with scaler instruments (Ludlum Model 2221) are used to perform gross gamma scans (to identify elevated areas) for each 2-foot lift of placed BCM. Typically, the portable survey meters are also coupled to a GPS unit and a data logger to provide electronic

downloads of coordinates and associated gross gamma count rates in units of counts per minute (cpm).

Per Section 5.3.3 of MARSSIM, scanning is used to identify locations within the survey unit that exceed the investigation level. For Class 1 survey units, the investigation level is the derived concentration guideline elevated measurement criteria (DCGL_{EMC}) value for the area scanned. The DCGL_{EMC} values applicable to the BCM survey units are calculated by multiplying the ADCL by the area factors presented in Chapter 3.0. ADCL_{EMC} values are also presented in Chapter 3.0.

The scan MDC and the scanning thresholds in measurement units of net counts per minute (ncpm) are calculated in accordance with MARSSIM and NUREG-1507. These values are summarized below in Table 4-6 for a maximum background of 50,000 cpm and increasing survey areas (A). The first line (A = 0.25 m²) is the default area used to demonstrate the calculation of scan MDC and the derivation of the conversion factor (CF in units of pCi/g or μ R/h) in NUREG-1507. However, surveys of an area this small are not applicable to final status, open land area surveys. The increasing areas presented in the table correspond to the approved area factors (DP) and result in scan thresholds for detection of both elevated areas (Fail DCGL_{EMC}) and complete surveys units with activity concentration greater than the DCGL_{LW} (Fail DCGL_{LW}). The CFs for increasing areas were derived using the identical inputs of the NUREG-1507 derivation changing only the area.

In addition to the derived scan thresholds, scan data are evaluated against empirical data gathered in the field. For example, soil samples are collected at biased locations (highest scan count rate) and screened on site for Th-232 activity concentration corresponding to the high count rate. All of these factors (derived thresholds, empirical thresholds, and biased samples) are used to identify elevated areas and to release the survey unit for final sampling. The threshold values provided are theoretical, depend on counting geometry and other factors that cannot be controlled in the field, and are used to aid identifying elevated areas that may require additional remediation or application of the elevated measurement comparison.

Table 4-6 – BCM Scan MDC and Threshold Values

A Area (m ²)	ADCL _{EMC} (pCi/g)	B (cpm)	CF (pCi/g / mR/h)	Scan MDC (pCi/g)	Fail ADCL _{EMC} (ncpm)	Fail DCCL (ncpm)
0.25	N/A	150,000	0.99	7.0	N/A	26,074
1	87.5	150,000	0.62	4.3	118,016	41,946
3	43.4	150,000	0.51	3.6	70,495	50,516
10	31.1	150,000	0.46	3.3	55,808	55,808
30	31.1	150,000	0.45	3.1	57,924	57,924
100	31.1	150,000	0.44	3.1	59,034	59,034
300	31.1	150,000	0.43	3.1	59,602	59,602
1000	31.1	150,000	0.43	3.0	59,938	59,938
3000	31.1	150,000	0.43	3.0	60,118	60,118

4.6.3 BCM Unit Systematic Soil Core Sampling

Upon completion of the placement of a BCM unit, systematic soil core samples are collected at locations determined through the use of a random start point and an equal-distant triangular grid in accordance with MARSSIM and the DP. Soil core sample locations are demarcated in the field using a GPS unit. Soil core samples are collected through the entire layer of placed BCM. It should be noted that the entire length of each soil core from a BCM survey unit may not equal the total depth of the placed BCM due to the following:

- The bottom surface (grade) of each excavation bottom unit may not be level when a BCM unit is placed.
- The top surface of BCM in a unit may not be level based upon the site's final grade plan relative to maintaining the minimum 10 feet of clean cover soil.
- BCM units are placed in 2 foot lifts with sloping side walls. As a result, succeeding lifts become smaller in surface area (a core sample point may fall on the unit's sloped side walls).

Core segments of BCM (typically 3 feet in length) are scanned in the field in 1-foot increments. Each one foot increment is also characterized by a 1-minute static count of gross gamma activity. A composite sample representing each core segment is then prepared by combining each set of three 1-foot increments in a bucket and breaking up the cores. The final segment of core may be less than or greater than 3 feet depending on the point at which virgin material is encountered. A sample (usually between 500 and 800 grams) is taken from each composite and forwarded to Outreach for analysis of Th-232 activity concentration.

5.0 SUMMARY OF FINDINGS

This chapter of Volume III of the Final Status Survey Report presents a summary of the final status survey findings for each Pond Parcel excavation backfill (BCM) survey unit.

Final status survey activities for Pond Parcel excavation backfill Survey Units Kaiser-FSSB-001 through Kaiser-FSSB-009 consisted of a gross gamma scan of each placed 2-foot lift of BCM and systematic soil core sampling upon completion of each BCM unit. The results of the final status survey activities were as follows:

- The 100 percent coverage gamma scan of each lift (final as-left condition) for each survey unit did not indicate the presence of small areas (1 m^2) of elevated activity (greater than the DCCL for the site).
- The systematic core sample (composited by core segment) analytical results (net) for each survey unit were below the BCM surrogate value of 31.1 pCi/g net Th-232 activity concentration (DCCL). It should be noted that the net Th-232 activity concentration for one systematic core sample (out of 44) for Survey Unit Kaiser-FSSB-007 slightly exceeded the DCCL. The average of all of the core composite samples for the subject core segment (including the original result) was used to represent the segment and the result (24.7 pCi/g) was below the surrogate value of 31.1 pCi/g of Th-232.
- The systematic composite sample analytical results for each survey met the DP statistical criterion based on the first statistical evaluation of the data (WRS Test procedure).

A summary of the final status survey results by survey unit is provided below in Table 1.

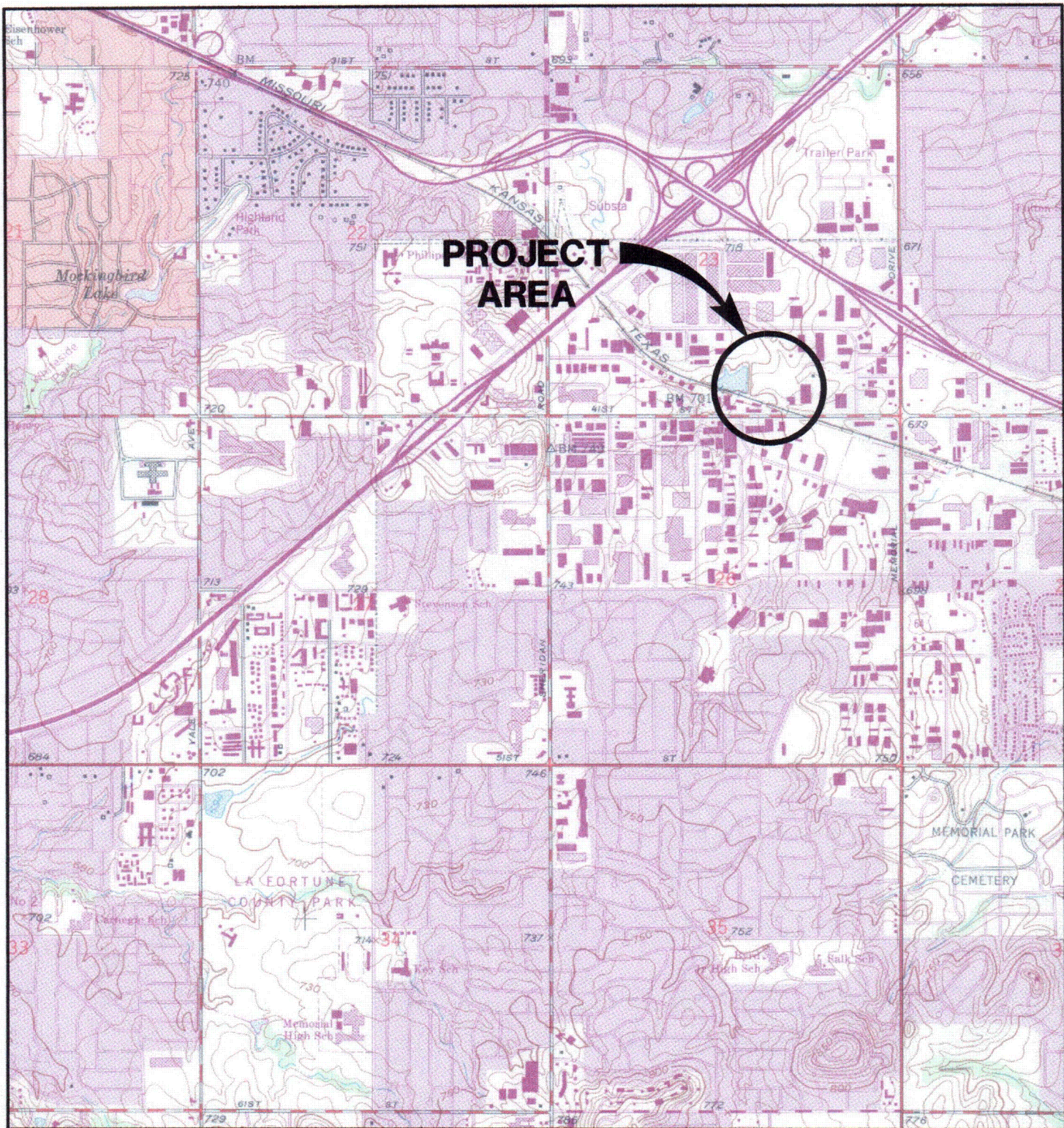
Of the 6 remaining BCM survey units for the pond parcel (Survey Units Kaiser-FSSB-010 through Kaiser-FSSB-015), it should be noted that the placement of BCM and final status survey sampling have been completed for 3 of those units (Kaiser-FSSB-010 through Kaiser-FSS-012). Soil screening values and/or analytical laboratory results for all systematic core samples for each survey unit were below the DCCL. Kaiser anticipates that the final status survey sampling results for Survey Units Kaiser-FSSB-013 through Kaiser-FSSB-015 will also meet the DP acceptance criteria. The results of the final status surveys for the remaining 6 Pond Parcel backfill survey units will be documented in an addendum to this **Final Status Survey Report** to be submitted at the end of the remediation project.

Table 1 – Pond Parcel Excavation Backfill Final Status Survey Summary by Survey Unit

Survey Unit	Base Surface Area (m ²)	No. of Systematic Soil Cores	No. of Systematic Soil Core Composite Samples	Systematic Soil Core Sample Exceedance of DCCL Value	WRS Test Criterion Met	Elevated Area(s) Present	Survey Unit Meets DP Acceptance Criteria
Kaiser-FSSB-001	2,220	11	28	NO	YES	NO	YES
Kaiser-FSSB-002	2,405	12	17	NO	YES	NO	YES
Kaiser-FSSB-003	1,709	11	37	NO	YES	NO	YES
Kaiser-FSSB-004	1,647	9	33	NO	YES	NO	YES
Kaiser-FSSB-005	1,716	9	34	NO	YES	NO	YES
Kaiser-FSSB-006	2,177	12	44	NO	YES	NO	YES
Kaiser-FSSB-007	1,381	9	44	NO	YES	NO	YES
Kaiser-FSSB-008	1,431	9	45	NO	YES	NO	YES
Kaiser-FSSB-009	1,840	9	20	NO	YES	NO	YES

REFERENCES

- (1) Earth Sciences Consultants, Inc., June 2001, Revised May 2003, Revised September 2003, Revised May 2005 (by Penn E&R), Revised September 2005 (by Penn E&R), Decommissioning Plan, Tulsa Facility, Tulsa Oklahoma, Kaiser Aluminum & Chemical Corporation.
- (2) Earth Sciences Consultants, Inc., May 2002, Revised May 2003, Decommissioning Plan Addendum, Tulsa Facility, Tulsa, Oklahoma, Kaiser Aluminum & Chemical Corporation.
- (3) USEPA 402-R-97-016, December 1997, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG-1575.
- (4) Earth Sciences Consultants, Inc., December 2001, Work Plan, Characterization Survey of the Operational Area, Former Kaiser Aluminum Specialty Products Facility, Tulsa, Oklahoma
- (5) Penn Environmental & Remediation, Inc., May 2005, Technical Addendum to the Decommissioning Plan and Addendum Revised Structural Surface Acceptance Criteria, Thorium Remediation Project, Tulsa, Oklahoma, Kaiser Aluminum & Chemical Corporation.
- (6) Title 10 CFR Part 20, Subpart E, Radiological Criteria for License Termination.
- (7) NUREG-1549, Decision Methods for Dose Assessments to Comply With Radiological Criteria for License Termination.
- (8) NUREG/CR-5849, June 1992, Manual for Conducting Radiological Surveys in Support of License Termination.
- (9) NRC, 1997, Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions, NUREG/CR-1507, Final, NRC, Washington, DC.



**PROJECT
AREA**

**FIGURE 1
SITE LOCATION MAP**

**THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY**

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
BATON ROUGE, LOUISIANA

APPROVED *RPD 3-3-06*

CHECKED *RPD 3-3-06*

DRAWN *DEB 08/17/05*

DRAWING NUMBER

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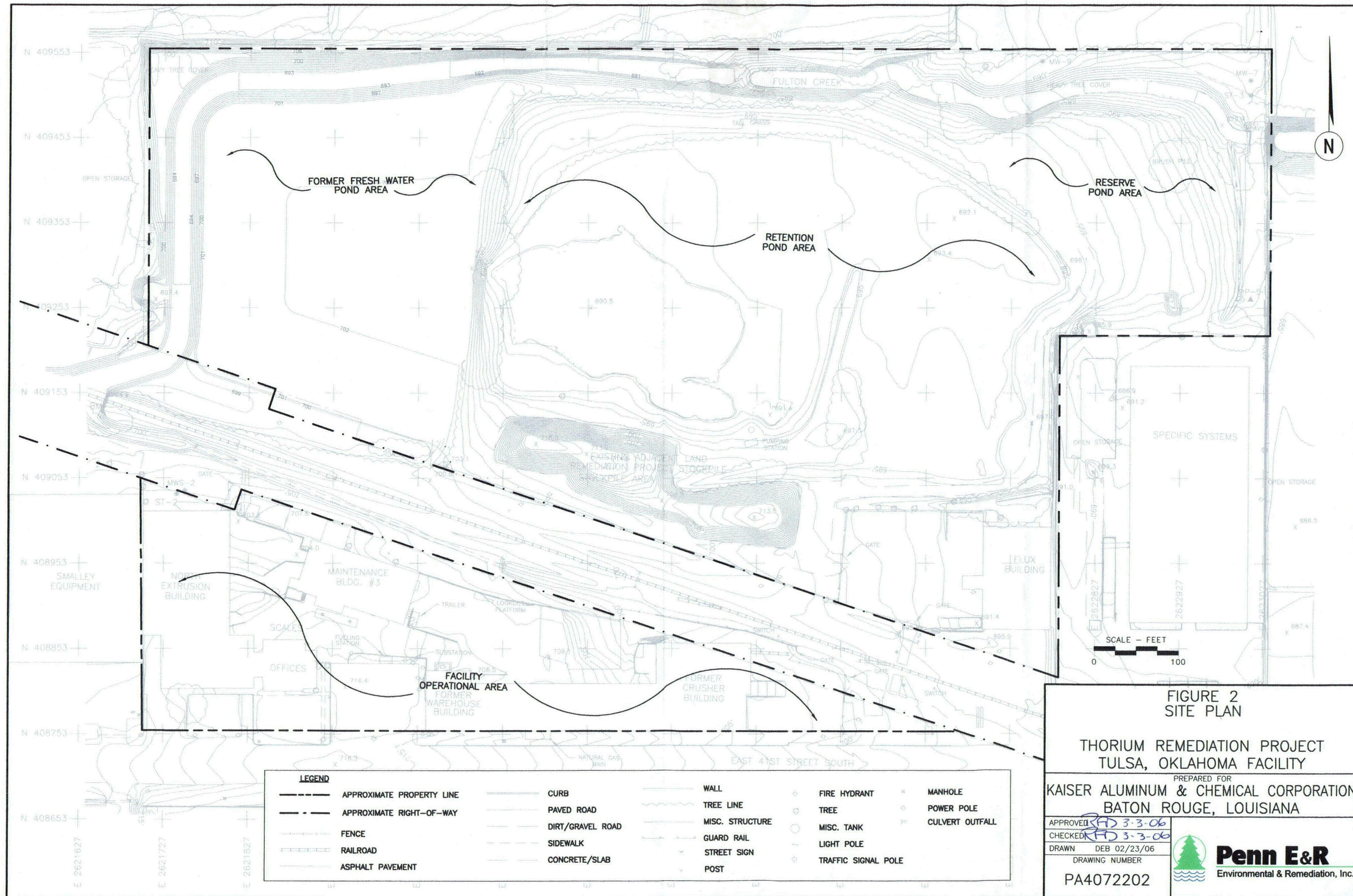


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SCALE - FEET
0 2000

REFERENCE
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JENKS, OK
DATED 1952, PHOTOREVISED 1982
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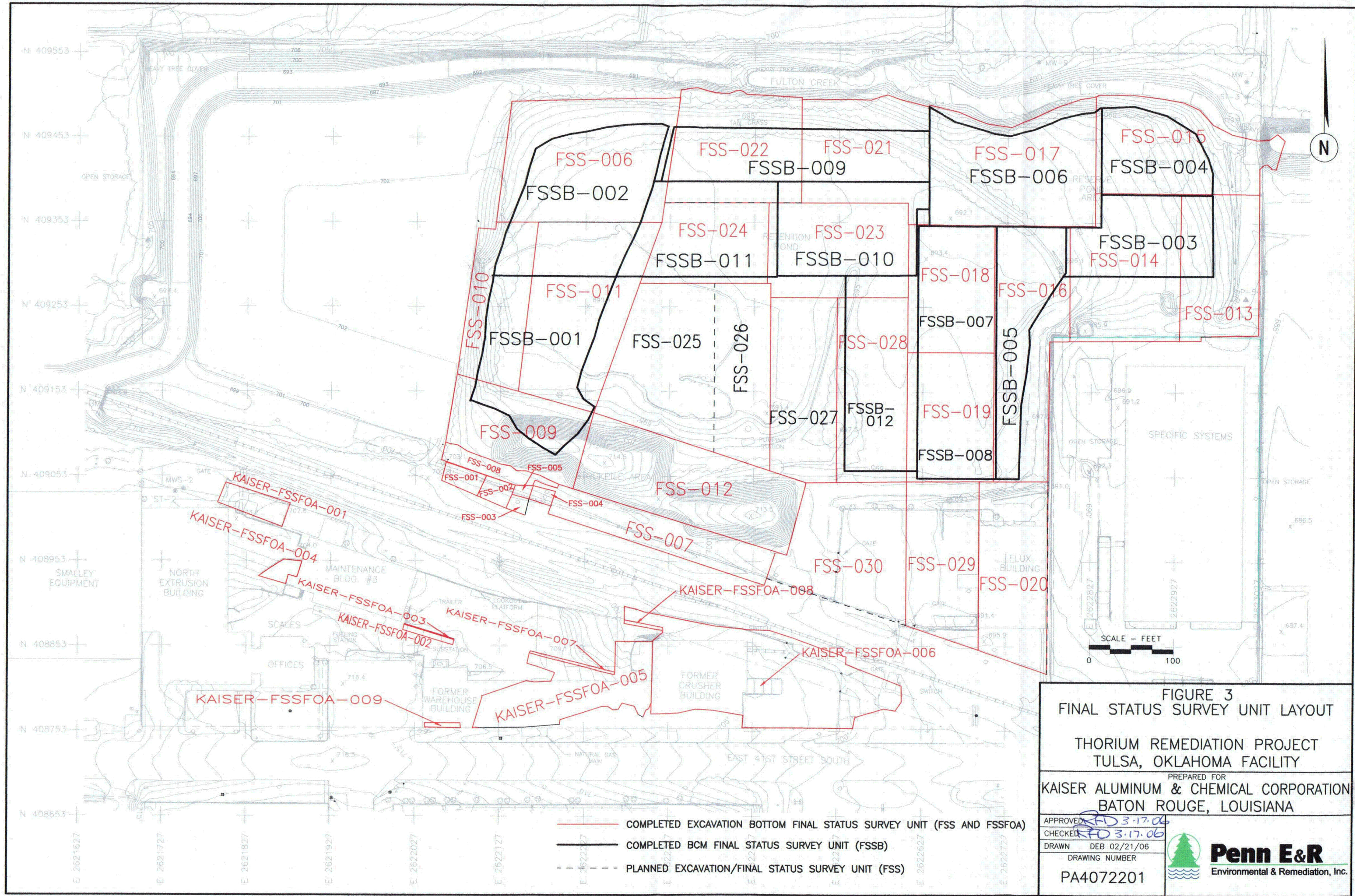



FIGURE 3
FINAL STATUS SURVEY UNIT LAYOUT

THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
BATON ROUGE, LOUISIANA

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CHECKED	RD 3.17.06
DRAWN	DEB 02/21/06
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SUB-REPORT

SURVEY UNIT KAISER-FSSB-001

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ATTACHMENTS

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ATTACHMENT B:	Soil Survey Unit Worksheet No. 1 Soil Survey Unit Worksheet No. 2
ATTACHMENT C:	Laboratory Analytical Results

**Final Status Survey Report
Volume III – Pond Parcel Excavation Backfill Units
Sub-Report No. BCM-001
Survey Unit Kaiser-FSSB-001
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation
March 22, 2006**

1.0 BACKGROUND

This sub-report documents the results of pond parcel excavation backfill unit final status survey activities completed as part of the Thorium Remediation Project at the Tulsa, Oklahoma facility (Figure 1). Specifically, this technical report addresses the final status survey of Survey Unit Kaiser-FSSB-001, which consists of a unit of Below Criteria Material or BCM (less than 31.1 net pCi/g Th-232 material) placed in an excavation resulting from the removal of radiologically-affected soil from the Retention Pond area. Survey Unit Kaiser-FSSB-001 is considered a Class 1 survey unit with an approximate base surface area of 2,220 m². It is located on the west side of the pond parcel within portions of excavation bottoms associated with Survey Units Kaiser-FSS-009, Kaiser-FSS-010, and Kaiser-FSS-011 (Figure 3). The survey unit is bordered by a wall of non-impacted soil to the west (former freshwater pond area), excavation backfill Survey Unit FSSB-002 to the north, excavation bottom Survey Unit Kaiser-FSS-008 to the south, and excavation bottom Survey Units Kaiser-FSS-025, Kaiser-FSS-026, and Kaiser-FSS-012 to the east. Excavation bottom Survey Units Kaiser-FSS-025 and Kaiser-FSS-026 were not excavated or backfilled at the time of the preparation of this sub-report.

A total of six 2-foot layers (lifts) of BCM was placed in Survey Unit Kaiser-FSSB-001. It should be noted that beginning with the 4th lift (from the bottom), additional sub-lifts were placed in the southeast corner and the east side of the survey unit to bring these areas up to an equal grade due to the general slope of the excavation from the northwest to the southeast.

Separate distinct final status surveys were completed for the pond parcel excavation bottom survey units prior to backfilling with BCM. The final status survey of the pond parcel excavation bottom survey units is documented in Volume I of the Final Status Survey Report.

2.0 SURVEY ACTIVITIES AND RESULTS

This section of the sub-report presents the final status survey data for the BCM placed within Survey Unit Kaiser-FSSB-001. The final status survey consisted of a gross gamma scan of each placed 2-foot lift of BCM and systematic soil core sampling upon completion of the BCM unit.

2.1 Gross Gamma Scan

Each 2-foot lift of BCM was surveyed through a 100 percent coverage gamma scan to confirm acceptable radiological conditions and identify any elevated areas. During the scanning of each lift, the detector was held close to the BCM surface (1 to 2 inches) and moved in a serpentine pattern. Approximate equal-distant background measurements were also obtained at 1-meter above the ground surface for each lift of BCM placed. A statistical summary of the background survey and 100 percent coverage gamma scan of each BCM lift placed in the survey unit is provided below in **Table 1**.

Table 1 – Gross Gamma Scan Results Summary

Name	Date	Lift Area (m ²)	No. of 2-sec. Scans	Scan Rate (m/s)	Ave. (cpm)	Std. Dev. (cpm)	Min. (cpm)	Max. (cpm)	Median (cpm)
1 st lift Scan	08/19/04	1,760	1,969	0.45	43,464	4,087	20,990	52,392	44,116
1 st lift Bkgrd.	08/19/04	1,760	24	N/A	38,324	3,872	21,980	43,183	39,006
2 nd lift Scan	08/23/04	1,480	2,296	0.32	40,150	4,228	23,889	52,161	39,955
2 nd lift Bkgrd.	08/23/04	1,480	24	N/A	37,821	2,265	31,423	42,331	37,933
3 rd lift Scan	08/27/04	1,810	2,193	0.41	42,355	4,197	22,417	59,055	43,138
3 rd lift Bkgrd.	08/27/04	1,810	24	N/A	38,242	2,262	32,132	42,241	38,725
4 th lift Scan	09/02/05	1,970	3,426	0.29	48,690	5,904	23,815	64,279	48,449
4 th lift Bkgrd.	09/02/05	1,970	24	N/A	40,262	2,996	34,485	47,854	40,127
SE Corner Scan	09/10/04	560	1,306	0.21	55,305	6,289	28,090	70,402	55,548
SE Corner Bkgrd.	09/10/04	560	12	N/A	48,271	3,957	42,522	55,958	47,794
SE Corner Scan	09/15/05	780	1,232	0.32	42,977	4,975	25,234	56,658	42,535
SE Corner Bkgrd.	09/15/04	780	13	N/A	38,720	2,676	35,455	44,101	37,686
5 th lift Scan	09/16/04	2,220	2,737	0.41	48,221	5,335	17,852	65,640	48,627
5 th lift Bkgrd.	09/16/04	2,220	15	N/A	41,600	5,232	26,309	50,624	42,168
East Bank Scan	09/17/04	300	296	0.51	52,060	5,700	33,062	64,978	51,832
East Bank Bkgrd.	09/17/04	300	15	N/A	43,401	3,823	35,896	49,969	42,767
East Bank Scan	09/20/04	300	283	0.53	52,001	5,736	33,118	65,034	51,857
East Bank Bkgrd.	09/20/04	300	15	N/A	44,303	3,347	40,090	52,497	43,257
East Bank Scan	09/21/04	300	390	0.38	52,301	4,808	41,853	62,712	53,372
East Bank Bkgrd.	09/21/04	300	14	N/A	46,583	3,938	39,336	51,734	47,048
6 th lift Scan	09/24/04	2,220	2,825	0.39	44,230	5,090	15,690	57,893	44,605
6 th lift Bkgrd.	09/24/04	2,220	14	N/A	37,496	6,358	20,248	44,773	39,477

Contour maps of the gross gamma background and final (as-left condition) scanning survey results are presented by BCM lift on Figures A-1 through A-6 contained in Attachment A. The 100 percent coverage gross gamma scan of the 2-foot lifts did not indicate the presence of small areas (1 m^2) of elevated activity (above the DCCL for the site).

2.2 Systematic Soil Core Sampling

The final status survey also consisted of systematic soil core sampling based on a random start point and an equal-distant triangular grid. It should be noted that Survey Units Kaiser-FSSB-001 and Kaiser-FSSB-002 were backfilled and final status surveyed simultaneously. As such, the following calculation of the minimum number of samples required, the corresponding dimensions of the equilateral triangular grid, and the random start point used to locate the samples are applicable to both survey units.

The Minimum Number of Core Samples (core holes) Required (N) based on the scan MDC was determined to be 9, as documented on Soil Survey Unit Worksheet No. 1 (Attachment B). The default Class 1 Survey Unit Area (A) of $2,000 \text{ m}^2$ along with the N of 9 were used to calculate the Triangular Grid Node Length (L) of 16.0 meters and the Height of the Equilateral Triangle (h) of 13.9 meters. Since A was greater than $2,000 \text{ m}^2$, (combined area of $4,625 \text{ m}^2$) the number of samples (N1) was recalculated (21) to correspond to the L of 16.0 meters. A random start point was generated using the random number feature of Excel and documented on Soil Survey Unit Worksheet No. 2 (Attachment B).

A layout of the soil sampling locations is provided on Figure A-7 contained in Attachment A. The soil core sample locations were demarcated in the field using a GPS unit. A total of 23 core holes (sample locations) were installed on the grid prescribed over the two survey units, with 11 falling within Survey Unit Kaiser-FSSB-001 (Core Nos. 13 through 23). The core holes were of various depths depending on the location within the survey unit, with core holes on the eastern side of the survey unit deeper than core holes on the west. Core segments of BCM (typically 3 feet in length) were scanned in the field in 1-foot increments. All but three of the 1-foot increments were also characterized by a 1 minute static count of gross gamma activity. The results are presented below in Table 2.

Table 2 - Soil Core Segment Gross Gamma Survey Results

Core Number	Core Segment	Segment Length (inches)	Core Depth Below Surface (ft)	Gross Scan Rate (kcpm)	Gross Static Count (cpm)	Net Static Count (cpm) ¹
13	A	36	1	24	23,569	5,775
13	A		2	24	23,992	6,198
13	A		3	22	21,551	3,757
13	B	36	4	23	23,390	5,596
13	B		5	24	24,939	7,145
13	B		6	22	24,441	6,647
13	C	24	7	23	22,566	4,772
13	C		8	23	23,189	5,395
14	A	36	1	22	22,965	5,171
14	A		2	23	23,583	5,789
14	A		3	22	21,753	3,959
14	B	36	4	22	23,026	5,232
14	B		5	23	22,975	5,181
14	B		6	22	22,289	4,495
14	C	36	7	23	22,746	4,952
14	C		8	24	23,476	5,682
14	C		9	22	22,610	4,816
14	D	24	10	23	21,726	3,932
14	D		11	22	21,443	3,649
15	A	36	1	25	23,191	5,397
15	A		2	24	23,076	5,282
15	A		3	23	22,949	5,155
15	B	36	4	26	25,764	7,970
15	B		5	25	25,072	7,278
15	B		6	23	24,150	6,356
15	C	48	7	23	23,046	5,252
15	C		8	22	23,327	5,533
15	C		9	22	22,705	4,911
15	C		10	22	21,859	4,065
16	A	36	1	23	24,132	6,338
16	A		2	23	23,463	5,669
16	A		3	23	23,825	6,031
16	B	36	4	24	24,417	6,623
16	B		5	25	23,866	6,072
16	B		6	26	23,031	5,237
16	C	36	7	22	22,959	5,165
16	C		8	23	22,250	4,456
16	C		9	22	22,189	4,395
16	D	38	10	23	23,189	5,395
16	D		11	23	22,786	4,992
16	D		12.2	22	20,941	3,147
17	A	36	1	28	25,246	7,452
17	A		2	25	24,469	6,675
17	A		3	24	23,598	5,804
17	B	38	4	24	23,891	6,097

Core Number	Core Segment	Segment Length (inches)	Core Depth Below Surface (ft)	Gross Scan Rate (kcpm)	Gross Static Count (cpm)	Net Static Count (cpm) ¹
17	B		5	24	24,179	6,385
17	B		6.2	24	22,939	5,145
18	A	36	1	24	24,298	6,504
18	A		2	23	23,338	5,544
18	A		3	23	22,639	4,845
18	B	36	4	24	23,370	5,576
18	B		5	24	23,130	5,336
18	B		6	25	24,623	6,829
19	A	36	1	26	24,631	6,837
19	A		2	25	23,098	5,304
19	A		3	24	23,036	5,242
20	A	36	1	22	24,594	6,800
20	A		2	25	25,712	7,918
20	A		3	24	24,378	6,584
20	B	14	4.2	21	20,791	2,997
21	A	36	1	25	24,472	6,678
21	A		2	24	24,990	7,196
21	A		3	24	24,074	6,280
21	B	24	4	22	23,559	5,765
21	B		5	23	22,310	4,516
22	A	36	1	24	ND	ND
22	A		2	23	ND	ND
22	A		3	23	ND	ND
22	B	36	4	22	23,714	5,920
22	B		5	23	23,819	6,025
22	B		6	22	23,320	5,526
23	A	36	1	23	23,560	5,766
23	A		2	24	24,359	6,565
23	A		3	23	22,381	4,587
23	B	36	4	23	24,870	7,076
23	B		5	25	24,049	6,255
23	B		6	23	22,429	4,635
23	C	26	7	23	22,860	5,066
23	C		8.2	22	21,643	3,849
			Count:	79	76	76
			Average:	23	23,379	5,585
			Std. Dev.:	1.2	1,054	1,054
			Minimum:	21	20,791	2,997
			Maximum:	28	25,764	7,970
			Median:	23	23,333	5,539

ND = No Data

¹Net Static Count values (cpm) are equal to the Gross Static Count minus a background value of 17,794 cpm, the average of 5 consecutive 1-minute counts performed with the detector on top of the table used to scan the cores, prior to scan activities.

A composite sample representing each core segment was then prepared by combining each set of three 1-foot increments in a bucket and breaking up the cores. The final segment of core may be less than or greater than 3 feet depending on the point at which virgin material was encountered. A sample (usually between 500 and 800 grams) was taken from each composite and forwarded to Outreach for analysis of Th-232 activity concentration. Analytical results are provided below in Table 3. Analytical data reports are contained in Attachment C.

Table 3 – Systematic Soil Core Composite Sample Results

Core Number	Core Segment	Segment Length (in.)	Composite Sample No.	Core Depth (ft)	Th-232 (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)
13	A	36	K-264	1	8.27	0.518	1.13
13	B	36	K-265	4	9.67	0.460	0.888
13	C	24	K-266	7	8.55	0.299	0.915
14	A	36	K-240	1	7.76	0.319	0.538
14	B	36	K-241	4	6.07	0.354	0.698
14	C	36	K-242	7	6.66	0.444	0.985
14	D	24	K-243	10	6.06	0.299	0.552
15	A	36	K-244	1	6.76	0.298	0.735
15	B	36	K-245	4	9.23	0.526	0.830
15	C	48	K-246	7	6.81	0.346	0.745
16	A	36	K-236	1	9.25	0.442	0.847
16	B	36	K-237	4	8.69	0.505	0.820
16	C	36	K-238	7	8.14	0.376	0.812
16	D	38	K-239	10	5.84	0.349	0.642
17	A	36	K-234	1	9.44	0.607	0.984
17	B	38	K-235	4	8.41	0.352	0.611
18	A	36	K-267	1	12.5	0.508	0.841
18	B	36	K-268	4	8.81	0.516	0.930
19	A	36	K-269	1	10.3	0.395	0.744
20	A	36	K-230	1	11.4	0.447	0.996
20	B	14	K-231	4.2	4.00	0.210	0.427
21	A	36	K-232	1	8.04	0.525	1.02
21	B	24	K-233	4	9.91	0.457	0.684
22	A	36	K-225	1	7.88	0.400	0.913
22	B	36	K-226	4	10.7	0.412	0.755
23	A	36	K-227	1	8.80	0.436	0.875
23	B	36	K-228	4	9.74	0.603	1.21
23	C	26	K-229	7	10.3	0.404	0.497
				Count:	28		
				Average:	8.50		
				Std. Dev.:	1.85		
				Minimum:	4.00		
				Maximum:	12.5		
				Median:	8.62		

The gross and net Th-232 activity concentrations for all 28 systematic composite samples were below the BCM surrogate value of 31.1 pCi/g net Th-232 activity concentration (DCCL). The

maximum gross Th-232 activity concentration was 12.5 pCi/g. The average gross Th-232 activity concentration was 8.50 pCi/g. The standard deviation of the 28 composite samples was 1.85, which fell below the estimated standard deviation of 4.4 used to calculate the minimum number of samples required in the decommissioning plan.

2.3 Wilcoxon Rank Sum (WRS) Testing

The analytical results for the systematic soil core composite samples were evaluated using the procedure contained in **Appendix C, Volume I** of this Final Status Survey Report (Wilcoxon Rank Sum Test). The evaluation showed that the survey unit core sample results meet the DP statistical criterion based on the first statistical test as described below.

If the difference (11.87 pCi/g) between the maximum survey unit soil sample activity concentration (12.5 pCi/g) and the minimum reference background area soil sample activity concentration (0.63 pCi/g) is less than DCCL (31.1 pCi/g), then the survey unit meets the release criterion. **Table 4** presents a summary of the data used to complete the statistical evaluation of the survey unit.

Table 4 -- Reference Group and Survey Unit Sample Results

Reference Group	Sample ID	Th-232 (pCi/g)	Survey Unit Group	Sample ID	Th-232 (pCi/g)
R1	76	0.97	S1	K-225	7.88
R2	160	1.20	S2	K-226	10.7
R3	126	1.29	S3	K-227	8.80
R4	171	1.16	S4	K-228	9.74
R5	12	0.96	S5	K-229	10.3
R6	47	0.63	S6	K-230	11.4
R7	348	0.87	S7	K-231	4.00
R8	315	0.84	S8	K-232	8.04
R9	271	1.49	S9	K-233	9.91
R10	252	1.63	S10	K-234	9.44
R11	7	0.70	S11	K-235	8.41
R12	212	1.29	S12	K-236	9.25
R13	257	1.31	S13	K-237	8.69
R14	188	1.25	S14	K-238	8.14
R15	328	1.25	S15	K-239	5.84
R16	207	1.56	S16	K-240	7.76
R17	99	1.37	S17	K-241	6.07
R18	136	1.25	S18	K-242	6.66
R19	232	1.25	S19	K-243	6.06
R20	58	1.04	S20	K-244	6.76
R21	129	0.93	S21	K-245	9.23
R22	320	0.93	S22	K-246	6.81
R23	340	1.10	S23	K-264	8.27
R24	228	1.62	S24	K-265	9.67
R25	258	0.81	S25	K-266	8.55
R26	59	0.96	S26	K-267	12.5
R27	125	0.81	S27	K-268	8.81
R28	51	1.72	S28	K-269	10.3
	Average:	1.15		Average:	8.50
	Std. Dev.:	0.29		Std. Dev.:	1.85
	Minimum:	0.63		Minimum:	4.00
	Maximum:	1.72		Maximum:	12.5
	Median:	1.18		Median:	8.62

3.0 SUMMARY OF FINDINGS

Survey Unit Kaiser-FSSB-001 which consists of a unit of BCM placed in an excavation resulting from the removal of radiologically-affected soil from the Retention Pond area, is considered a Class 1 survey unit with an approximate base surface area of 2,220 m². It is located on the west side of the pond parcel within portions of excavation bottoms associated with Survey Units Kaiser-FSS-009, Kaiser-FSS-010 and Kaiser-FSS-011 (Figure 3). The survey unit is bordered by a wall of non-impacted soil to the west (former freshwater pond area), excavation backfill Survey Unit FSSB-002 to the north, excavation bottom Survey Unit Kaiser-FSS-008 to the south, and excavation bottom Survey Units Kaiser-FSS-025, Kaiser-FSS-026, and Kaiser-FSS-012 to the east. Excavation bottom Survey Units Kaiser-FSS-025 and Kaiser-FSS-026 were not excavated or backfilled at the time of the preparation of this sub-report.

A total of six 2-foot layers (lifts) of BCM was placed in Survey Unit Kaiser-FSSB-001. It should be noted that beginning with the 4th lift (from the bottom), additional sub-lifts were placed in the southeast corner and the east side of the survey unit to bring these areas up to an equal grade due to the general slope of the excavation from the northwest to the southeast.

The acceptance criterion for BCM survey units at the Tulsa facility is the DCCL of 31.1 pCi/g net Th-232 activity concentration. The final status survey consisted of a gross gamma scan of each placed 2-foot lift of BCM and systematic soil core sampling upon completion of the BCM unit. The results of the final status survey activities were as follows:

- The 100 percent coverage gamma scan of each lift (final as-left condition) did not indicate the presence of small areas (1 m²) of elevated activity (greater than the DCCL for the site).
- All 28 systematic composite sample results (gross and net) were below the BCM surrogate value of 31.1 pCi/g net Th-232 activity concentration (DCCL).
- The analytical results meet the DP statistical criterion based on the first statistical evaluation of the data (WRS Test procedure).

The results of the final status survey activities show that Survey Unit Kaiser-FSSB-001 meets the DP acceptance criteria.

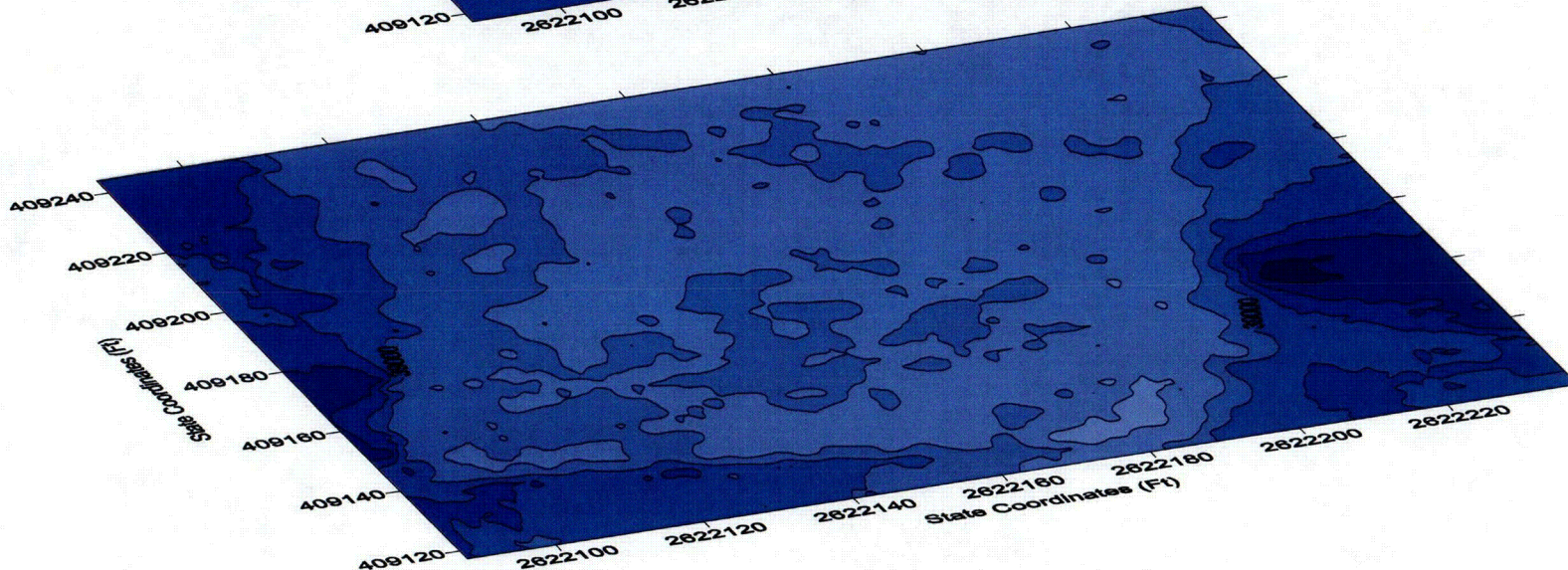
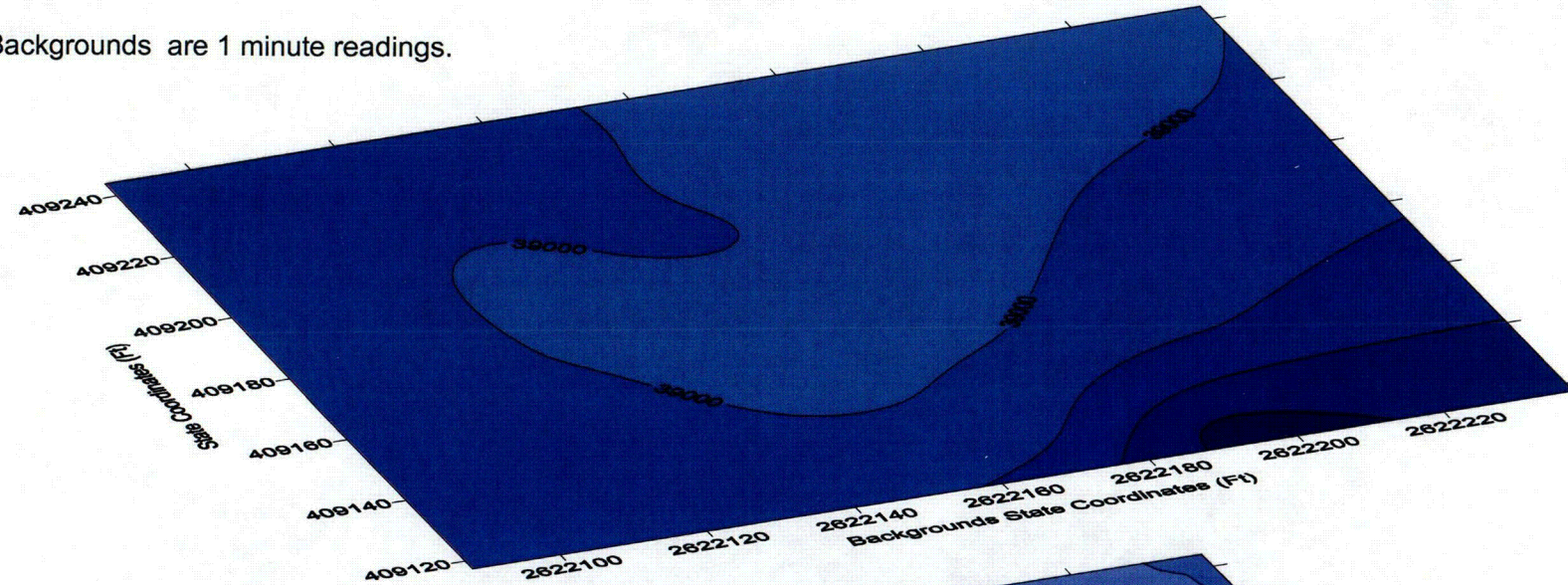
ATTACHMENT A TABLE OF CONTENTS

- **FIGURE A-1 Gross Gamma Background and Scanning Survey Results – Lift 1**
- **FIGURE A-2 Gross Gamma Background and Scanning Survey Results – Lift 2**
- **FIGURE A-3 Gross Gamma Background and Scanning Survey Results – Lift 3**
- **FIGURE A-4 Gross Gamma Background and Scanning Survey Results – Lift 4**
- **FIGURE A-5 Gross Gamma Background and Scanning Survey Results – Lift 5**
- **FIGURE A-6 Gross Gamma Background and Scanning Survey Results – Lift 6**
- **FIGURE A-7 Systematic Soil Core Sampling Locations**

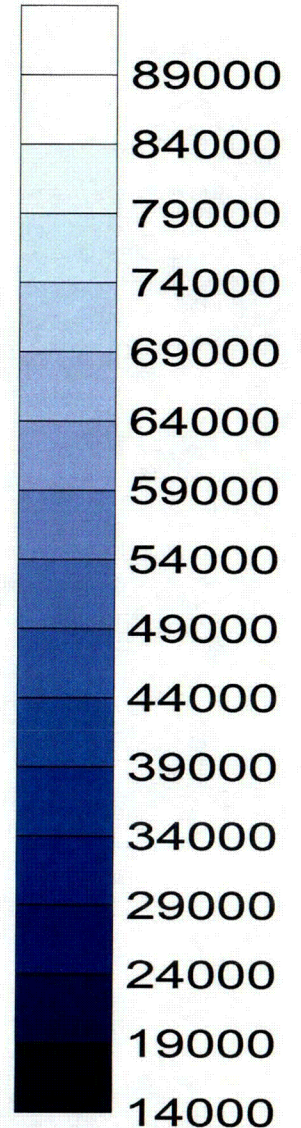


Attachment A, Figure A-1
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSB-001 - Lift No. 1

Backgrounds are 1 minute readings.



CPM NaI # 3

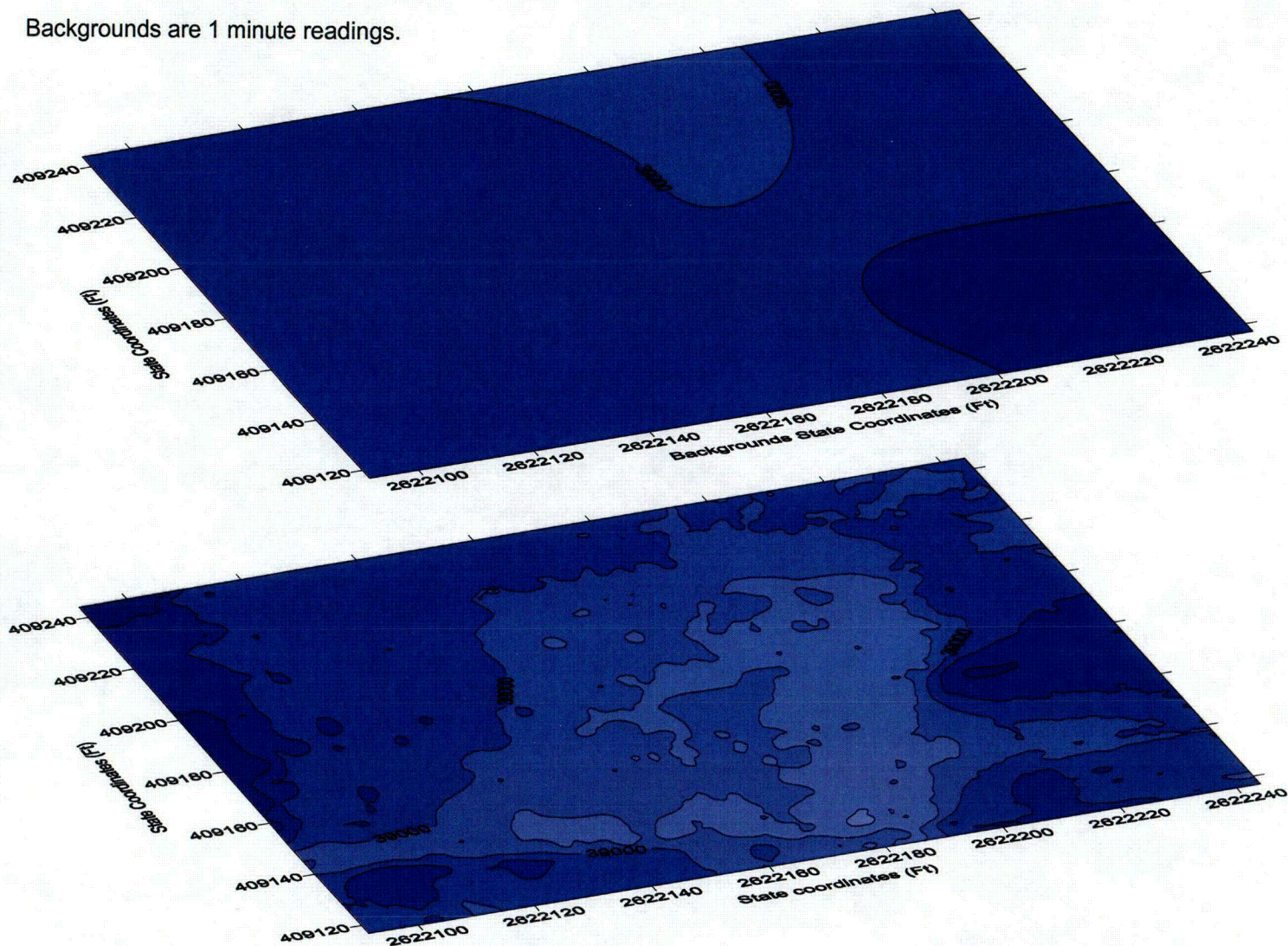


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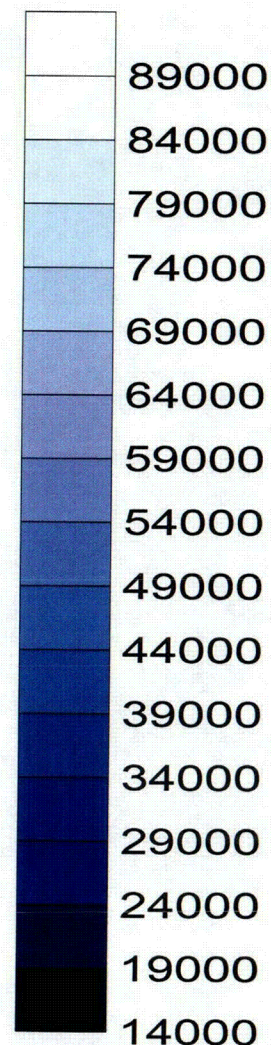


Attachment A, Figure A-2
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSB-001 - Lift No. 2

Backgrounds are 1 minute readings.



CPM Nal # 3



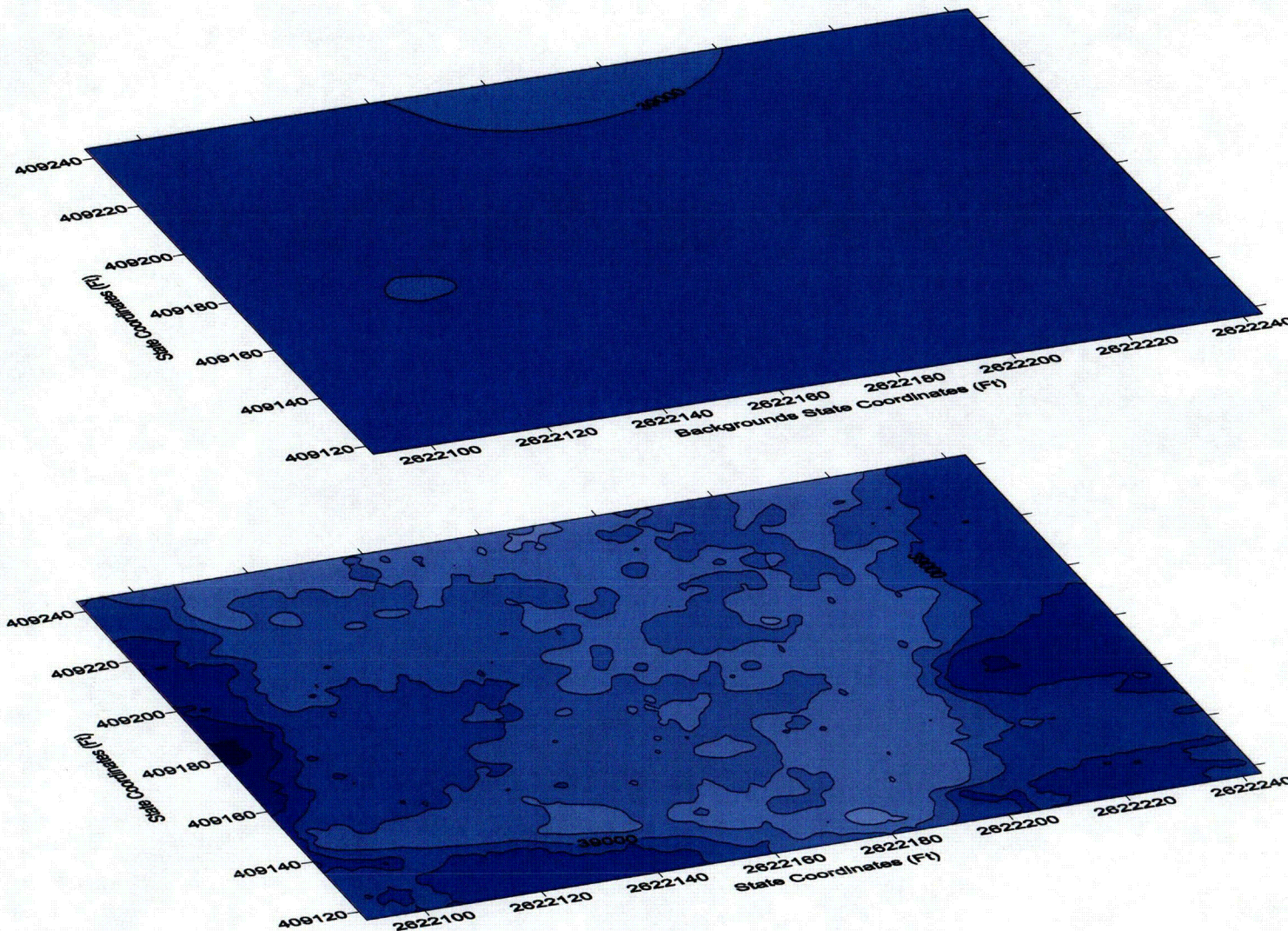
Scanning readings are recorded at 2 second intervals



Attachment A, Figure A-3
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSB-001 - Lift No. 3

Backgrounds are 1 minute readings.

CPM NaI # 3

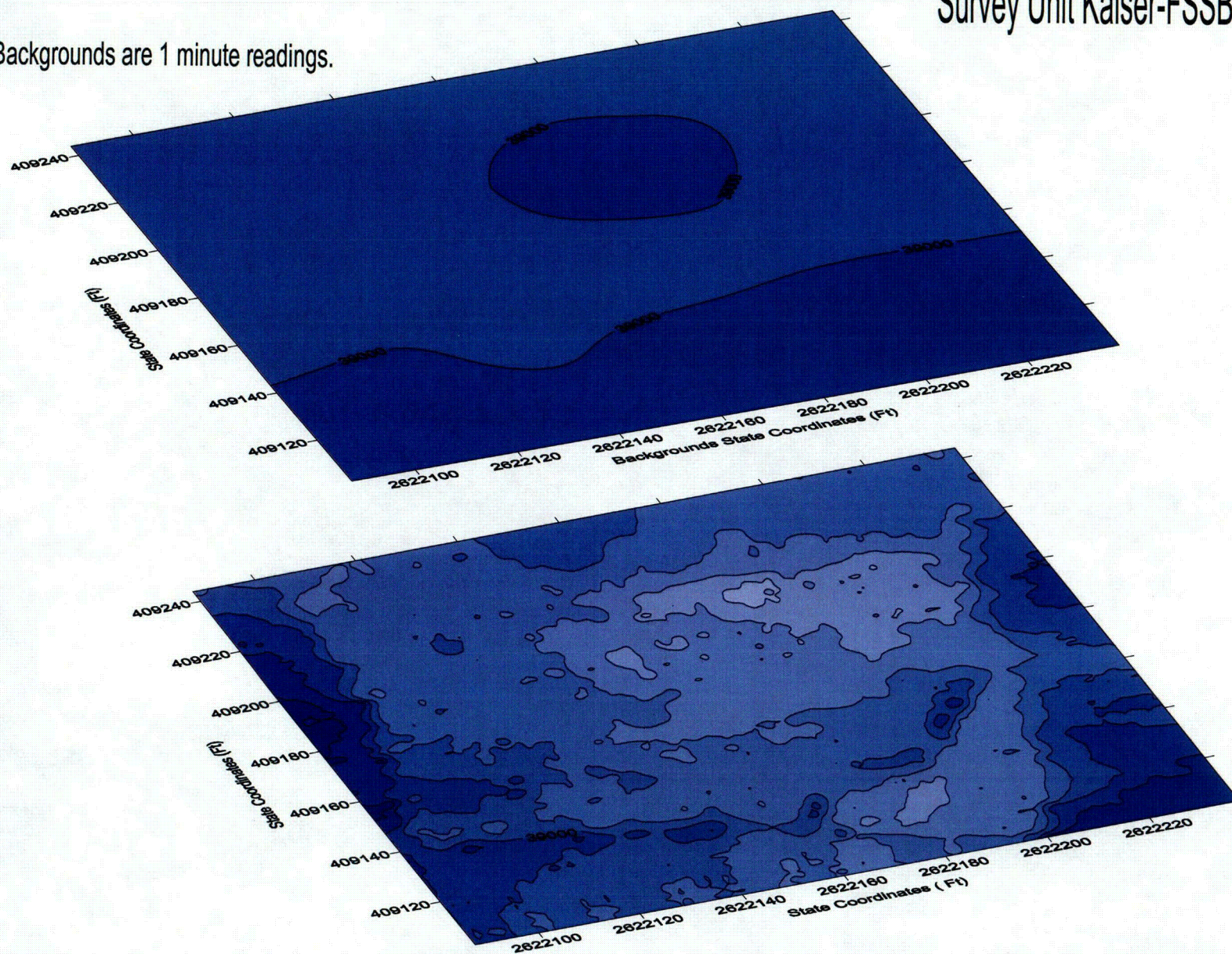


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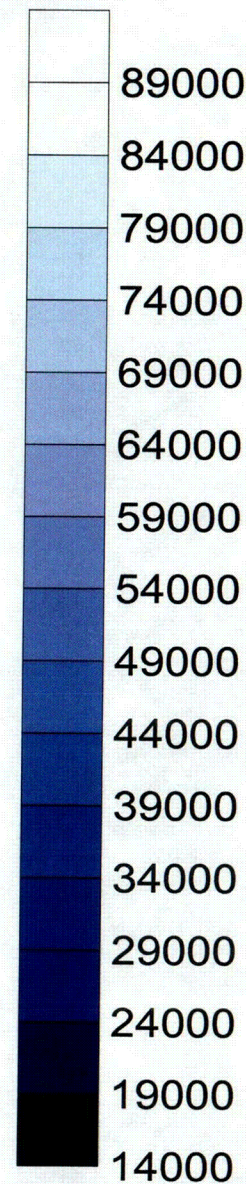


Attachment A, Figure A-4
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSB-001 - Lift No. 4

Backgrounds are 1 minute readings.



CPM NaI # 3

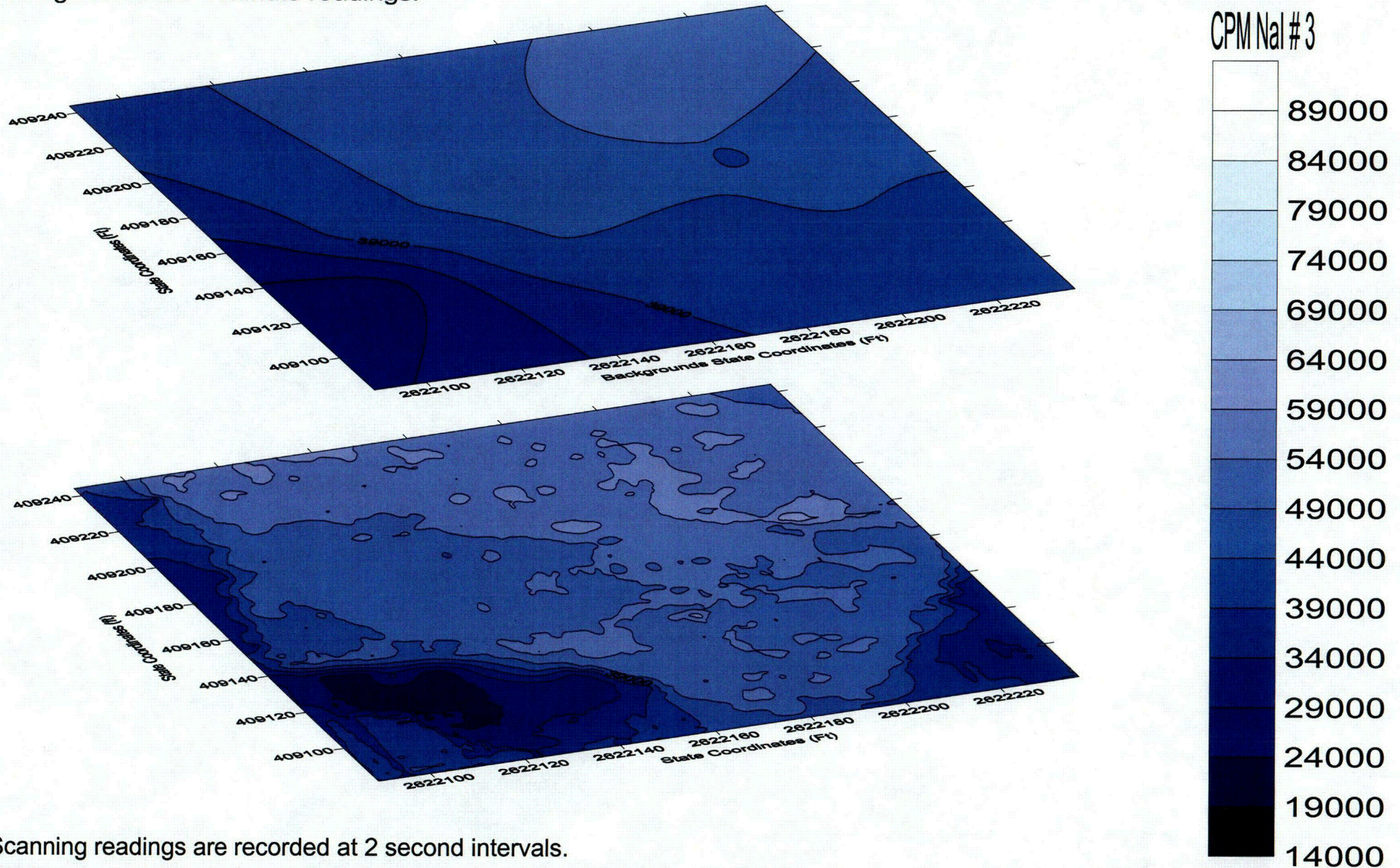


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Attachment A, Figure A-5
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSB-001 - Lift No. 5

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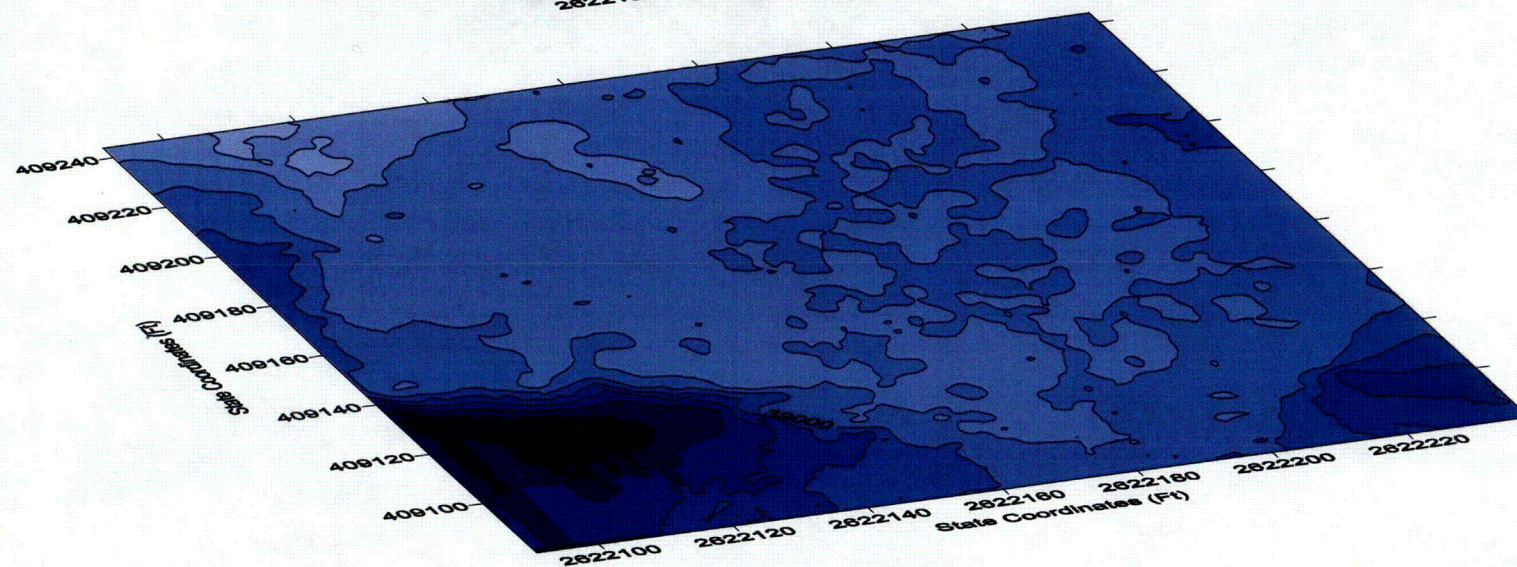
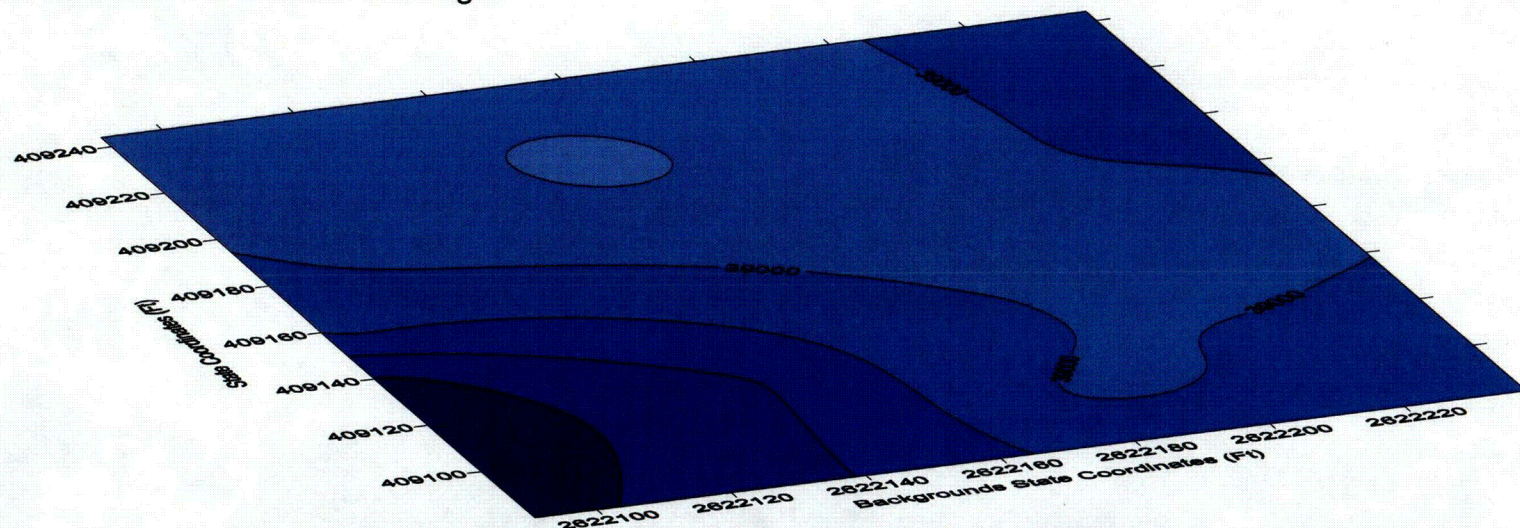


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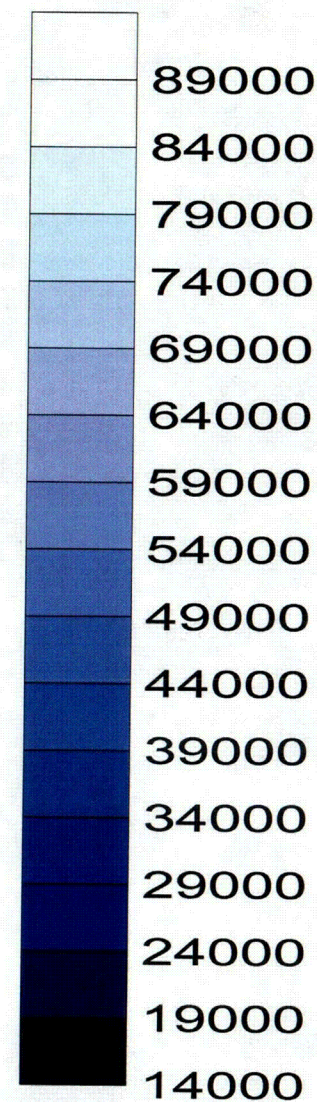
Attachment A, Figure A-6
Gross Gamma Background and Scanning Suvey Results
Survey Unit Kaiser-FSSB-001 - Lift No. 6

Backgrounds are 1 minute readings.



Scanning readings are recorded at 2 second intervals.

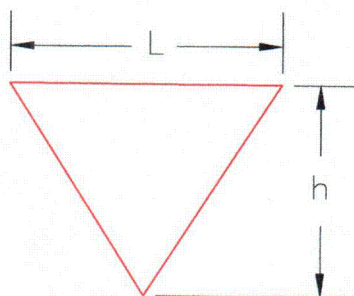
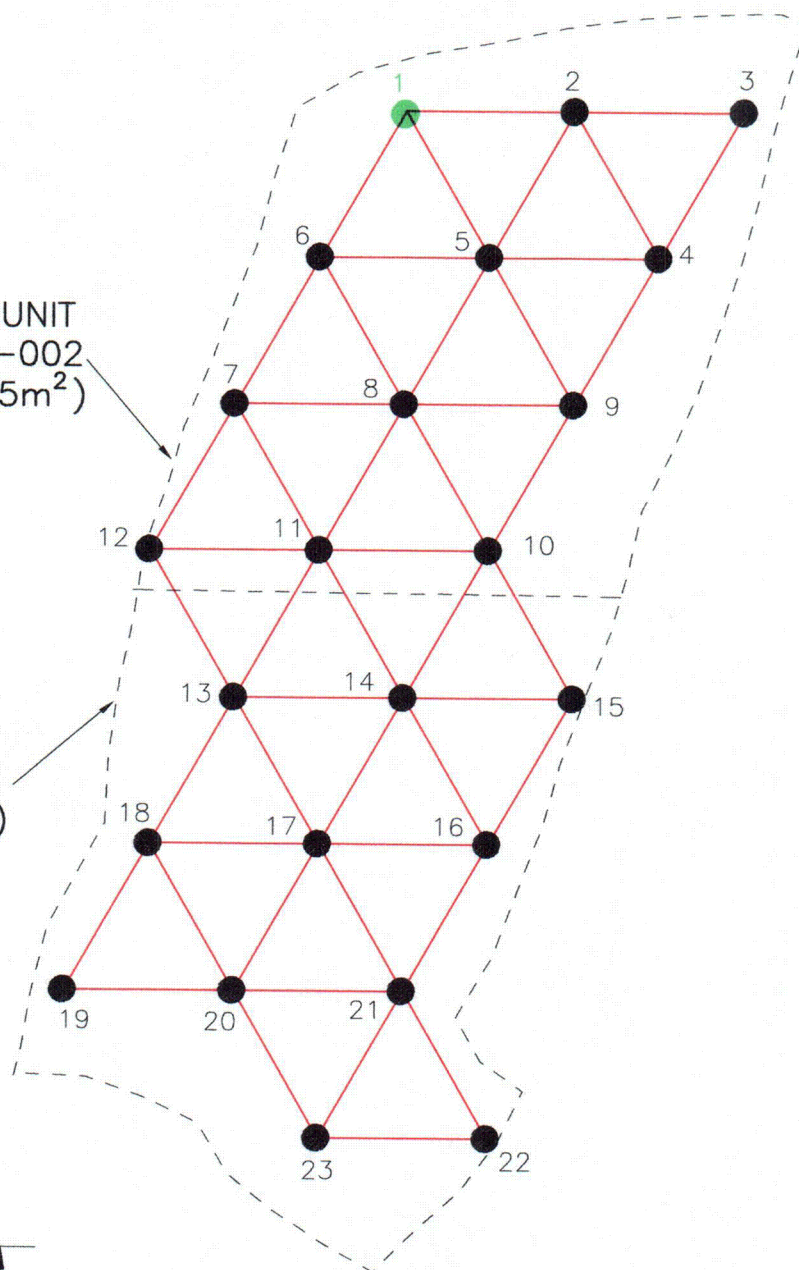
CPM NaI #3



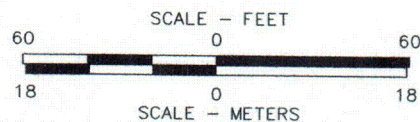


SURVEY UNIT
KAISER FSSB-002
(AREA=2,405m²)

SURVEY UNIT
KAISER FSSB-001
(AREA=2,220m²)



N = 21 (COLLECTED 23)
L = 16.0m
h = 13.9m
AREA = 4,625m²



2

● SYSTEMATIC SOIL CORE SAMPLING LOCATION
BASED ON RANDOM START POINT AND
AN EQUAL DISTANT TRIANGULAR GRID

1

● RANDOM START POINT

FIGURE A-7
SYSTEMATIC SOIL CORE SAMPLING LOCATIONS
SURVEY UNIT KAISER - FSSB-001 AND FSSB-002
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED RFD 3.3.06

CHECKED RFD 3.3.06

DRAWN DEB 01/30/06

DRAWING NUMBER

PA4072075



Penn E&R
Environmental & Remediation, Inc.

**ATTACHMENT B
TABLE OF CONTENTS**

- **Soil Survey Unit Worksheet No. 1**
- **Soil Survey Unit Worksheet No. 2**

Soil Survey Unit Work Sheet No. 1
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

1. Soil Survey Unit: Kaiser-FSSB-001 and Kaiser-FSSB-002

2. Description: Pond Parcel Excavation Backfill Unit

3. Net Th-232 Acceptance Criteria (pCi/g): 31.1

4. Dimensions (m): Excavation Bottom – Approx. 45 meters x 103 meters; Area, A (m²): 4,625

5. Estimate of Gross Gamma Scan Background Readings (cpm)

Average: 40,000 Minimum: 30,000 Maximum: 50,000

6. Based on the maximum background gross gamma scan reading, the scan MDC (Minimum Detectable Concentration of Th-232), the corresponding N (Minimum Number of Required Samples) and L (Triangular Grid Node Length) for a standard 2,000 m² Class 1 survey unit are:

- Gross Gamma Scan MDC (pCi/g): 4.0
- Minimum Number of Samples (N): 9 Triangular Grid Node Length (L): 16.0 m

7. If the area of the Survey Unit is less than 2,000 m², recalculate the corresponding Triangular Grid Node Length (L₁) for the Survey Unit Area (A), using the following formula: $L_1 = (A / (0.866 \times 9))^{1/2}$: N/A

8. If N is greater than 9 and the A is other than 2,000 m², recalculate the corresponding Triangular Grid Node Length (L₁) using the following formula $L_1 = (A / (0.866 \times N))^{1/2}$: N/A

9. If A is greater than 2,000 m² and N is equal to 9, recalculate the minimum number of samples (N₁) corresponding to a Triangular Grid Node Length (L) of 16 m using the following formula $N_1 = A / (0.866 \times 16^2)$, N₁: 21

10. Calculate the height (h) of the equilateral triangle with side length equal to L (or (L₁)) using the following formula: $h = ((L^2 - (L/2)^2)^{1/2})$: 13.9 m.

Soil Survey Unit Worksheet No. 2
Random Number Generator for Start Point
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

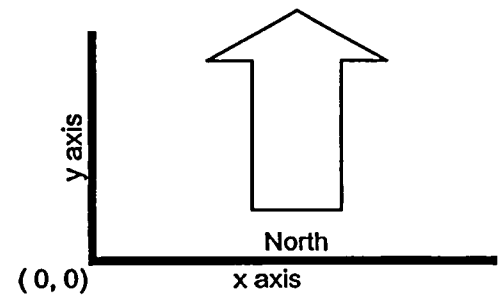
SURVEY UNIT: KAISER-FSSB-001 and KAISER-FSSB-002

RANDOM START POINT

x axis (Meters)	y axis (Meters)
26	110

lower bound
upper bound

x axis	y axis
0	0
68	126



ATTACHMENT C
LABORATORY ANALYTICAL RESULTS



Joe #
10375 81-
10/5/04

October 5, 2004

David Weyant
Kaiser Aluminum & Chemical
7311 E. 41st Street
Tulsa, OK 74145

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20040683

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples received in our laboratory on September 29, 2004 for the above captioned project. Forty-one soil samples were received in good condition and analyzed for Th-232 by Gamma Spectroscopy and Percent Moisture without drying and grinding with an expedited 5 work-day turn. Results were faxed early on 10/5/04.

All QC is within control limits with the exception of one Am-241 LCS% Rec and one % Moisture. The sample results are not effected. Samples will be returned after 30 days as requested.

Thank you for choosing Outreach Laboratory and if you have any questions, please call us at 918-251-2515.

Laboratory Director

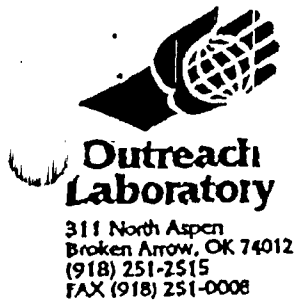
ODEQ ID #9517
DEQ LIC. #27522-01



Client: Kaiser Aluminum
Client Project: Thorium Remediation PA-4000-4072
Lab Number: 20040683
Date Reported: 10/5/2004
Date Received: 9/29/04
Page Number: 1 of 11

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-01							
Client ID: K-224							
Date Sampled: 9/28/2004 12:20:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	0.591 +/- 0.124	pCi/g	0.321		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	6.6	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-02							
Client ID: K-225							
Date Sampled: 9/28/2004 12:25:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	7.88 +/- 0.400	pCi/g	0.913		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	13.6	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-03							
Client ID: K-226							
Date Sampled: 9/28/2004 12:51:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	10.7 +/- 0.412	pCi/g	0.755		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	12.1	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-04							
Client ID: K-227							
Date Sampled: 9/28/2004 12:58:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	8.80 +/- 0.436	pCi/g	0.875		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	16.7	%		9/29/2004	9/30/2004	RT



Client: Kaiser Aluminum
Client Project: Thorium Remediation PA-4000-4072
Lab Number: 20040683
Date Reported: 10/5/2004
Date Received: 9/29/04
Page Number: 2 of 11

Analytical Report

Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-05						
Client ID: K-228						
Date Sampled: 9/28/2004 1:02:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	9.74 +/- 0.603 pCi/g	1.21		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	15.7 %		9/29/2004	9/30/2004	RT
Lab ID: 20040683-06						
Client ID: K-229						
Date Sampled: 9/28/2004 1:10:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	10.3 +/- 0.404 pCi/g	0.497		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	19.4 %		9/29/2004	9/30/2004	RT
Lab ID: 20040683-07						
Client ID: K-230						
Date Sampled: 9/28/2004 1:13:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	11.4 +/- 0.447 pCi/g	0.996		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	13.7 %		9/29/2004	9/30/2004	RT
Lab ID: 20040683-08						
Client ID: K-231						
Date Sampled: 9/28/2004 1:40:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	4.00 +/- 0.210 pCi/g	0.427		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	12.6 %		9/29/2004	9/30/2004	RT



Client: Kaiser Aluminum
Client Project: Thorium Remediation PA-4000-4072
Lab Number: 20040683
Date Reported: 10/5/2004
Date Received: 9/29/04
Page Number: 3 of 11

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-09							
Client ID: K-232							
Date Sampled: 9/28/2004 1:55:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	8.04 +/- 0.525	pCi/g	1.02		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	14.4	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-10							
Client ID: K-233							
Date Sampled: 9/28/2004 2:05:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	9.91 +/- 0.457	pCi/g	0.684		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	18.3	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-11							
Client ID: K-234							
Date Sampled: 9/28/2004 2:09:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	9.44 +/- 0.607	pCi/g	0.984		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	10.6	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-12							
Client ID: K-235							
Date Sampled: 9/28/2004 2:15:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	8.41 +/- 0.352	pCi/g	0.611		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	15.4	%		9/29/2004	9/30/2004	RT

BDL = Below Detection Limit



Outreach Laboratory

311 North Aspen
Broken Arrow, OK 74012
(918) 251-2515
FAX (918) 251-0006

Client: Kaiser Aluminum
Client Project: Thorium Remediation PA-4000-4072
Lab Number: 20040683
Date Reported: 10/5/2004
Date Received: 9/29/04
Page Number: 4 of 11

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-13							
Client ID: K-236							
Date Sampled: 9/28/2004 2:19:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	9.25 +/- 0.442	pCi/g	0.847		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	16.2	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-14							
Client ID: K-237							
Date Sampled: 9/28/2004 2:32:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	8.69 +/- 0.505	pCi/g	0.820		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	12.7	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-15							
Client ID: K-238							
Date Sampled: 9/28/2004 2:38:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	8.14 +/- 0.376	pCi/g	0.812		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	14.5	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-16							
Client ID: K-239							
Date Sampled: 9/28/2004 2:00:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	5.84 +/- 0.349	pCi/g	0.642		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	19.2	%		9/29/2004	9/30/2004	RT

BDL = Below Detection Limit

Client: Kaiser Aluminum
Client Project: Thorium Remediation PA-4000-4072
Lab Number: 20040683
Date Reported: 10/5/2004
Date Received: 9/29/04
Page Number: 5 of 11

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-17							
Client ID: K-240							
Date Sampled: 9/28/2004 2:23:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	7.76 +/- 0.319	pCi/g	0.538		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	11.9	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-18							
Client ID: K-241							
Date Sampled: 9/28/2004 2:25:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	6.07 +/- 0.354	pCi/g	0.698		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	12.5	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-19							
Client ID: K-242							
Date Sampled: 9/28/2004 2:36:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	6.66 +/- 0.444	pCi/g	0.985		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	15.8	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-20							
Client ID: K-243							
Date Sampled: 9/28/2004 2:41:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	6.06 +/- 0.299	pCi/g	0.552		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	20.1	%		9/29/2004	9/30/2004	RT

Client: Kaiser Aluminum
Client Project: Thorium Remediation PA-4000-4072
Lab Number: 20040683
Date Reported: 10/5/2004
Date Received: 9/29/04
Page Number: 6 of 11

Analytical Report

Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-21						
Client ID: K-244						
Date Sampled: 9/28/2004 2:42:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	6.76 +/- 0.298	pCi/g	0.735	9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	15.2	%	9/29/2004	9/30/2004	RT
Lab ID: 20040683-22						
Client ID: K-245						
Date Sampled: 9/28/2004 2:48:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	9.23 +/- 0.526	pCi/g	0.830	9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	13.6	%	9/29/2004	9/30/2004	RT
Lab ID: 20040683-23						
Client ID: K-246						
Date Sampled: 9/28/2004 2:54:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	6.81 +/- 0.346	pCi/g	0.745	9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	17.9	%	9/29/2004	9/30/2004	RT
Lab ID: 20040683-24						
Client ID: K-247						
Date Sampled: 9/28/2004 3:02:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	10.4 +/- 0.398	pCi/g	0.803	9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	13.6	%	9/29/2004	9/30/2004	RT



Outreach Laboratory

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Client: Kaiser Aluminum
Client Project: Thorium Remediation PA-4000-4072
Lab Number: 20040683
Date Reported: 10/5/2004
Date Received: 9/29/04
Page Number: 7 of 11

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20040683-25						
Client ID:	K-248						
Date Sampled:	9/28/2004 3:08:00 PM						
Matrix:	Soil						
Th-232	HASL 300	Radiochemical Analyses 7.44 +/- 0.323	pCi/g	0.464		9/30/2004	SD
Percent Moisture	LOD	Inorganics Analyses 18.6	%		9/29/2004	9/30/2004	RT
Lab ID:	20040683-26						
Client ID:	K-249						
Date Sampled:	9/28/2004 3:10:00 PM						
Matrix:	Soil						
Th-232	HASL 300	Radiochemical Analyses 10.6 +/- 0.621	pCi/g	0.833		9/30/2004	SD
Percent Moisture	LOD	Inorganics Analyses 16.3	%		9/29/2004	9/30/2004	RT
Lab ID:	20040683-27						
Client ID:	K-250						
Date Sampled:	9/28/2004 3:20:00 PM						
Matrix:	Soil						
Th-232	HASL 300	Radiochemical Analyses 9.44 +/- 0.392	pCi/g	0.625		9/30/2004	SD
Percent Moisture	LOD	Inorganics Analyses 13.9	%		9/29/2004	9/30/2004	RT
Lab ID:	20040683-28						
Client ID:	K-251						
Date Sampled:	9/28/2004 3:18:00 PM						
Matrix:	Soil						
Th-232	HASL 300	Radiochemical Analyses 10.8 +/- 0.395	pCi/g	0.537		9/30/2004	SD
Percent Moisture	LOD	Inorganics Analyses 13.8	%		9/29/2004	9/30/2004	RT

BDL = Below Detection Limit



311 North Aspen
Broken Arrow, OK 74012
(918) 251-2515
FAX (918) 251-0008

Client: Kaiser Aluminum
Client Project: Thorium Remediation PA-4000-4072
Lab Number: 20040683
Date Reported: 10/5/2004
Date Received: 9/29/04
Page Number: 8 of 11

Analytical Report

Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-29						
Client ID: K-252						
Date Sampled: 9/28/2004 3:23:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	8.26 +/- 0.391 pCi/g	0.465		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	13.8 %		9/29/2004	9/30/2004	RT
Lab ID: 20040683-30						
Client ID: K-253						
Date Sampled: 9/28/2004 3:28:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	10.0 +/- 0.747 pCi/g	1.30		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	9.9 %		9/29/2004	9/30/2004	RT
Lab ID: 20040683-31						
Client ID: K-254						
Date Sampled: 9/28/2004 3:38:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	9.00 +/- 0.416 pCi/g	0.911		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	14.2 %		9/29/2004	9/30/2004	RT
Lab ID: 20040683-32						
Client ID: K-255						
Date Sampled: 9/28/2004 3:44:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	9.48 +/- 0.256 pCi/g	0.650		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	13.3 %		9/29/2004	9/30/2004	RT

BDL - Below Detection Limit

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-33							
Client ID: K-256							
Date Sampled: 9/28/2004 3:53:00 PM							
Matrix: Soil							
Th-232	HASL 300	Radiochemical Analyses					
		8.39 +/- 0.336	pCi/g	0.742		9/30/2004	SD
		Inorganics Analyses					
Percent Moisture	LOD	15.2	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-34							
Client ID: K-257							
Date Sampled: 9/28/2004 4:01:00 PM							
Matrix: Soil							
Th-232	HASL 300	Radiochemical Analyses					
		8.07 +/- 0.522	pCi/g	1.36		9/30/2004	SD
		Inorganics Analyses					
Percent Moisture	LOD	14.7	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-35							
Client ID: K-258							
Date Sampled: 9/28/2004 4:08:00 PM							
Matrix: Soil							
Th-232	HASL 300	Radiochemical Analyses					
		10.6 +/- 0.460	pCi/g	0.743		9/30/2004	SD
		Inorganics Analyses					
Percent Moisture	LOD	10.9	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-36							
Client ID: K-259							
Date Sampled: 9/28/2004 4:10:00 PM							
Matrix: Soil							
Th-232	HASL 300	Radiochemical Analyses					
		7.42 +/- 0.309	pCi/g	0.792		9/30/2004	SD
		Inorganics Analyses					
Percent Moisture	LOD	14.9	%		9/29/2004	9/30/2004	RT



Outreach Laboratory

311 North Aspen
Broken Arrow, OK 74012
(918) 251-2515
FAX (918) 251-0001

Client: Kaiser Aluminum
Client Project: Thorium Remediation PA-4000-4072
Lab Number: 20040683
Date Reported: 10/5/2004
Date Received: 9/29/04
Page Number: 10 of 11

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20040683-37						
Client ID:	K-260						
Date Sampled:	9/28/2004 4:15:00 PM						
Matrix:	Soil						
Th-232	HASL 300	11.2 +/- 0.460	pCi/g	0.790		9/30/2004	SD
		Radiochemical Analyses					
		Inorganics Analyses					
Percent Moisture	LOD	12.1	%		9/29/2004	9/30/2004	RT
Lab ID:	20040683-38						
Client ID:	K-261						
Date Sampled:	9/28/2004 4:24:00 PM						
Matrix:	Soil						
Th-232	HASL 300	8.72 +/- 0.510	pCi/g	0.900		9/30/2004	SD
		Radiochemical Analyses					
		Inorganics Analyses					
Percent Moisture	LOD	16.5	%		9/29/2004	9/30/2004	RT
Lab ID:	20040683-39						
Client ID:	K-262						
Date Sampled:	9/28/2004 4:27:00 PM						
Matrix:	Soil						
Th-232	HASL 300	11.1 +/- 0.458	pCi/g	0.636		9/30/2004	SD
		Radiochemical Analyses					
		Inorganics Analyses					
Percent Moisture	LOD	14.4	%		9/29/2004	9/30/2004	RT
Lab ID:	20040683-40						
Client ID:	K-263						
Date Sampled:	9/28/2004 4:33:00 PM						
Matrix:	Soil						
Th-232	HASL 300	10.1 +/- 0.430	pCi/g	0.955		9/30/2004	SD
		Radiochemical Analyses					
		Inorganics Analyses					
Percent Moisture	LOD	16.2	%		9/29/2004	9/30/2004	RT

BDL = Below Detection Limit

Client: Kaiser Aluminum
Client Project: Thorium Remediation PA-4000-4072
Lab Number: 20040683
Date Reported: 10/5/2004
Date Received: 9/29/04
Page Number: 11 of 11

Analytical Report

Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20040683-41					
Client ID:	K-264					
Date Sampled:	9/28/2004 4:38:00 PM					
Matrix:	Soil					
Radiochemical Analyses						
Th-232	HASL 300	8.27 +/- 0.518 pCi/g	1.13		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	12.3 %		9/29/2004	9/30/2004	RT

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	RPD	DUP RPD	MS %REC	MSD %REC	RPD	Date
Am-241		94.0	90.0	4.5					9/30/2004
Am-241		64.0	90.0	34.4					9/30/2004
Am-241		88.0	92.0	4.6					9/30/2004
Co-60		94.0	91.0	3.2					9/30/2004
Co-60		94.0	92.0	1.9					9/30/2004
Co-60		94.0	94.0	0.0					9/30/2004
Cs-137		98.0	95.0	3.3					9/30/2004
Cs-137		96.0	94.0	1.7					9/30/2004
Cs-137		100.0	94.0	6.8					9/30/2004
Percent Moisture					11.9				9/30/2004
Percent Moisture					7.1				9/30/2004
Percent Moisture					24.3				9/30/2004
Th-232					12.7				9/30/2004
Th-232					7.7				9/30/2004
Th-232					9.2				9/30/2004

Lab Approval: 



OUTREACH LABORATORY

CHAIN OF CUSTODY

311 North Aspen
Broken Arrow, OK 74012
Phone: (918) 251-2515
Fax: (918) 251-0008

Results To: Company KARSON - ALUM & CHIM INC.
LOCAL Name DAVID R. WEYANT
918-384-0566 Address 7311 E. 41ST STREET
City TULSA State OK Zip 74145
Cell 779-934-3530 Phone 779-934-3530 Fax 918-384-7171
779-0071

Bill To:
Company KARSON / PIAN EPC
Name DAVID R. WEYANT / PAUL HARRIS
Address 7311 E. 41ST STREET
City TULSA State OK Zip 74145

ANALYSIS REQUESTED

PO #	PROJECT #	PROJECT NAME	REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY)	SAMPLER	SIGNATURE	DATE	TIME	MATRIX	# CONTAINERS	CONTAINER SIZE	PRESERVATIVE	PLASTIC OR GLASS	ANALYSIS	REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
		KARSON - 4-72	5 DAY	DAVID WEYANT	Signature	2004				PLASTIC	1. HNO ₃ pH<2 2. Ice <4°C 3. HCl pH<2 4. H ₂ SO ₄ pH<2 5. NaOH pH>11			
1	K-224	9:29	12:20	Soil	1	Sealed								Grab
2	K-225		12:25		1									
3	K-226		12:51		1									
4	K-227		12:59		1									
5	K-228		13:02		1									
6	K-229		13:10		1									
7	K-230		13:13		1									
8	K-231		13:40		1									
9	K-232		13:55		1									
10	K-233		14:05		1									
11	K-234		14:09		1									
12	K-235		14:15		1									
13	K-236		14:19		1									
14	K-237		14:32		1									

RELINQUISHED BY: DAVID WEYANT

DATE 4-29-04 TIME 11:11

RECEIVED BY: R. P. L. R.

DATE 9/29/04 TIME 11:11

FOR LABORATORY USE ONLY: 207/083-1

RELINQUISHED BY: _____ DATE _____ TIME _____ RECEIVED BY: _____ DATE _____ TIME _____

My signature on this chain of custody form indicates that I am authorized by the above company to release samples for analysis. The company agrees to pay the entire balance upon receipt of sample data and it is understood and agreed that any balance carried over thirty (30) days is subject to a 1.5% per month (18% per annum) late charge. In the event of default, the company becomes legally liable for any reasonable attorney and/or collection fees and all related costs necessary to remit the entire balance to Outreach Technologies, Inc. (Outreach Laboratory).

SAMPLE RETURN/DISPOSAL: All non-hazardous samples shall be disposed of 30 days after issue of final report. All others will be returned at client's expense.

Sample Condition Upon Receipt _____

Custody Seals Intact Y N

Cooler Temperature _____



311 North Aspen
Broken Arrow, OK 74012
Phone: (918) 251-2515
Fax: (918) 251-0008

CHAIN CUSTODY

Results To: Company Malisa. Dean & China TNC.
Local 918-384-0566 Name Malisa Q. Wilson
Address 211 E. 41st Street
City Tulsa State OK Zip 74115
Cell: 724-799-0271 Phone 724-934-3530 Fax # 918-284-2171

Bill To:
Company MAYA-PENN E&K
Name DR. G. WYANT / PAUL HART
Address 7211 E 115TH ST
City TULSA State OK Zip 74115

ANALYSIS REQUESTED

PO # PROJECT # PROJECT NAME REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY) SAMPLER					# C O N T A I N E R S	CONTAINER SIZE PLASTIC OR GLASS	PRESERVATIVE S 1. HNO ₃ pH<2 2. Ice <4°C 3. HCl pH<2 4. H ₂ SO ₄ pH<2 5. NaOH pH>11	REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
DATE SAMPLED	TIME SAMPLED	MATRIX						
HANSEN-4572 A-4000-4572 HANSEN-THORIUM REMEDIATION 5 DAYS Signature: [Signature] 2004								
1	K-238	9-28	14:38	Soil	1	PLASTIC	NONE	GRAB A Z
2	K-239		14:00		1			
3	K-240		14:23		1			
4	K-241		14:25		1			
5	K-242		14:26		1			
6	K-243		14:41		1			
7	K-244		14:42		1			
8	K-245		14:48		1			
9	K-246		14:54		1			
10	K-247		15:02		1			
11	K-248		15:08		1			
12	K-249		15:10		1			
13	K-250		15:20		1			
14	K-251		15:18		1			

REF INQUIRED BY:

DATE: 6-9-01 TIME: 1110

RECEIVED BY:

DATE 12/12 TIME 111

REINQUISHED BY:

DATE

TIME

RECEIVED BY:

..DATE

TIME

My signature on this chain of custody form indicates that I am authorized by the above company to release samples for analysis. The company agrees to pay the entire balance upon receipt of sample data and it is understood and agreed that any balance carried over thirty (30) days is subject to a 1.5% per month (18% per annum) late charge. In the event of default, the company becomes legally liable for any reasonable attorney and/or collection fees and all related costs necessary to remit the entire balance to Outreach Technologies, Inc. (Outreach Laboratory).

SAMPLE RETURN/DISPOSAL: All non-hazardous samples shall be disposed of 30 days after issue of final report. All others will be returned at client's expense.

FOR LABORATORY USE ONLY:

Sample Condition Upon Receipt

Custody Seals Intact	Y	N
----------------------	---	---

Cooler Temperature _____



OUTREACH LABORATORY

CHAIN OF CUSTODY

311 North Aspen
Broken Arrow, OK 74012
Phone: (918) 251-2515
Fax: (918) 251-0008

Results To: Company KALISA - Alon & Chm Inc
Local: Name David G. Weyant
918-384- Address 7311 E. 41st Street
City Tulsa State OK Zip 74115
Cell: 724- Phone 724-934-3535 Fax # 918-384-3171
779 0071

Bill To:
Company KALISA / P&S E&C
Name DAVID G. WEYANT
Address 7311 E. 41st Street
City Tulsa State OK Zip 74115

ANALYSIS REQUESTED

PO # KALISA-4072
PROJECT # PA-4000-4072
PROJECT NAME KALISA - thorn lawn Remo.
REQUESTED TURNAROUND TIME 5 DAYS
(ADDITIONAL CHARGES MAY APPLY)
SAMPLER David Weyant Signature David Weyant
2004

CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER SIZE	PRESERVATIVE	ANALYSIS REQUESTED	REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
K-252	9-28	15:23	Soil	1	None	X	Grab
K-253		15:28		1		X	
K-254		15:38		1		X	
K-255		15:44		1		X	
K-256		15:53		1		X	
K-257		16:01		1		X	
K-258		16:08		1		X	
K-259		16:10		1		X	
K-260		16:15		1		X	
K-261		16:24		1		X	
K-262		16:27		1		X	
K-263		16:33		1		X	
K-264		16:38		1		X	

RELINQUISHED BY: David Weyant DATE 9/27/04 TIME 1110 RECEIVED BY: Alon & Chm DATE 9/29/04 TIME 1110

RELINQUISHED BY: _____ DATE _____ TIME _____ RECEIVED BY: _____ DATE _____ TIME _____

My signature on this chain of custody form indicates that I am authorized by the above company to release samples for analysis. The company agrees to pay the entire balance upon receipt of sample data and it is understood and agreed that any balance carried over thirty (30) days is subject to a 1.5% per month (18% per annum) late charge. In the event of default, the company becomes legally liable for any reasonable attorney and/or collection fees and all related costs necessary to remit the entire balance to Outreach Technologies, Inc. (Outreach Laboratory).

HAZARDOUS WASTE DISPOSAL: All non-hazardous samples shall be disposed of 30 days after issue of final report. All others will be returned at client's expense.

FOR LABORATORY USE ONLY:

Sample Condition Upon Receipt: Good

Custody Seals Intact: Y N

Cooler Temperature: _____

SAMPLE LOGIN

Date Received: 9/29/2004 1:08:45

Lab Number: 20040683

Due: 10/6/2004

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20040683-01 A Percent Moisture Th-232 by Gamma Spec	K-224	Soil	09/28/04	Plastic	500 ml	None	No	No
20040683-02 A Percent Moisture Th-232 by Gamma Spec	K-225	Soil	09/28/04	Plastic	500 ml	None	No	No
20040683-03 A Percent Moisture Th-232 by Gamma Spec	K-226	Soil	09/28/04	Plastic	500 ml	None	No	No
20040683-04 A Percent Moisture Th-232 by Gamma Spec	K-227	Soil	09/28/04	Plastic	500 ml	None	No	No
20040683-05 A Percent Moisture Th-232 by Gamma Spec	K-228	Soil	09/28/04	Plastic	500 ml	None	No	No
20040683-06 A Percent Moisture Th-232 by Gamma Spec	K-229	Soil	09/28/04	Plastic	500 ml	None	No	No
20040683-07 A Percent Moisture Th-232 by Gamma Spec	K-230	Soil	09/28/04	Plastic	500 ml	None	No	No
20040683-08 A	K-231	Soil	09/28/04	Plastic	500 ml	None	No	No

Percent Moisture
Th-232 by Gamma Spec

20040683-09 A	K-232	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-10 A	K-233	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-11 A	K-234	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-12 A	K-235	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-13 A	K-236	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-14 A	K-237	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-15 A	K-238	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-16 A	K-239	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-17 A	K-240	Soil	09/28/04	Plastic	500 ml	None	No	No

Percent Moisture
Th-232 by Gamma Spec

20040683-18 A	K-241	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-19 A	K-242	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-20 A	K-243	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-21 A	K-244	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-22 A	K-245	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-23 A	K-246	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-24 A	K-247	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-25 A	K-248	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-26 A	K-249	Soil	09/28/04	Plastic	500 ml	None	No	No

Percent Moisture

Th-232 by Gamma Spec

20040683-27 A	K-250	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture								
Th-232 by Gamma Spec								
20040683-28 A	K-251	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture								
Th-232 by Gamma Spec								
20040683-29 A	K-252	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture								
Th-232 by Gamma Spec								
20040683-30 A	K-253	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture								
Th-232 by Gamma Spec								
20040683-31 A	K-254	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture								
Th-232 by Gamma Spec								
20040683-32 A	K-255	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture								
Th-232 by Gamma Spec								
20040683-33 A	K-256	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture								
Th-232 by Gamma Spec								
20040683-34 A	K-257	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture								
Th-232 by Gamma Spec								
20040683-35 A	K-258	Soil	09/28/04	Plastic	500 ml	None	No	No

Percent Moisture
Th-232 by Gamma Spec

20040683-36 A K-259
Percent Moisture
Th-232 by Gamma Spec

Soil 09/28/04 Plastic 500 ml None No No

20040683-37 A K-260
Percent Moisture
Th-232 by Gamma Spec

Soil 09/28/04 Plastic 500 ml None No No

20040683-38 A K-261
Percent Moisture
Th-232 by Gamma Spec

Soil 09/28/04 Plastic 500 ml None No No

20040683-39 A K-262
Percent Moisture
Th-232 by Gamma Spec

Soil 09/28/04 Plastic 500 ml None No No

20040683-40 A K-263
Percent Moisture
Th-232 by Gamma Spec

Soil 09/28/04 Plastic 500 ml None No No

20040683-41 A K-264
Percent Moisture
Th-232 by Gamma Spec

Soil 09/28/04 Plastic 500 ml None No No

CONTAINER INSPECTION

Coolers 2 Custody Seals Broken - YN Temperature amb Blue Ice N/A Wet Ice _____ Radiation Survey 1300 fixed _____ removable _____

SAMPLE INSPECTION

Custody Seals Broken - YN Chain of Custody Record YN Labels in Tact YN Radiation Survey Complete YN

Anomalies: _____

Inspected By: [Signature]

DATE

9/29/04

QA or Designee Review: [Signature]

DATE

09/29/04

Sample Custodian Review: [Signature]

DATE

9/29/04
9:29 AM

Project Notes:



311 North Aspen
Broken Arrow, OK 74012
(918) 251-2515
FAX (918) 251-0008

October 5, 2004

David Weyant
Kaiser Aluminum & Chemical
7311 E. 41st Street
Tulsa, OK 74145

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20040686

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples received in our laboratory on September 30, 2004 for the above captioned project. Five soil samples were received in good condition and analyzed for Th-232 by Gamma Spectroscopy without drying and grinding and Percent Moisture with an expedited 5-work day turn. Results were faxed on 10/4/04.

All Quality Control for the requested analyses is reported on the analytical report. The laboratory control standard and duplicates for all analyses were within method control limits.

Your samples will be returned as requested.

Thank you for choosing Outreach Laboratory and if you have any questions, please call us at 918-251-2515.

Laboratory Director

ODEQ ID #9517
DEQ LIC. #27522-01



Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040686-01							
Client ID: K-265							
Date Sampled: 9/28/04 4:44:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	9.67 +/- 0.460	pCi/g	0.888		9/30/04	SD
Inorganics Analyses							
Percent Moisture	LOD	11.0	%	1	9/30/04	10/1/04	RT
Lab ID: 20040686-02							
Client ID: K-266							
Date Sampled: 9/28/04 4:52:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	8.55 +/- 0.299	pCi/g	0.915		9/30/04	SD
Inorganics Analyses							
Percent Moisture	LOD	11.2	%	1	9/30/04	10/1/04	RT
Lab ID: 20040686-03							
Client ID: K-267							
Date Sampled: 9/28/04 5:00:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	12.5 +/- 0.508	pCi/g	0.841		9/30/04	SD
Inorganics Analyses							
Percent Moisture	LOD	10.2	%	1	9/30/04	10/1/04	RT
Lab ID: 20040686-04							
Client ID: K-268							
Date Sampled: 9/28/04 4:56:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	8.81 +/- 0.516	pCi/g	0.930		9/30/04	SD
Inorganics Analyses							
Percent Moisture	LOD	11.2	%	1	9/30/04	10/1/04	RT
Lab ID: 20040686-05							
Client ID: K-269							
Date Sampled: 9/28/04 5:06:00 PM							
Matrix: Soil							
Radiochemical Analyses							

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Th-232	HASL 300	10.3 +/- 0.395	pCi/g	0.744		9/30/04	SD
Inorganics Analyses							
Percent Moisture	LOD	10.8	%	1	9/30/04	10/1/04	RT

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	RPD	DUP RPD	MS %REC	MSD %REC	RPD	Date
Am-241		88.0	92.0	4.6					9/30/04
Co-60		94.0	94.0	0.0					9/30/04
Cs-137		100.0	94.0	6.8					9/30/04
Percent Moisture					1.1				10/1/04
Th-232					7.7				9/30/04
Th-232					9.2				9/30/04

Lab Approval: 



311 North Aspen
Broken Arrow, OK 74012
Phone: (918) 251-2515
Fax: (918) 251-0008

CHAIN OF CUSTODY

Results To: Company Kaiser-Alon 8 Chem Lab.
Local: Name David A. Weyant
98-384-0566 Address 7211 E. 41st Street
City Tulsa State OK Zip 74145
Call: 789-789-0671 Phone 789-974-3530 Fax # 98-384-3171

Bill To: _____
 Company MASSA - / PEARL EJA
 Name David G. W. / PLX W. W.
 Address 7311 E. 4th Street
 City Tulsa State OK Zip 74145

ANALYSIS REQUESTED[illegible]

REMOVED BY

DATE

RECEIVED BY:

DATE

RELINQUISHED BY:

DATE

TIME

RECEIVED BY:

DATE

TIME

My signature on this chain of custody form indicates that I am authorized by the above company to release samples for analysis. The company agrees to pay the entire balance upon receipt of sample data and it is understood and agreed that any balance carried over thirty (30) days is subject to a 7.5% per month (18% per annum) late charge. In the event of default, the company becomes legally liable for any reasonable attorney and/or collection fees and all related costs necessary to remit the entire balance to Outreach Technologies, Inc. (Outreach Laboratory).

FOR LABORATORY USE ONLY

Service Capabilities Upon Request

Customs Service Interacts

SAMPLE LOGIN

Date Received: 9/30/2004 2:57:09

Lab Number: 20040686

Due: 10/4/2004

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20040686-01 A Percent Moisture Th-232 by Gamma Spec	K-265	Soil	09/28/04	Plastic	500 ml	None	Yes	Yes
20040686-02 A Percent Moisture Th-232 by Gamma Spec	K-266	Soil	09/28/04	Plastic	500 ml	None	Yes	Yes
20040686-03 A Percent Moisture Th-232 by Gamma Spec	K-267	Soil	09/28/04	Plastic	500 ml	None	Yes	Yes
20040686-04 A Percent Moisture Th-232 by Gamma Spec	K-268	Soil	09/28/04	Plastic	500 ml	None	Yes	Yes
20040686-05 A Percent Moisture Th-232 by Gamma Spec	K-269	Soil	09/28/04	Plastic	500 ml	None	Yes	Yes

CONTAINER INSPECTION

Coolers 5 Custody Seals Broken - Y/N Temperature _____ Blue Ice / Wet Ice Radiation Survey _____ fixed _____ removable

SAMPLE INSPECTION

Custody Seals Broken - Y/N N Chain of Custody Record Y/N Labels in Tact N Radiation Survey Complete Y/N

Anomalies: _____

Inspected By: WGL

DATE

9/30/04

QA or Designee Review: _____

DATE

Sample Custodian Review: Michelle Datta

DATE

9/30/04

Project Notes:

SUB-REPORT
SURVEY UNIT KAISER-FSSB-002

TABLE OF CONTENTS

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2.0 SURVEY ACTIVITIES AND RESULTS	2
2.1 Gross Gamma Scan	2
2.2 Systematic Soil Core Sampling	3
2.3 Wilcoxon Rank Sum (WRS) Testing	6
3.0 SUMMARY OF FINDINGS	7

ATTACHMENTS

ATTACHMENT A:	Figure A-1 Gross Gamma Background and Scanning Survey Results – Lift 1 Figure A-2 Gross Gamma Background and Scanning Survey Results – Lift 2 Figure A-3 Gross Gamma Background and Scanning Survey Results – Lift 3 Figure A-4 Gross Gamma Background and Scanning Survey Results – Lift 4 Figure A-5 Gross Gamma Background and Scanning Survey Results – Lift 5 Figure A-6 Gross Gamma Background and Scanning Survey Results – Lift 6 Figure A-7 Systematic Soil Core Sampling Locations
ATTACHMENT B:	Soil Survey Unit Worksheet No. 1 Soil Survey Unit Worksheet No. 2
ATTACHMENT C:	Laboratory Analytical Results

**Final Status Survey Report
Volume III – Pond Parcel Excavation Backfill Units
Sub-Report No. BCM-002
Survey Unit Kaiser-FSSB-002
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation
March 22, 2006**

1.0 BACKGROUND

This sub-report documents the results of pond parcel excavation backfill unit final status survey activities completed as part of the Thorium Remediation Project at the Tulsa, Oklahoma facility (Figure 1). Specifically, this technical report addresses the final status survey of Survey Unit Kaiser-FSSB-002, which consists of a unit of Below Criteria Material or BCM (less than 31.1 net pCi/g Th-232 material) placed in an excavation resulting from the removal of radiologically-affected soil from the Retention Pond area. Survey Unit Kaiser-FSSB-002 is considered a Class 1 survey unit with an approximate base surface area of 2,405 m². It is located in the northwest corner of the pond parcel within portions of excavation bottoms associated with Survey Units Kaiser-FSS-006, Kaiser-FSS-010, and Kaiser-FSS-011 (Figure 3). The survey unit is bordered by a wall of non-impacted soil to the west (former freshwater pond area) and north (along Fulton Creek), excavation backfill Survey Unit Kaiser-FSSB-001 to the south, and excavation backfill Survey Units Kaiser-FSSB-009 and Kaiser-FSSB-011 to the east.

A total of six 2-foot layers (lifts) of BCM was placed in Survey Unit Kaiser-FSSB-002. It should be noted that beginning with the 4th lift (from the bottom), additional sub-lifts were placed on the east side of the survey unit to bring these areas up to an equal grade due to the general slope of the excavation from the northwest to the southeast.

Separate distinct final status surveys were completed for the pond parcel excavation bottom survey units prior to backfilling with BCM. The final status survey of the pond parcel excavation bottom survey units is documented in Volume I of the Final Status Survey Report.

2.0 SURVEY ACTIVITIES AND RESULTS

This section of the sub-report presents the final status survey data for the BCM placed within Survey Unit Kaiser-FSSB-002. The final status survey consisted of a gross gamma scan of each placed 2-foot lift of BCM and systematic soil core sampling upon completion of the BCM unit.

2.1 Gross Gamma Scan

Each 2-foot lift of BCM was surveyed through a 100 percent coverage gamma scan to confirm acceptable radiological conditions and identify any elevated areas. During the scanning of each lift, the detector was held close to the BCM surface (1 to 2 inches) and moved in a serpentine pattern. Approximate equal-distant background measurements were also obtained at 1-meter above the ground surface for each lift of BCM placed. A statistical summary of the background survey and 100 percent coverage gamma scan of each BCM lift placed in the survey unit is provided below in Table 1.

Table 1 – Gross Gamma Scan Results Summary

Name	Date	Lift Area (m ²)	No. of 2-sec. Scans	Scan Rate (m/s)	Ave. (cpm)	Std. Dev. (cpm)	Min. (cpm)	Max. (cpm)	Median (cpm)
1 st lift Scan	08/19/04	2,405	3,100	0.39	42,135	6,756	18,688	56,705	43,144
1 st lift Bkgrd.	08/21/04	2,405	24	N/A	37,194	5,766	18,632	43,270	38,994
2 nd lift Scan	08/24/04	2,405	5,213	0.23	41,323	5,934	19,436	58,444	40,562
2 nd lift Bkgrd.	08/24/04	2,405	27	N/A	37,797	3,314	30,005	45,212	37,598
3 rd lift Scan ¹	08/27/04	1,000	1,085	0.46	42,926	4,052	35,298	58,464	42,950
3 rd lift Bkgrd.	08/27/04	1,000	14	N/A	38,372	2,770	32,132	42,241	39,384
4 th lift Scan	09/03/04	2,405	5,003	0.24	48,824	4,928	30,040	65,766	48,843
4 th lift Bkgrd.	09/03/04	2,405	27	N/A	43,448	2,889	35,977	47,854	43,597
5 th lift Scan	09/16/04	2,405	2,977	0.40	48,312	4,225	20,620	60,198	48,542
5 th lift Bkgrd.	09/16/04	2,405	12	N/A	45,910	3,763	36,069	51,493	46,069
East Bank Scan	09/17/04	300	348	0.43	56,824	4,469	48,304	73,202	56,078
East Bank Bkgrd.	09/17/04	300	7	N/A	46,438	2,619	43,348	49,969	46,029
East Bank Scan	09/20/04	300	349	0.43	56,805	4,426	48,294	73,242	56,034
East Bank Bkgrd.	09/20/04	300	7	N/A	46,505	3,440	43,257	52,497	45,236

Name	Date	Area (m ²)	No. of 2-sec. Scans	Scan Rate (m/s)	Ave. (cpm)	Std. Dev. (cpm)	Min. (cpm)	Max. (cpm)	Median (cpm)
East Bank Scan	09/21/04	300	400	0.38	57,570	3,533	49,389	67,073	57,500
East Bank Bkgrd.	09/21/04	300	7	N/A	49,571	1,909	47,217	51,734	49,987
6 th lift Scan	09/24/04	2,405	3,921	0.20	48,237	5,035	25,894	68,789	47,795
6 th lift Bkgrd.	09/24/04	2,405	19	N/A	44,161	5,741	33,810	54,888	43,945

¹³rd Lift was a partial lift placement to bring entire unit surface to an equal level.

Contour maps of the gross gamma background and final (as-left condition) scanning survey results are presented by BCM lift on **Figures A-1 through A-6** contained in **Attachment A**. The 100 percent coverage gross gamma scan of the 2-foot lifts did not indicate the presence of small areas (1 m²) of elevated activity (above the DCCL for the site).

2.2 Systematic Soil Core Sampling

The final status survey also consisted of systematic soil core sampling based on a random start point and an equal-distant triangular grid. It should be noted that Survey Units Kaiser-FSSB-001 and Kaiser-FSSB-002 were backfilled and final status surveyed simultaneously. As such, the following calculation of the minimum number of samples required, the corresponding dimensions of the equilateral triangular grid, and the random start point used to locate the samples are applicable to both survey units.

The Minimum Number of Core Samples (core holes) Required (N) based on the scan MDC was determined to be 9, as documented on Soil Survey Unit Worksheet No. 1 (**Attachment B**). The default Class 1 Survey Unit Area (A) of 2,000 m² along with the N of 9 were used to calculate the Triangular Grid Node Length (L) of 16.0 meters and the Height of the Equilateral Triangle (h) of 13.9 meters. Since A was greater than 2,000 m², (combined area of 4,625 m²) the number of samples (N1) was recalculated (21) to correspond to the L of 16.0 meters. A random start point was generated using the random number feature of Excel and documented on Soil Survey Unit Worksheet No. 2 (**Attachment B**).

A layout of the soil sampling locations is provided on **Figure A-7** contained in **Attachment A**. The soil core sample locations were demarcated in the field using a GPS unit. A total of 23 core holes (sample locations) were installed on the grid prescribed over the two survey units, with 12 falling within Survey Unit Kaiser-FSSB-002 (Core Nos. 1 through 12). The core holes were of various depths depending on the location within the survey unit, with core holes on the eastern side of the survey unit deeper than core holes on the west. Core segments of BCM (typically 3 feet in length) were scanned in the field in 1-foot increments. All of the 1-foot increments were also characterized by a 1 minute static count of gross gamma activity. The results are presented below in **Table 2**.

Table 2 - Soil Core Segment Gross Gamma Survey Results

Core Number	Core Segment	Segment Length (inches)	Core Depth Below Surface (ft)	Gross Scan Rate (kcpm)	Gross Static Count (cpm)	Net Static Count (cpm) ¹
1	A	12	1	22	21,922	4,128
2	A	36	1	22	22,015	4,221
2	A		2	23	22,648	4,854
2	A		3	22	20,839	3,045
3	A	40	1	21	23,230	5,436
3	A		2	23	22,989	5,195
3	A		3.3	21	22,249	4,455
4	A	38	1	22	23,065	5,271
4	A		2	22	22,983	5,189
4	A		3.2	22	21,954	4,160
5	A	36	1	21	19,794	2,000
5	A		2	22	22,589	4,795
5	A		3	22	23,775	5,981
6	A	24	1	21	21,341	3,547
6	A		2	21	20,495	2,701
7	A	36	1	26	26,490	8,696
7	A		2	26	24,046	6,252
7	A		3	25	25,102	7,308
8	A	36	1	24	25,388	7,594
8	A		2	25	24,832	7,038
8	A		3	24	23,389	5,595
8	B	14	4.2	21	20,496	2,702
9	A	36	1	22	22,683	4,889
9	A		2	22	23,399	5,605
9	A		3	22	21,899	4,105
9	B	12	4	21	20,870	3,076
10	A	36	1	25	24,256	6,462
10	A		2	24	22,719	4,925
10	A		3	23	23,956	6,162
10	B	36	4	25	23,919	6,125
10	B		5	25	24,151	6,357
10	B		6	22	23,164	5,370
10	C	39	7	24	24,190	6,396
10	C		8	25	25,632	7,838
10	C		9.3	23	24,464	6,670
11	A	36	1	23	23,306	5,512
11	A		2	24	24,851	7,057
11	A		3	24	24,954	7,160
12	A	36	1	25	24,780	6,986
12	A		2	25	23,989	6,195
12	A		3	24	23,904	6,110
12	B	42	4	23	24,696	6,902
12	B		5	22	23,561	5,767

Core Number	Core Segment	Segment Length (inches)	Core Depth Below Surface (ft)	Gross Scan Rate (kcpm)	Gross Static Count (cpm)	Net Static Count (cpm) ¹
12	B		6.5	22	22,454	4,660
			<i>Count:</i>	<i>44</i>	<i>44</i>	<i>44</i>
			<i>Average:</i>	<i>23</i>	<i>23,260</i>	<i>5,466</i>
			<i>Std. Dev.:</i>	<i>1.5</i>	<i>1,494</i>	<i>1,494</i>
			<i>Minimum:</i>	<i>21</i>	<i>19,794</i>	<i>2,000</i>
			<i>Maximum:</i>	<i>26</i>	<i>26,490</i>	<i>8,696</i>
			<i>Median:</i>	<i>23</i>	<i>23,348</i>	<i>5,554</i>

¹Net Static Count values (cpm) are equal to the Gross Static Count minus a background value of 17,794 cpm based on the average of 5 consecutive 1-minute counts performed with the detector on top of the table used to scan the cores, prior to scan activities.

A composite sample representing each core segment was then prepared by combining each set of three 1-foot increments in a bucket and breaking up the cores. The final segment of core may be less than or greater than 3 feet depending on the point at which virgin material was encountered. A sample (usually between 500 and 800 grams) was taken from each composite and forwarded to Outreach for analysis of Th-232 activity concentration. Analytical results are provided below in Table 3. Analytical data reports are contained in Attachment C.

Table 3 -- Systematic Soil Core Composite Sample Results

Core Number	Core Segment	Segment Length (in.)	Composite Sample No.	Core Depth (ft)	Th-232 (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)
1	A	12	K-258	1	10.6	0.460	0.743
2	A	36	K-257	1	8.07	0.522	1.36
3	A	40	K-256	1	8.39	0.336	0.742
4	A	38	K-255	1	9.48	0.256	0.650
5	A	36	K-254	1	9.00	0.416	0.911
6	A	24	K-259	1	7.42	0.309	0.792
7	A	36	K-260	1	11.2	0.460	0.790
8	A	36	K-250	1	9.44	0.392	0.625
8	B	14	K-251	4.2	10.8	0.395	0.537
9	A	36	K-252	1	8.26	0.391	0.465
9	B	12	K-253	4	10.0	0.747	1.30
10	A	36	K-247	1	10.4	0.398	0.803
10	B	36	K-248	4	7.44	0.323	0.464
10	C	39	K-249	7	10.6	0.621	0.833
11	A	36	K-263	1	10.1	0.430	0.955
12	A	36	K-261	1	8.72	0.510	0.900
12	B	42	K-262	4	11.1	0.458	0.636
				<i>Count:</i>	<i>17</i>		
				<i>Average:</i>	<i>9.47</i>		
				<i>Std. Dev.:</i>	<i>1.26</i>		
				<i>Minimum:</i>	<i>7.42</i>		
				<i>Maximum:</i>	<i>11.2</i>		
				<i>Median:</i>	<i>9.48</i>		

The gross and net Th-232 activity concentrations for all 17 systematic composite samples were below the BCM surrogate value of 31.1 pCi/g net Th-232 activity concentration (DCCL). The maximum gross Th-232 activity concentration was 11.2 pCi/g. The average gross Th-232 activity concentration was 9.47 pCi/g. The standard deviation of the 17 composite samples was 1.26, which fell below the estimated standard deviation of 4.4 used to calculate the minimum number of samples required in the decommissioning plan.

2.3 Wilcoxon Rank Sum (WRS) Testing

The analytical results for the systematic soil core composite samples were evaluated using the procedure contained in **Appendix C, Volume I** of this Final Status Survey Report (Wilcoxon Rank Sum Test). The evaluation showed that the survey unit core sample results meet the DP statistical criterion based on the first statistical test as described below.

If the difference (10.8 pCi/g) between the maximum survey unit soil sample activity concentration (11.2 pCi/g) and the minimum reference background area soil sample activity concentration (0.36 pCi/g) is less than DCCL (31.1 pCi/g), then the survey unit meets the release criterion. Table 4 presents a summary of the data used to complete the statistical evaluation of the survey unit.

Table 4 -- Reference Group and Survey Unit Sample Results

Reference Group	Sample ID	Th-232 (pCi/g)	Survey Unit Group	Sample ID	Th-232 (pCi/g)
R1	161	1.20	S1	K-258	10.6
R2	158	1.22	S2	K-247	10.4
R3	83	1.22	S3	K-248	7.44
R4	132	1.48	S4	K-249	10.6
R5	77	0.80	S5	K-250	9.44
R6	216	0.64	S6	K-251	10.8
R7	16	0.53	S7	K-252	8.26
R8	108	1.01	S8	K-253	10.0
R9	269	0.97	S9	K-254	9.00
R10	349	0.82	S10	K-255	9.48
R11	51	1.72	S11	K-256	8.39
R12	303	0.98	S12	K-257	8.07
R13	130	0.94	S13	K-259	7.42
R14	208	0.79	S14	K-260	11.2
R15	328	1.25	S15	K-261	8.72
R16	296	0.79	S16	K-262	11.1
R17	19	0.36	S17	K-263	10.1
	<i>Average:</i>	<i>0.98</i>		<i>Average:</i>	<i>9.47</i>
	<i>Std. Dev.:</i>	<i>0.34</i>		<i>Std. Dev.:</i>	<i>1.26</i>
	<i>Minimum:</i>	<i>0.36</i>		<i>Minimum:</i>	<i>7.42</i>
	<i>Maximum:</i>	<i>1.72</i>		<i>Maximum:</i>	<i>11.2</i>
	<i>Median:</i>	<i>0.97</i>		<i>Median:</i>	<i>9.48</i>

3.0 SUMMARY OF FINDINGS

Survey Unit Kaiser-FSSB-002 which consists of a unit of BCM placed in an excavation resulting from the removal of radiologically-affected soil from the Retention Pond area, is considered a Class 1 survey unit with an approximate base surface area of 2,405 m². It is located in the northwest corner of the pond parcel within portions of excavation bottoms associated with Survey Units Kaiser-FSS-006, Kaiser-FSS-010, and Kaiser-FSS-011 (Figure 3). The survey unit is bordered by a wall of non-impacted soil to the west (former freshwater pond area) and north (along Fulton Creek), excavation backfill Survey Unit Kaiser-FSSB-001 to the south, and excavation backfill Survey Units Kaiser-FSSB-009 and Kaiser-FSSB-011.

A total of six 2-foot layers (lifts) of BCM was placed in Survey Unit Kaiser-FSSB-002. It should be noted that beginning with the 4th lift (from the bottom), additional sub-lifts were placed on the east side of the survey unit to bring these areas up to an equal grade due to the general slope of the excavation from the northwest to the southeast.

The acceptance criterion for BCM survey units at the Tulsa facility is the DCCL of 31.1 pCi/g net Th-232 activity concentration. The final status survey consisted of a gross gamma scan of each placed 2-foot lift of BCM and systematic soil core sampling upon completion of the BCM unit. The results of the final status survey activities were as follows:

- The 100 percent coverage gamma scan of each lift (final as-left condition) did not indicate the presence of small areas (1 m²) of elevated activity (greater than the DCCL for the site).
- All 17 systematic composite sample results (gross and net) were below the BCM surrogate value of 31.1 pCi/g net Th-232 activity concentration (DCCL).
- The analytical results meet the DP statistical criterion based on the first statistical evaluation of the data (WRS Test procedure).

The results of the final status survey activities show that Survey Unit Kaiser-FSSB-002 meets the DP acceptance criteria.

ATTACHMENT A TABLE OF CONTENTS

- **FIGURE A-1 Gross Gamma Background and Scanning Survey Results – Lift 1**
- **FIGURE A-2 Gross Gamma Background and Scanning Survey Results – Lift 2**
- **FIGURE A-3 Gross Gamma Background and Scanning Survey Results – Lift 3**
- **FIGURE A-4 Gross Gamma Background and Scanning Survey Results – Lift 4**
- **FIGURE A-5 Gross Gamma Background and Scanning Survey Results – Lift 5**
- **FIGURE A-6 Gross Gamma Background and Scanning Survey Results – Lift 6**
- **FIGURE A-7 Systematic Soil Core Sampling Locations**

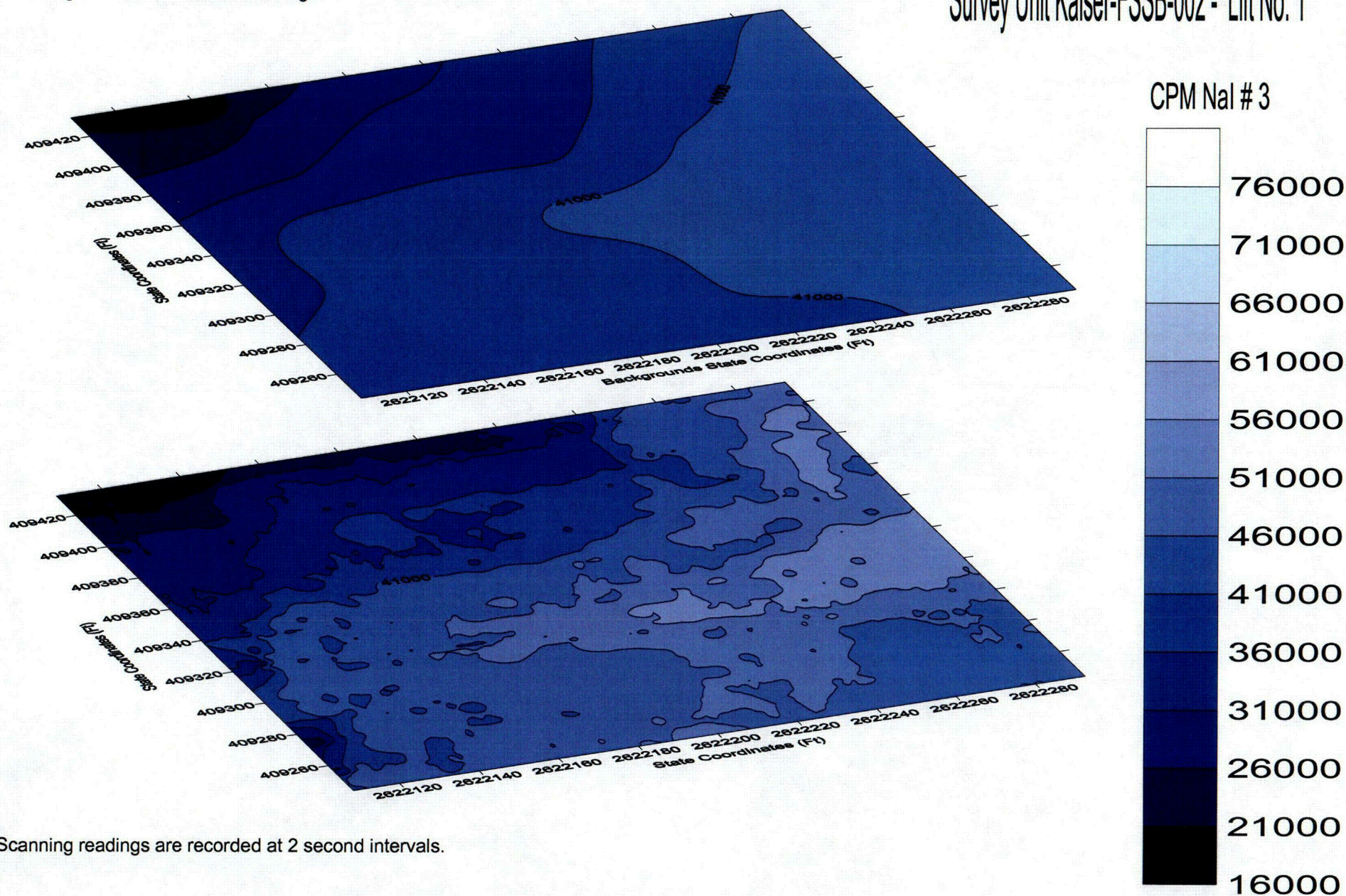


Backgrounds are 1 minute readings.

Attachment A, Figure A-1

Gross Gamma Background and Scanning Survey Results

Survey Unit Kaiser-FSSB-002 - Lift No. 1

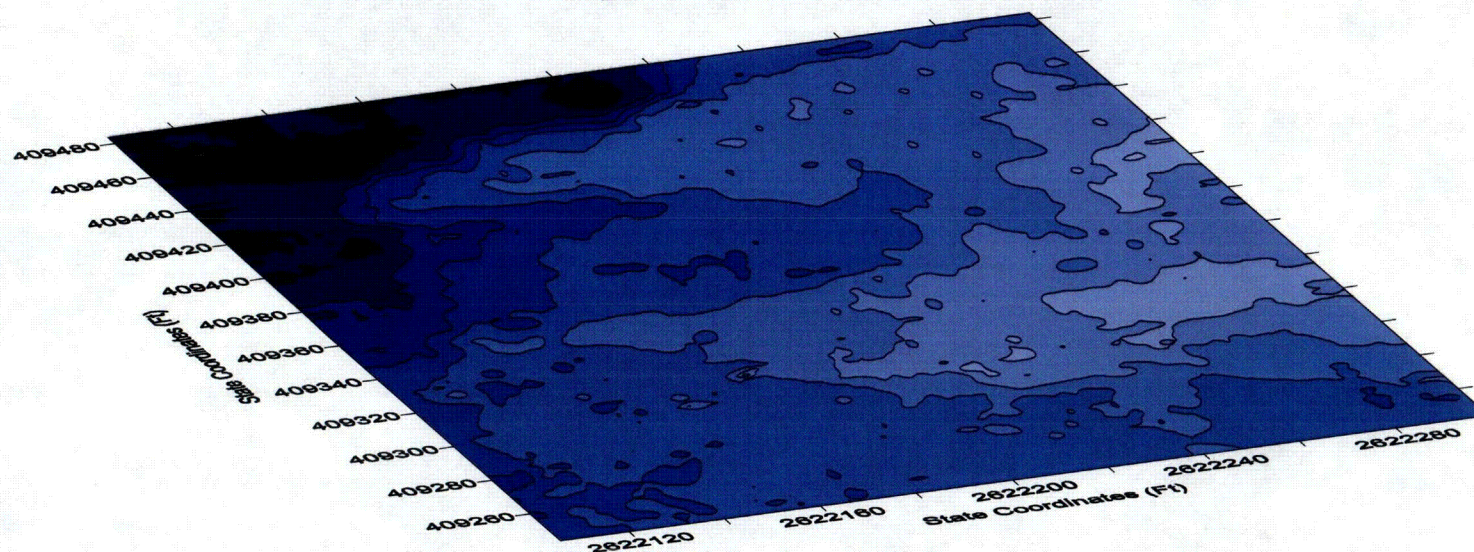
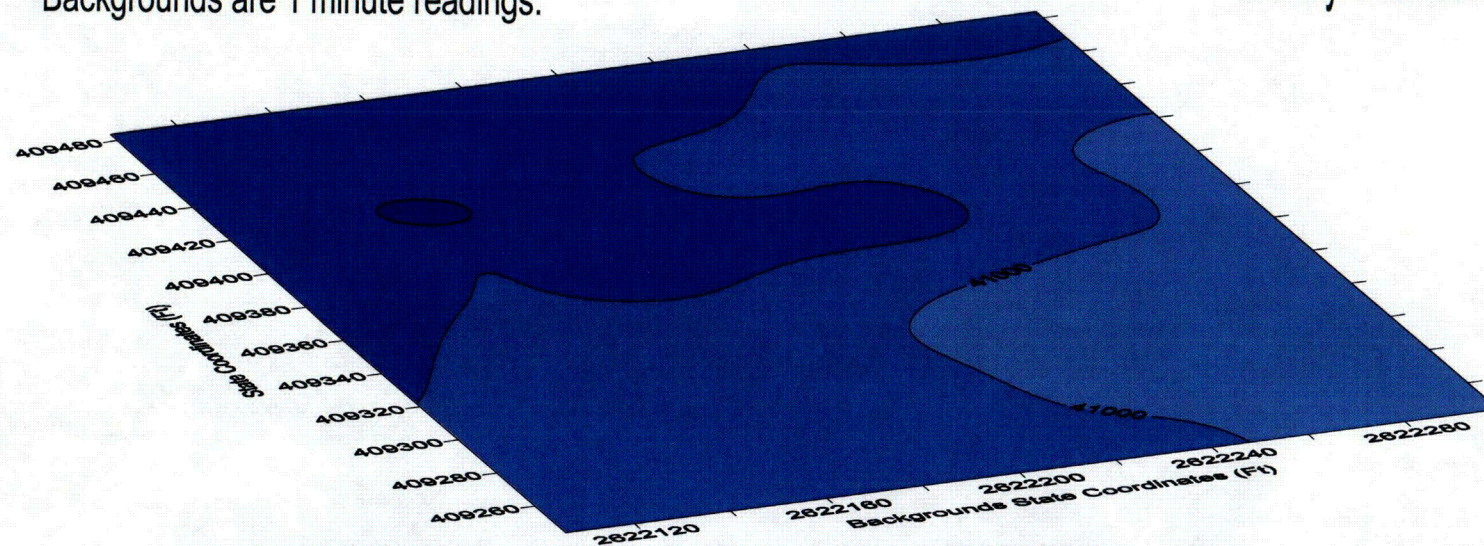


Scanning readings are recorded at 2 second intervals.

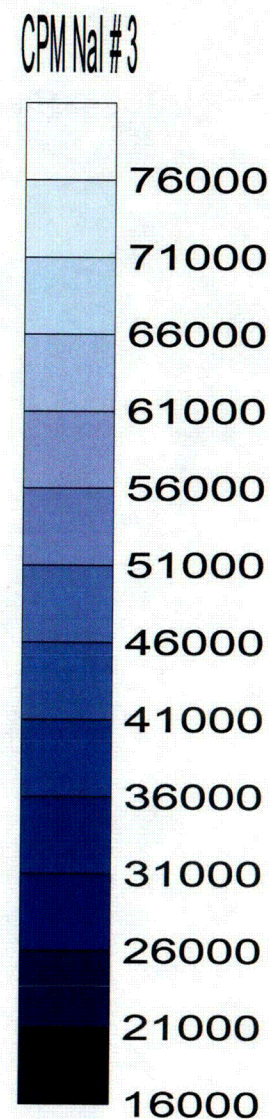


Attachment A, Figure A-2
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSB-002 - Lift No. 2

Backgrounds are 1 minute readings.



Scanning readings are recorded at 2 second intervals.

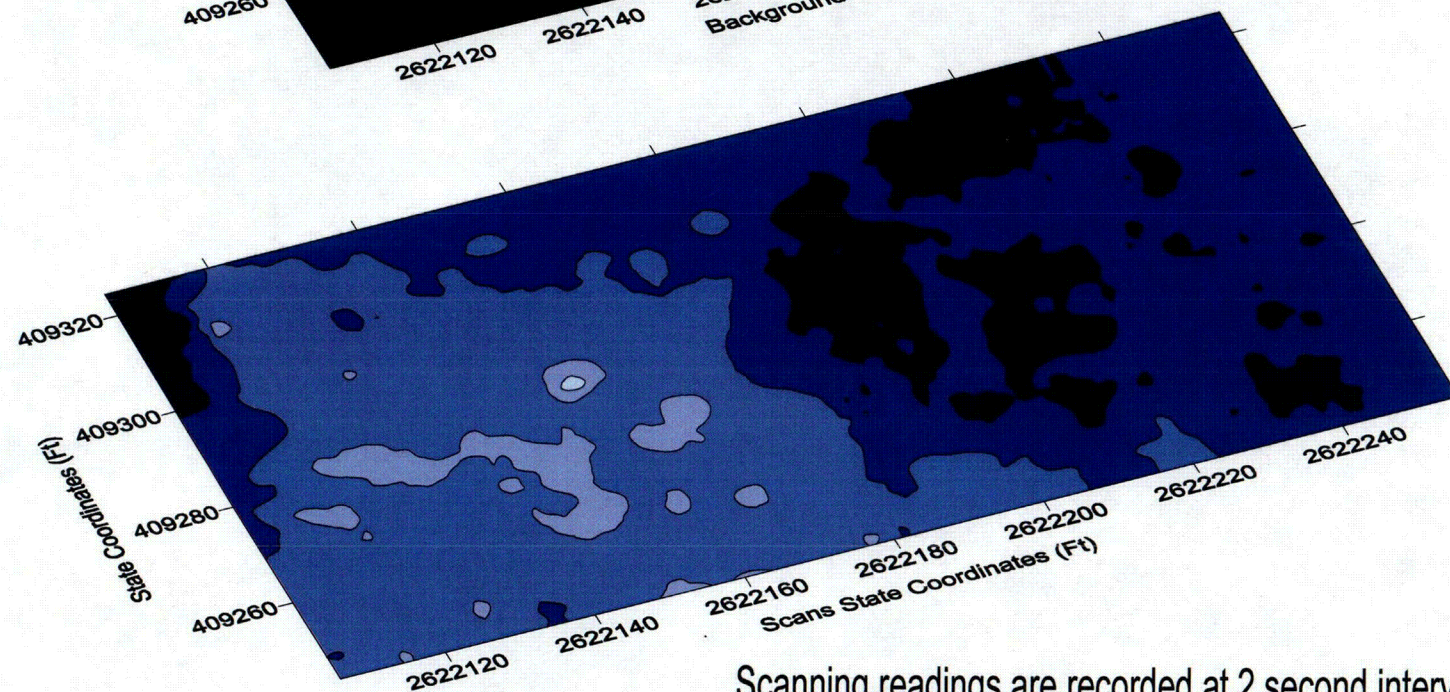
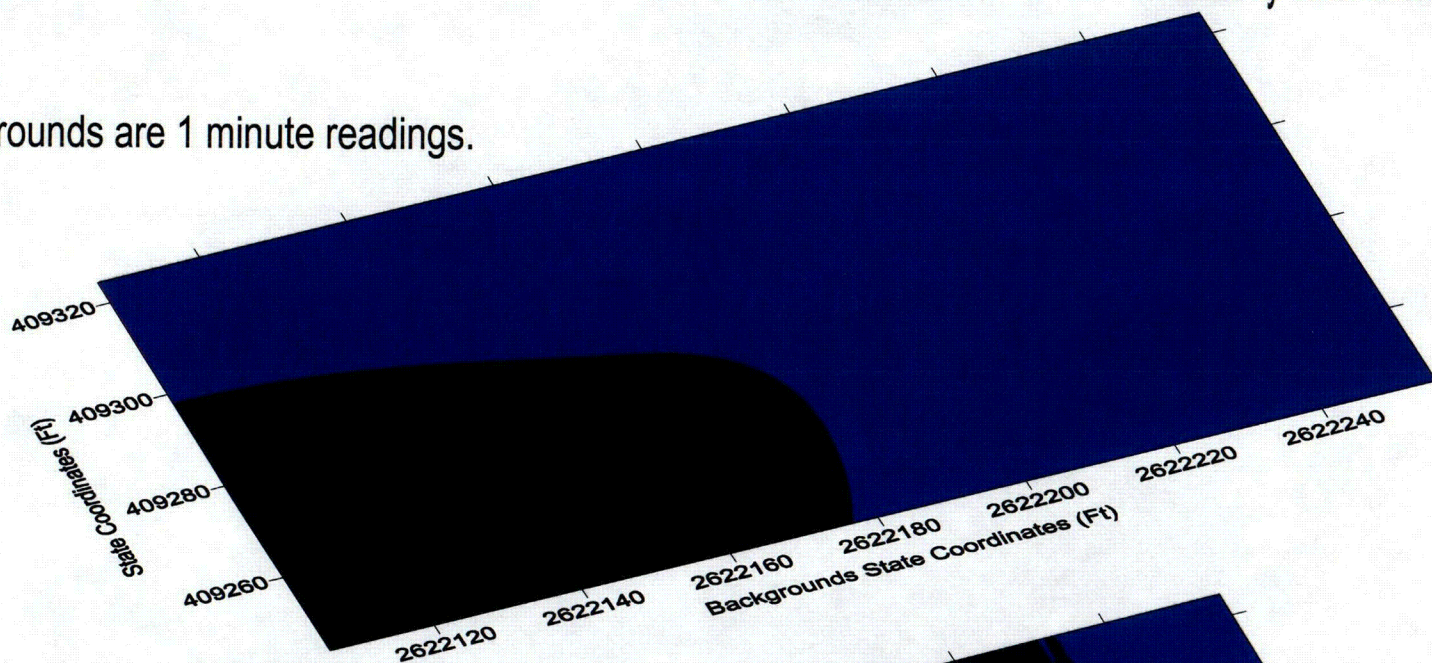
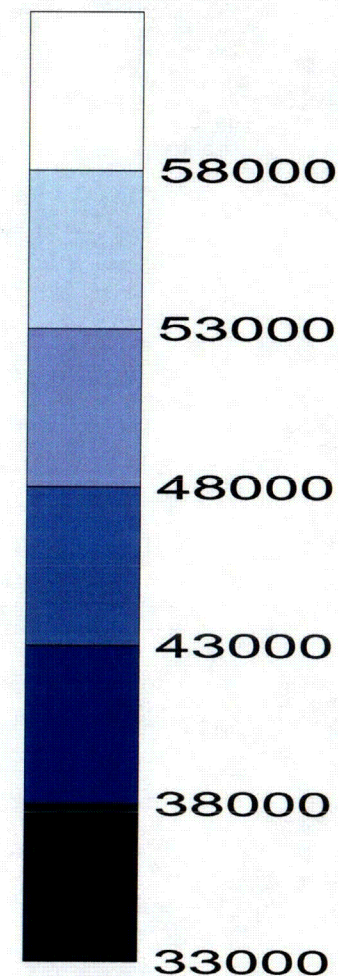




Attachment A, Figure A-3
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSB-002 - Lift No. 3

Backgrounds are 1 minute readings.

CPM NaI # 3

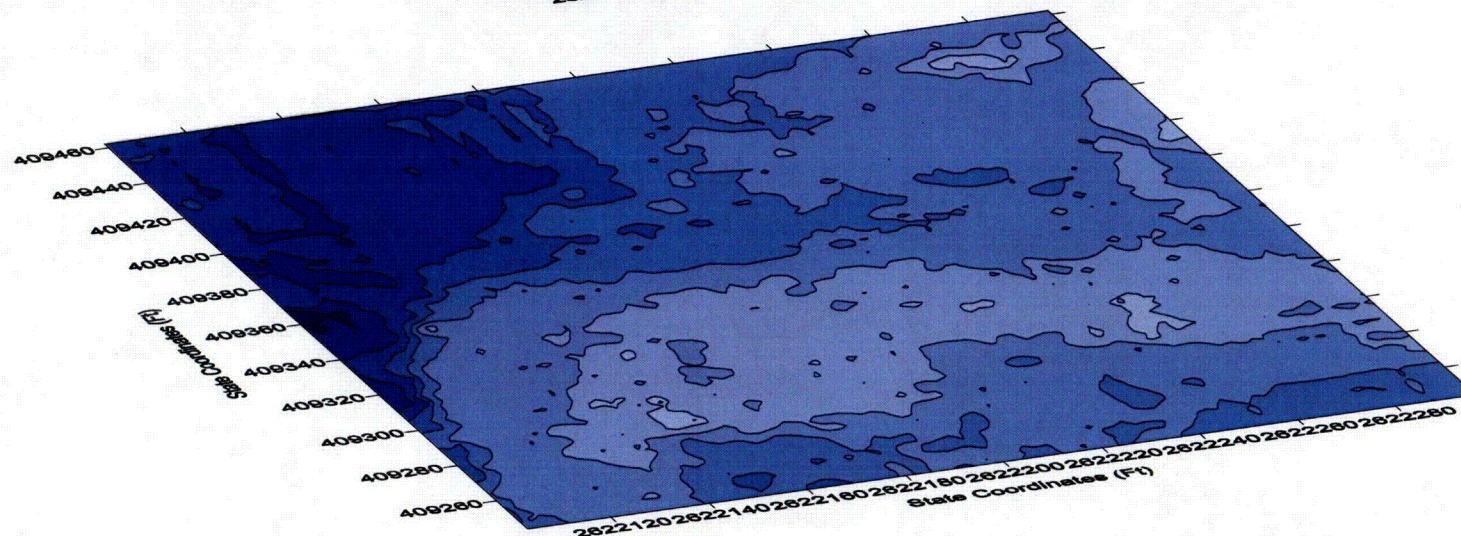
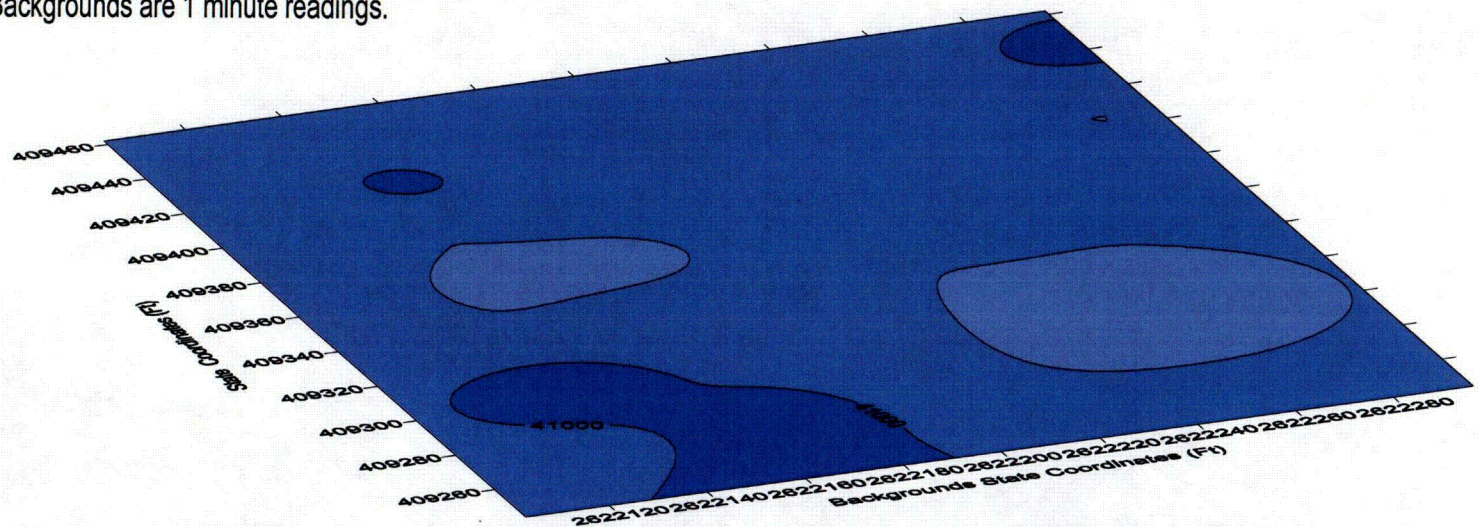


Scanning readings are recorded at 2 second intervals.

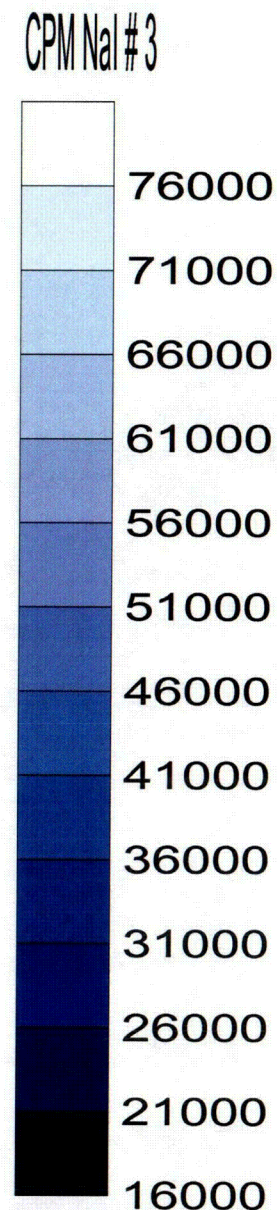


Attachment A, Figure A-4
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSB-002 - Lift No. 4

Backgrounds are 1 minute readings.



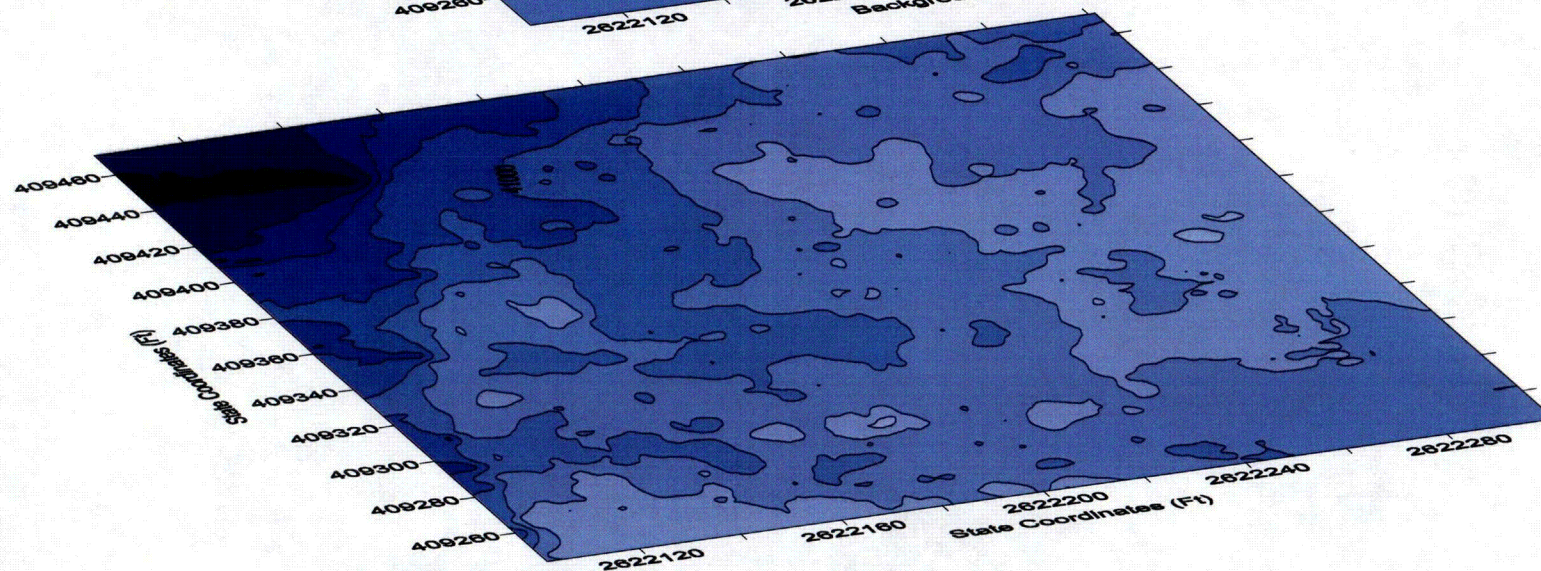
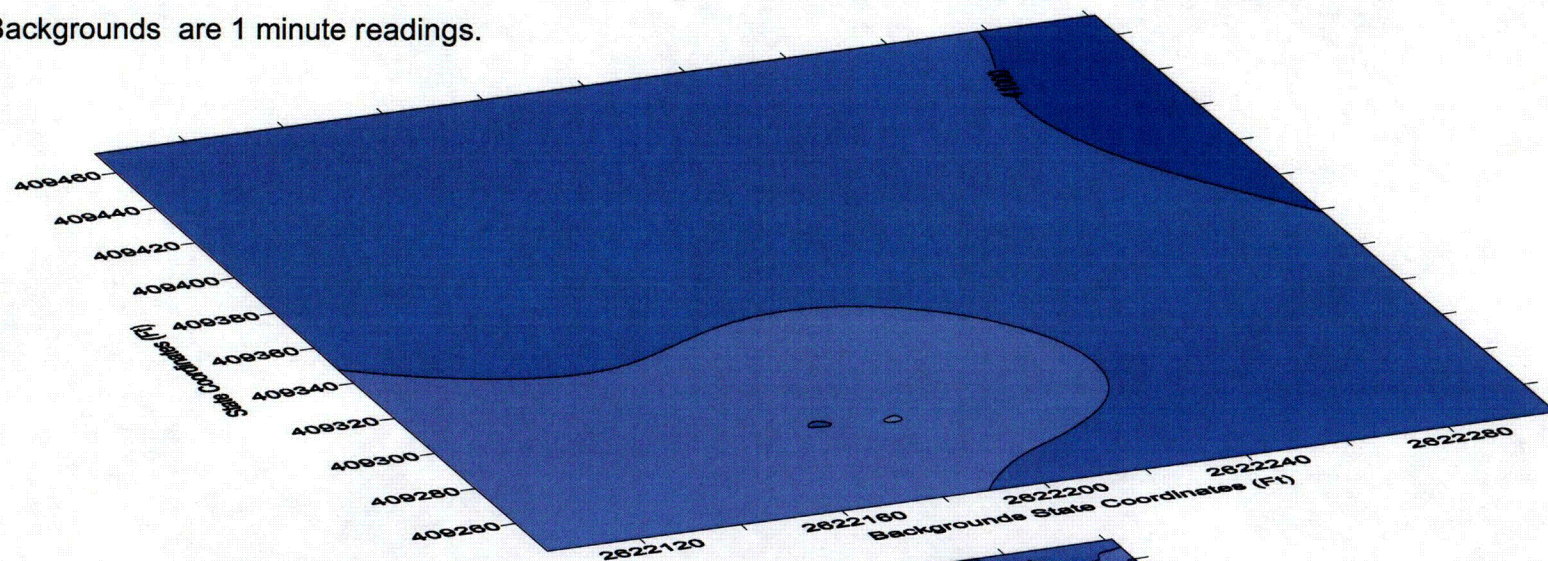
Scanning readings are recorded at 2 second intervals.





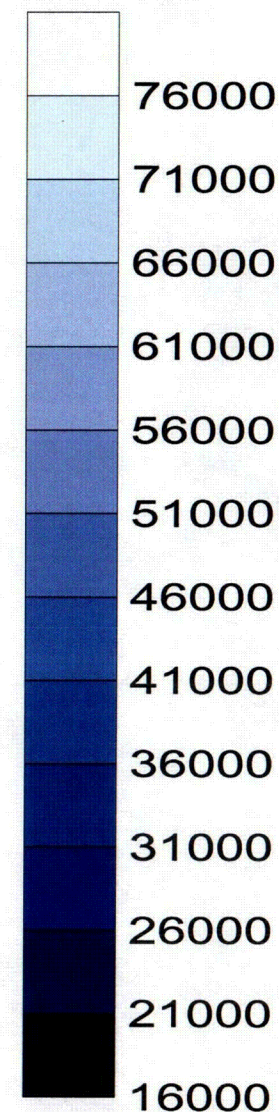
Attachment A, Figure A-5
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSB-002 - Lift No. 5

Backgrounds are 1 minute readings.



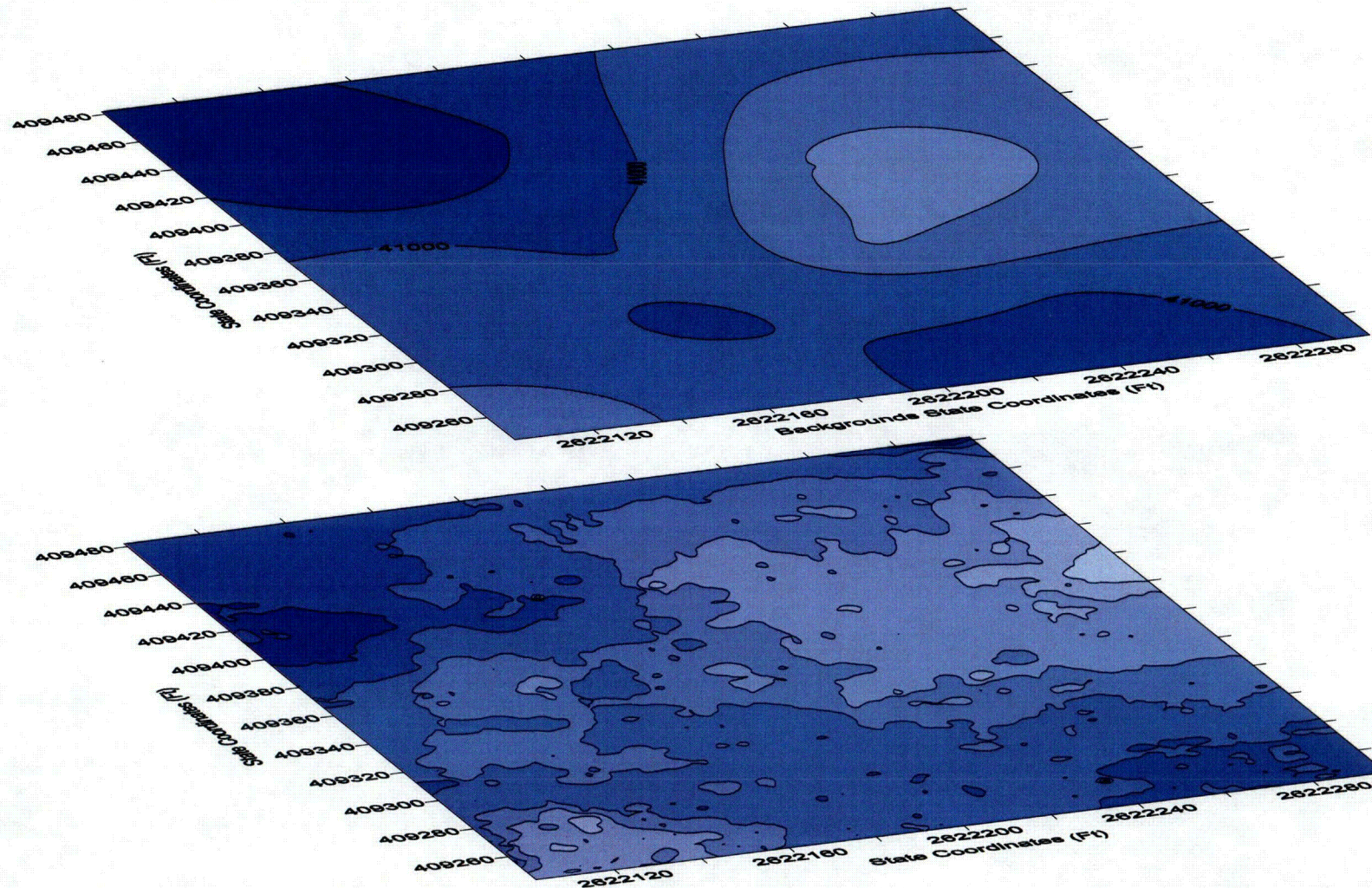
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CPM NaI #3

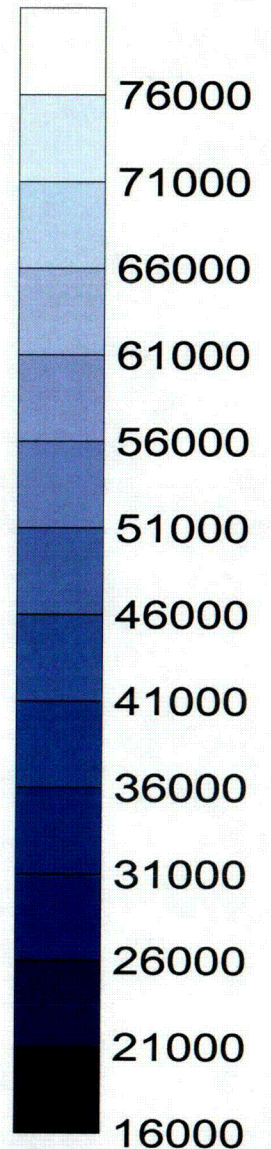


Attachment A, Figure A-6 Gross Gamma Background and Scanning Survey Results Survey Unit Kaiser-FSSB-002 - Lift No. 6

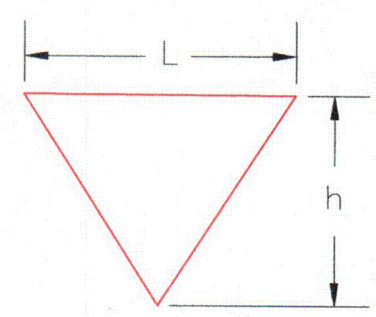
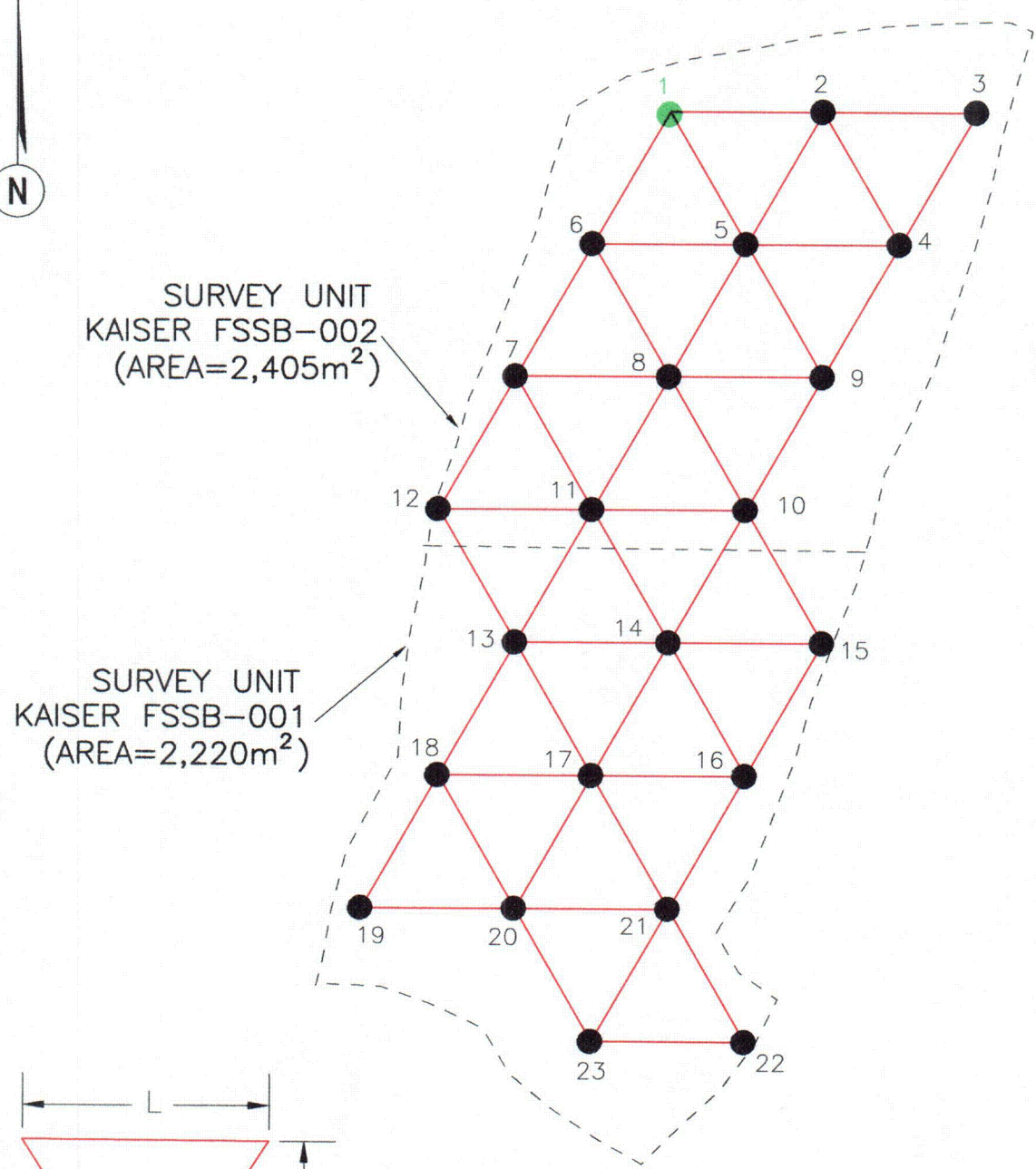
Backgrounds are 1 minute readings.



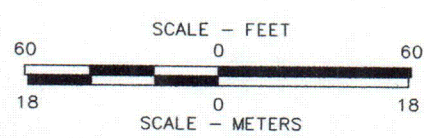
CPM NaI #3



Scanning readings are recorded at 2 second intervals.



N = 21 (COLLECTED 23)
L = 16.0m
h = 13.9m
AREA = 4,625m²



- 2
● SYSTEMATIC SOIL CORE SAMPLING LOCATION
BASED ON RANDOM START POINT AND
AN EQUAL DISTANT TRIANGULAR GRID
- 1
● RANDOM START POINT

FIGURE A-7
SYSTEMATIC SOIL CORE SAMPLING LOCATIONS
SURVEY UNIT KAISER - FSSB-001 AND FSSB-002
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED *RFD 3-3-06*
CHECKED *RFD 3-3-06*
DRAWN *DEB 01/30/06*
DRAWING NUMBER
PA4072075



Penn E&R
Environmental & Remediation, Inc.

**ATTACHMENT B
TABLE OF CONTENTS**

- **Soil Survey Unit Worksheet No. 1**
- **Soil Survey Unit Worksheet No. 2**

Soil Survey Unit Work Sheet No. 1
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

1. Soil Survey Unit: Kaiser-FSSB-001 and Kaiser-FSSB-002

2. Description: Pond Parcel Excavation Backfill Unit

3. Net Th-232 Acceptance Criteria (pCi/g): 31.1

4. Dimensions (m): Excavation Bottom – Approx. 45 meters x 103 meters; Area, A (m²): 4,625

5. Estimate of Gross Gamma Scan Background Readings (cpm)

Average: 40,000 Minimum: 30,000 Maximum: 50,000

6. Based on the maximum background gross gamma scan reading, the scan MDC (Minimum Detectable Concentration of Th-232), the corresponding N (Minimum Number of Required Samples) and L (Triangular Grid Node Length) for a standard 2,000 m² Class 1 survey unit are:

- Gross Gamma Scan MDC (pCi/g): 4.0
- Minimum Number of Samples (N): 9 Triangular Grid Node Length (L): 16.0 m

7. If the area of the Survey Unit is less than 2,000 m², recalculate the corresponding Triangular Grid Node Length (L₁) for the Survey Unit Area (A), using the following formula: $L_1 = (A / (0.866 \times 9))^{1/2}$: N/A

8. If N is greater than 9 and the A is other than 2,000 m², recalculate the corresponding Triangular Grid Node Length (L₁) using the following formula $L_1 = (A / (0.866 \times N))^{1/2}$: N/A

9. If A is greater than 2,000 m² and N is equal to 9, recalculate the minimum number of samples (N₁) corresponding to a Triangular Grid Node Length (L) of 16 m using the following formula $N_1 = A / (0.866 \times 16^2)$, N₁: 21

10. Calculate the height (h) of the equilateral triangle with side length equal to L (or (L₁)) using the following formula: $h = ((L^2 - (L/2)^2)^{1/2})$: 13.9 m.

Soil Survey Unit Worksheet No. 2
Random Number Generator for Start Point
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

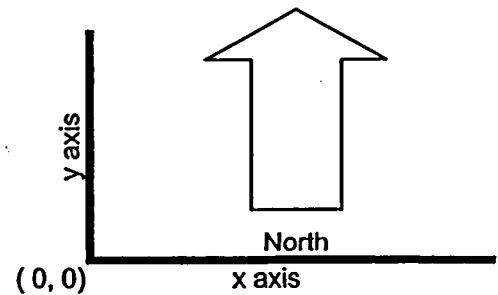
SURVEY UNIT: KAISER-FSSB-001 and KAISER-FSSB-002

RANDOM START POINT

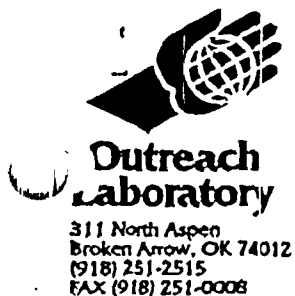
x axis (Meters)	y axis (Meters)
26	110

lower bound
upper bound

x axis	y axis
0	0
68	126



ATTACHMENT C
LABORATORY ANALYTICAL RESULTS



J. Weyant

10375 21-
10/5/04

October 5, 2004

David Weyant
Kaiser Aluminum & Chemical
7311 E. 41st Street
Tulsa, OK 74145

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20040683

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples received in our laboratory on September 29, 2004 for the above captioned project. Forty-one soil samples were received in good condition and analyzed for Th-232 by Gamma Spectroscopy and Percent Moisture without drying and grinding with an expedited 5 work-day turn. Results were faxed early on 10/5/04.

All QC is within control limits with the exception of one Am-241 LCS% Rec and one % Moisture. The sample results are not effected. Samples will be returned after 30 days as requested.

Thank you for choosing Outreach Laboratory and if you have any questions, please call us at 918-251-2515.

Laboratory Director

ODEQ ID #9517
DEQ LIC. #27522-01



Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-01							
Client ID: K-224							
Date Sampled: 9/28/2004 12:20:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	0.591 +/- 0.124	pCi/g	0.321		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	6.6	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-02							
Client ID: K-225							
Date Sampled: 9/28/2004 12:25:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	7.88 +/- 0.400	pCi/g	0.913		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	13.6	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-03							
Client ID: K-226							
Date Sampled: 9/28/2004 12:51:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	10.7 +/- 0.412	pCi/g	0.755		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	12.1	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-04							
Client ID: K-227							
Date Sampled: 9/28/2004 12:58:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	8.80 +/- 0.436	pCi/g	0.875		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	16.7	%		9/29/2004	9/30/2004	RT

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-05							
Client ID: K-228							
Date Sampled: 9/28/2004 1:02:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	9.74 +/- 0.603	pCi/g	1.21		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	15.7	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-06							
Client ID: K-229							
Date Sampled: 9/28/2004 1:10:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	10.3 +/- 0.404	pCi/g	0.497		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	19.4	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-07							
Client ID: K-230							
Date Sampled: 9/28/2004 1:13:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	11.4 +/- 0.447	pCi/g	0.996		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	13.7	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-08							
Client ID: K-231							
Date Sampled: 9/28/2004 1:40:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	4.00 +/- 0.210	pCi/g	0.427		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	12.6	%		9/29/2004	9/30/2004	RT



Outreach Laboratory

311 North Aspen
Broken Arrow, OK 74012
(918) 251-2515
FAX (918) 251-0008

Client: Kaiser Aluminum
Client Project: Thorium Remediation PA-4000-4072
Lab Number: 20040683
Date Reported: 10/5/2004
Date Received: 9/29/04
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Analytical Report

Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-09						
Client ID: K-232						
Date Sampled: 9/28/2004 1:55:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	8.04 +/- 0.525 pCi/g	1.02		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	14.4 %		9/29/2004	9/30/2004	RT
Lab ID: 20040683-10						
Client ID: K-233						
Date Sampled: 9/28/2004 2:05:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	9.91 +/- 0.457 pCi/g	0.684		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	18.3 %		9/29/2004	9/30/2004	RT
Lab ID: 20040683-11						
Client ID: K-234						
Date Sampled: 9/28/2004 2:09:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	9.44 +/- 0.607 pCi/g	0.984		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	10.6 %		9/29/2004	9/30/2004	RT
Lab ID: 20040683-12						
Client ID: K-235						
Date Sampled: 9/28/2004 2:15:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	8.41 +/- 0.352 pCi/g	0.611		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	15.4 %		9/29/2004	9/30/2004	RT

BDL = Below Detection Limit

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-13							
Client ID: K-236							
Date Sampled: 9/28/2004 2:19:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	9.25 +/- 0.442	pCi/g	0.847		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	16.2	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-14							
Client ID: K-237							
Date Sampled: 9/28/2004 2:32:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	8.69 +/- 0.505	pCi/g	0.820		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	12.7	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-15							
Client ID: K-238							
Date Sampled: 9/28/2004 2:38:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	8.14 +/- 0.376	pCi/g	0.812		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	14.5	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-16							
Client ID: K-239							
Date Sampled: 9/28/2004 2:00:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	5.84 +/- 0.349	pCi/g	0.642		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	19.2	%		9/29/2004	9/30/2004	RT



311 North Aspen
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Client: Kaiser Aluminum
Client Project: Thorium Remediation PA-4000-4072
Lab Number: 20040683
Date Reported: 10/5/2004
Date Received: 9/29/04
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Analytical Report

Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-17						
Client ID: K-240						
Date Sampled: 9/28/2004 2:23:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	7.76 +/- 0.319 pCi/g	0.538		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	11.9 %		9/29/2004	9/30/2004	RT
Lab ID: 20040683-18						
Client ID: K-241						
Date Sampled: 9/28/2004 2:25:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	6.07 +/- 0.354 pCi/g	0.698		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	12.5 %		9/29/2004	9/30/2004	RT
Lab ID: 20040683-19						
Client ID: K-242						
Date Sampled: 9/28/2004 2:36:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	6.66 +/- 0.444 pCi/g	0.985		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	15.8 %		9/29/2004	9/30/2004	RT
Lab ID: 20040683-20						
Client ID: K-243						
Date Sampled: 9/28/2004 2:41:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	6.06 +/- 0.299 pCi/g	0.552		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	20.1 %		9/29/2004	9/30/2004	RT

BDL = Below Detection Limit

Client: Kaiser Aluminum
Client Project: Thorium Remediation PA-4000-4072
Lab Number: 20040683
Date Reported: 10/5/2004
Date Received: 9/29/04
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Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-21							
Client ID: K-244							
Date Sampled: 9/28/2004 2:42:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	6.76 +/- 0.298	pCi/g	0.735		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	15.2	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-22							
Client ID: K-245							
Date Sampled: 9/28/2004 2:48:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	9.23 +/- 0.526	pCi/g	0.830		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	13.6	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-23							
Client ID: K-246							
Date Sampled: 9/28/2004 2:54:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	6.81 +/- 0.346	pCi/g	0.745		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	17.9	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-24							
Client ID: K-247							
Date Sampled: 9/28/2004 3:02:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	10.4 +/- 0.398	pCi/g	0.803		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	13.6	%		9/29/2004	9/30/2004	RT

Client: Kaiser Aluminum
Client Project: Thorium Remediation PA-4000-4072
Lab Number: 20040683
Date Reported: 10/5/2004
Date Received: 9/29/04
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Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-25							
Client ID: K-248							
Date Sampled: 9/28/2004 3:08:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	7.44 +/- 0.323	pCi/g	0.464		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	18.6	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-26							
Client ID: K-249							
Date Sampled: 9/28/2004 3:10:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	10.6 +/- 0.621	pCi/g	0.833		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	16.3	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-27							
Client ID: K-250							
Date Sampled: 9/28/2004 3:20:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	9.44 +/- 0.392	pCi/g	0.625		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	13.9	%		9/29/2004	9/30/2004	RT
Lab ID: 20040683-28							
Client ID: K-251							
Date Sampled: 9/28/2004 3:18:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	10.8 +/- 0.395	pCi/g	0.537		9/30/2004	SD
Inorganics Analyses							
Percent Moisture	LOD	13.8	%		9/29/2004	9/30/2004	RT

Client: Kaiser Aluminum
Client Project: Thorium Remediation PA-4000-4072
Lab Number: 20040683
Date Reported: 10/5/2004
Date Received: 9/29/04
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Analytical Report

Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-29						
Client ID: K-252						
Date Sampled: 9/28/2004 3:23:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	8.26 +/- 0.391	pCi/g	0.465	9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	13.8	%	9/29/2004	9/30/2004	RT
Lab ID: 20040683-30						
Client ID: K-253						
Date Sampled: 9/28/2004 3:28:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	10.0 +/- 0.747	pCi/g	1.30	9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	9.9	%	9/29/2004	9/30/2004	RT
Lab ID: 20040683-31						
Client ID: K-254						
Date Sampled: 9/28/2004 3:38:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	9.00 +/- 0.416	pCi/g	0.911	9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	14.2	%	9/29/2004	9/30/2004	RT
Lab ID: 20040683-32						
Client ID: K-255						
Date Sampled: 9/28/2004 3:44:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	9.48 +/- 0.256	pCi/g	0.650	9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	13.3	%	9/29/2004	9/30/2004	RT

Client: Kaiser Aluminum
Client Project: Thorium Remediation PA-4000-4072
Lab Number: 20040683
Date Reported: 10/5/2004
Date Received: 9/29/04
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Analytical Report

Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-33						
Client ID: K-256						
Date Sampled: 9/28/2004 3:53:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	8.39 +/- 0.336 pCi/g	0.742		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	15.2 %		9/29/2004	9/30/2004	RT
Lab ID: 20040683-34						
Client ID: K-257						
Date Sampled: 9/28/2004 4:01:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	8.07 +/- 0.522 pCi/g	1.36		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	14.7 %		9/29/2004	9/30/2004	RT
Lab ID: 20040683-35						
Client ID: K-258						
Date Sampled: 9/28/2004 4:08:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	10.6 +/- 0.460 pCi/g	0.743		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	10.9 %		9/29/2004	9/30/2004	RT
Lab ID: 20040683-36						
Client ID: K-259						
Date Sampled: 9/28/2004 4:10:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	7.42 +/- 0.309 pCi/g	0.792		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	14.9 %		9/29/2004	9/30/2004	RT



Outreach Laboratory

311 North Aspen
Broken Arrow, OK 74312
(918) 251-2515
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Client: Kaiser Aluminum
Client Project: Thorium Remediation PA-4000-4072
Lab Number: 20040683
Date Reported: 10/5/2004
Date Received: 9/29/04
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Analytical Report

Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-37						
Client ID: K-260						
Date Sampled: 9/28/2004 4:15:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	11.2 +/- 0.460	pCi/g	0.790	9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	12.1	%	9/29/2004	9/30/2004	RT
Lab ID: 20040683-38						
Client ID: K-261						
Date Sampled: 9/28/2004 4:24:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	8.72 +/- 0.510	pCi/g	0.900	9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	16.5	%	9/29/2004	9/30/2004	RT
Lab ID: 20040683-39						
Client ID: K-262						
Date Sampled: 9/28/2004 4:27:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	11.1 +/- 0.458	pCi/g	0.636	9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	14.4	%	9/29/2004	9/30/2004	RT
Lab ID: 20040683-40						
Client ID: K-263						
Date Sampled: 9/28/2004 4:33:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	10.1 +/- 0.430	pCi/g	0.955	9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	16.2	%	9/29/2004	9/30/2004	RT

BDL = Below Detection Limit

Client: Kaiser Aluminum
Client Project: Thorium Remediation PA-4000-4072
Lab Number: 20040683
Date Reported: 10/5/2004
Date Received: 9/29/04
Page Number: 11 of 11

Analytical Report

Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20040683-41						
Client ID: K-264						
Date Sampled: 9/28/2004 4:38:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	8.27 +/- 0.518 pCi/g	1.13		9/30/2004	SD
Inorganics Analyses						
Percent Moisture	LOD	12.3 %		9/29/2004	9/30/2004	RT

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	RPD	DUP RPD	MS %REC	MSD %REC	RPD	Date
Am-241		94.0	90.0	4.5					9/30/2004
Am-241		64.0	90.0	34.4					9/30/2004
Am-241		88.0	92.0	4.6					9/30/2004
Co-60		94.0	91.0	3.2					9/30/2004
Co-60		94.0	92.0	1.9					9/30/2004
Co-60		94.0	94.0	0.0					9/30/2004
Cs-137		98.0	95.0	3.3					9/30/2004
Cs-137		96.0	94.0	1.7					9/30/2004
Cs-137		100.0	94.0	6.8					9/30/2004
Percent Moisture					11.9				9/30/2004
Percent Moisture					7.1				9/30/2004
Percent Moisture					24.3				9/30/2004
Th-232					12.7				9/30/2004
Th-232					7.7				9/30/2004
Th-232					9.2				9/30/2004

Lab Approval: 



CHAIN OF CUSTODY

Cal-724,
1799-0071

Phone 714-934-1530 Fax # 918-364-717

City Tulsa State OK Zip 74145

ANALYSIS REQUESTED

PO # PROJECT # PROJECT NAME REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY) SAMPLER Signature					# CONTAINERS	CONTAINER SIZE	PRESERVATIVE	PLASTIC OR GLASS	REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
LAB SAMPLE #	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX					
1	K-224	9:29	12:20	SOL	1	PLASTIC	NONE	<div style="position: absolute; top: 0; right: 0; text-align: right;"> GRAB 222-77 224-10 225-10 226-10 227-10 228-10 229-10 230-10 231-10 232-10 233-10 234-10 235-10 236-10 237-10 </div>	
2	K-225		12:25		1				
3	K-226		12:51		1				
4	K-227		12:58		1				
5	K-228		13:02		1				
6	K-229		13:10		1				
7	K-230		13:13		1				
8	K-231		13:40		1				
9	K-232		13:55		1				
10	K-233		14:05		1				
11	K-234		14:09		1				
12	K-235		14:15		1				
13	K-236		14:19		1				
14	K-237		14:32		1				

RELINQUISHED BY:

DATE 9-7-9 JME

RECEIVED BY:

DATE 12/1/84 TIME

FOR LABORATORY USE ONLY: *2070683-1*

RELINQUISHED BY:

DATE _____

TIME

RECEIVED BY:

DATE _____

TIME

Sample Condition Upon Receipt

Custody Seals Intact	Y	N
----------------------	---	---

Cooler Temperature _____

My signature on this chain of custody form indicates that I am authorized by the above company to release samples for analysis. The company agrees to pay the entire balance upon receipt of sample data and it is understood and agreed that any balance carried over thirty (30) days is subject to a 1.5% per month (18% per annum) late charge. In the event of default, the company becomes legally liable for any reasonable attorney and/or collection fees and all related costs necessary to remit the entire balance to Outreach Technologies, Inc. (Outreach Laboratory).



CHAIN CUSTODY

Bill To:
Company MAISON-PERRIN E&K
Name DR. G. WEYANT / PAUL HART
Address 7211 E 41ST. STREET
City TULSA State OK Zip 74115

ANALYSIS REQUESTED

PO #		PROJECT #		PROJECT NAME		REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY)		SAMPLER		CONTAINER		PRESERVATIVE		REMARKS (I.E. FILTERED, UNFILTERED, GRAIN, COMPOSITE)	
HALL - 4072		PA-4000-4072		HALL - 4000 REMEDIATION		5 DAYS		Signature: [Signature]		# CONTAINERS		1. HNO ₃ pH=2 2. Ice <4°C 3. HCl pH=2 4. H ₂ SO ₄ pH=2 5. NaOH pH=11			
DATE SAMPLED	TIME SAMPLED	LOCATION	CONTAINER	PRESERVATIVE	REMARKS	DATE SAMPLED	TIME SAMPLED	LOCATION	CONTAINER	PRESERVATIVE	REMARKS				
9-28	14:38	Soil	1	None		9-28	14:38	Soil	1	None					
9-28	14:00		1			9-28	14:00		1						
9-28	14:23		1			9-28	14:23		1						
9-28	14:25		1			9-28	14:25		1						
9-28	14:36		1			9-28	14:36		1						
9-28	14:41		1			9-28	14:41		1						
9-28	14:42		1			9-28	14:42		1						
9-28	14:48		1			9-28	14:48		1						
9-28	14:54		1			9-28	14:54		1						
9-28	15:02		1			9-28	15:02		1						
9-28	15:08		1			9-28	15:08		1						
9-28	15:16		1			9-28	15:16		1						
9-28	15:20		1			9-28	15:20		1						
9-28	15:18		1			9-28	15:18		1						

RELINQUISHED BY: [Signature] DATE 9-29-08 TIME 1110 RECEIVED BY: [Signature] DATE 11/29/08 TIME 1110

FOR LABORATORY USE ONLY: 201/1193 -1

RELINQUISHED BY: _____ DATE _____ TIME _____ RECEIVED BY: _____ DATE _____ TIME _____

My signature on this chain of custody form indicates that I am authorized by the above company to release samples for analysis. The company agrees to pay the entire balance upon receipt of sample data and it is understood and agreed that any balance carried over thirty (30) days is subject to a 1.5% per month (18% per annum) late charge. In the event of default, the company becomes legally liable for any reasonable attorney and/or collection fees and all related costs necessary to remit the entire balance to Outreach Technologies, Inc. (Outreach Laboratory).

SAMPLE RETURN/DISPOSAL: All non-hazardous samples shall be disposed of 30 days after issue of final report. All others will be returned at client's expense.

Sample Condition Upon Receipt _____

Custody Seals Intact	Y	N
----------------------	---	---

Cooler Temperature _____



CHAIN OF CUSTODY

Results To: Company KALISSA - ALON & CHIM JAL
 Local: Name ORON G. WEYANT
 918-384- Address 7211 E. 41ST Street
 054 City INDIA State OK Zip 74115
 Cell: 1724- Phone 724-934-3530 Fax # 918-384-3171
 79 0071

Bill To: Company KAIWA / PSAD EIK
Name DAVID C. WEDAL / PSAD HAN
Address 7311 E. 41ST STREET
City TUWA State AK Zip 74144

ANALYSIS REQUESTED

PO # PROJECT # PROJECT NAME REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY) SAMPLER					# CONTAINERS	CONTAINER SIZE PLASTIC OR GLASS	PRESERVATIVE 1. HNO ₃ pH<2 2. Ice 4°C 3. HCl pH<2 4. H ₂ SO ₄ pH<2 5. NaOH pH>11	GAMMA SPEC (AL-232)	RETURN TO CLIENT FOR ANALYSIS	MDS 20.5 PULP	ASPD 226.92 mainline Cust Test	REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
DATE SAMPLED	TIME SAMPLED	MATRIX										
PAISON-4072 PA-400-4072 PAISON-40012m Remo. 5 DAYS Signature: [Signature] 2004												
24	K-252	9:28	15:23	Soil	1	PLASTIC	NONE	X	X	X	X	GRAB
25	K-253		15:28		1			X	X	X	X	
26	K-254		15:38		1			X	X	X	X	
27	K-255		15:44		1			X	X	X	X	
28	K-256		15:53		1			X	X	X	X	
29	K-257		16:01		1			X	X	X	X	
30	K-258		16:08		1			X	X	X	X	
31	K-259		16:10		1			X	X	X	X	
32	K-260		16:15		1			X	X	X	X	
33	K-261		16:24		1			X	X	X	X	
34	K-262		16:27		1			X	X	X	X	
35	K-263		16:33		1			X	X	X	X	
36	K-264		16:38		1			X	X	X	X	

RELINQUISHED BY:

DATE 9/27/54

TIME 1110

RECEIVED BY:

As per 11/1

DATE:

TIME.

FOR LABORATORY USE ONLY:

Sample Condition Upon Receipt

Dusiodry Seals Intact	Y	N
-----------------------	---	---

Cooler Temperature _____

My signature on this chain of custody form indicates that I am authorized by the above company to release samples for analysis. The company agrees to pay the entire balance upon receipt of sample data and it is understood and agreed that any balance carried over thirty (30) days is subject to a 1.5% per month (18% per annum) late charge. In the event of default, the company becomes legally liable for any reasonable attorney and/or collection fees and all related costs necessary to remit the entire balance to Outreach Technologies, Inc. (Outreach Laboratory).

SAMPLE RETURN/DISPOSAL: All non-hazardous samples shall be disposed of 30 days after issue of final report. All others will be returned at client's expense.

SAMPLE LOGIN

Date Received: 9/29/2004 1:08:45

Lab Number: 20040683

Due: 10/6/2004

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20040683-01 A Percent Moisture Th-232 by Gamma Spec	K-224	Soil	09/28/04	Plastic	500 ml	None	No	No
20040683-02 A Percent Moisture Th-232 by Gamma Spec	K-225	Soil	09/28/04	Plastic	500 ml	None	No	No
20040683-03 A Percent Moisture Th-232 by Gamma Spec	K-226	Soil	09/28/04	Plastic	500 ml	None	No	No
20040683-04 A Percent Moisture Th-232 by Gamma Spec	K-227	Soil	09/28/04	Plastic	500 ml	None	No	No
20040683-05 A Percent Moisture Th-232 by Gamma Spec	K-228	Soil	09/28/04	Plastic	500 ml	None	No	No
20040683-06 A Percent Moisture Th-232 by Gamma Spec	K-229	Soil	09/28/04	Plastic	500 ml	None	No	No
20040683-07 A Percent Moisture Th-232 by Gamma Spec	K-230	Soil	09/28/04	Plastic	500 ml	None	No	No
20040683-08 A	K-231	Soil	09/28/04	Plastic	500 ml	None	No	No

Percent Moisture
Th-232 by Gamma Spec

20040683-09 A	K-232	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-10 A	K-233	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-11 A	K-234	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-12 A	K-235	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-13 A	K-236	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-14 A	K-237	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-15 A	K-238	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-16 A	K-239	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-17 A	K-240	Soil	09/28/04	Plastic	500 ml	None	No	No

Percent Moisture
Th-232 by Gamma Spec

20040683-27 A	K-250	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-28 A	K-251	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-29 A	K-252	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-30 A	K-253	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-31 A	K-254	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-32 A	K-255	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-33 A	K-256	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-34 A	K-257	Soil	09/28/04	Plastic	500 ml	None	No	No
Percent Moisture Th-232 by Gamma Spec								
20040683-35 A	K-258	Soil	09/28/04	Plastic	500 ml	None	No	No

Percent Moisture
Th-232 by Gamma Spec

20040683-36 A K-259
Percent Moisture
Th-232 by Gamma Spec

Soil 09/28/04 Plastic 500 ml None No No

20040683-37 A K-260
Percent Moisture
Th-232 by Gamma Spec

Soil 09/28/04 Plastic 500 ml None No No

20040683-38 A K-261
Percent Moisture
Th-232 by Gamma Spec

Soil 09/28/04 Plastic 500 ml None No No

20040683-39 A K-262
Percent Moisture
Th-232 by Gamma Spec

Soil 09/28/04 Plastic 500 ml None No No

20040683-40 A K-263
Percent Moisture
Th-232 by Gamma Spec

Soil 09/28/04 Plastic 500 ml None No No

20040683-41 A K-264
Percent Moisture
Th-232 by Gamma Spec

Soil 09/28/04 Plastic 500 ml None No No

CONTAINER INSPECTION

Coolers 2 Custody Seals Broken - Y/N (N) Temperature amb Blue Ice N/A Wet Ice Radiation Survey 1300 fixed removable

SAMPLE INSPECTION

Custody Seals Broken - Y/N (N) Chain of Custody Record Y/N (N) Labels in Tact Y/N (N) Radiation Survey Complete Y/N (N)

Anomalies: _____

Inspected By: [Signature] DATE 9/29/04

QA or Designee Review: [Signature] DATE 09/29/04

Sample Custodian Review: [Signature] DATE 9/29/04
9/29/04

Project Notes:

SUB-REPORT
SURVEY UNIT KAISER-FSSB-003

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ATTACHMENTS

ATTACHMENT A:	Figure A-1 Gross Gamma Background and Scanning Survey Results – Lift 1 Figure A-2 Gross Gamma Background and Scanning Survey Results – Lift 2 Figure A-3 Gross Gamma Background and Scanning Survey Results – Lift 3 Figure A-4 Gross Gamma Background and Scanning Survey Results – Lift 4 Figure A-5 Gross Gamma Background and Scanning Survey Results – Lift 5 Figure A-6 Gross Gamma Background and Scanning Survey Results – Lift 6 Figure A-7 Gross Gamma Background and Scanning Survey Results – Lift 7 Figure A-8 Systematic Soil Core Sampling Locations
ATTACHMENT B:	Soil Survey Unit Worksheet No. 1 Soil Survey Unit Worksheet No. 2
ATTACHMENT C:	Laboratory Analytical Results

**Final Status Survey Report
Volume III – Pond Parcel Excavation Backfill Units
Sub-Report No. BCM-003
Survey Unit Kaiser-FSSB-003
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation
March 22, 2006**

1.0 BACKGROUND

This sub-report documents the results of pond parcel excavation backfill unit final status survey activities completed as part of the Thorium Remediation Project at the Tulsa, Oklahoma facility (Figure 1). Specifically, this technical report addresses the final status survey of Survey Unit Kaiser-FSSB-003, which consists of a unit of Below Criteria Material or BCM (less than 31.1 net pCi/g Th-232 material) placed in an excavation resulting from the removal of radiologically-affected soil from the former Reserve Pond area. Survey Unit Kaiser-FSSB-003 is considered a Class 1 survey unit with an approximate base surface area of 1,709 m². It is located on the east side of the pond parcel within portions of the excavation bottoms associated with Survey Units Kaiser-FSS-013 and Kaiser-FSS-014 (Figure 3). The survey unit is bordered by a wall of non-impacted soil (clean import borrow material) to the south (along the Specific Systems Property) and east (along the Redman Property), excavation backfill Survey Units Kaiser-FSSB-004 and Kaiser-FSSB-006 to the north, and excavation backfill Survey Units Kaiser-FSSB-005 and Kaiser-FSSB-006 to the west.

A total of seven 2-foot layers (lifts) of BCM were placed in Survey Unit Kaiser-FSSB-003.

Separate distinct final status surveys were completed for the pond parcel excavation bottom survey units prior to backfilling with BCM. The final status survey of the pond parcel excavation bottom survey units is documented in Volume I of the Final Status Survey Report.

2.0 SURVEY ACTIVITIES AND RESULTS

This section of the sub-report presents the final status survey data for the BCM placed within Survey Unit Kaiser-FSSB-003. The final status survey consisted of a gross gamma scan of each placed 2-foot lift of BCM and systematic soil core sampling upon completion of the BCM unit.

2.1 Gross Gamma Scan

Each 2-foot lift of BCM was surveyed through a 100 percent coverage gamma scan to confirm acceptable radiological conditions and identify any elevated areas. During the scanning of each lift, the detector was held close to the BCM surface (1 to 2 inches) and moved in a serpentine pattern. Approximate equal-distant background measurements were also obtained at 1-meter above the ground surface for each lift of BCM placed. A statistical summary of the background survey and 100 percent coverage gamma scan of each BCM lift placed in the survey unit is provided below in Table 1.

Table 1 -- Gross Gamma Scan Results Summary

Name	Date	Lift Area (m ²)	No. of 1-sec. Scans	Scan Rate (m/s)	Ave. ³ (cpm)	Stdev. (cpm)	Min. (cpm)	Max. (cpm)	Median (cpm)
1 st lift Scan	03/15/05	349	1,676	0.21	71,245	19,077	18,593	96,484	81,880
1 st lift Scan ¹	03/15/05	1,360	60	0.5	83,556	13,410	44,000	103,570	87,100
1 st lift Scan Total	03/15/05	1,709	1,736	0.44	81,042	N/A	18,593	103,570	NA
1 st lift Bkgrd.	03/15/05	1,709	20	N/A	65,693	13,943	38,550	84,286	67,376
2 nd lift Scan	03/24/05	1,709	6,602	0.26	92,149	19,263	21,402	131,973	85,502
2 nd lift Bkgd.	03/24/05	1,709	25	N/A	81,154	11,034	59,823	98,631	77,346
3 rd lift Scan ²	04/05/05	1,450	44	0.5	97,021	19,382	62,000	131,500	101,335
3 rd lift Bkgd.	04/05/05	1,450	15	N/A	75,455	16,094	52,477	99,296	71,593
4 th lift Scan	04/11/05	1,200	4,394	0.27	80,014	11,277	50,603	111,588	79,265
4 th lift Bkgd.	04/11/05	1,200	15	N/A	68,653	12,501	47,004	85,903	66,843
5 th lift Scan	04/13/05	1020	4,050	0.25	90,140	7,013	60,377	106,929	90,537
5 th lift Bkgd.	04/13/05	1020	15	N/A	82,598	6,519	64,634	90,201	83,885
6 th lift Scan	04/15/05	850	3,099	0.27	83,395	8,809	63,505	118,942	82,037

Name	Date	Lift Area (m ²)	No. of 1-sec. Scans	Scan Rate (m/s)	Ave. ³ (cpm)	Stdev. (cpm)	Min. (cpm)	Max. (cpm)	Median (cpm)
6 th lift Bkgd.	04/15/05	850	11	N/A	74,384	5,884	65,670	86,715	74,166
7 th lift Scan	04/19/05	720	1,663	0.43	45,120	7,704	29,884	76,593	43,964
7 th lift Bkgd.	04/19/05	720	13	N/A	42,127	4,504	36,354	51,397	40,415

¹The first lift was scanned in two parts. The first part (approximately 349 m²) was surveyed with the GPS/data logger coupled to the detector. The second part (approximately 1,360 m²) was surveyed without the GPS/data logger by recording the average gross gamma reading for each approximately 20 m² section of the remaining lift area.

²The 3rd lift was surveyed without the GPS/data logger buy recording the average gross gamma reading for each approximately 30 m² section of the lift area.

³The average of the 1st lift scan total is a weighted average of the two parts by area.

Contour maps of the gross gamma background and final (as-left condition) scanning survey results are presented by BCM lift on **Figures A-1 through A-7** contained in **Attachment A**. The 100 percent coverage gross gamma scan of the 2-foot lifts did not indicate the presence of small areas (1 m²) of elevated activity (above the DCCL for the site).

2.2 Systematic Soil Core Sampling

The final status survey also consisted of systematic soil core sampling based on a random start point and an equal-distant triangular grid. The Minimum Number of Core Samples (core holes) Required (N) based on the scan MDC was determined to be 9, as documented on Soil Survey Unit Worksheet No. 1 (**Attachment B**). Once N was determined, the Survey Unit Area (A) of 1,709 m² along with the N of 9 were used to calculate the Triangular Grid Node Length (L) of 14.8 meters and the Height of the Equilateral Triangle (h) of 12.8 meters. A random start point was generated using the random number feature of Excel and documented on Soil Survey Unit Worksheet No. 2 (**Attachment B**).

A layout of the soil sampling locations is provided on **Figure A-8** contained in **Attachment A**. The soil core sample locations were demarcated in the field using a GPS unit. A total of 11 core holes (sample locations) were installed on the grid prescribed over the survey unit (Core Nos. 1 through 11). The core holes were of various depths depending on the location within the survey unit. Core segments of BCM (typically 3 feet in length) were scanned in the field in 1-foot increments. All of the 1-foot increments were also characterized by a 1 minute static count of gross gamma activity. The results are presented below in **Table 2**.

Table 2 - Soil Core Segment Gross Gamma Survey Results

Core Number	Core Segment	Segment Length (inches)	Core Depth Below Surface (ft)	Gross Scan Rate (kcpm)	Gross Static Count (cpm)	Net Static Count (cpm) ¹
1	A	36	1	53	52,753	17,217
1	A		2	46	47,623	12,087
1	A		3	44	44,656	9,120
1	B	36	4	50	51,811	16,275
1	B		5	46	48,231	12,695
1	B		6	48	47,021	11,485
1	C	36	7	48	49,876	14,340
1	C		8	49	46,953	11,417
1	C		9	44	42,085	6,549
2	A	36	1	46	47,321	11,785
2	A		2	45	45,415	9,879
2	A		3	47	43,336	7,800
2	B	36	4	47	51,608	16,072
2	B		5	51	47,770	12,234
2	B		6	45	44,939	9,403
2	C	36	7	46	47,313	11,777
2	C		8	48	46,208	10,672
2	C		9	42	41,107	5,571
2	D	36	10	48	47,171	11,635
2	D		11	46	44,750	9,214
2	D		12	42	36,892	1,356
3	A	36	1	43	44,244	8,708
3	A		2	43	40,417	4,881
3	A		3	40	39,911	4,375
3	B	36	4	44	45,202	9,666
3	B		5	45	44,347	8,811
3	B		6	44	40,308	4,772
3	C	36	7	42	46,518	10,982
3	C		8	42	45,611	10,075
3	C		9	44	43,749	8,213
3	D	36	10	50	44,623	9,087
3	D		11	47	43,129	7,593
3	D		12	40	36,276	740
4	A	36	1	43	44,347	8,811
4	A		2	43	42,712	7,176
4	A		3	43	43,292	7,756
4	B	36	4	49	47,088	11,552
4	B		5	43	44,633	9,097
4	B		6	42	40,156	4,620
5	A	36	1	44	43,709	8,173
5	A		2	41	40,645	5,109
5	A		3	46	39,938	4,402
5	B	36	4	44	48,937	13,401
5	B		5	46	46,409	10,873
5	B		6	41	43,747	8,211
5	C	36	7	47	46,994	11,458

Core Number	Core Segment	Segment Length (inches)	Core Depth Below Surface (ft)	Gross Scan Rate (kepm)	Gross Static Count (cpm)	Net Static Count (cpm) ¹
5	C		8	43	46,635	11,099
5	C		9	38	42,802	7,266
5	D	36	10	46	48,351	12,815
5	D		11	43	46,969	11,433
5	D		12	43	50,470	14,934
5	E	36	13	49	50,436	14,900
5	E		14	48	50,087	14,551
5	E		15	42	46,588	11,052
5	F	24	16	48	50,533	14,997
5	F		17	50	46,399	10,863
6	A	36	1	46	46,352	10,816
6	A		2	40	42,435	6,899
6	A		3	40	45,314	9,778
6	B	36	4	47	52,536	17,000
6	B		5	46	48,193	12,657
6	B		6	45	44,973	9,437
6	C	36	7	53	53,134	17,598
6	C		8	51	51,352	15,816
6	C		9	50	48,822	13,286
6	D	60	10	51	50,184	14,648
6	D		11	53	49,988	14,452
6	D		12	49	45,693	10,157
6	D		13	48	46,291	10,755
6	D		14	46	47,112	11,576
7	A	36	1	47	47,179	11,643
7	A		2	47	43,013	7,477
7	A		3	45	45,643	10,107
7	B	36	4	48	53,008	17,472
7	B		5	50	47,882	12,346
7	B		6	47	47,539	12,003
7	C	36	7	44	46,740	11,204
7	C		8	42	46,630	11,094
7	C		9	42	43,242	7,706
7	D	36	10	48	48,140	12,604
7	D		11	43	45,512	9,976
7	D		12	45	46,422	10,886
7	E	60	13	43	44,945	9,409
7	E		14	46	45,923	10,387
7	E		15	41	43,542	8,006
7	E		16	42	42,499	6,963
7	E		17	42	41,307	5,771
8	A	48	1	55	55,957	20,421
8	A		2	54	50,475	14,939
8	A		3	50	48,718	13,182
8	A		4	48	42,520	6,984
8	B	24	5	44	41,516	5,980
8	B		6	44	36,224	688

Core Number	Core Segment	Segment Length (inches)	Core Depth Below Surface (ft)	Gross Scan Rate (kcpm)	Gross Static Count (cpm)	Net Static Count (cpm) ¹
9	A	36	1	52	55,288	19,752
9	A		2	53	46,876	11,340
9	A		3	47	44,080	8,544
9	B	36	4	42	44,858	9,322
9	B		5	42	38,192	2,656
9	B		6	37	35,628	92
10	A	36	1	50	51,551	16,015
10	A		2	43	42,844	7,308
10	A		3	42	44,761	9,225
10	B	36	4	46	47,803	12,267
10	B		5	48	47,642	12,106
10	B		6	44	42,393	6,857
10	C	36	7	42	39,517	3,981
10	C		8	40	38,911	3,375
10	C		9	41	40,656	5,120
11	A	36	1	45	46,208	10,672
11	A		2	47	44,578	9,042
11	A		3	45	44,551	9,015
11	B	36	4	48	45,623	10,087
11	B		5	38	35,981	445
11	B		6	41	34,499	-1,037
			Count:	114	114	114
			Average:	45	45,443	9,907
			Std. Dev.:	3.7	4,139	4,139
			Minimum:	37	34,499	-1,037
			Maximum:	55	55,957	20,421
			Median:	45	45,633	10,097

¹Net Static Count values (cpm) are equal to the Gross Static Count minus a background value of 35,536 cpm, the average of 5 consecutive 1-minute counts performed with the detector on top of the table used to scan the cores, prior to scan activities.

A composite sample representing each core segment was then prepared by compositing each set of three 1-foot increments in a bucket and breaking up the cores. The final segment of core may be less than or greater than 3 feet depending on the point at which virgin material was encountered. A sample (usually between 500 and 800 grams) was taken from each composite and forwarded to Outreach for analysis of Th-232 activity concentration. Analytical results are provided below in Table 3. Analytical data reports are contained in Attachment C.

Table 3 -- Systematic Soil Core Composite Sample Results

Core Number	Core Segment	Segment Length (in.)	Composite Sample No.	Core Depth (ft)	Th-232 (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)
1	A	36	K-584	1	26.9	0.704	0.746
1	B	36	K-585	4	19.1	0.399	0.440
1	C	36	K-586	7	15.3	0.334	0.329
2	A	36	K-596	1	24.8	0.713	1.55
2	B	36	K-597	4	29.6	0.703	0.772
2	C	36	K-598	7	22.5	0.525	0.901
2	D	36	K-599	10	17.3	0.418	0.576
3	A	36	K-600	1	21.7	0.520	0.982
3	B	36	K-601	4	22.9	0.480	0.535
3	C	36	K-602 ¹	7	31.4	0.960	1.18
3	D	36	K-603	10	23.3	0.596	0.880
4	A	36	K-604	1	19.1	0.478	0.674
4	B	36	K-605	4	20.9	0.472	0.557
5	A	36	K-578	1	10.8	0.256	0.370
5	B	36	K-579	4	14.7	0.351	0.380
5	C	36	K-580	7	23.9	0.656	0.779
5	D	36	K-581	10	22.2	0.545	1.05
5	E	36	K-582	13	18.8	0.389	0.460
5	F	24	K-583	16	11.7	0.287	0.340
6	A	36	K-587	1	15.7	0.437	0.842
6	B	36	K-588	4	18.2	0.375	0.457
6	C	36	K-589	7	18.3	0.412	0.380
6	D	60	K-590	10	27.8	0.736	1.21
7	A	36	K-591	1	15.5	0.413	0.489
7	B	36	K-592	4	25.8	0.571	0.629
7	C	36	K-593	7	15.7	0.412	0.606
7	D	36	K-594	10	17.4	0.439	0.867
7	E	60	K-595	13	25.1	0.764	0.821
8	A	48	K-606	1	21.4	0.594	1.21
8	B	24	K-607	5	2.86	0.146	0.474
9	A	36	K-608 ¹	1	29.3	0.770	1.25
9	B	36	K-609	4	8.54	0.333	0.702
10	A	36	K-610	1	23.1	0.444	0.570
10	B	36	K-611	4	26.5	0.550	0.659
10	C	36	K-612	7	27.6	0.643	0.969
11	A	36	K-613	1	21.0	0.600	0.802
11	B	36	K-614	4	14.9	0.486	0.861
				Count:	37		
				Average:	20.3		
				Std. Dev.:	6.22		
				Minimum:	2.86		
				Maximum:	31.4		
				Median:	21.0		

¹Samples K-602 (35.1pCi/g) and K-608 (32.5 pCi/g) were reanalyzed after each sample was remixed and the clumps within the sample were busted and mixed with the remaining sample. The results of the re-analysis were used to evaluate the survey unit.

The gross and net Th-232 activity concentrations for 36 of the 37 systematic composite soil samples were below the BCM surrogate value of 31.1 pCi/g net Th-232 activity concentration (DCCL). The gross Th-232 activity concentration for Sample K-602 (Soil Core No. 3, Segment C – 31.4 pCi/g) slightly exceeded the DCCL value. However, the net Th-232 activity concentration for the sample (30.3 pCi/g) was below the DCCL value. The average gross Th-232 activity concentration for the survey unit was 20.3 pCi/g. The standard deviation of the 37 composite samples was 6.22, which fell above the estimated standard deviation of 4.4 used to calculate the minimum number of samples required in the decommissioning plan.

Since the estimated variance (standard deviation) is greater than the variance used to calculate the minimum number of samples required (N), N was recalculated using the measured variance of 6.22 to ensure enough samples were taken, as follows:

Paramount to determining the minimum number of samples is the determination of the relative shift, delta over sigma (Δ/σ). Delta is equal to the DCGL minus the lower-bound gray region (LBGR) value. The LBGR value is arbitrarily set at one-half the DCGL value to start the determination. Sigma is an estimate of the variability in a set of sample analysis results from a survey unit. In the DP, the estimate of sigma used was based on the standard deviations in Th-232 activity measured in survey units during the FSS sampling of the adjacent land remediation final survey. The net Th-232 activity concentration of 31.1 pCi/g was used as the DCCL and Δ was equal to $31.1 - 15.55$, or 15.55. Delta divided by the sigma of 4.4 resulted in a relative shift of 3.53 which is rounded to 3.5 for the purpose of determining the required number of samples. The number of samples was then looked up in Table 5.3 of MARSSIM (9 for selected alpha and beta error rates of 0.05).

Using the original net DCCL value of 31.1 pCi/g, a recalculation of N results in a delta of $(31.1 - 15.55)$ of 15.55 and a relative shift of $(15.55 / 6.22)$ of 2.5. The resulting N for a standard Class 1 survey unit of 2,000 m² is 11 (MARSSIM Table 5.3). Eleven systematic core samples were taken resulting in 37 1-meter composite samples.

2.3 Wilcoxon Rank Sum (WRS) Testing

The analytical results for the systematic soil core composite samples were evaluated using the procedure contained in Appendix C, Volume I of this Final Status Survey Report (Wilcoxon Rank Sum Test). The evaluation showed that the survey unit core sample results meet the DP statistical criterion based on the first statistical test as described below.

If the difference (30.9 pCi/g) between the maximum survey unit soil sample activity concentration (31.4 pCi/g) and the minimum reference background area soil sample activity concentration (0.54 pCi/g) is less than DCCL (31.1 pCi/g), then the survey unit meets the release criterion. Table 4 presents a summary of the data used to complete the statistical evaluation of the survey unit.

Table 4 – Reference Group and Survey Unit Sample Results

Reference Group	Sample ID	Th-232 (pCi/g)	Survey Unit Group	Sample ID	Th-232 (pCi/g)
R1	13	1.31	S1	K-578	10.8
R2	14	1.13	S2	K-579	14.7
R3	40	1.13	S3	K-580	23.9
R4	52	1.63	S4	K-581	22.2
R5	56	1.17	S5	K-582	18.8
R6	58	1.04	S6	K-583	11.7
R7	86	0.88	S7	K-584	26.9
R8	92	1.37	S8	K-585	19.1
R9	98	1.39	S9	K-586	15.3
R10	104	1.45	S10	K-587	15.7
R11	116	0.65	S11	K-588	18.2
R12	134	0.75	S12	K-589	18.3
R13	138	0.86	S13	K-590	27.8
R14	142	1.36	S14	K-591	15.5
R15	154	1.06	S15	K-592	25.8
R16	158	1.22	S16	K-593	15.7
R17	165	0.54	S17	K-594	17.4
R18	174	0.78	S18	K-595	25.1
R19	178	0.71	S19	K-596	24.8
R20	194	0.89	S20	K-597	29.6
R21	209	0.90	S21	K-598	22.5
R22	229	1.22	S22	K-599	17.3
R23	252	1.63	S23	K-600	21.7
R24	255	1.42	S24	K-601	22.9
R25	256	1.49	S25	K-602	31.4
R26	258	0.81	S26	K-603	23.3
R27	312	1.26	S27	K-604	19.1
R28	321	1.03	S28	K-605	20.9
R29	325	1.50	S29	K-606	21.4
R30	337	1.21	S30	K-607	2.86
R31	340	1.10	S31	K-608	29.3
R32	342	1.26	S32	K-609	8.54
R33	344	1.61	S33	K-610	23.1
R34	348	0.87	S34	K-611	26.5
R35	356	1.45	S35	K-612	27.6
R36	357	0.94	S36	K-613	21.0
R37	358	0.74	S37	K-614	14.9
Average:		1.13	Average:		20.3
Std. Dev.:		0.30	Std. Dev:		6.22
Minimum:		0.54	Minimum:		2.86
Maximum:		1.63	Maximum:		31.4
Median:		1.13	Median:		21.0

3.0 SUMMARY OF FINDINGS

Survey Unit Kaiser-FSSB-003 which consists of a unit of BCM placed in an excavation resulting from the removal of radiologically-affected soil from the former Reserve Pond area, is considered a Class 1 survey unit with an approximate base surface area of 1,709 m². It is located on the east side of the pond parcel within portions of the excavation bottoms associated with Survey Units Kaiser-FSS-013 and Kaiser-FSS-014 (Figure 3). The survey unit is bordered by a wall of non-impacted soil (clean import borrow material) to the south (along the Specific Systems Property) and east (along the Redman Property), excavation backfill Survey Units Kaiser-FSSB-004 and Kaiser-FSSB-006 to the north, and excavation backfill Survey Units Kaiser-FSSB-005 and Kaiser-FSSB-006 to the west.

A total of seven 2-foot layers (lifts) of BCM were placed in Survey Unit Kaiser-FSSB-003.

The acceptance criterion for BCM survey units at the Tulsa facility is the DCCL of 31.1 pCi/g net Th-232 activity concentration. The final status survey consisted of a gross gamma scan of each placed 2-foot lift of BCM and systematic soil core sampling upon completion of the BCM unit. The results of the final status survey activities were as follows:

- The 100 percent coverage gamma scan of each lift (final as-left condition) did not indicate the presence of small areas (1 m²) of elevated activity (greater than the DCCL for the site).
- All 37 systematic composite sample results (net) were below the BCM surrogate value of 31.1 pCi/g net Th-232 activity concentration (DCCL).
- The analytical results meet the DP statistical criterion based on the first statistical evaluation of the data (WRS Test procedure).

The results of the final status survey activities show that Survey Unit Kaiser-FSSB-003 meets the DP acceptance criteria.

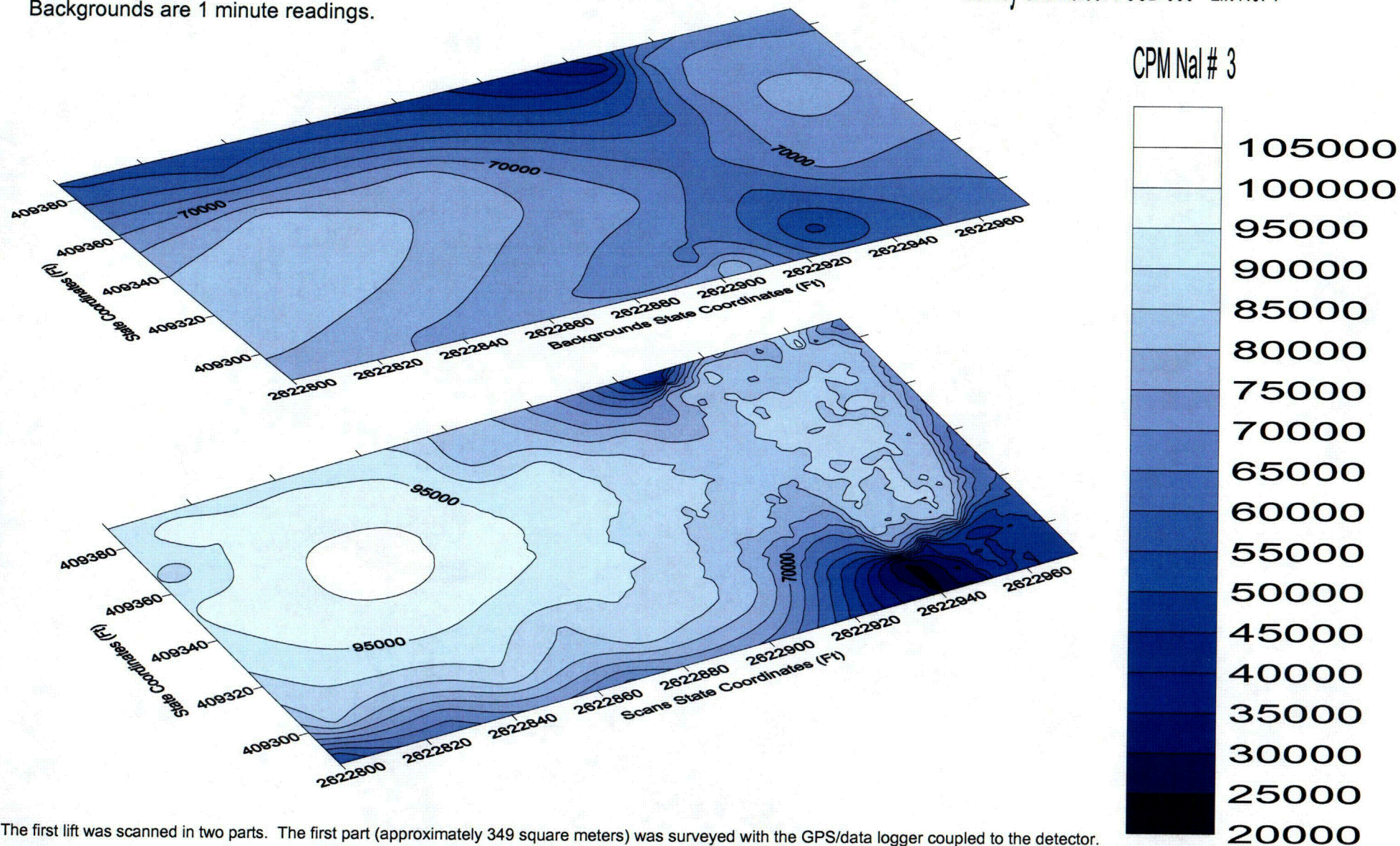
ATTACHMENT A TABLE OF CONTENTS

- **FIGURE A-1 Gross Gamma Background and Scanning Survey Results – Lift 1**
- **FIGURE A-2 Gross Gamma Background and Scanning Survey Results – Lift 2**
- **FIGURE A-3 Gross Gamma Background and Scanning Survey Results – Lift 3**
- **FIGURE A-4 Gross Gamma Background and Scanning Survey Results – Lift 4**
- **FIGURE A-5 Gross Gamma Background and Scanning Survey Results – Lift 5**
- **FIGURE A-6 Gross Gamma Background and Scanning Survey Results – Lift 6**
- **FIGURE A-7 Gross Gamma Background and Scanning Survey Results – Lift 7**
- **FIGURE A-8 Systematic Soil Core Sampling Locations**



Attachment A, Figure A-1
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSB-003 - Lift No. 1

Backgrounds are 1 minute readings.

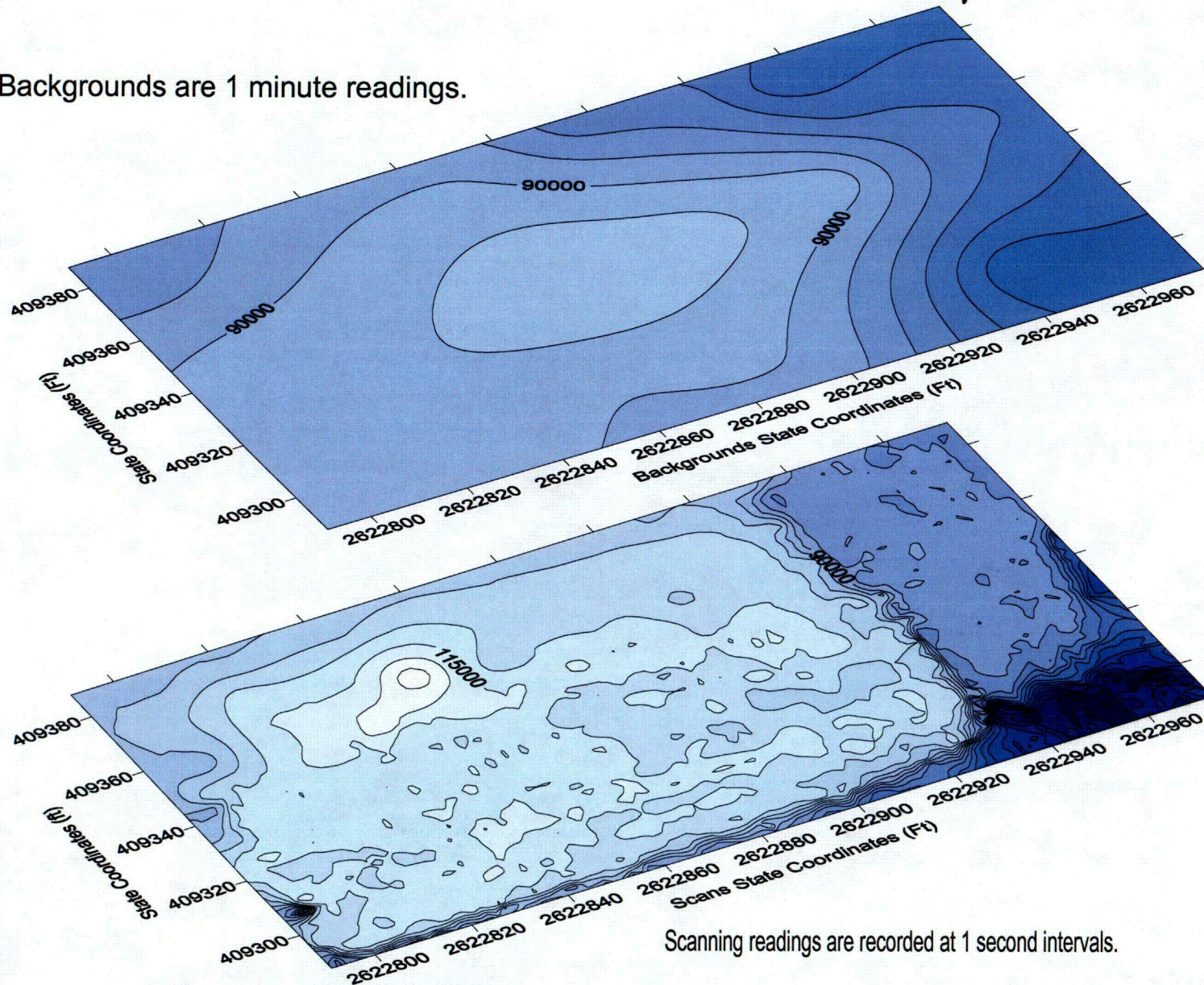


The first lift was scanned in two parts. The first part (approximately 349 square meters) was surveyed with the GPS/data logger coupled to the detector.

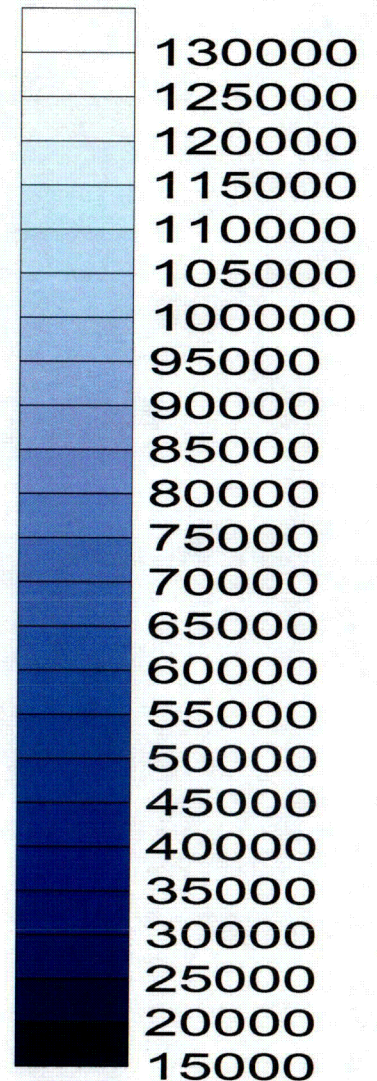
The second part (approximately 1,360 square meters) was surveyed by recording the average gross gamma reading for each approximately 20 square meter section of the remaining lift area.

Attachment A, Figure A-2 Gross Gamma Background and Scanning Survey Results Survey Unit Kaiser-FSSB-003 - Lift No. 2

Backgrounds are 1 minute readings.



CPM NaI # 3

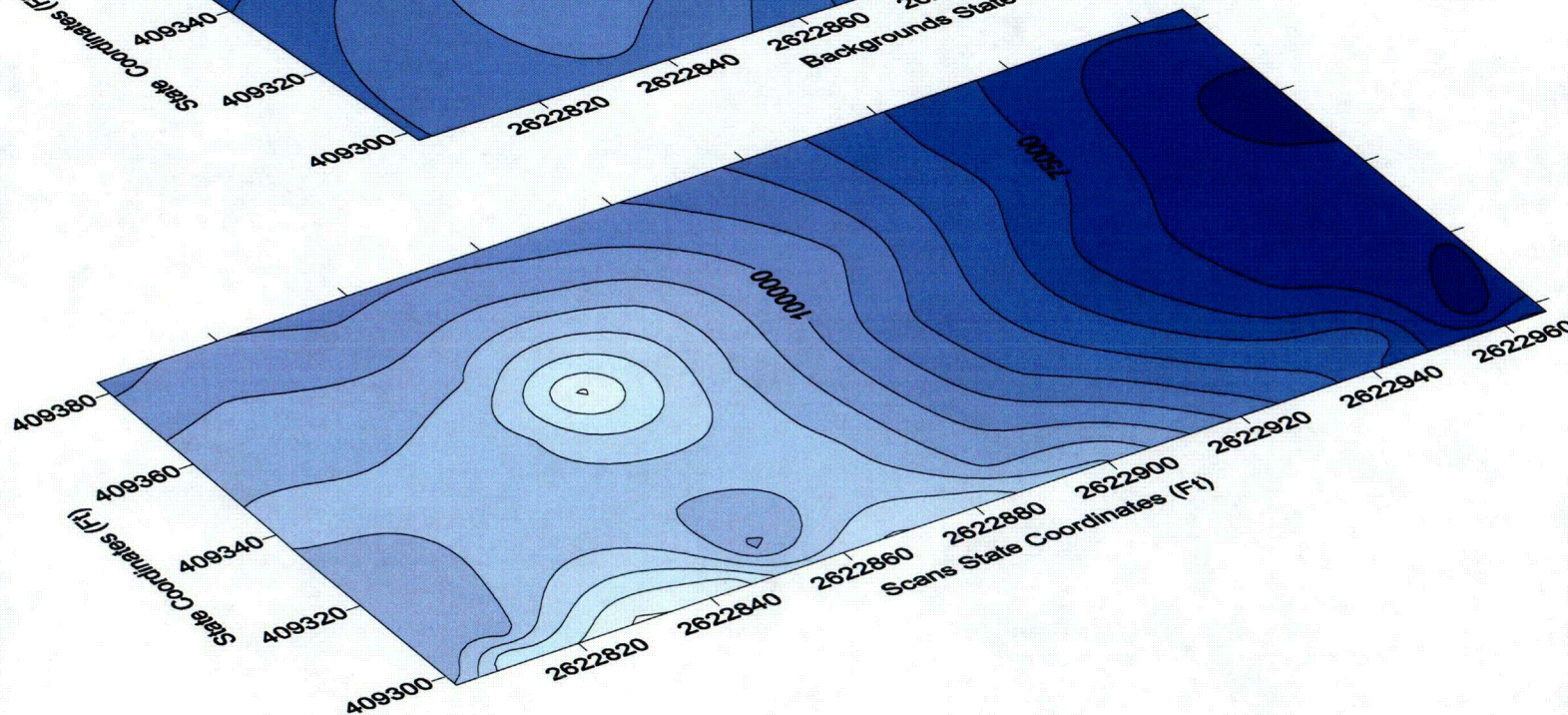
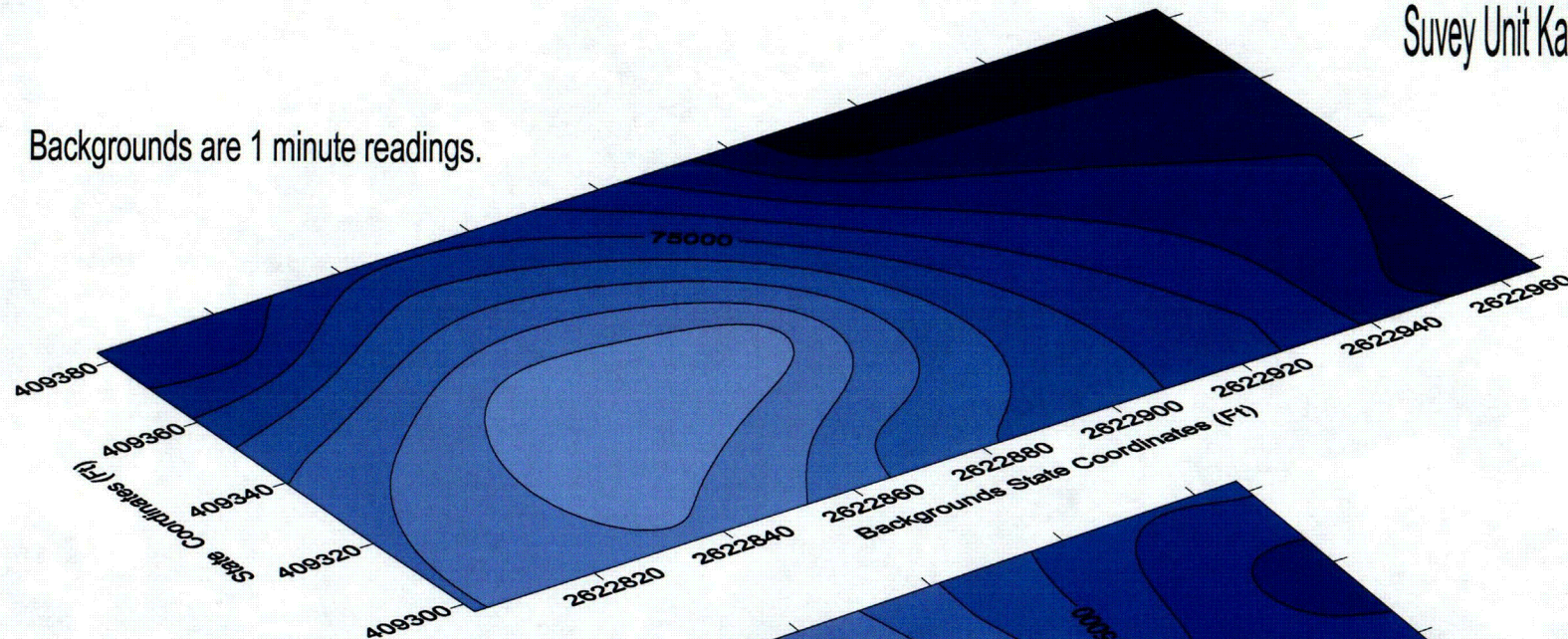


Scanning readings are recorded at 1 second intervals.

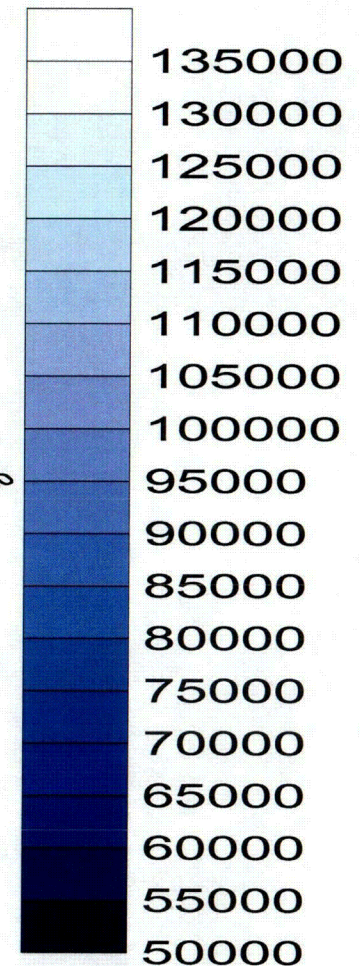


Attachment A, Figure A-3
Gross Gamma Background and Scanning Survey Results
Suvey Unit Kaiser-FSSB-003 - Lift No. 3

Backgrounds are 1 minute readings.



CPM NaI # 3

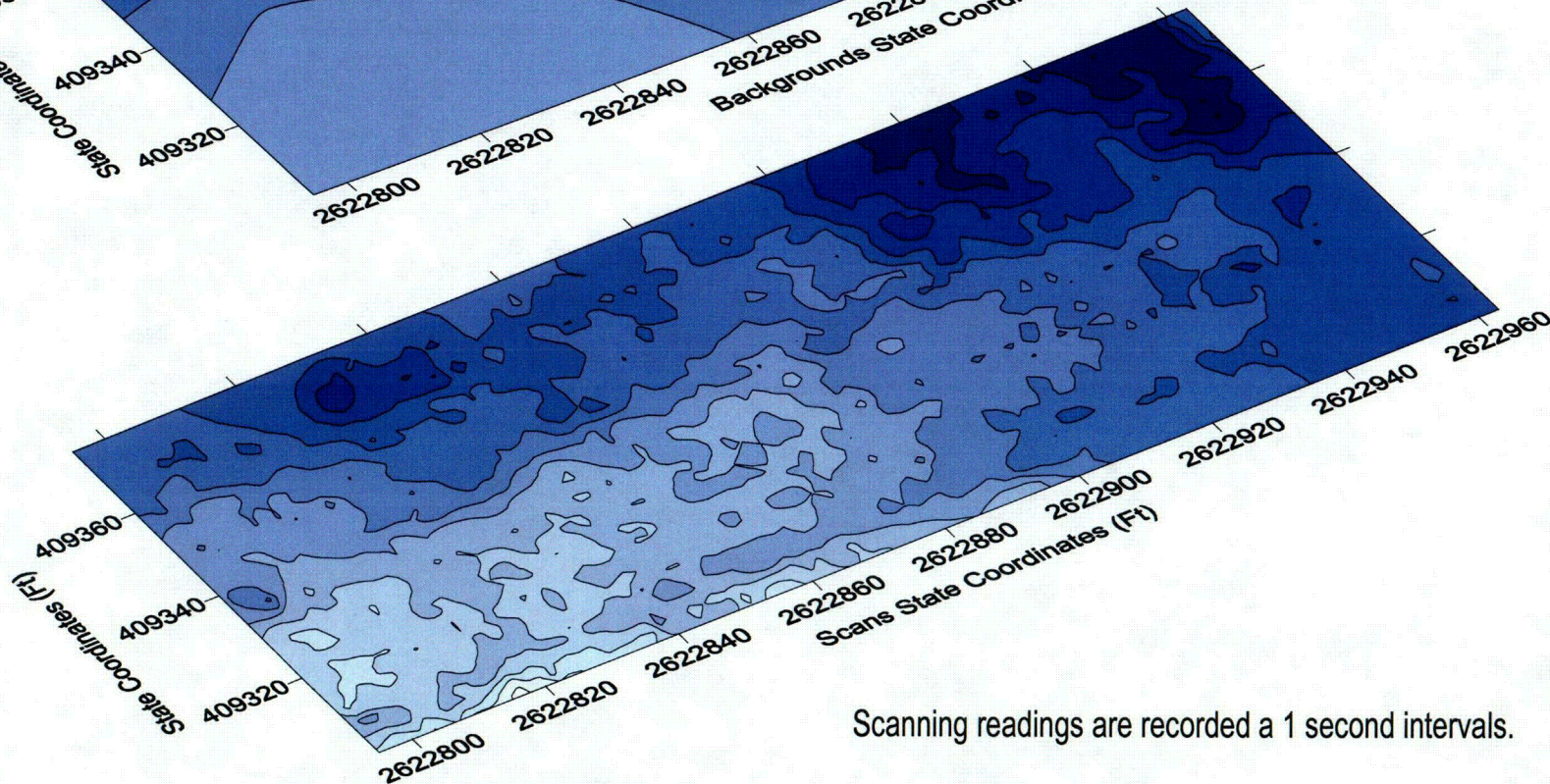
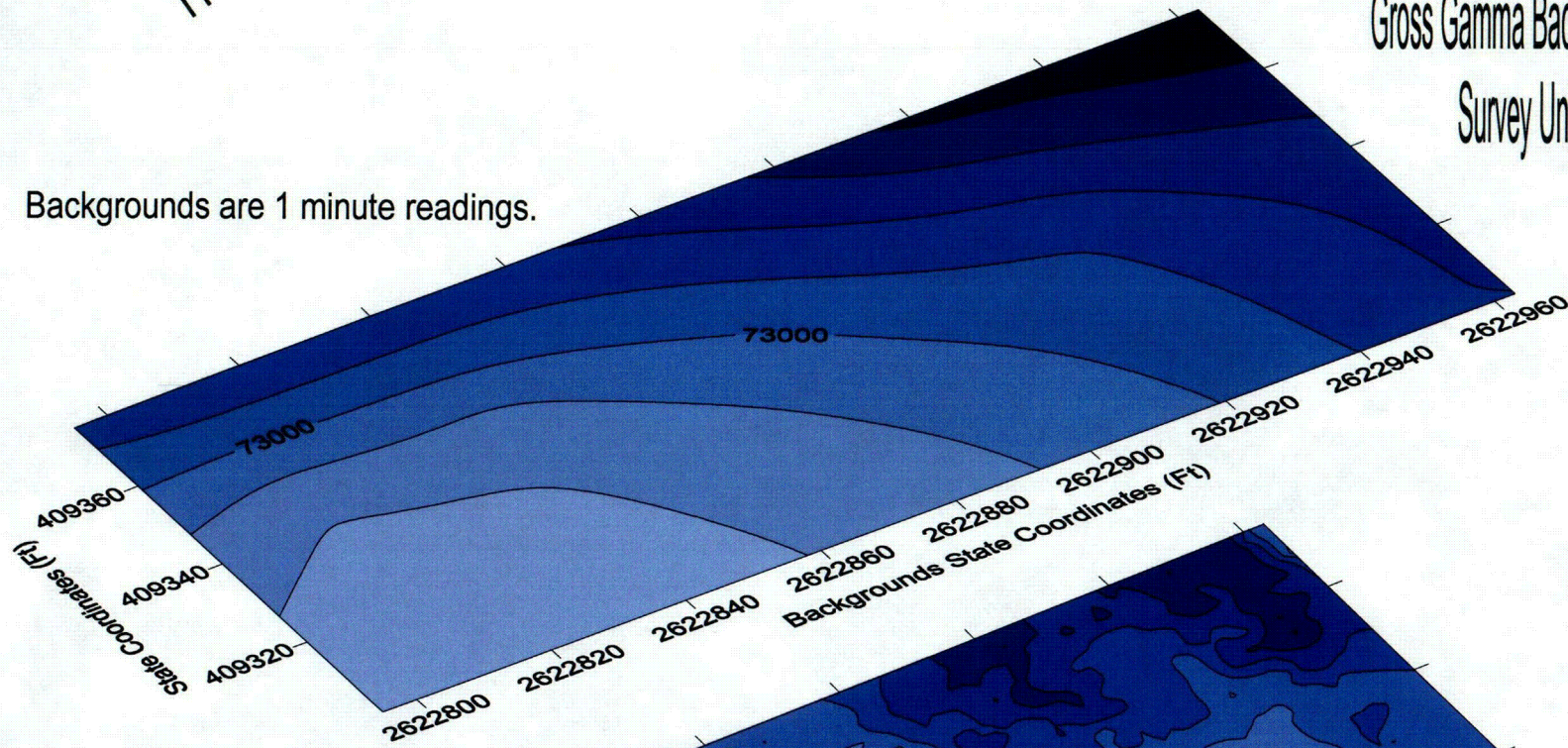


Lift No. 3 was surveyed without GPS/data logger by recording the average gross gamma reading for each approximately 30 square meter section of the lift area.



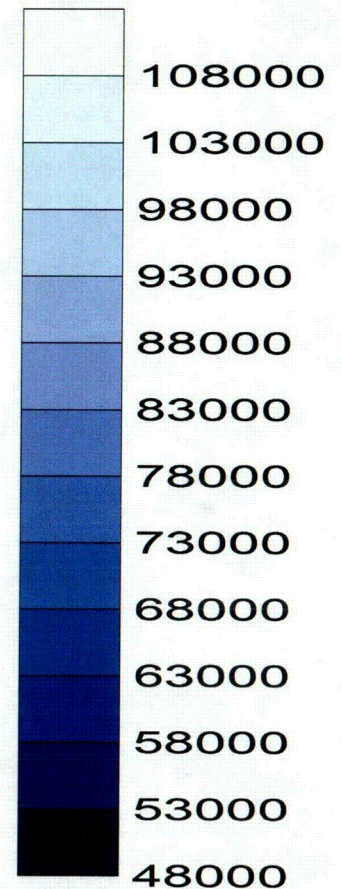
Attachement A, Figure A-4
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSB-003 - Lift No. 4

Backgrounds are 1 minute readings.



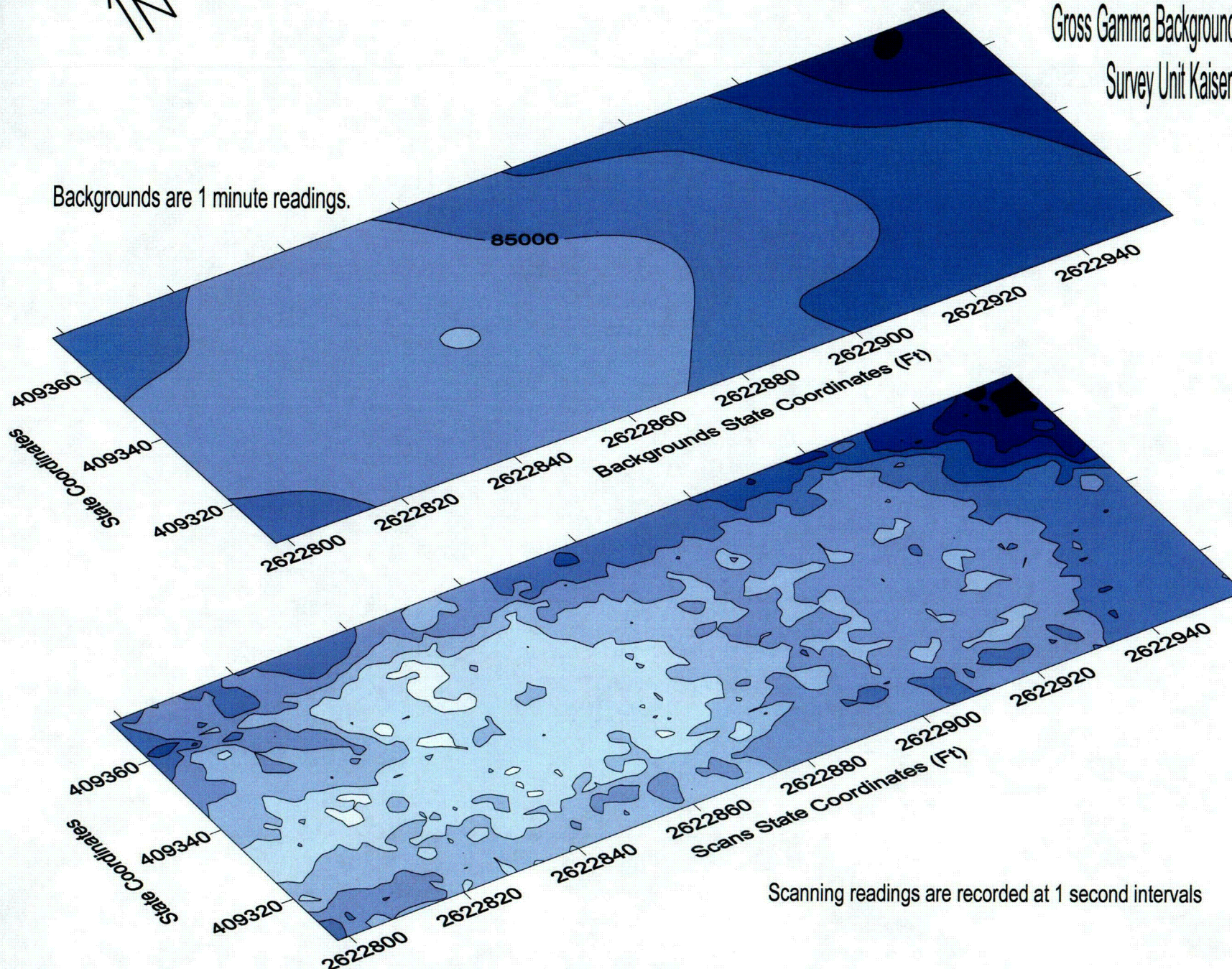
Scanning readings are recorded a 1 second intervals.

CPM NaI # 3

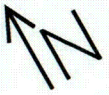


Attachment A, Figure A-5
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser FSSB-003 - Lift No. 5

Backgrounds are 1 minute readings.

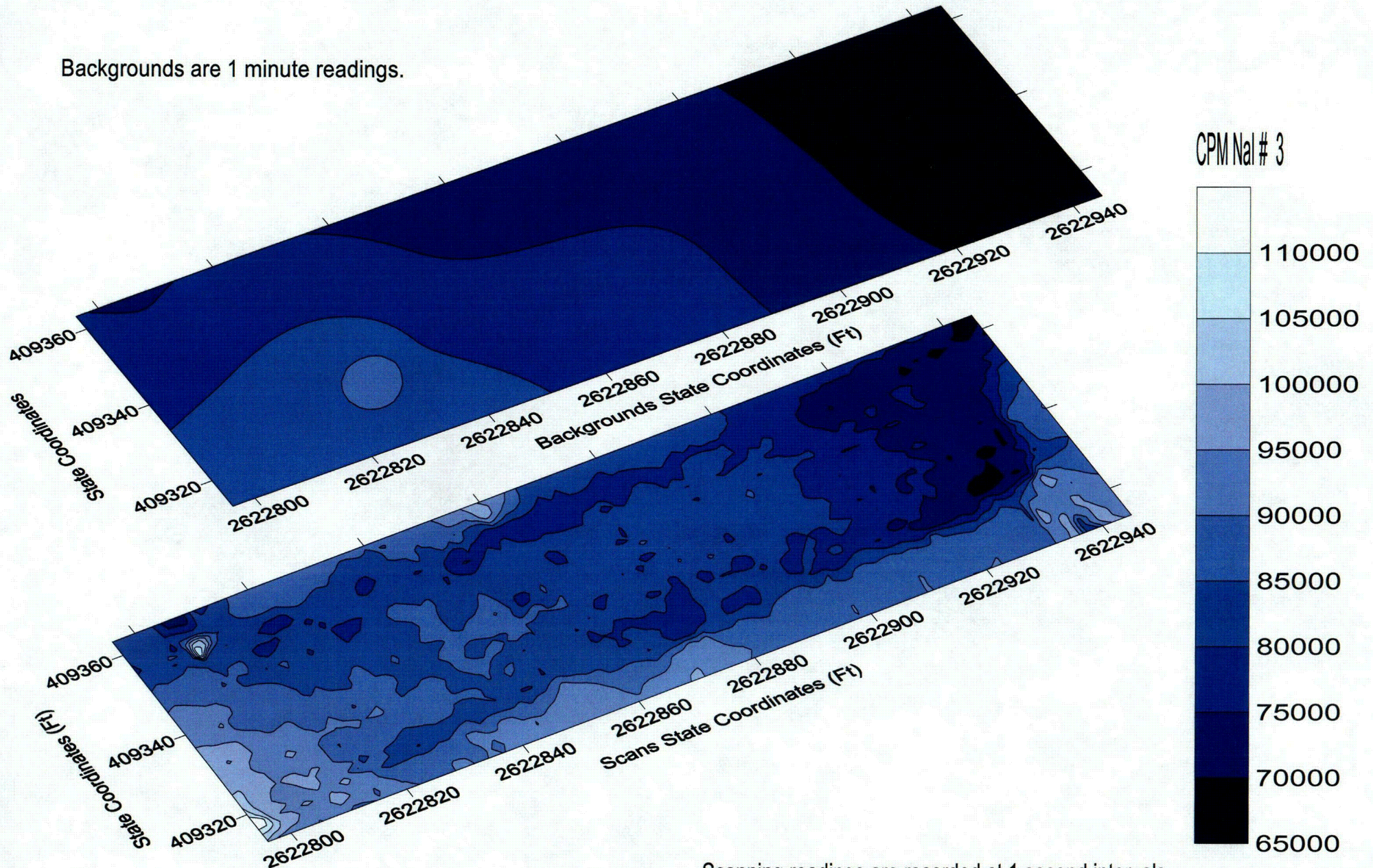


Scanning readings are recorded at 1 second intervals



Attachment A, Figure A-6
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSB-003 - Lift No. 6

Backgrounds are 1 minute readings.

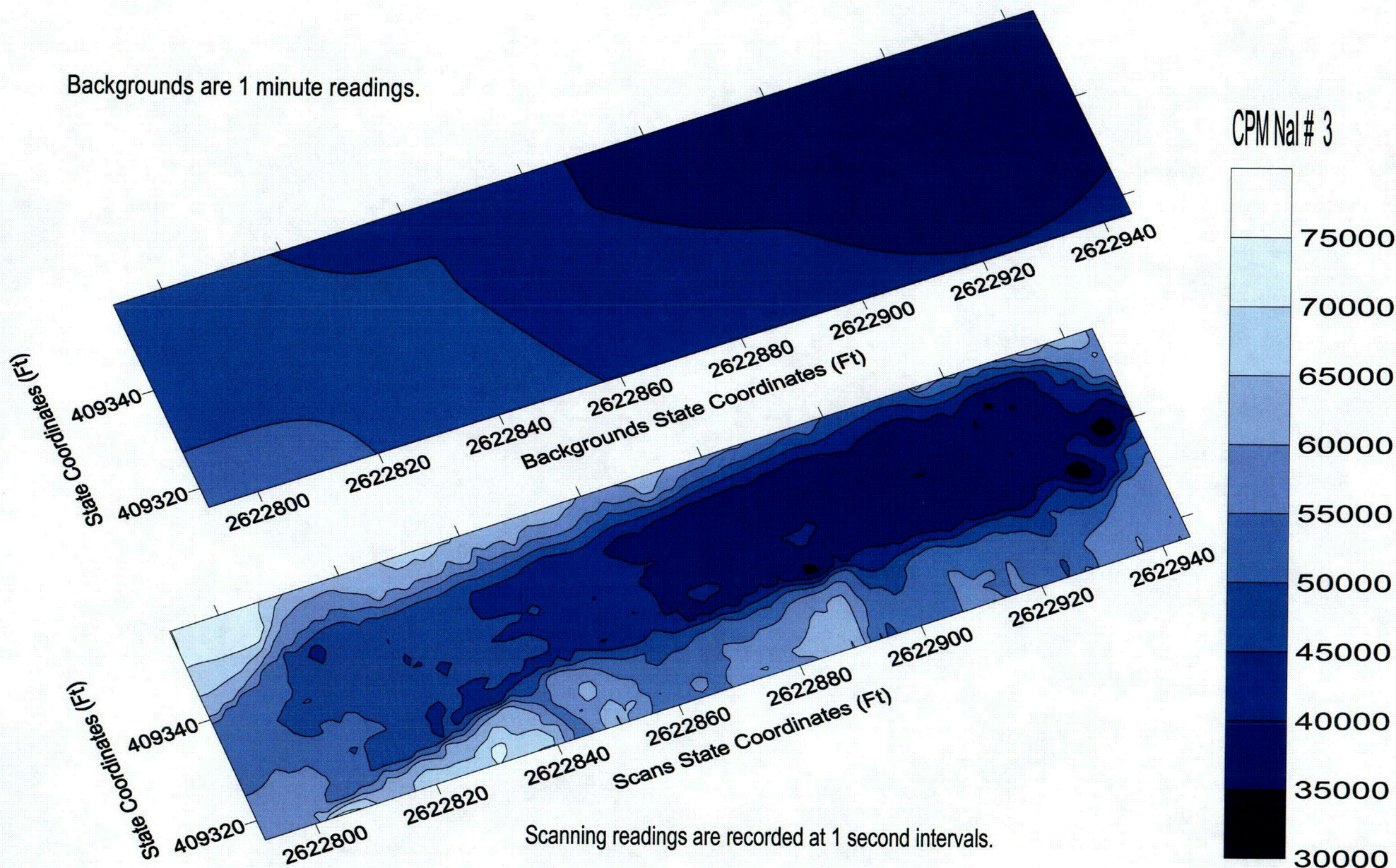


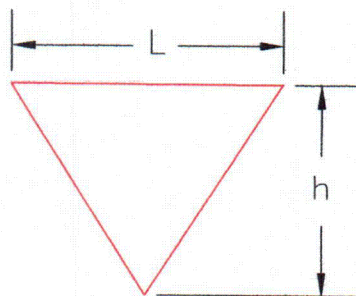
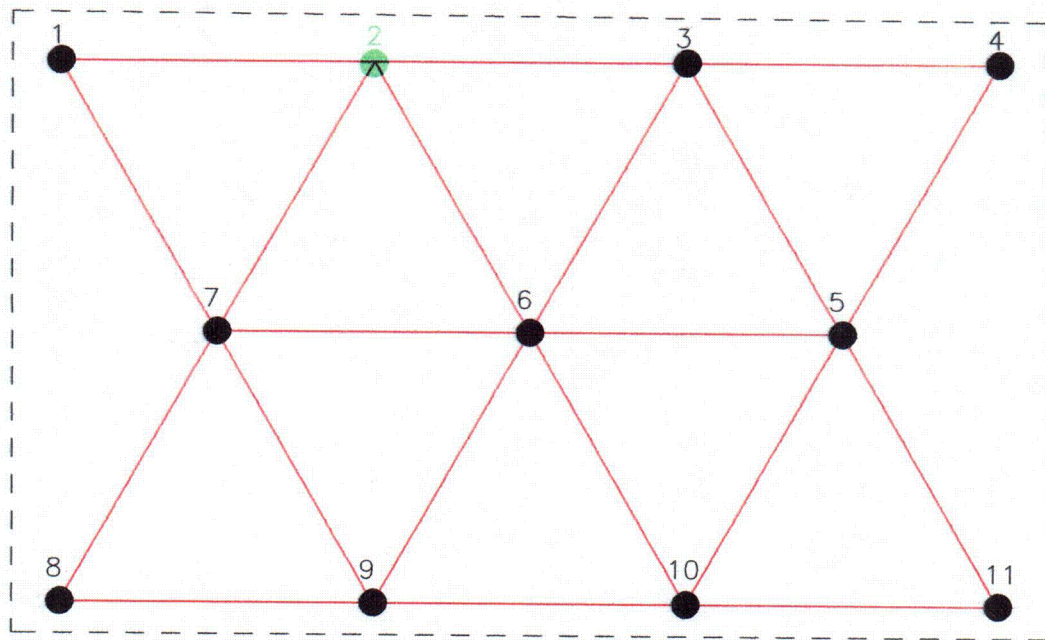
Scanning readings are recorded at 1 second intervals.



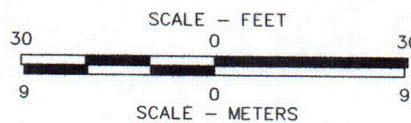
Attachment A, Figure A-7
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSB-003 - Lift No. 7

Backgrounds are 1 minute readings.





$N = 9$ (11 COLLECTED)
 $L = 14.8\text{m}$
 $h = 12.8\text{m}$
 $\text{AREA} = 1,709\text{m}^2$



- 1 ● SYSTEMATIC SOIL CORE SAMPLING LOCATION
BASED ON RANDOM START POINT AND
AN EQUAL DISTANT TRIANGULAR GRID
- 2 ● RANDOM START POINT

FIGURE A-8
 SYSTEMATIC SOIL CORE SAMPLING LOCATIONS
 SURVEY UNIT KAISER - FSSB-003
 FINAL STATUS SURVEY
 THORIUM REMEDIATION PROJECT
 TULSA, OKLAHOMA FACILITY

PREPARED FOR
 KAISER ALUMINUM & CHEMICAL CORPORATION
 TULSA, OKLAHOMA

APPROVED *3-3-06*

CHECKED *3-3-06*

DRAWN DEB 01/31/06

DRAWING NUMBER

PA4072076



Penn E&R
 Environmental & Remediation, Inc.

**ATTACHMENT B
TABLE OF CONTENTS**

- **Soil Survey Unit Worksheet No. 1**
- **Soil Survey Unit Worksheet No. 2**

Soil Survey Unit Work Sheet No. 1
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

1. Soil Survey Unit: Kaiser-FSSB-003

2. Description: Pond Parcel Excavation Backfill Unit

3. Net Th-232 Acceptance Criteria (pCi/g): 31.1

4. Dimensions (m): Approximately 55 meters x 31 meters; Area, A (m²): 1,709

5. Estimate of Gross Gamma Scan Background Readings (cpm)

Average: 80,000 Minimum: 50,000 Maximum: 100,000

6. Based on the maximum background gross gamma scan reading, the scan MDC (Minimum Detectable Concentration of Th-232), the corresponding N (Minimum Number of Required Samples) and L (Triangular Grid Node Length) for a standard 2,000 m² Class 1 survey unit are:

- Gross Gamma Scan MDC (pCi/g): 5.7
- Minimum Number of Samples (N): 9 Triangular Grid Node Length (L): 16.0 m

7. If the area of the Survey Unit is less than 2,000 m², recalculate the corresponding Triangular Grid Node Length (L₁) for the Survey Unit Area (A), using the following formula: $L_1 = (A / (0.866 \times 9))^{1/2}$: 14.8

8. If N is greater than 9 and the A is other than 2,000 m², recalculate the corresponding Triangular Grid Node Length (L₁) using the following formula $L_1 = (A / (0.866 \times N))^{1/2}$: N/A

9. If A is greater than 2,000 m² and N is equal to 9, recalculate the minimum number of samples (N₁) corresponding to a Triangular Grid Node Length (L) of 16 m using the following formula $N_1 = A / (0.866 \times 16^2)$, N₁: N/A

10. Calculate the height (h) of the equilateral triangle with side length equal to L (or (L₁)) using the following formula: $h = ((L^2 - (L/2)^2)^{1/2})$: 12.8 m.

Soil Survey Unit Worksheet No. 2
Random Number Generator for Start Point
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

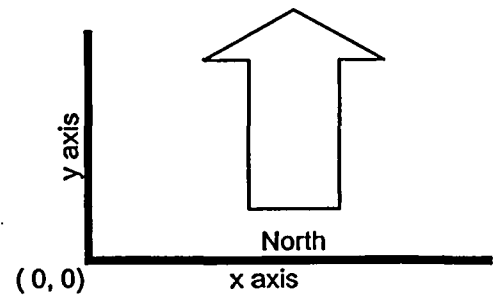
SURVEY UNIT: KAISER-FSSB-003

RANDOM START POINT

x axis (Meters)	y axis (Meters)
17	27

lower bound
upper bound

x axis	y axis
0	0
55	31



ATTACHMENT C
LABORATORY ANALYTICAL RESULTS



Outreach Laboratory

11 North Aspen
Broken Arrow, OK 74012
(918) 251-2515
FAX (918) 251-0008

April 29, 2005

David Weyant
Kaiser Aluminum & Chemical
7311 E. 41st Street
Tulsa, OK 74145

Inov # 10932

D/- 4/29/05

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20050299

Dear Mr. Weyant:

Please find enclosed the analytical report for your sample received in our laboratory on April 25, 2005 for the above captioned project. Thirty three soil samples were received in good condition and analyzed for Th-232 by Gamma Spectroscopy without drying and grinding and Percent Moisture with an expedited 5 work day turn. Results were faxed 4/29/05.

All Quality Control for the requested analyses is reported on the analytical report. The laboratory control standard and duplicates for all analyses were within method control limits.

Your samples will be returned as requested.

Thank you for choosing Outreach Laboratory and if you have any questions, please call us at 918-251-2515.

Laboratory Director

ODEQ ID #9517
DEQ LIC. #27522-01



CERT. ID #OK001



11 North Aspen
Broken Arrow, OK 74012
(918) 251-2515
FAX (918) 251-0008

Client: Kaiser Aluminum
Client Project: Thorium Remediation
Lab Number: 20050299
Date Reported: 4/29/05
Date Received: 4/25/05
Page Number: 1 of 8

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20050299-01							
Client ID: K-578							
Date Sampled: 4/22/05 10:10:00 AM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	10.8 +/- 0.256	pCi/g	0.370		4/25/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	14.4	%		4/25/05	4/26/05	RT
Lab ID: 20050299-02							
Client ID: K-579							
Date Sampled: 4/22/05 10:27:00 AM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	14.7 +/- 0.351	pCi/g	0.380		4/25/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	17.4	%		4/25/05	4/26/05	RT
Lab ID: 20050299-03							
Client ID: K-580							
Date Sampled: 4/22/05 10:37:00 AM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	23.9 +/- 0.656	pCi/g	0.779		4/25/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	16.0	%		4/25/05	4/26/05	RT
Lab ID: 20050299-04							
Client ID: K-581							
Date Sampled: 4/22/05 10:42:00 AM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	22.2 +/- 0.545	pCi/g	1.05		4/25/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	19.9	%		4/25/05	4/26/05	RT
Lab ID: 20050299-05							
Client ID: K-582							
Date Sampled: 4/22/05 10:51:00 AM							
Matrix: Soil							
Radiochemical Analyses							

BDL = Below Detection Limit



311 North Aspen
Broken Arrow, OK 74012
(918) 251-2515
FAX (918) 251-0008

Client: Kaiser Aluminum
Client Project: Thorium Remediation
Lab Number: 20050299
Date Reported: 4/29/05
Date Received: 4/25/05
Page Number: 2 of 8

Analytical Report

		Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Th-232		HASL 300	18.8 +/- 0.389	pCi/g	0.460		4/25/05	RE
		Inorganics Analyses						
Percent Moisture		ASTM D2216-92	23.1	%		4/25/05	4/26/05	RT
Lab ID:		20050299-06						
Client ID:		K-583						
Date Sampled:		4/22/05 11:01:00 AM						
Matrix:		Soil						
		Radiochemical Analyses						
Th-232		HASL 300	11.7 +/- 0.287	pCi/g	0.340		4/25/05	RE
		Inorganics Analyses						
Percent Moisture		ASTM D2216-92	21.1	%		4/25/05	4/26/05	RT
Lab ID:		20050299-07						
Client ID:		K-584						
Date Sampled:		4/22/05 11:09:00 AM						
Matrix:		Soil						
		Radiochemical Analyses						
Th-232		HASL 300	26.9 +/- 0.704	pCi/g	0.746		4/25/05	RE
		Inorganics Analyses						
Percent Moisture		ASTM D2216-92	14.6	%		4/25/05	4/26/05	RT
Lab ID:		20050299-08						
Client ID:		K-585						
Date Sampled:		4/22/05 11:19:00 AM						
Matrix:		Soil						
		Radiochemical Analyses						
Th-232		HASL 300	19.1 +/- 0.399	pCi/g	0.440		4/25/05	RE
		Inorganics Analyses						
Percent Moisture		ASTM D2216-92	15.6	%		4/25/05	4/26/05	RT
Lab ID:		20050299-09						
Client ID:		K-586						
Date Sampled:		4/22/05 11:27:00 AM						
Matrix:		Soil						
		Radiochemical Analyses						
Th-232		HASL 300	15.3 +/- 0.334	pCi/g	0.329		4/25/05	RE
		Inorganics Analyses						
Percent Moisture		ASTM D2216-92	16.1	%		4/25/05	4/26/05	RT



311 North Aspen
Broken Arrow, OK 74012
(918) 251-2515
FAX (918) 251-0008

Client: Kaiser Aluminum
Client Project: Thorium Remediation
Lab Number: 20050299
Date Reported: 4/29/05
Date Received: 4/25/05
Page Number: 3 of 8

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20050299-10							
Client ID: K-588							
Date Sampled: 4/22/05 11:48:00 AM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	18.2 +/- 0.375	pCi/g	0.457		4/25/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	14.9	%		4/25/05	4/26/05	RT
Lab ID: 20050299-11							
Client ID: K-589							
Date Sampled: 4/21/05 11:58:00 AM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	18.3 +/- 0.412	pCi/g	0.380		4/25/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	15.0	%		4/25/05	4/26/05	RT
Lab ID: 20050299-12							
Client ID: K-590							
Date Sampled: 4/22/05 1:20:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	27.8 +/- 0.736	pCi/g	1.21		4/25/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	19.0	%		4/25/05	4/26/05	RT
Lab ID: 20050299-13							
Client ID: K-591							
Date Sampled: 4/22/05 1:28:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	15.5 +/- 0.413	pCi/g	0.489		4/25/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	18.0	%		4/25/05	4/26/05	RT
Lab ID: 20050299-14							
Client ID: K-592							
Date Sampled: 4/22/05 1:36:00 PM							
Matrix: Soil							
Radiochemical Analyses							



311 North Aspen
Broken Arrow, OK 74012
(918) 251-2515
FAX (918) 251-0008

Client: Kaiser Aluminum
Client Project: Thorium Remediation
Lab Number: 20050299
Date Reported: 4/29/05
Date Received: 4/25/05
Page Number: 4 of 8

Analytical Report

		Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Th-232		HASL 300	25.8 +/- 0.571	pCi/g	0.629		4/25/05	RE
Inorganics Analyses								
Percent Moisture		ASTM D2216-92	17.3	%		4/25/05	4/26/05	RT
Lab ID:		20050299-15						
Client ID:		K-593						
Date Sampled:		4/22/05 1:50:00 PM						
Matrix:		Soil						
Radiochemical Analyses								
Th-232		HASL 300	15.7 +/- 0.412	pCi/g	0.606		4/25/05	RE
Inorganics Analyses								
Percent Moisture		ASTM D2216-92	17.2	%		4/25/05	4/26/05	RT
Lab ID:		20050299-16						
Client ID:		K-594						
Date Sampled:		4/22/05 2:05:00 PM						
Matrix:		Soil						
Radiochemical Analyses								
Th-232		HASL 300	17.4 +/- 0.439	pCi/g	0.867		4/25/05	RE
Inorganics Analyses								
Percent Moisture		ASTM D2216-92	21.4	%		4/25/05	4/26/05	RT
Lab ID:		20050299-17						
Client ID:		K-595						
Date Sampled:		4/22/05 2:13:00 PM						
Matrix:		Soil						
Radiochemical Analyses								
Th-232		HASL 300	25.1 +/- 0.764	pCi/g	0.821		4/25/05	RE
Inorganics Analyses								
Percent Moisture		ASTM D2216-92	19.6	%		4/25/05	4/26/05	RT
Lab ID:		20050299-18						
Client ID:		K-596						
Date Sampled:		4/22/05 2:20:00 PM						
Matrix:		Soil						
Radiochemical Analyses								
Th-232		HASL 300	24.8 +/- 0.713	pCi/g	1.55		4/25/05	RE
Inorganics Analyses								
Percent Moisture		ASTM D2216-92	16.6	%		4/25/05	4/26/05	RT



311 North Aspen
Broken Arrow, OK 74012
(918) 251-2515
FAX (918) 251-0003

Client: Kaiser Aluminum
Client Project: Thorium Remediation
Lab Number: 20050299
Date Reported: 4/29/05
Date Received: 4/25/05
Page Number: 5 of 8

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20050299-19							
Client ID: K-597							
Date Sampled: 4/22/05 2:38:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	29.6 +/- 0.703	pCi/g	0.772		4/25/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	15.9	%		4/25/05	4/26/05	RT
Lab ID: 20050299-20							
Client ID: K-598							
Date Sampled: 4/22/05 2:45:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	22.5 +/- 0.525	pCi/g	0.901		4/25/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	15.6	%		4/25/05	4/26/05	RT
Lab ID: 20050299-21							
Client ID: K-599							
Date Sampled: 4/22/05 2:56:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	17.3 +/- 0.418	pCi/g	0.576		4/26/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	14.8	%		4/25/05	4/26/05	RT
Lab ID: 20050299-22							
Client ID: K-600							
Date Sampled: 4/22/05 3:06:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	21.7 +/- 0.520	pCi/g	0.982		4/26/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	14.4	%		4/25/05	4/26/05	RT
Lab ID: 20050299-23							
Client ID: K-601							
Date Sampled: 4/22/05 3:15:00 PM							
Matrix: Soil							

Radiochemical Analyses

BDL = Below Detection Limit

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Th-232	HASL 300	22.9 +/- 0.480	pCi/g	0.535		4/26/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	11.4	%		4/25/05	4/26/05	RT
Lab ID: 20050299-24							
Client ID: K-602							
Date Sampled: 4/22/05 3:28:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	35.1 +/- 0.772	pCi/g	1.09		4/26/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	18.8	%		4/25/05	4/26/05	RT
Lab ID: 20050299-25							
Client ID: K-603							
Date Sampled: 4/22/05 3:36:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	23.3 +/- 0.596	pCi/g	0.880		4/26/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	14.0	%		4/25/05	4/26/05	RT
Lab ID: 20050299-26							
Client ID: K-604							
Date Sampled: 4/22/05 3:52:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	19.1 +/- 0.478	pCi/g	0.674		4/26/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	18.1	%		4/25/05	4/26/05	RT
Lab ID: 20050299-27							
Client ID: K-605							
Date Sampled: 4/22/05 4:00:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	20.9 +/- 0.472	pCi/g	0.557		4/26/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	15.2	%		4/25/05	4/26/05	RT

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20050299-28							
Client ID: K-606							
Date Sampled: 4/22/05 4:14:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	21.4 +/- 0.594	pCi/g	1.21		4/26/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	19.4	%		4/25/05	4/26/05	RT
Lab ID: 20050299-29							
Client ID: K-608							
Date Sampled: 4/22/05 4:28:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	32.5 +/- 0.811	pCi/g	1.53		4/26/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	22.9	%		4/25/05	4/26/05	RT
Lab ID: 20050299-30							
Client ID: K-610							
Date Sampled: 4/22/05 4:46:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	23.1 +/- 0.444	pCi/g	0.570		4/26/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	18.0	%		4/25/05	4/26/05	RT
Lab ID: 20050299-31							
Client ID: K-611							
Date Sampled: 4/22/05 4:53:00 PM							
Matrix: Soil							
Radiochemical Analyses							
Th-232	HASL 300	26.5 +/- 0.550	pCi/g	0.659		4/26/05	RE
Inorganics Analyses							
Percent Moisture	ASTM D2216-92	10.0	%		4/25/05	4/26/05	RT
Lab ID: 20050299-32							
Client ID: K-612							
Date Sampled: 4/22/05 5:00:00 PM							
Matrix: Soil							
Radiochemical Analyses							



**311 North Aspen
Broken Arrow, OK 74012
Phone: (918) 251-2515
Fax: (918) 251-0008**

CHAIN CUSTODY

Results To:

LOCAL:
916-384-
0566

CELL: 724.
759: 0071

Company Kaiser-Alum & Chem Inc.

Name ATTN: DAVID G. WEINAT

Address 7311 E. 41st Street

City Yuba State OK Zip 7145

Phone 724 - 934 - 3530 Fax # 914 - 384 - 3171

Bill To:

Company Kaiser/Penn Ear

Name PASLIPADA DAVID WEYAL

Address 7311 E. 41st Street

City Tulsa State ok Zip 74145

ANALYSIS REQUESTED

PO #

PROJECT #

PROJECT NAME

REQUESTED TURNAROUND TIME
(ADDITIONAL CHARGES MAY APPLY)

SAMPLER

Signature _____

DAVID R. WELSH

CONTAINERS

CONTAINMENT
SIZE

PLASTIC
OR
GLASS

PRESERVATIVE

1. HNO_3 pH < 2
2. Ice < 4°C
3. HCl pH < 2
4. H_2SO_4 pH < 2
5. NaOH pH > 11

Gamma Spec

Return to Client

For Archival

5.07 JAW

pci/qs.

ASTM D 2216.9

poist Constant

REMARKS
(I.E. FILTERED, UNFILTERED,
GRAB. COMPOSITE)

SLAB SAMPLE NO.	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX
1	K-578	4-27-05	1010	SOIL
2	K-579		1027	
3	K-580		1037	
4	K-581		1042	
5	K-582		1051	
6	K-583		1101	
7	K-584		1109	
8	K-585		1119	
9	K-586		1127	
10	K-588		1148	
11	K-589		1158	
12	K-590		1320	
13	K-591		1328	
14	K-592		1336	

RELINQUISHED BY: DAVID G. WELBY JR DATE: 4/21/03 TIME: 9:55 RECEIVED BY: Donna Gibson DATE: 4/21/03 TIME: 2:25

RELINQUISHED BY: _____ DATE _____ TIME _____ RECEIVED BY: _____ DATE _____ TIME _____

My signature on this chain of custody form indicates that I am authorized by the above company to release samples for analysis. The company agrees to pay the entire balance upon receipt of sample data and it is understood and agreed that any balance carried over thirty (30) days is subject to a 1.5% per month (18% per annum) late charge. In the event of default, the company becomes legally liable for any reasonable attorney and/or collection fees and all related costs necessary to remit the entire balance to Outreach Technologies, Inc. (Outreach Laboratory).

SAMPLE RETURN/DISPOSAL: All non-hazardous samples shall be disposed of 30 days after issue of final report. All others will be returned at client's expense.



**311 North Aspen
Broken Arrow, OK 74012
Phone: (918) 251-2515
Fax: (918) 251-0008**

CHAIN OF CUSTODY

Results To: Company Kaiser - Almond Chem Tr.
Local: 918- Name ATTN: David B. Weyant
364- 6566 Address 7711 E. 41st St.
Cell: 774- City Tulsa State OK Zip 74145
744-0071 Phone 774-934-3530 Fax # 918-364-3171

Bill To:
Company KAISER / PEN CAR
Name PAUL PAPER / DAVID WYATT
Address 7311 E. 41st St
City TULSA State OK Zip 74145

ANALYSIS REQUESTED

PO # PROJECT # PROJECT NAME REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY) SAMPLER Signature						# CONTAINERS	CONTAINER SIZE	PRESERVATIVE #	REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)								
TAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX		PLASTIC OR GLASS											
	K-597	4-22-05	1350	SOT1	1	Plastic	None	GAMA SPEC (HL-232)	Return to Client	Fec Analysis	MDC Co's	pci/d	ASTM D 2116.92	moist Content			
	K-594		1405		1			X	X	X	X	X	X				
	K-595		1413		1			X	X	X	X	X	X				
	K-596		1420		1			X	X	X	X	X	X				
	K-597		1438		1			X	X	X	X	X	X				
	K-598		1445		1			X	X	X	X	X	X				
	K-599		1456		1			X	X	X	X	X	X				
	K-600		1506		1			X	X	X	X	X	X				
	K-601		1515		1			X	X	X	X	X	X				
	K-602		1528		1			X	X	X	X	X	X				
	K-603		1536		1			X	X	X	X	X	X				
	K-604		1552		1			X	X	X	X	X	X				
	K-605		1600		1			X	X	X	X	X	X				
	K-606		1614		1			X	X	X	X	X	X				

RELINQUISHED BY: David G. Weyant DATE 4/11/05 TIME 9:55 RECEIVED BY: Donna Edson DATE 4/11/05 TIME 9:55

RELINQUISHED BY: _____ DATE _____ TIME _____ RECEIVED BY: _____ DATE _____ TIME _____

My signature on this chain of custody form indicates that I am authorized by the above company to release samples for analysis. The company agrees to pay the entire balance upon receipt of sample data and it is understood and agreed that any balance carried over thirty (30) days is subject to a 1.5% per month (18% per annum) late charge. In the event of default, the company becomes legally liable for any reasonable attorney and/or collection fees and all related costs necessary to remit the entire balance to Outreach Technologies, Inc. (Outreach Laboratory).

SAMPLE RETURN/DISPOSAL: All non-hazardous samples shall be disposed of 30 days after issue of final report. All others will be returned at client's expense.



**311 North Aspen
Broken Arrow, OK 74012
Phone: (918) 251-2515
Fax: (918) 251-0008**

CHAIN OF CUSTODY

Results To: Company Kaiser Aluminum Chem Ind.
Local: 918 - Name ATTN: David R. Webster
364-0166 Address 7311 E. 41st St.
Cell: 724 - City Tulsa State OK Zip 74145
799-0071 Phone 724-9344 353 Fax # 918-364-3771

Bill To:
Company KAISER / BOND E & K
Name PAUL HARRIS / DAVID G. WEHART
Address 7311 E. 41ST ST.
City TULSA State OK Zip 74145

ANALYSIS REQUESTED

[illegible]

RELINQUISHED BY: David O. Wetzel DATE 4/25/05 TIME 955 RECEIVED BY: Pamela Edson DATE 4/25/05 TIME 955

RELINQUISHED BY: _____ DATE _____ TIME _____ RECEIVED BY: _____ DATE _____ TIME _____

My signature on this chain of custody form indicates that I am authorized by the above company to release samples for analysis. The company agrees to pay the entire balance upon receipt of sample data and it is understood and agreed that any balance carried over thirty (30) days is subject to a 1.5% per month (18% per annum) late charge. In the event of default, the company becomes legally liable for any reasonable attorney and/or collection fees and all related costs necessary to remit the entire balance to Outreach Technologies, Inc. (Outreach Laboratory).

SAMPLE RETURN/DISPOSAL: All non-hazardous samples shall be disposed of 30 days after issue of final report. All others will be returned at client's expense.

SAMPLE IN

Date Received: 4/25/05 10:31:41

Lab Number: 20050299

Due: 4/29/05

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20050299-01 A Percent Moisture (LOD) Th-232 by Gamma Spec	K-578	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-02 A Percent Moisture (LOD) Th-232 by Gamma Spec	K-579	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-03 A Percent Moisture (LOD) Th-232 by Gamma Spec	K-580	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-04 A Percent Moisture (LOD) Th-232 by Gamma Spec	K-581	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-05 A Percent Moisture (LOD) Th-232 by Gamma Spec	K-582	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-06 A Percent Moisture (LOD) Th-232 by Gamma Spec	K-583	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-07 A Percent Moisture (LOD) Th-232 by Gamma Spec	K-584	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-08 A Percent Moisture (LOD) Th-232 by Gamma Spec	K-585	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-09 A Percent Moisture (LOD) Th-232 by Gamma Spec	K-586	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-10 A	K-588	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes

Percent Moisture (LOD)
Th-232 by Gamma Spec

20050299-11 A K-589 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-12 A K-590 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-13 A K-591 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-14 A K-592 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-15 A K-593 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-16 A K-594 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-17 A K-595 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-18 A K-596 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-19 A K-597 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-20 A K-598 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes

Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	
20050299-22 A K-600 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-23 A K-601 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-24 A K-602 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-25 A K-603 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-26 A K-604 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-27 A K-605 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-28 A K-606 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-29 A K-608 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-30 A K-610 Percent Moisture (LOD) Th-232 by Gamma Spec	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050299-31 A K-611	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes

Th-232 Gamma Spec

20050299-32 A K-612
Percent Moisture (LOD)
Th-232 by Gamma Spec

Soil 04/22/05 Plastic 16 oz None Yes Yes

20050299-33 A K-613
Percent Moisture (LOD)
Th-232 by Gamma Spec

Soil 04/22/05 Plastic 16 oz None Yes Yes

CONTAINER INSPECTION

Coolers 1 Custody Seals Broken - Y/N 0 Temperature NA Blue Ice / Wet Ice Radiation Survey LB fixed removable

SAMPLE INSPECTION

Custody Seals Broken - Y/N 0 Chain of Custody Record 0 Labels in Tact 0 Y/N Radiation Survey Complete 0 Y/N

Anomalies: _____

Inspected By: Raymond Thomas DATE 04/25/05

QA or Designee Review: RL DATE 4/25/05

Sample Custodian Review: _____ DATE _____

Project Notes:



**Outreach
Laboratory**

11 North Aspen
Broken Arrow, OK 74012
(918) 251-2515
FAX (918) 251-0006

April 29, 2005

David Weyant
Kaiser Aluminum & Chemical
7311 E. 41st Street
Tulsa, OK 74145

Inv# 10933
4/29/05

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20050300

Dear Mr. Weyant:

Please find enclosed the analytical report for your sample received in our laboratory on April 25, 2005 for the above captioned project. Four soil samples were received in good condition and analyzed for Th-232 by Gamma Spectroscopy without drying and grinding and Percent Moisture with an expedited 5 work day turn. Results were faxed 4/29/05.

All Quality Control for the requested analyses is reported on the analytical report. The laboratory control standard and duplicates for all analyses were within method control limits.

Your samples will be returned as requested.

Thank you for choosing Outreach Laboratory and if you have any questions, please call us at 918-251-2515.

Laboratory Director

ODEQ ID #9517
DEQ LIC. #27522-01



CERT. ID #OK001



11 North Aspen
Broken Arrow, OK 74012
(918) 251-2515
FAX (918) 251-0008

Client: Kaiser Aluminum
Client Project: Thorium Remediation
Lab Number: 20050300
Date Reported: 4/29/05
Date Received: 4/25/05
Page Number: 1 of 2

Analytical Report

Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID: 20050300-01						
Client ID: K-587						
Date Sampled: 4/22/05 11:35:00 AM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	15.7 +/- 0.437	pCi/g	0.842	4/26/05	RE
Inorganics Analyses						
Percent Moisture	ASTM D2216-92	16.2	%	4/25/05	4/26/05	RT
Lab ID: 20050300-02						
Client ID: K-607						
Date Sampled: 4/22/05 4:21:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	2.86 +/- 0.146	pCi/g	0.474	4/26/05	RE
Inorganics Analyses						
Percent Moisture	ASTM D2216-92	21.2	%	4/25/05	4/26/05	RT
Lab ID: 20050300-03						
Client ID: K-609						
Date Sampled: 4/22/05 4:46:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	8.54 +/- 0.333	pCi/g	0.702	4/26/05	RE
Inorganics Analyses						
Percent Moisture	ASTM D2216-92	19.4	%	4/25/05	4/26/05	RT
Lab ID: 20050300-04						
Client ID: K-614						
Date Sampled: 4/22/05 5:17:00 PM						
Matrix: Soil						
Radiochemical Analyses						
Th-232	HASL 300	14.9 +/- 0.486	pCi/g	0.861	4/26/05	RE
Inorganics Analyses						
Percent Moisture	ASTM D2216-92	16.0	%	4/25/05	4/26/05	RT



511 North Aspen
Broken Arrow, OK 74012
(918) 251-2515
FAX (918) 251-0006

Client: Kaiser Aluminum
Client Project: Thorium Remediation
Lab Number: 20050300
Date Reported: 4/29/05
Date Received: 4/25/05
Page Number: 2 of 2

QC Report

Parameter	Blank	LCS	LCSD		DUP RPD	MS	MSD		Date
		%REC	%REC	RPD		%REC	%REC	RPD	
Ac-228					3.9				4/26/05
Am-241		92.0	93.0	0.9					4/26/05
Co-60		91.0	94.0	2.3					4/26/05
Cs-137		97.0	94.0	2.6					4/26/05
Percent Moisture					3.4				4/26/05

Lab Approval: _____



**311 North Aspen
Broken Arrow, OK 74012
Phone: (918) 251-2515
Fax: (918) 251-0008**

CHAIN OF CUSTODY

Results To: Company KARSTAR - Plom & Chemical
 LOCAL: Name ATTN: David B. WEFANT
 918-384- Address 7311 E. 41ST ST.
 0566
 City Tulsa State OK Zip 7145
 Cell: 724-
799-0071 Phone 724-934-3530 Fax # 918-3843171

Bill To: _____
 Company KAISER / PEN & EAR
 Name PAUL HANNA / DAVID R. WEYAN
 Address 7211 E. 41ST ST.
 City TULSA State OK Zip 74145

ANALYSIS REQUESTED[illegible]

RELINQUISHED BY: DAVID G. WEYAL DATE: 4/25/05 TIME: 9:55 RECEIVED BY: Bonnie Edson DATE: 4/25/05 TIME: 9:35

My signature on this chain of custody form indicates that I am authorized by the above company to release samples for analysis. The company agrees to pay the entire balance upon receipt of sample data and it is understood and agreed that any balance carried over thirty (30) days is subject to a 1.5% per month (18% per annum) late charge. In the event of default, the company becomes legally liable for any reasonable attorney and/or collection fees and all related costs necessary to remit the entire balance to Outreach Technologies, Inc. (Outreach Laboratory).

SAMPLE RETURN/DISPOSAL: All non-hazardous samples shall be disposed of 30 days after issue of final report. All others will be returned at client's expense.

FOR LEADERSHIP, THE ONLY
SINGLE SOURCE FOR THE
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SAMPLE GIN

Date Received: 4/25/05 10:45:37

Lab Number: 20050300

Due: 4/29/05

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20050300-01 A Percent Moisture (LOD) Th-232 by Gamma Spec	K-587	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050300-02 A Percent Moisture (LOD) Th-232 by Gamma Spec	K-607	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050300-03 A Percent Moisture (LOD) Th-232 by Gamma Spec	K-609	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050300-04 A Percent Moisture (LOD) Th-232 by Gamma Spec	K-614	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes

CONTAINER INSPECTION

Coolers 1 Custody Seals Broken - Y/N (N) Temperature N/A Blue Ice / Wet Ice Radiation Survey fixed removable

SAMPLE INSPECTION

Custody Seals Broken - Y/N Chain of Custody Record Y/N Labels in Tact Y/N Radiation Survey Complete Y/N

Anomalles: _____

Inspected By: Kenneth Thomas DATE 09/25/05

QA or Designee Review: AKC DATE 9/25/05

Sample Custodian Review: _____ **DATE** _____

Project Notes:



**Outreach
Laboratory**

11 North Aspen
Broken Arrow, OK 74012
(918) 251-2515
FAX (918) 251-0008

May 11, 2005

David Weyant
Kaiser Aluminum & Chemical
7311 E. 41st Street
Tulsa, OK 74145

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20050330

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples K-602 and K-608. At your request on 5/3/05, these samples, which were originally part of project 20050299, were reanalyzed. They were each opened, dumped out, mixed up and the concrete and dirt clumps were busted up and blended for one hour on the TCLP tumbler before reanalyzing for Th-232 by Gamma Spectroscopy. Each sample was counted on two different gamma detectors for reproducibility and the average of both results was reported. Results were faxed the same day.

All Quality Control for the requested analyses is reported on the analytical report. The laboratory control standard and duplicates for all analyses were within method control limits.

Your samples will be returned as requested.

Thank you for choosing Outreach Laboratory and if you have any questions, please call us at 918-251-2515.

Laboratory Director

ODEQ ID #9517
DEQ LIC. #27522-01



CERT. ID #OK001



Outreach Laboratory

11 North Aspen
Broken Arrow, OK 74012
(918) 251-2515
FAX (918) 251-0008

Client:

Kaiser Aluminum

Client Project:

Lab Number:

20050330

Date Reported:

5/3/05

Date Received:

5/3/05

Page Number:

1 of 1

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20050330-01						
Client ID:	K-602						
Date Sampled:	4/22/05 3:28:00 PM						
Matrix:	Soil						
Radiochemical Analyses							
Th-232	HASL 300	31.4 +/- 0.96	pCi/g	1.18	5/3/05	5/3/05	RE
Lab ID:	20050330-02						
Client ID:	K-608						
Date Sampled:	4/22/05 4:28:00 PM						
Matrix:	Soil						
Radiochemical Analyses							
Th-232	HASL 300	29.3 +/- 0.77	pCi/g	1.25	5/3/05	5/3/05	RE

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	RPD	DUP RPD	MS %REC	MSD %REC	RPD	Date
Am-241		104.0	96.0	8.8					5/3/05
Co-60		97.0	99.0	1.6					5/3/05
Cs-137		100.0	101.0	0.7					5/3/05
Th-232					3.5				5/3/05

Lab Approval:



OUTREACH LABORATORY

311 North Aspen
Broken Arrow, OK 74012
Phone: (918) 251-2515
Fax: (918) 251-0008

CHAIN CUSTODY

Results To: Company Kaiser-Alum & Chem Inc.
Local: 918-364-6566 Name ATTN: David G. Weyant
Cell: 724-799-0011 Address 7311 E. 41st St.
City Tulsa State OK Zip 74145
Phone 918-934-3330 Fax # 918-364-3171

Bill To:
Company Kaiser/Peapack
Name Paul Darda / David Weyant
Address 7311 E. 41st St.
City Tulsa State OK Zip 74145

ANALYSIS REQUESTED

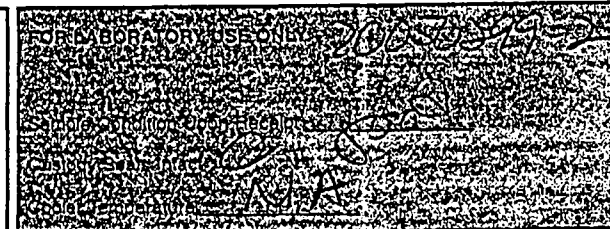
PO #	PROJECT #	PROJECT NAME	REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY)	SAMPLER	LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER SIZE	PRESERVATIVE	ANALYSIS REQUESTED	REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
		Kaiser-Alum & Chem Inc.	5 DAY	David G. Weyant							PLASTIC	1. HNO ₃ pH<2 2. Ice <4°C 3. HCl pH<2 4. H ₂ SO ₄ pH<2 5. NaOH pH>11	GARMA SPEC (H-232) Return to Client For Analysis MOC Co. 5 pci/gc ASTM D 2216, 91 moist content	
					K-593		4-22-05	1350	SOTL	1	500ml	NONE	X	Comp
					K-594			1405		1			X	
					K-595			1413		1			X	
					K-596			1420		1			X	
					K-597			1438		1			X	
					K-598			1445		1			X	
					K-599			1456		1			X	
					K-600			1506		1			X	
					K-601			1515		1			X	
					K-602			1528		1			X	
					K-603			1536		1			X	
					K-604			1532		1			X	
					K-605			1600		1			X	
					K-606			1614		1			X	

RELINQUISHED BY: David G. Weyant DATE 4/25/05 TIME 955 RECEIVED BY: Donna Edison DATE 4/25/05 TIME 955

RELINQUISHED BY: _____ DATE _____ TIME _____ RECEIVED BY: _____ DATE _____ TIME _____

My signature on this chain of custody form indicates that I am authorized by the above company to release samples for analysis. The company agrees to pay the entire balance upon receipt of sample data and it is understood and agreed that any balance carried over thirty (30) days is subject to a 1.5% per month (18% per annum) late charge. In the event of default, the company becomes legally liable for any reasonable attorney and/or collection fees and all related costs necessary to remit the entire balance to Outreach Technologies, Inc. (Outreach Laboratory).

SAMPLE RETURN/DISPOSAL: All non-hazardous samples shall be disposed of 30 days after issue of final report. All others will be returned at client's expense.





CHAIN CUSTODY

Results To: Company MAISSA ALZM & Chem Inc.
 Local: 918 - Name ATTN: DAVID R. WEYANT
 384-0566 Address 7311 E. 41ST ST.
 Cell: 724 - City TULSA State OK Zip 74145
 799-0071 Phone 724-934 3330 Fax # 718-384 3171

Bill To:
Company Kaiser / Penn E & K
Name Paul Harris / David B. Weyant
Address 711 E. 41st St.
City Tulsa State OK Zip 74145

ANALYSIS REQUESTED

[illegible]

RELINQUISHED BY: DAVID O. WEISS DATE 1/25/10 TIME 9:55 RECEIVED BY: Pamela Edson DATE 1/25/10 TIME 9:55

My signature on this chain of custody form indicates that I am authorized by the above company to release samples for analysis. The company agrees to pay the entire balance upon receipt of sample data and it is understood and agreed that any balance carried over thirty (30) days is subject to a 1.5% per month (18% per annum) late charge. In the event of default, the company becomes legally liable for any reasonable attorney and/or collection fees and all related costs necessary to remit the entire balance to Outreach Technologies, Inc. (Outreach Laboratory).

SAMPLE RETURN/DISPOSAL: All non-hazardous samples shall be disposed of 30 days after issue of final report. All others will be returned at client's expense.

FOR LABORATORY USE ONLY

SALESMAN'S IDENTIFICATION NUMBER

SALESMAN'S SIGNATURE

DATE OF PURCHASE

SAMPLE IN

Date Received: 5/3/05 4:12:47 P

Lab Number: 20050330

Due: 5/3/05

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20050330-01 A Th-232 by Gamma Spec	K-602	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes
20050330-02 A Th-232 by Gamma Spec	K-608	Soil	04/22/05	Plastic	16 oz	None	Yes	Yes

CONTAINER INSPECTION

Coolers _____ Custody Seals Broken - Y/N _____ Temperature _____ Blue Ice / Wet Ice _____ Radiation Survey _____ fixed _____ removable

SAMPLE INSPECTION

Custody Seals Broken - Y/N _____ Chain of Custody Record Y/N _____ Labels in Tact Y/N _____ Radiation Survey Complete Y/N _____

Anomalies: _____

Samples in house

Inspected By: _____ DATE 5/3/05
 QA or Designee Review: _____ DATE 5/3/05
 Sample Custodian Review: _____ DATE _____

Project Notes:

SUB-REPORT

SURVEY UNIT KAISER-FSSB-004

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2.0 SURVEY ACTIVITIES AND RESULTS	2
2.1 Gross Gamma Scan	2
2.2 Systematic Soil Core Sampling	3
2.3 Wilcoxon Rank Sum (WRS) Testing	7
3.0 SUMMARY OF FINDINGS	9

ATTACHMENTS

ATTACHMENT A:	Figure A-1 Gross Gamma Background and Scanning Survey Results – Lift 1 Figure A-2 Gross Gamma Background and Scanning Survey Results – Lift 2 Figure A-3 Gross Gamma Background and Scanning Survey Results – Lift 3 Figure A-4 Gross Gamma Background and Scanning Survey Results – Lift 4 Figure A-5 Gross Gamma Background and Scanning Survey Results – Lift 5 Figure A-6 Gross Gamma Background and Scanning Survey Results – Lift 6 Figure A-7 Gross Gamma Background and Scanning Survey Results – Lift 7 Figure A-8 Gross Gamma Background and Scanning Survey Results – Lift 8 Figure A-9 Systematic Soil Core Sampling Locations
ATTACHMENT B:	Soil Survey Unit Worksheet No. 1 Soil Survey Unit Worksheet No. 2
ATTACHMENT C:	Laboratory Analytical Results

**Final Status Survey Report
Volume III – Pond Parcel Excavation Backfill Units
Sub-Report No. BCM-004
Survey Unit Kaiser-FSSB-004
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation
March 22, 2006**

1.0 BACKGROUND

This sub-report documents the results of pond parcel excavation backfill unit final status survey activities completed as part of the Thorium Remediation Project at the Tulsa, Oklahoma facility (Figure 1). Specifically, this technical report addresses the final status survey of Survey Unit Kaiser-FSSB-004, which consists of a unit of Below Criteria Material or BCM (less than 31.1 net pCi/g Th-232 material) placed in an excavation resulting from the removal of radiologically-affected soil from the former Reserve Pond area. Survey Unit Kaiser-FSSB-004 is considered a Class 1 survey unit with an approximate base surface area of 1,647 m². It is located on the east side of the pond parcel within the excavation bottom associated with Survey Unit Kaiser-FSS-015 (Figure 3). The survey unit is bordered by a wall of non-impacted soil (clean import borrow material) to the north (along Fulton Creek) and east (along the Redman Property), excavation backfill Survey Unit Kaiser-FSSB-003 to the south, and excavation backfill Survey Unit Kaiser-FSSB-006 to the west.

A total of eight 2-foot layers (lifts) of BCM was placed in Survey Unit Kaiser-FSSB-004.

Separate distinct final status surveys were completed for the pond parcel excavation bottom survey units prior to backfilling with BCM. The final status survey of the pond parcel excavation bottom survey units is documented in Volume I of the Final Status Survey Report.

2.0 SURVEY ACTIVITIES AND RESULTS

This section of the sub-report presents the final status survey data for the BCM placed within Survey Unit Kaiser-FSSB-004. The final status survey consisted of a gross gamma scan of each placed 2-foot lift of BCM and systematic soil core sampling upon completion of the BCM unit.

2.1 Gross Gamma Scan

Each 2-foot lift of BCM was surveyed through a 100 percent coverage gamma scan to confirm acceptable radiological conditions and identify any elevated areas. During the scanning of each lift, the detector was held close to the BCM surface (1 to 2 inches) and moved in a serpentine pattern. Approximate equal-distant background measurements were also obtained at 1-meter above the ground surface for each lift of BCM placed. A statistical summary of the background survey and 100 percent coverage gamma scan of each BCM lift placed in the survey unit is provided below in Table 1.

Table 1 -- Gross Gamma Scan Results Summary

Name	Date	Lift Area (m ²)	No. of 1-sec. Scans	Scan Rate (m/s)	Ave. (cpm)	Std. Dev. (cpm)	Min. (cpm)	Max. (cpm)	Median (cpm)
1 st lift Scan	5/07/05	1,647	3,062	0.54	72,745	6,149	44,793	84,602	74,615
1 st lift Bkgrd.	5/07/05	1,647	15	N/A	71,160	4,288	60,342	74,826	73,030
2 nd lift Scan	5/10/05	1,647	5,966	0.28	75,671	4,354	43,703	89,618	76,610
2 nd lift Bkgrd.	5/11/05	1,647	15	N/A	75,094	2,628	69,920	78,748	75,311
3 rd lift Scan	5/12/05	1,647	6,712	0.25	87,754	4,975	60,410	105,488	87,984
3 rd lift Bkgrd.	5/13/05	1,647	15	N/A	81,452	2,041	76,879	84,946	81,725
4 th lift Scan	5/14/05	1,420	5,172	0.27	79,227	4,207	64,582	110,563	78,885
4 th lift Bkgrd.	5/14/05	1,420	15	N/A	73,394	2,446	68,488	77,580	72,882
5 th lift Scan	5/17/05	1,210	5,226	0.23	84,494	8,689	44,583	121,508	85,879
5 th lift Bkgrd.	5/17/05	1,210	15	N/A	76,086	6,298	65,248	82,948	75,998
6 th lift Scan	5/18/05	990	2,027	0.49	83,691	3,894	79,946	100,914	82,433
6 th lift Bkgrd.	5/18/05	990	15	N/A	71,874	3,380	64,173	76,853	72,645
7 th lift Scan	5/20/05	810	2,390	0.34	81,831	8,248	53,498	109,921	80,369
7 th lift Bkgrd.	5/20/05	810	9	N/A	70,306	4,954	61,975	78,980	69,996

Name	Date	Lift Area (m ²)	No. of 1-sec. Scans	Scan Rate (m/s)	Ave. (cpm)	Std. Dev. (cpm)	Min. (cpm)	Max. (cpm)	Median (cpm)
8 th lift Scan	5/21/05	790	2,056	0.38	82,530	6,308	54,521	107,741	82,480
8 th lift Bkgd.	5/21/05	790	8	N/A	75,290	5,602	65,410	83,356	76,817

Contour maps of the gross gamma background and final (as-left condition) scanning survey results are presented by BCM lift on Figures A-1 through A-8 contained in Attachment A. The 100 percent coverage gross gamma scan of the 2-foot lifts did not indicate the presence of small areas (1 m²) of elevated activity (above the DCCL for the site).

2.2 Systematic Soil Core Sampling

The final status survey also consisted of systematic soil core sampling based on a random start point and an equal-distant triangular grid. The Minimum Number of Core Samples (core holes) Required (N) based on the scan MDC was determined to be 9, as documented on Soil Survey Unit Worksheet No. 1 (Attachment B). Once N was determined, the Survey Unit Area (A) of 1,647 m² along with the N of 9 were used to calculate the Triangular Grid Node Length (L) of 14.5 meters and the Height of the Equilateral Triangle (h) of 12.6 meters. A random start point was generated using the random number feature of Excel and documented on Soil Survey Unit Worksheet No. 2 (Attachment B).

A layout of the soil sampling locations is provided on Figure A-9 contained in Attachment A. The soil core sample locations were demarcated in the field using a GPS unit. A total of 9 core holes (sample locations) were installed on the grid prescribed over the survey unit (Cores Nos. 1 through 9). Core segments of BCM (typically 3 feet in length) were scanned in the field in 1-foot increments. The 1-foot increments were also characterized by a 1 minute static count of gross gamma activity. The results are presented below in Table 2.

Table 2 - Soil Core Segment Gross Gamma Survey Results

Core Number	Core Segment	Segment Length (inches)	Core Depth Below Surface (ft)	Gross Scan Rate (kepm)	Gross Static Count (cpm)	Net Static Count (cpm) ¹
1	A	36	1	31	31,128	6,459
1	A		2	34	35,335	10,666
1	A		3	34	35,635	10,966
1	B	48	4	28	30,469	5,800
1	B		5	30	31,056	6,387
1	B		6	29	30,703	6,034
1	B		7	30	32,127	7,458
1	C	48	8	30	30,042	5,373
1	C		9	30	31,085	6,416
1	C		10	32	30,286	5,617
1	C		11	34	34,176	9,507
2	A	36	1	31	30,742	6,073
2	A		2	33	33,449	8,780

Core Number	Core Segment	Segment Length (inches)	Core Depth Below Surface (ft)	Gross Scan Rate (kepm)	Gross Static Count (cpm)	Net Static Count (cpm) ¹
2	A		3	34	35,540	10,871
2	B	36	4	30	30,566	5,897
2	B		5	31	31,729	7,060
2	B		6	32	28,550	3,881
2	C	48	7	30	31,154	6,485
2	C		8	30	30,993	6,324
2	C		9	29	31,842	7,173
2	C		10	30	30,855	6,186
3	A	36	1	30	30,477	5,808
3	A		2	31	31,935	7,266
3	A		3	30	33,862	9,193
3	B	36	4	28	30,798	6,129
3	B		5	29	31,890	7,221
3	B		6	30	31,192	6,523
3	C	36	7	31	32,521	7,852
3	C		8	30	32,248	7,579
3	C		9	31	32,239	7,570
3	D	36	10	31	30,519	5,850
3	D		11	32	32,342	7,673
3	D		12	31	32,636	7,967
3	E	36	13	30	30,285	5,616
3	E		14	34	33,363	8,694
3	E		15	32	32,769	8,100
4	A	36	1	28	31,756	7,087
4	A		2	30	31,274	6,605
4	A		3	31	31,139	6,470
4	B	36	4	29	30,187	5,518
4	B		5	29	32,539	7,870
4	B		6	30	32,791	8,122
4	C	48	7	30	30,829	6,160
4	C		8	29	33,750	9,081
4	C		9	31	32,175	7,506
4	C		10	32	34,021	9,352
4	D	48	11	32	31,793	7,124
4	D		12	33	33,401	8,732
4	D		13	36	34,089	9,420
4	D		14	33	35,468	10,799
4	E	48	15	28	31,501	6,832
4	E		16	32	30,002	5,333
4	E		17	32	32,650	7,981
4	E		18	33	33,551	8,882
5	A	36	1	29	27,110	2,441
5	A		2	30	32,190	7,521
5	A		3	30	31,950	7,281
5	B	48	4	31	31,489	6,820
5	B		5	32	32,923	8,254

Core Number	Core Segment	Segment Length (inches)	Core Depth Below Surface (ft)	Gross Scan Rate (kepm)	Gross Static Count (cpm)	Net Static Count (cpm) ¹
5	B		6	31	32,392	7,723
5	B		7	33	33,811	9,142
6	A	36	1	31	31,168	6,499
6	A		2	31	31,287	6,618
6	A		3	31	31,891	7,222
6	B	48	4	29	31,500	6,831
6	B		5	29	32,025	7,356
6	B		6	29	31,983	7,314
6	B		7	30	32,410	7,741
6	C	48	8	32	31,190	6,521
6	C		9	33	32,264	7,595
6	C		10	32	34,475	9,806
6	C		11	34	34,627	9,958
6	D	48	12	31	31,506	6,837
6	D		13	32	31,746	7,077
6	D		14	32	34,265	9,596
6	D		15	32	33,359	8,690
7	A	36	1	32	32,311	7,642
7	A		2	31	33,688	9,019
7	A		3	33	34,970	10,301
7	B	36	4	29	31,040	6,371
7	B		5	30	32,000	7,331
7	B		6	34	34,520	9,851
7	C	36	7	32	31,899	7,230
7	C		8	32	31,965	7,296
7	C		9	32	34,013	9,344
7	D	36	10	31	31,346	6,677
7	D		11	32	33,399	8,730
7	D		12	31	34,090	9,421
7	E	36	13	31	29,621	4,952
7	E		14	32	33,368	8,699
7	E		15	31	31,887	7,218
8	A	48	1	29	30,796	6,127
8	A		2	32	33,084	8,415
8	A		3	33	35,185	10,516
8	A		4	33	35,292	10,623
8	B	60	5	31	31,807	7,138
8	B		6	30	33,458	8,789
8	B		7	32	33,973	9,304
8	B		8	33	32,162	7,493
8	B		9	32	34,296	9,627
8	C	60	10	32	31,386	6,717
8	C		11	32	32,632	7,963
8	C		12	33	33,116	8,447
8	C		13	32	35,537	10,868
8	C		14	33	34,261	9,592

Core Number	Core Segment	Segment Length (inches)	Core Depth Below Surface (ft)	Gross Scan Rate (kcpm)	Gross Static Count (cpm)	Net Static Count (cpm) ¹
9	A	36	1	31	30,777	6,108
9	A		2	31	31,179	6,510
9	A		3	33	33,868	9,199
9	B	36	4	29	31,097	6,428
9	B		5	30	31,106	6,437
9	B		6	32	31,466	6,797
9	C	48	7	27	28,440	3,771
9	C		8	28	29,600	4,931
9	C		9	29	29,252	4,583
9	C		10	29	28,682	4,013
			Count:	115	115	115
			Average:	31	32,170	7,502
			Std. Dev.:	1.6	1,665	1,665
			Minimum:	27	27,110	2,441
			Maximum:	36	35,635	10,996
			Median:	31	31,965	7,296

¹Net Static Count values (cpm) are equal to the Gross Static Count minus a background value of 24,669 cpm based on the average of 5 consecutive 1-minute counts performed with the detector on top of the table used to scan the cores, prior to scan activities.

A composite sample representing each core segment was then prepared by combining each set of three 1-foot increments in a bucket and breaking up the cores. The final segment of core may be less than or greater than 3 feet depending on the point at which virgin material was encountered. A sample (usually between 500 and 800 grams) was taken from each composite and forwarded to Outreach for analysis of Th-232 activity concentration. Analytical results are provided below in Table 3. Analytical data reports are contained in Attachment C.

Table 3 -- Systematic Soil Core Composite Sample Results

Core Number	Core Segment	Segment Length (in.)	Composite Sample No.	Core Depth (ft)	Th-232 (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)
1	A	36	K-690	1	24.2	0.618	0.757
1	B	48	K-691	4	20.9	0.508	0.842
1	C	48	K-692	8	19.2	0.414	0.566
2	A	36	K-687	1	22.0	0.501	0.677
2	B	36	K-688	4	18.8	0.404	0.504
2	C	48	K-689	7	20.7	0.509	0.878
3	A	36	K-703	1	23.9	0.499	0.575
3	B	36	K-704	4	21.8	0.505	0.739
3	C	36	K-705	7	24.2	0.551	0.538
3	D	36	K-706	10	21.9	0.468	0.526
3	E	36	K-707	13	22.4	0.499	0.525
4	A	36	K-678	1	22.1	0.522	0.573
4	B	36	K-679	4	18.6	0.418	0.513
4	C	48	K-680	7	20.0	0.451	0.801
4	D	48	K-681	11	21.3	0.469	0.524

Core Number	Core Segment	Segment Length (in.)	Composite Sample No.	Core Depth (ft)	Th-232 (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)
4	E	48	K-682	15	22.6	0.612	1.17
5	A	36	K-701	1	18.3	0.514	1.20
5	B	48	K-702	4	24.4	0.566	0.844
6	A	36	K-683	1	18.6	0.434	0.567
6	B	48	K-684	4	20.2	0.431	0.528
6	C	48	K-685	8	22.2	0.484	0.532
6	D	48	K-686	12	21.1	0.576	0.733
7	A	36	K-696	1	25.0	0.536	0.557
7	B	36	K-697	4	23.3	0.620	1.04
7	C	36	K-698	7	26.3	0.578	0.665
7	D	36	K-699	10	23.7	0.494	0.572
7	E	36	K-700	13	20.9	0.470	0.458
8	A	48	K-675	1	22.5	0.482	0.550
8	B	60	K-676	5	22.6	0.534	0.990
8	C	60	K-677	10	22.8	0.607	0.972
9	A	36	K-693	1	23.1	0.576	0.852
9	B	36	K-694	4	27.5	0.679	0.766
9	C	48	K-695	7	16.9	0.432	0.672
				Count:	33		
				Average:	21.9		
				Std. Dev.:	2.36		
				Minimum:	16.9		
				Maximum:	27.5		
				Median:	22.1		

The gross and net Th-232 activity concentrations for all 33 systematic composite samples were below the BCM surrogate value of 31.1 pCi/g net Th-232 activity concentration (DCCL). The maximum gross Th-232 activity concentration was 27.5 pCi/g. The average gross Th-232 activity concentration was 21.9 pCi/g. The standard deviation of the 33 composite samples was 2.36, which fell below the estimated standard deviation of 4.4 used to calculate the minimum number of samples required in the decommissioning plan.

2.3 Wilcoxon Rank Sum (WRS) Testing

The analytical results for the systematic soil core composite samples were evaluated using the procedure contained in **Appendix C, Volume I** of this Final Status Survey Report (Wilcoxon Rank Sum Test). The evaluation showed that the survey unit core sample results meet the DP statistical criterion based on the first statistical test as described below.

If the difference (27.12 pCi/g) between the maximum survey unit soil sample activity concentration (27.5 pCi/g) and the minimum reference background area soil sample activity concentration (0.38 pCi/g) is less than DCCL (31.1 pCi/g), then the survey unit meets the release criterion. **Table 4** presents a summary of the data used to complete the statistical evaluation of the survey unit.

Table 4 – Reference Group and Survey Unit Sample Results

Reference Group	Sample ID	Th-232 (pCi/g)	Survey Unit Group	Sample ID	Th-232 (pCi/g)
R1	271	1.49	S1	K-675	22.5
R2	162	1.00	S2	K-676	22.6
R3	33	0.92	S3	K-677	22.8
R4	128	1.07	S4	K-678	22.1
R5	237	0.70	S5	K-679	18.6
R6	83	1.22	S6	K-680	20.0
R7	37	0.86	S7	K-681	21.3
R8	331	0.55	S8	K-682	22.6
R9	121	1.47	S9	K-683	18.6
R10	340	1.10	S10	K-684	20.2
R11	72	1.21	S11	K-685	22.2
R12	272	1.43	S12	K-686	21.1
R13	61	0.92	S13	K-687	22.0
R14	119	1.32	S14	K-688	18.8
R15	355	0.96	S15	K-689	20.7
R16	253	1.27	S16	K-690	24.2
R17	311	1.42	S17	K-691	20.9
R18	128	1.07	S18	K-692	19.2
R19	362	1.18	S19	K-693	23.1
R20	240	1.08	S20	K-694	27.5
R21	222	1.19	S21	K-695	16.9
R22	308	0.38	S22	K-696	25.0
R23	298	1.38	S23	K-697	23.3
R24	145	0.86	S24	K-698	26.3
R25	148	1.37	S25	K-699	23.7
R26	181	1.35	S26	K-700	20.9
R27	359	0.74	S27	K-701	18.3
R28	189	1.03	S28	K-702	24.4
R29	170	1.20	S29	K-703	23.9
R30	162	1.00	S30	K-704	21.8
R31	336	1.36	S31	K-705	24.2
R32	227	2.25	S32	K-706	21.9
R33	323	0.87	S33	K-707	22.4
	Average:	1.13		Average:	21.9
	Std. Dev.:	0.34		Std. Dev.:	2.36
	Minimum:	0.38		Minimum:	16.9
	Maximum:	2.25		Maximum:	27.5
	Median:	1.10		Median:	22.1

3.0 SUMMARY OF FINDINGS

Survey Unit Kaiser-FSSB-004 which consists of a unit of BCM placed in an excavation resulting from the removal of radiologically-affected soil from the former Reserve Pond area, is considered a Class 1 survey unit with an approximate base surface area of 1,647 m². It is located on the east side of the pond parcel within the excavation bottom associated with Survey Unit Kaiser-FSS-015 (Figure 3). The survey unit is bordered by a wall of non-impacted soil (clean import borrow material) to the north (along Fulton Creek) and east (along the Redman Property), excavation backfill Survey Unit Kaiser-FSSB-003 to the south, and excavation backfill Survey Unit Kaiser-FSSB-006 to the west.

A total of eight 2-foot layers (lifts) of BCM was placed in Survey Unit Kaiser-FSSB-004.

The acceptance criterion for BCM survey units at the Tulsa facility is the DCCL of 31.1 pCi/g net Th-232 activity concentration. The final status survey consisted of a gross gamma scan of each placed 2-foot lift of BCM and systematic soil core sampling upon completion of the BCM unit. The results of the final status survey activities were as follows:

- The 100 percent coverage gamma scan of each lift (final as-left condition) did not indicate the presence of small areas (1 m²) of elevated activity (greater than the DCCL for the site).
- All 33 systematic composite sample results (gross and net) were below the BCM surrogate value of 31.1 pCi/g net Th-232 activity concentration (DCCL).
- The analytical results meet the DP statistical criterion based on the first statistical evaluation of the data (WRS Test procedure).

The results of the final status survey activities show that Survey Unit Kaiser-FSSB-004 meets the DP acceptance criteria.