Final Status Survey Report
Volume VI – Post Operational Area Survey Units and Final Site Documentation

Survey Units Kaiser – FSSPOA – 001
Through Kaiser – FSSPOA – 012

Prepared For:

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

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Executive Summary
Final Status Survey Report
Volumes I through VI
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation
September 14, 2006

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 was 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). Kaiser has completed the remedial excavation, backfilling, and final status survey activities for the Thorium Remediation Project.

The DP addressed the remediation of the impacted portions of the 14-acre "Pond Parcel" at the Tulsa, Oklahoma facility and the DPA addressed the approximate 3.5-acre "Former Operational Area" (FOA). The remediation alternative chosen and implemented for the Pond Parcel required 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 was 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) was 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 was placed over the BCM and graded in a manner to direct drainage away from the site. The site was then permanently revegetated

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 Grandview, 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 were final graded and vegetated to minimize soil erosion and promote positive site drainage.

Final status surveys for the Thorium Remediation Project consisted 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 and post operational areas; (2) surveys of BCM placed in the Pond Parcel excavations; and (3) surveys of structural surfaces. Final status surveys were 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 were applicable to the entire site. Thus, if each survey unit met the acceptance criteria, the dose for the entire site would 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 were conducted through a progression of Class 1 survey units. Survey units generally consisted 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 consisted of a gross gamma scan of the exposed surface soil of the unit and systematic soil sampling. Additional scanning and soil sampling were included for each elevated measurement comparison (EMC) performed for elevated areas left in-place. Embedded structures (typically small pipes and concrete) were surveyed for total alpha contamination (when possible) and removable alpha contamination.

Compliance with survey unit acceptance criteria has been 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 also has been calculated. The sum of fractions provides 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). Systematic final status survey data also have been evaluated using the Wilcoxan Rank Sum Test procedure.

Final status surveying and reporting have been completed for all 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. **Volume IV** of this **Final Status Survey Report** documents the final status survey results for Survey Units Kaiser-FSS-025 through Kaiser-FSS-030. One of the 30 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**.

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

Survey Unit	Surface Area (m²)	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	0.47	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
Kaiser-FSS-025	1,930	9	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-026	1,300	10	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-027	1,680	9	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-028	1,835	9	NO	YES	NO	NO	0.00	YES
Kaiser-FSS-029	1,481	10	NO	YES	NO	YES	0.25	YES
Kaiser-FSS-030	1,876	9	NO	YES	NO	YES	0.26	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) were conducted through a progression of Class 1 survey units. A unit of BCM was 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 were 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 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. Compliance with survey unit acceptance criteria has been demonstrated by comparison of the average residual contamination for the survey unit to the appropriate acceptance criteria value. Systematic soil core sampling data also have been evaluated using the Wilcoxan Rank Sum Test procedure.

Final status surveying and reporting have been completed for all 15 Pond Parcel excavation backfill survey units (Survey Units Kaiser-FSSB-001 through Kaiser-FSSB-015). **Volume III** of this **Final Status Survey Report** documents the final status survey results for Survey Units Kaiser-FSSB-001 through Kaiser-FSSB-009. **Volume V** of this **Final Status Survey Report** documents the final status survey results for Survey Units

Kaiser-FSSB-010 through Kaiser-FSSB-015. A summary of the final status survey results by survey unit is provided below in **Table 3**.

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
Kaiser-FSSB-010	1,770	9	28	NO	YES	NO	YES
Kaiser-FSSB-011	1,754	11	22	NO	YES	NO	YES
Kaiser-FSSB-012	1,840	9	38	NO	YES	NO	YES
Kaiser-FSSB-013	1,620	9	28	NO	YES	NO	YES
Kaiser-FSSB-014	1,660	10	41	NO	YES	NO	YES
Kaiser-FSSB-015	1,820	9	40	NO	YES	NO	YES

Post Operational Area Final Status Surveys

Post Operational Areas (POA) consisted of site areas where potential radiological materials may have been handled or stored during the Thorium Remediation Project (such as the water storage tank area, the material segregation/storage areas, the railcar loading area, and the equipment decontamination area). Final status surveys associated with the POA units were conducted through a progression of Class 1 and Class 3 survey units. Survey units generally consisted of the exposed surface soil and embedded structures (if encountered and left in-place). The final status survey of post operational area survey units typically consisted of a gross gamma scan of the exposed surface soil of the unit and systematic/random soil sampling. Embedded structures (if encountered and left in-place) were surveyed for total alpha contamination and removable alpha contamination.

Final status surveying and reporting have been completed for all 12 POA survey units (Survey Units Kaiser-FSSPOA-001 through Kaiser-FSSPOA-012). **Volume VI** of this **Final Status Survey Report** documents the final status survey results for Survey Units Kaiser-FSSPOA-001 through Kaiser-FSSPOA-012. A summary of the final status survey results by survey unit is provided below in **Table 4**.

Table 4 – Post Operational Area Final Status Survey Summary by Survey Unit

Survey Unit	Survey Class	Surface Area (m^2)	No. of Systematic/Random Samples Collected	Systematic/Random Sample Exceedance of DCGL Value	WRS Test Criterion Met	Embedded Structure(s) Present	Survey Unit Meets DP Acceptance Criteria
Kaiser-FSSPOA-001	1	2,000	9	NO	YES	NO	YES
Kaiser-FSSPOA-002	1	1,776	10	NO	YES	NO	YES
Kaiser-FSSPOA-003	1	1,604	9	NO	YES	NO	YES
Kaiser-FSSPOA-004	1	1,841	9	NO	YES	NO	YES
Kaiser-FSSPOA-005	1	1,660	10	NO	YES	NO	YES
Kaiser-FSSPOA-006	1	111	9	NO	YES	NO	YES
Kaiser-FSSPOA-007	3	5,220	9	NO	YES	NO	YES
Kaiser-FSSPOA-008	3	4,375	9	NO	YES	NO	YES
Kaiser-FSSPOA-009*	1	740**	14 per sub-unit	NO	YES	N/A	YES
Kaiser-FSSPOA-010	3	309	13	NO	YES	YES	YES
Kaiser-FSSPOA-011	1	23	12	NO	YES	YES	YES
Kaiser-FSSPOA-012	1	1,577	11	NO	YES	NO	YES

* Survey Unit Kaiser- FSSPOA-009 is the 740 m^2 asphalt loading pad structure. The asphalt pad's structural surface was divided into eight sub-units of areas less than or equal to 100 m^2. The other POA survey units are defined as open land areas.

** Divided into 8 sub-units

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.

Final Status Survey Report
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation
September 14, 2006

1.0 ROAD MAP – VOLUMES I THROUGH VI

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)**. Kaiser has completed the remedial excavation, backfilling, and final status survey activities for the Thorium Remediation Project.

The remediation of radiologically impacted portions of the Tulsa, Oklahoma facility was 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 specified 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 reduced 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) included 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 the completed site remediation and associated final status survey activities.

1.1 Decommissioning Plan and Decommissioning Plan Addendum

The DP addressed the remediation of the impacted portions of the 14-acre "Pond Parcel" at the Tulsa, Oklahoma facility and the DPA addressed the approximate 3.5-acre "Former Operational Area". The Pond Parcel had 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, formerly located to the northeast of the triangular parcel, was listed as 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 had 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 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 contained the Retention Pond and former Reserve Pond area. The non-impacted portion of the Pond Parcel contained 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 was 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 was 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 and implemented for the Pond Parcel required 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 was 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) was 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 was then placed over the BCM and graded in a manner to direct drainage away from the site. The site was then permanently revegetated.

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 was 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 Volume II Final Status Survey Report (March 2006), 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 were 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 consisted 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 and post operational areas; (2) surveys of BCM placed in the Pond Parcel excavations; and (3) surveys of structural surfaces. Final status surveys were 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 were applicable to the entire site. Thus, if each survey unit met the acceptance criteria, the dose for the entire site would 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 for the Thorium Remediation Project. The layout of this report is as follows:

- Volume I – Pond Parcel Excavation Bottom Survey Units Kaiser-FSS-001 through Kaiser-FSS-024 (Submitted March 2006)
- Volume II – Former Operational Area Excavation Survey Units Kaiser-FSSFOA-001 through Kaiser-FSSFOA-009 (Submitted March 2006)
- Volume III – Pond Parcel Backfill (BCM) Survey Units Kaiser_FSSB-001 through Kaiser-FSSB-009 (Submitted March 2006)
- Volume IV – Pond Parcel Excavation Bottom Survey Units Kaiser-FSS-025 through Kaiser-FSS-030 (Submitted June 2006)
- Volume V – Pond Parcel Backfill (BCM) Survey Units Kaiser-FSSB-010 through Kaiser-FSSB-15 (Submitted July 2006)
- Volume VI – Post-Operational Area (POA) Survey Units Kaiser-FSSPOA-001 through Kaiser-FSSPOA-012 and Final Project Documentation – Final Site Configuration Drawings, Final Status Survey Quality Assurance Analytical Data, and NRC Form 314(Submitted September 2006)

Volumes I through VI of the Final Status Survey Report contain individual sub-reports that provide final status survey results for a particular survey unit. These six volumes also contain 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. In a letter dated June 19, 2006 (John T. Buckley to Bill Vinzant), NRC approved Volumes I through IV of the Final Status Survey Report.

1.4.1 Pond Parcel and FOA Excavation Bottom Surveys and Reporting

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

Compliance with survey unit acceptance criteria has been 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 also has been calculated. The sum of fractions provides 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). Systematic final status survey data also have been evaluated using the Wilcoxan Rank Sum Test procedure.

Final status surveying and reporting have been completed for all 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. **Volume IV** of this **Final Status Survey Report** documents the final status survey results for Survey Units Kaiser-FSS-025 through Kaiser-FSS-030. One of the 30 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 **Volumes I and IV** of this **Final Status Survey Report.**

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) were conducted through a progression of Class 1 survey units. A unit of BCM was 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 were 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 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. Compliance with survey unit acceptance criteria has been demonstrated by comparison of the average residual contamination for the survey unit to the appropriate acceptance criteria value. Systematic soil core sampling data also have been evaluated using the Wilcoxan Rank Sum Test procedure.

Final status surveying and reporting have been completed for all 15 Pond Parcel excavation backfill survey units (Survey Units Kaiser-FSSB-001 through Kaiser-FSSB-015). **Volume III** of this **Final Status Survey Report** documents the final status survey results for Survey Units Kaiser-FSSB-001 through Kaiser-FSSB-009. **Volume V** of this **Final Status Survey Report** documents the final status survey results for Survey Units Kaiser-FSSB-010 through Kaiser-FSSB-015. A discussion of the appropriate survey unit acceptance criteria and surveying protocol for the Pond Parcel excavation backfill units is also presented in **Volumes III and IV** of this **Final Status Survey Report.**

1.4.3 Final Status Survey QA Program

The final status survey QA program implemented for the Thorium Remediation Project included QA functions that covered 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 VI of this Final Status Survey Report**. Analytical QA data for the final status surveys are documented in **Appendix E of Volume VI** of this Final Status Survey Report.

1.4.4 Final Project Documentation

Final project documentation contained in **Volume VI** of the Final Status Survey Report consists of the following:

- A completed and signed NRC Form 314, Certificate of Disposition of Materials
- As-Left Condition Drawings illustrating the horizontal extent and bottom elevation grade of the Pond Parcel excavation, horizontal extent and top elevation grade of the BCM, and final elevation grade of the backfilled Pond Parcel excavation. Supporting thickness maps and cross-sections have been included to

document that the minimum soil cover thickness requirement of 10 feet for the project has been met.

- Post Operational (Remediation) Final Status Survey Results – Post operational final status surveys consisted of radiological surveys using portable instrumentation and sampling, if necessary, of site areas where potential radiological materials may have been handled or stored during the Thorium Remediation Project (such as the water storage tank area, the material segregation/storage areas, and the railcar loading area).

1.4.5 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.

Final Status Survey Report
Volume VI – Post Operational Area Survey Units
and Final Site Documentation
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation
September 14, 2006

2.0 INTRODUCTION

This volume of the Final Status Survey Report presents the results of Post Operational Area (POA) final status survey activities completed as part of the Thorium Remediation Project at the Tulsa, Oklahoma facility **(Figure 1)**. POAs consisted of site areas where potential radiological materials may have been handled or stored during the Thorium Remediation Project (such as the water storage tank area, the material segregation/storage areas, the railcar loading area, and the equipment decontamination area). Final status surveys associated with the POA units were conducted through a progression of Class 1 and Class 3 survey units. Survey units generally consisted of the exposed surface soil and embedded structures (if encountered and left in-place). The final status survey of post operational area survey units typically consisted of a gross gamma scan of the exposed surface soil of the unit and systematic/random soil sampling. Embedded structures (if encountered and left in-place) were surveyed for total alpha contamination and removable alpha contamination.

Final status surveying and reporting have been completed for all 12 POA survey units (Survey Units Kaiser-FSSPOA-001 through Kaiser-FSSPOA-012) **(Figure 3)**. This volume of the Final Status Survey Report contains 12 individual sub-reports (POA-001 through POA-012), each documenting the final status survey results for a particular survey unit. Sub-Report POA-009 documents the final status survey results for Survey Unit Kaiser-FSSPOA-009, the asphalt loading pad structure associated with the railroad spur constructed for the load-out of exempt radiological materials to be disposed at the U.S. Ecology, Grandview, Idaho facility. Survey Unit Kaiser-FSSPOA-009 is unique in that the structural surface was large, constituted the entire survey unit and as such was systematically scanned and sampled per the final status protocols for structures. All additional embedded structures are included as part of the open land area survey unit sub-reports. Sub-Reports POA-001 (Survey Unit Kaiser-FSSPOA-001) through POA-008 (Survey Unit Kaiser-FSSPOA-008) and POA-010 (Survey Unit Kaiser-FSSPOA-0010) through POA-012 (Survey Unit Kaiser-FSSPOA-012) document the final status survey results for open land areas.

The remaining chapters of this volume present 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 open land area and structural survey units **(Chapter 4.0)**, and a summary of findings relative to the final status survey of Post Operational Area Survey Units Kaiser-FSSPOA-001 through Kaiser-FSSPOA-012 **(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** – Analytical Analyses Quality Assurance
- **Appendix F** – NRC Form 314, Certificate of Disposition of Materials
- **Appendix G** – Final Site Configuration Drawings
- **Appendix H** – Final Walk-Over Gross Gamma Survey of Pond Parcel and Former Operational Area
- **Appendix I** – Adjacent Land Remediation Area Gamma Exposure Rate Survey

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 or disturbed 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, Pond Parcel excavation bottoms and Post Operational Areas (POAs); (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 m^2. 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 m^2. 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/100cm^2 gross alpha over 100 m^2. Inputs/assumptions include 100 m^2 of surface area and a removable fraction of 0.1.
- **Structure Surface Removable Contamination GA-DCGL** – 94.4 net dpm/100cm^2 gross alpha over 100 m^2. Inputs/assumptions are the same as structure surface total contamination.
- **Structure Surface Total Contamination GA-$DCGL_{EMC}$** – 92,700 net dpm/100cm^2 gross alpha over 1 m^2. Inputs/assumptions are the same as structure surface total contamination except for area.
- **Structure Surface Removable Contamination GA-$DCGL_{EMC}$** – 9,270 net dpm/100cm^2 gross alpha over 1 m^2. 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, post operational areas) 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/100cm^2 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 $GA\text{-}DCGL_{EMC}$ 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**.

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

Table 3-4 Structures Area Factors

Area Factors									
GA-	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
DCGL	98.2	49.2	32.9	24.7	19.8	9.91	4.97	3.32	1.00

Table 3-5 $GA\text{-}DCGL_{EMC}$ Values Structures

$DCGL_{EMC}$ (dpm/100cm^2)									
GA-	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
DCGL	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 cm^2 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_1. If N_1 exceeds the value assigned to N, an alternate spacing L_1 for the systematic sampling grid is calculated using the equation:

$$L_1 = \sqrt{\frac{A}{0.866N_1}}$$

The corresponding height (h) of the equilateral triangle with side length equal to L (or L_1) 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 μR/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 × 2 NaI Detector[a]

Bkg (cpm)	i (sec)	P -	ε (cpm per µR/hr)	D' -	s_i (counts)	$MDCR$ (ncpm)	$MDCR_S$ (ncpm)	CF[b]	*Scan MDC*[c] µR/hr	*Scan MDC*[c] 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 µR/hr) taken from NUREG-1507, modeled using *MicroShield*. CF = Scan MDC (pCi/g) / Scan MDC (µR/hr)

c. *Scan MDC* (µR/hr) = $MDCR_S/\varepsilon$ and *Scan MDC* (pCi/g) = $(MDCR_S/\varepsilon)CF$

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 cm^2. 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 instruments are being used for the Thorium Remediation Project to survey structural surfaces:

Meter Manufacturer and Model	Detector Manufacturer and Model	Detector Type	Use
Ludlum 2360	Ludlum 43-68 Gas Proportional	Gas Proportional Hand Held Area = 126 cm^2	Final status survey scans and static counts for total alpha contamination measurements
Ludlum 2360	Ludlum 43-37 Gas Proportional	Gas Proportional Floor Monitor Area = 582 cm^2	Final status survey scans and static counts for total alpha contamination measurements (Survey Unit Kaiser-FSSPOA-009)

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:

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

where:

$P(n \geq 1)$ = 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/100cm^2.

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 cm^2. 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 cm^2,
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 cm^2, and
E_{tot} = total detector efficiency for radionuclide emission of
= E_i x 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 (Ludlum 43-68 Detector)

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

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 ($DCGL_{EMC}$) value for the area scanned. The $DCGL_{EMC}$ 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 m^2) 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 μR/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 / μR/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 or 43-37) 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/100cm^2). Smear samples representing 100cm^2 areas are also collected at the

same sample point location to assess removable alpha contamination (in units of dpm/100cm^2). 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/100cm^2) at biased locations (highest scan result) when possible. Smear samples representing 100 cm^2 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 m^2) 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 μR/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 $DCGL_W$ (Fail

$DCGL_W$). 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 VI of the Final Status Survey Report presents a summary of the final status survey findings for Post Operational Survey Units Kaiser-FSSPOA-001 through Kaiser-FSSPOA-012.

5.1 Structural Surfaces - Survey Unit Kaiser-FSSPOA-009

Survey Unit Kaiser-FSSPOA-009 consists of the 740 m^2 asphalt loading pad associated with the railroad spur constructed for the load-out of exempt radiological materials to be disposed at the U.S. Ecology, Grandview, Idaho facility. For final status surveying purposes, the asphalt pad's structural surface was divided into eight Class 1 sub-units of areas less than or equal to 100 m^2. These eight sub-units are identified as Kaiser-FSSPOA-009A through Kaiser-FSSPOA-009H.

The acceptance criterion for structures remaining at the Tulsa facility is the DCGL-GA of 944 dpm/100cm^2 for total alpha contamination and 94.4 dpm/100cm^2 for removable alpha contamination. The final status survey of each survey sub-unit consisted of a gross alpha scan of the structural surface and systematic measurements of total and removable alpha contamination. The results of the final status survey activities for all 8 survey sub-units were as follows:

- The 100 percent coverage gross alpha scan of the structural surface did not indicate the presence of small areas of elevated activity (above the DCGL-GA for the site).
- All systematic measurements of total alpha contamination were below the DCGL-GA of 944 dpm/100cm^2.
- All smear sample results were below the DCGL-GA of 94.4 dpm/100cm^2 for removable alpha contamination.
- The total alpha contamination 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-FSSPOA-009 meets the DP acceptance criteria. A summary of the final status survey results by survey unit is provided below in Table 5-1.

5.2 Open Land Areas - Survey Units Kaiser-FSSPOA-001 through Kaiser-FSSPOA-008 and Kaiser-FSSPOA-010 through Kaiser-FSSPOA-012

Final status survey activities for open land areas Survey Units Kaiser-FSSPOA-001 through Kaiser-FSSPOA-008 and Kaiser-FSSPOA-010 through Kaiser-FSSPOA-012 consisted of a gross gamma scan of the exposed surface soil of each survey unit and systematic/random soil sampling. Survey Units Kaiser-FSSPOA-001 through Kaiser-FSSPOA-006, Kaiser-FSSPOA-011, and Kaiser-FSSPOA-012 were designated as Class 1 survey units. Survey Units Kaiser-FSSPOA-007, Kasier-FSSPOA-008, and Kaiser-FSSPOA-010 were designated as Class 3 survey units. The results of the final status survey activities were as follows:

Class 1 Survey Units Kaiser-FSSPOA-001 through Kaiser-FSSPOA-006 and Kaiser-FSSPOA-011 through Kaiser-FSSPOA-012

- The 100 percent coverage gamma scan (final as left-condition) for each survey unit did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site).
- The systematic soil sample analytical results (net) for each survey unit were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$).
- The systematic soil sample analytical results for each survey met the DP statistical criterion based on the first statistical evaluation of the data (WRS Test procedure).
- Embedded structures were encountered, surveyed, and left in-place for Survey Unit Kaiser-FSSPOA-011.

Class 3 Survey Units Survey Units Kaiser-FSSPOA-007, Kasier-FSSPOA-008, and Kaiser-FSSPOA-010

- The gross gamma scan for each survey unit did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site).
- The random soil sample analytical results (net) for each survey unit were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$).
- The random soil sample analytical results for each survey met the DP statistical criterion based on the first statistical evaluation of the data (WRS Test procedure).
- Embedded structures were encountered, surveyed, and left in-place for Survey Unit Kaiser-FSSPOA-010.

A summary of the final status survey results by survey unit is provided below in **Table 5-1**.

Table 5-1 – Post Operational Area Final Status Survey Summary by Survey Unit

Survey Unit	Survey Class	Surface Area (m^2)	No. of Systematic/Random Samples Collected	Systematic/Random Sample Exceedance of DCGL Value	WRS Test Criterion Met	Embedded Structure(s) Present	Survey Unit Meets DP Acceptance Criteria
Kaiser-FSSPOA-001	1	2,000	9	NO	YES	NO	YES
Kaiser-FSSPOA-002	1	1,776	10	NO	YES	NO	YES
Kaiser-FSSPOA-003	1	1,604	9	NO	YES	NO	YES
Kaiser-FSSPOA-004	1	1,841	9	NO	YES	NO	YES
Kaiser-FSSPOA-005	1	1,660	10	NO	YES	NO	YES
Kaiser-FSSPOA-006	1	111	9	NO	YES	NO	YES
Kaiser-FSSPOA-007	3	5,220	9	NO	YES	NO	YES
Kaiser-FSSPOA-008	3	4,375	9	NO	YES	NO	YES
Kaiser-FSSPOA-009*	1	740**	14 per sub-unit	NO	YES	N/A	YES
Kaiser-FSSPOA-010	3	309	13	NO	YES	YES	YES
Kaiser-FSSPOA-011	1	23	12	NO	YES	YES	YES
Kaiser-FSSPOA-012	1	1,577	11	NO	YES	NO	YES

* Survey Unit Kaiser- FSSPOA-009 is the 740 m^2 asphalt loading pad structure. The asphalt pad's structural surface was divided into eight sub-units of areas less than or equal to 100 m^2. The other POA survey units are defined as open land areas.

** Divided into 8 sub-units

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) Penn Environmental & Remediation, Inc., March 2006, Final Status Survey Report, Volume I – Pond Parcel Excavation Bottom, Survey Units Kaiser-FSS-001 through Kaiser-FSS-024, Thorium Remediation Project, Tulsa, Oklahoma, Kaiser Aluminum & Chemical Corporation.

(7) Penn Environmental & Remediation, Inc., March 2006, Final Status Survey Report, Volume II – Former Operational Area, Survey Units Kaiser-FSSFOA-001 through Kaiser-FSSFOA-009, Thorium Remediation Project, Tulsa, Oklahoma, Kaiser Aluminum & Chemical Corporation.

(8) Penn Environmental & Remediation, Inc., March 2006, 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, Kaiser Aluminum & Chemical Corporation.

(9) Penn Environmental & Remediation, Inc., June 2006, Final Status Survey Report, Volume IV – Pond Parcel Excavation Bottom, Survey Units Kaiser-FSS-0025 through Kaiser-FSS-030, Thorium Remediation Project, Tulsa, Oklahoma, Kaiser Aluminum & Chemical Corporation.

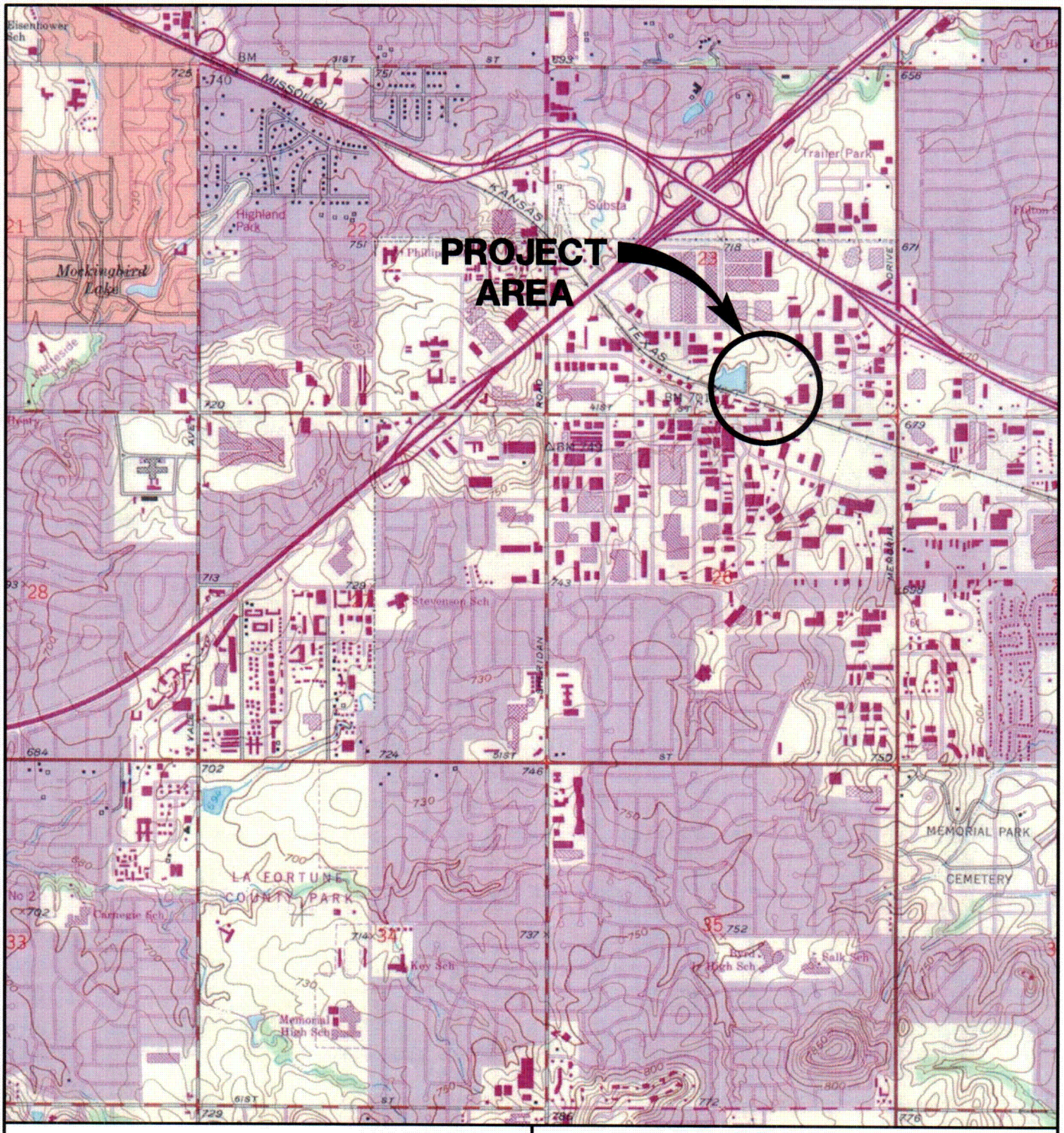
(10) Penn Environmental & Remediation, Inc., July 2006, Final Status Survey Report, Volume V – Pond Parcel Excavation Backfill Units Kaiser-FSSB-010 through Kaiser-FSSB-015, Thorium Remediation Project, Tulsa, Oklahoma, Kaiser Aluminum & Chemical Corporation.

(11) Title 10 CFR Part 20, Subpart E, Radiological Criteria for License Termination.

(12) NUREG-1549, Decision Methods for Dose Assessments to Comply With Radiological Criteria for License Termination.

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

(14) NRC, 1997, Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions, NUREG/CR-1507, Final, NRC, Washington, DC.



N

SCALE – FEET

0 2000

REFERENCE
USGS 7.5-MIN TOPOGRAPHIC QUADRANGLE
JENKS, OK
DATED 1952, PHOTOREVISED 1982
SCALE 1:24000.

FIGURE 1
SITE LOCATION MAP

THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
BATON ROUGE, LOUISIANA

APPROVED	RFD	05/08/06
CHECKED	RFD	05/08/06
DRAWN	DEB	05/08/06

DRAWING NUMBER
PA4072021

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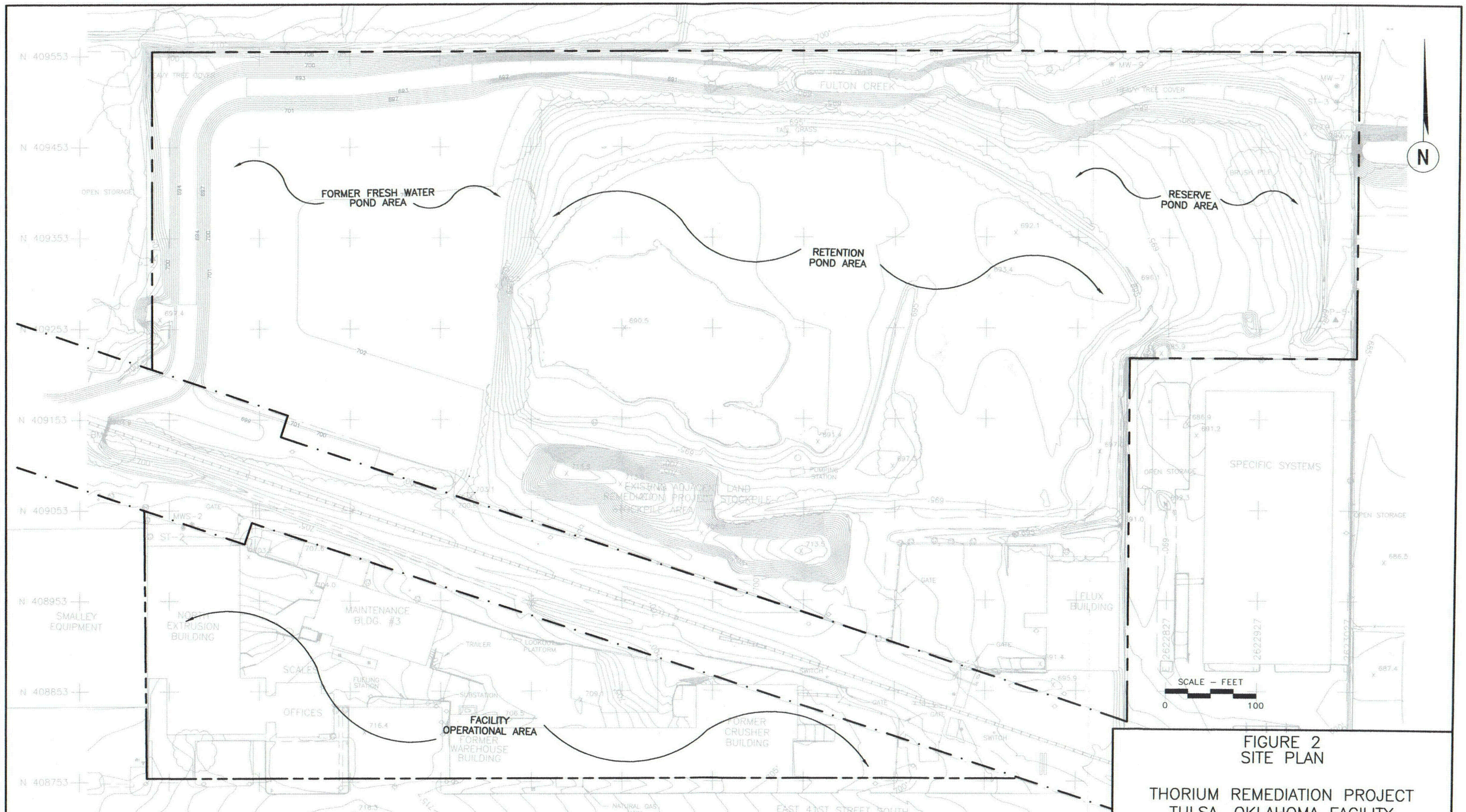

FIGURE 2
SITE PLAN

THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
BATON ROUGE, LOUISIANA

APPROVED	RFD	06/09/06
CHECKED	RFD	06/09/06
DRAWN	DEB	06/09/06

DRAWING NUMBER
PA4072202

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Environmental & Remediation, Inc.

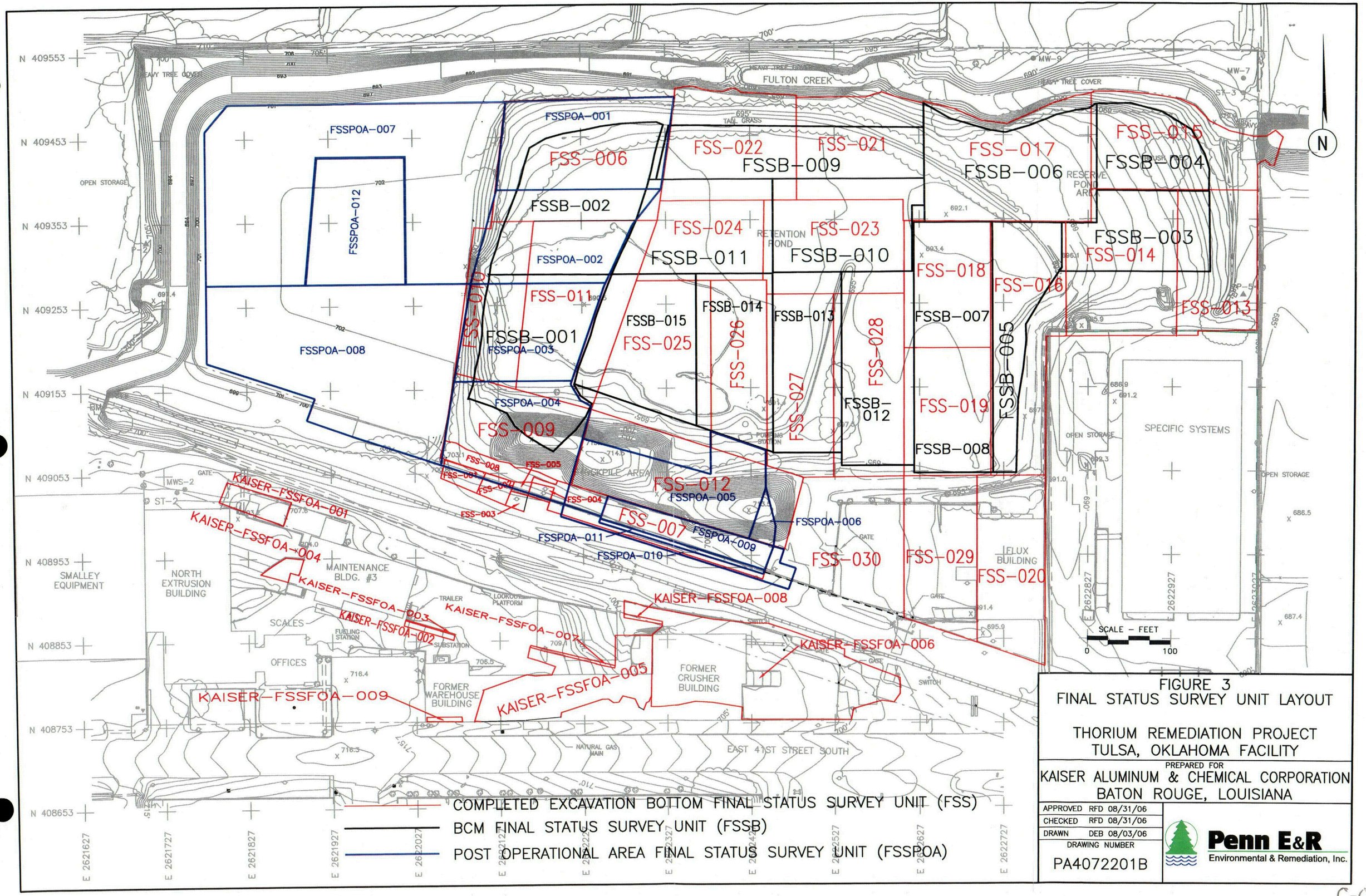

FIGURE 3
FINAL STATUS SURVEY UNIT LAYOUT

THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
BATON ROUGE, LOUISIANA

APPROVED	RFD	08/31/06
CHECKED	RFD	08/31/06
DRAWN	DEB	08/03/06

DRAWING NUMBER
PA4072201B

Penn E&R
Environmental & Remediation, Inc.

C-02

SUB-REPORT

SURVEY UNIT KAISER-FSSPOA-001

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2.0 SURVEY ACTIVITIES AND RESULTS	2
2.1 Gross Gamma Scan	2
2.2 Systematic Soil Sampling – Surface Soil	3
2.3 Wilcoxon Rank Sum (WRS) Testing	4
3.0 SUMMARY OF FINDINGS	5

ATTACHMENTS

ATTACHMENT A: Figure A-1 Gross Gamma Background and Scanning Survey Results
Figure A-2 Gross Gamma Survey – Biased Soil Sampling Locations
Figure A-3 Systematic Soil 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 VI - Post Operational Areas
Sub-Report No. POA-001
Survey Unit Kaiser-FSSPOA-001
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation
September 12, 2006

1.0 BACKGROUND

This sub-report documents the results of post operational 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-FSSPOA-001, a previously remediated and backfilled open land area used subsequently for material processing and storage. A plastic liner and several feet of clean imported borrow material (limestone screenings) were placed over the remediated and backfilled area prior to using it for material processing and storage. The limestone screening material and underlying plastic liner were removed under the guidance of a Health Physics Technician prior to conducting post-operational final status survey activities.

Survey Unit Kaiser-FSSPOA-001 is considered a Class 1 survey unit with an approximate surface area of 2,000 m^2. It overlies Excavation Bottom Survey Unit Kaiser-FSS-006. It is bounded to the south by Post Operational Survey Unit Kaiser-FSSPOA-002, to the east by Excavation Bottom Survey Unit Kaiser-FSS-022, to the north by Fulton Creek, and to the west by Post Operational Survey Unit Kaiser-FSSPOA-007 **(Figure 3)**.

2.0 SURVEY ACTIVITIES AND RESULTS

This section of the sub-report presents the final status survey data for the surface soil of Survey Unit Kaiser-FSSPOA-001. The final status survey consisted of a gross gamma scan of the exposed surface soil of the survey unit and systematic soil sampling.

2.1 Gross Gamma Scan

The exposed surface soil of the Class 1 survey unit was surveyed through a 100 percent coverage gamma scan to confirm acceptable radiological conditions and identify any elevated areas. During the scanning of the soil, the detector was held close to the ground surface (1 to 2 inches) and moved in a serpentine pattern. Background measurements were obtained at 1-meter above the ground surface at 20 approximately equal-distant locations in the survey unit. The statistics for the 20 background measurements are provided below in **Table 1**. Background measurements ranged from 7,462 counts per minute (cpm) to 16,901 cpm.

A total of 3,974 measurements of gross count rate were made at two second intervals across the survey unit's 2,000 m^2 surface area. The results ranged from 5,132 cpm to 29,641 cpm. A statistical summary of the 100 percent coverage gamma scan of the survey unit is also provided below in **Table 1**.

Table 1 – Gross Gamma Scan Results Summary

Survey Area:	2,000 m^2	
Number of Scan Measurements (2-Second Intervals):	3,974	
Detector Swing Rate: (Swinging the detector a width of 1-meter side to side)	0.25 m/s (MARSSIM recommends 0.5 m/s)	
Results Summary:	**Background (Gross cpm)**	**Scan (Gross cpm)**
Minimum	7,462	5,132
Maximum	16,901	29,641
Average	12,376	11,316
Standard Deviation	4,310	4,497
Median	12,551	8,650

Contour maps of the gross gamma background and final (as-left condition) scanning survey results are presented on **Figure A-1** contained in **Attachment A**. The 100 percent coverage gross gamma scan did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site). As part of the gross gamma survey, four biased soil samples were collected at locations exhibiting the highest scan rates **(Figure A-2, Attachment A)**. The biased soil samples were screened on-site in a lead cave. The results of the sample screening are presented below in **Table 2.** The sample screening levels were below the $DCGL_W$ for the site.

Table 2 – Biased Soil Sample Screening Result

Soil Sample ID	Cave Counter Screening Results (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)
$DCGL_W$	*3.0*		
Site Background	*1.1*	*0.3*	
K-1290	-0.123	0.901	1.52
K-1766	0.229	0.974	1.50
K-1767	1.71	1.05	1.50
K-1768	-0.132	1.18	1.50

2.2 Systematic Soil Sampling – Surface Soil

The final status survey also consisted of systematic soil sampling based on a random start point and an equal-distant triangular grid. The Minimum Number of Samples 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 2,000 m^2 along with the N of 9 was 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. 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-2** contained in **Attachment A**. The soil sample locations were demarcated in the field using a GPS unit. A total of 9 soil samples (identified as K-1271 through K-1279) were collected at the surface (0-6-inch depth interval) level using a clean, decontaminated sampling auger or sharpshooter shovel. The samples were 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 Sample Results

Soil Sample ID	Gross Th-232 (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)	Net Th-232 (pCi/g)	Net DCGL (pCi/g)
K-1271	0.982	0.183	0.151	0	3.0
K-1272	0.238	0.086	0.128	0	3.0
K-1273	0.267	0.102	0.112	0	3.0
K-1274	0.215	0.099	0.189	0	3.0
K-1275	0.018	0.033	0.284	0	3.0
K-1276	0.112	0.093	0.225	0	3.0
K-1277	0.169	0.068	0.210	0	3.0
K-1278	0.022	0.006	0.102	0	3.0
K-1279	0.122	0.104	0.234	0	3.0
Average	***0.238***				
Standard Dev.	***0.292***				
Minimum	***0.018***				
Maximum	***0.982***				
Median	***0.169***				

All 9 systematic soil sample results (gross and net) were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$). The maximum gross Th-232 activity concentration was 0.982 pCi/g, which fell below the background Th-232 activity of 1.1 pCi/g for the site. The average gross Th-232 activity concentration was 0.238 pCi/g. The standard deviation of the 9 equal-distant samples was 0.292, which fell below the estimated standard deviation of 0.42 (based on the adjacent land final status survey results) used to calculate the minimum number of samples required.

2.3 Wilcoxon Rank Sum (WRS) Testing

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

If the difference (0.24 pCi/g) between the maximum survey unit soil sample activity concentration (0.982 pCi/g) and the minimum reference background area soil sample activity concentration (0.74 pCi/g) is less than $DCGL_W$ (3.0 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	203	1.43	S1	K-1271	0.982
R2	91	0.97	S2	K-1272	0.238
R3	370	0.79	S3	K-1273	0.267
R4	316	1.13	S4	K-1274	0.215
R5	249	1.27	S5	K-1275	0.018
R6	365	0.74	S6	K-1276	0.112
R7	60	1.00	S7	K-1277	0.169
R8	51	1.72	S8	K-1278	0.022
R9	33	0.92	S9	K-1279	0.122
	Average	***1.11***		***Average***	***0.238***
	Standard Dev.	***0.32***		***Standard Dev.***	***0.292***
	Minimum	***0.74***		***Minimum***	***0.018***
	Maximum	***1.72***		***Maximum***	***0.982***
	Median	***1.00***		***Median***	***0.169***

3.0 SUMMARY OF FINDINGS

Survey Unit Kaiser-FSSPOA-001 is a previously remediated and backfilled open land area used subsequently for material processing and storage. A plastic liner and several feet of clean imported borrow material (limestone screenings) were placed over the remediated area prior to using it for material processing and storage. The limestone screening material and plastic liner were removed under the guidance of a Health Physics Technician prior to conducting post-operational final status survey activities.

Survey Unit Kaiser-FSSPOA-001 is considered a Class 1 survey unit with an approximate surface area of 2,000 m^2. It overlies Excavation Bottom Survey Unit Kaiser-FSS-006. It is bounded to the south by Post Operational Survey Unit Kaiser-FSSPOA-002, to the east by Excavation Bottom Survey Unit Kaiser-FSS-022, to the north by Fulton Creek, and to the west by Post Operational Survey Unit Kaiser-FSSPOA-007 **(Figure 3)**.

The acceptance criterion for open land areas (surface soil) at the Tulsa facility is the $DCGL_W$ of 3.0 pCi/g net Th-232 activity concentration. Final status survey activities for Survey Unit Kaiser-FSSPOA-001 consisted of a gross gamma scan of the exposed surface soil of the survey unit and systematic soil sampling. The results of the final status survey activities were as follows:

- The 100 percent coverage gamma scan (final as-left condition) did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site).
- All 9 systematic soil sample results (gross and net) were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$).
- The analytical results met 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-FSSPOA-001 meets the DP acceptance criteria.

ATTACHMENT A
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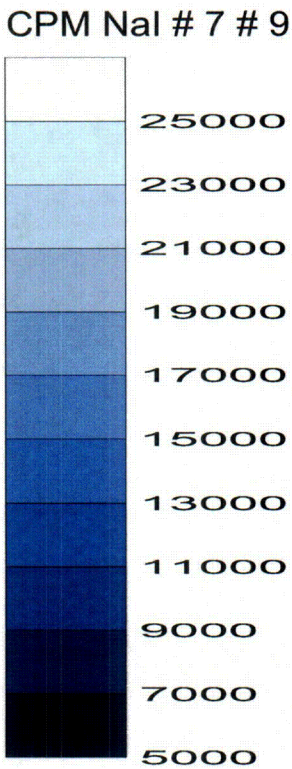
- **FIGURE A-1 Gross Gamma Background and Scanning Survey Results**
- **FIGURE A-2 Gross Gamma Survey - Biased Soil Sampling Locations**
- **FIGURE A-3 Systematic Soil Sampling Locations**

Attachment A, Figure A-1
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSPOA-001



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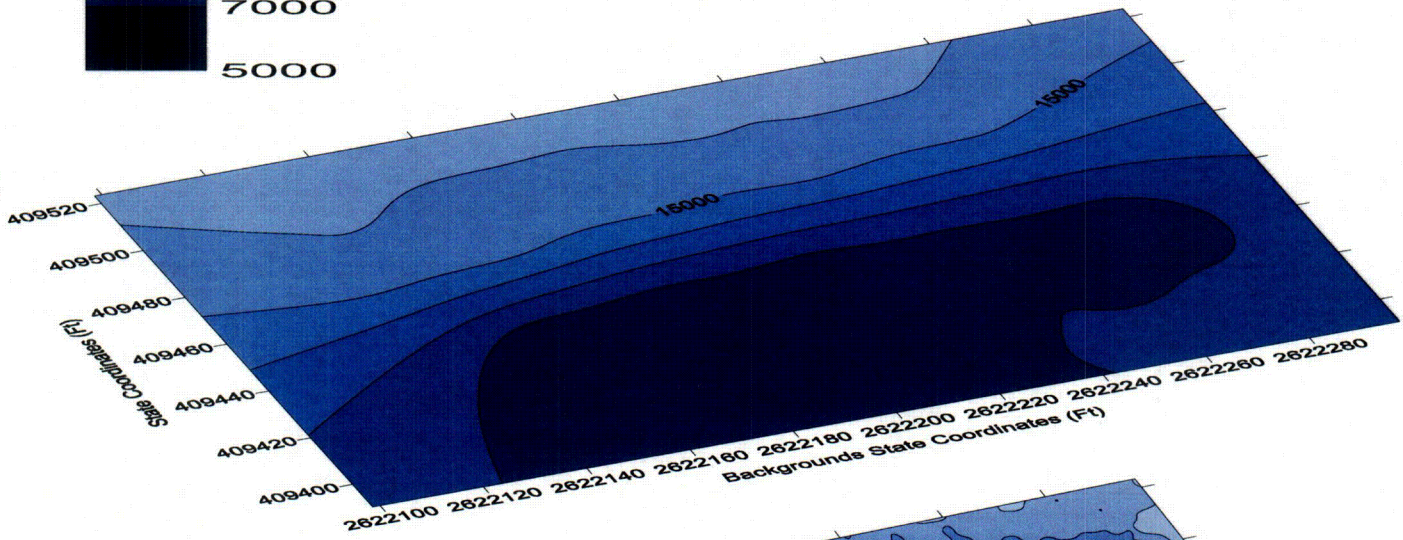
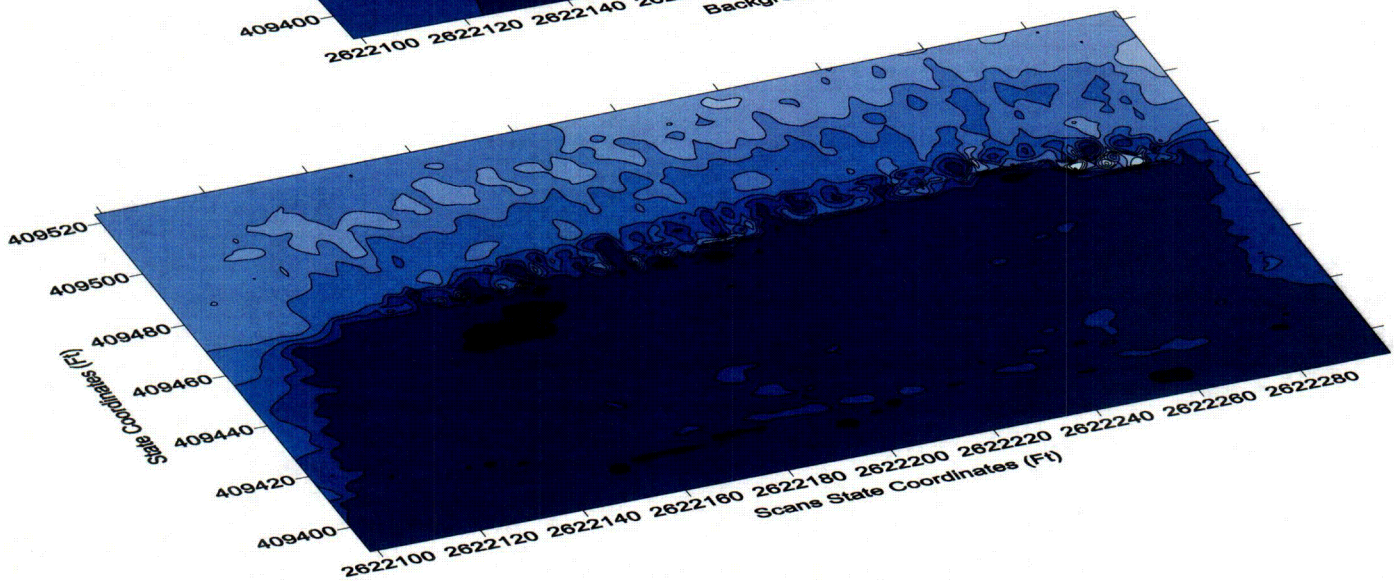
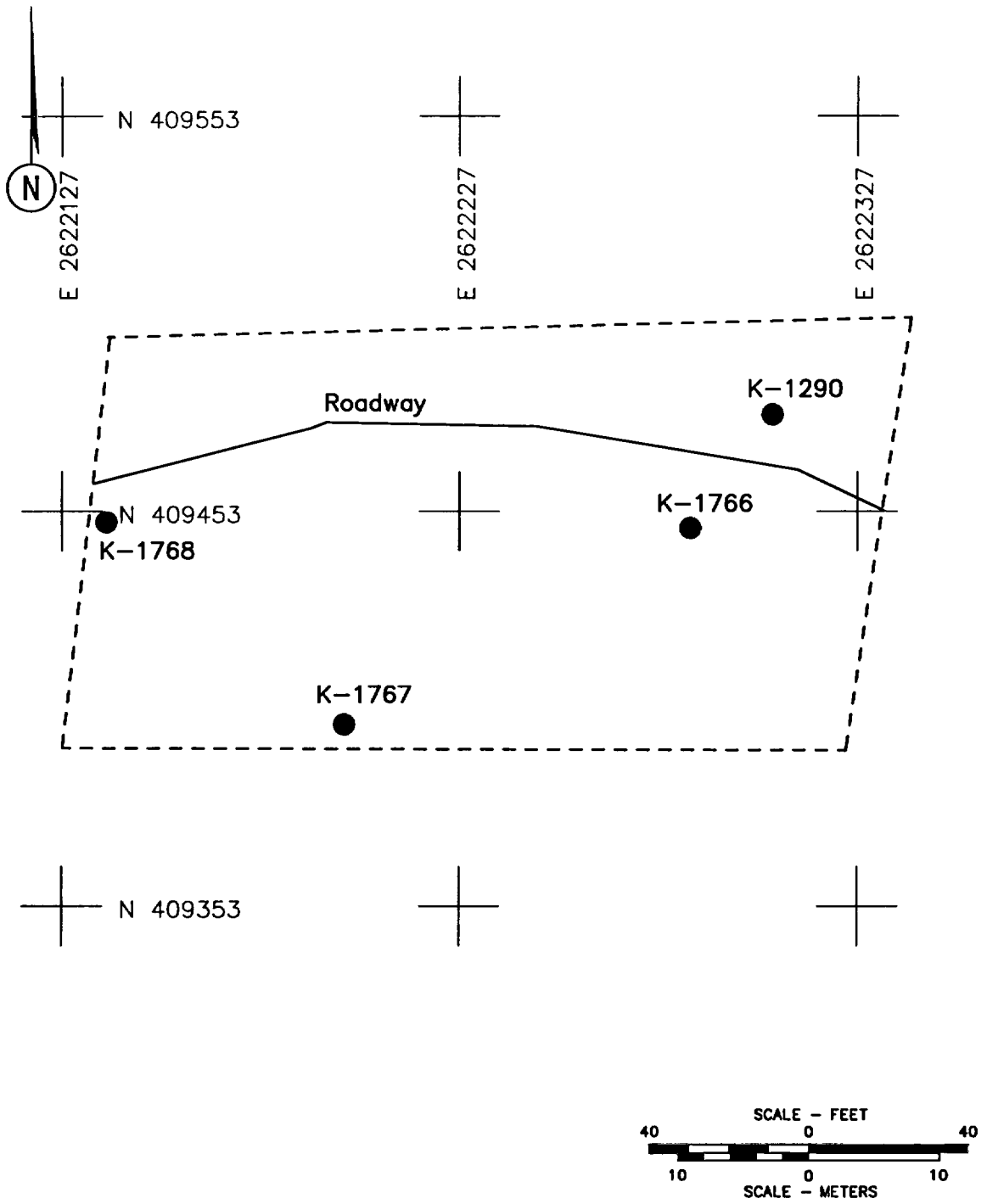
Backgrounds are 1 minute readings.





Scanning readings are recorded at 2 second intervals.

C-03



K-1766

● BIASED SOIL SAMPLING LOCATION BASED ON GROSS GAMMA SCAN RESULTS

FIGURE A-2
GROSS GAMMA SURVEY BIASED SOIL SAMPLING LOCATIONS
SURVEY UNIT KAISER - FSSPOA-001
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFD	08/18/06
CHECKED	RFD	08/18/06
DRAWN	DEB	07/17/06

DRAWING NUMBER
PA4072091A

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Environmental & Remediation, Inc.

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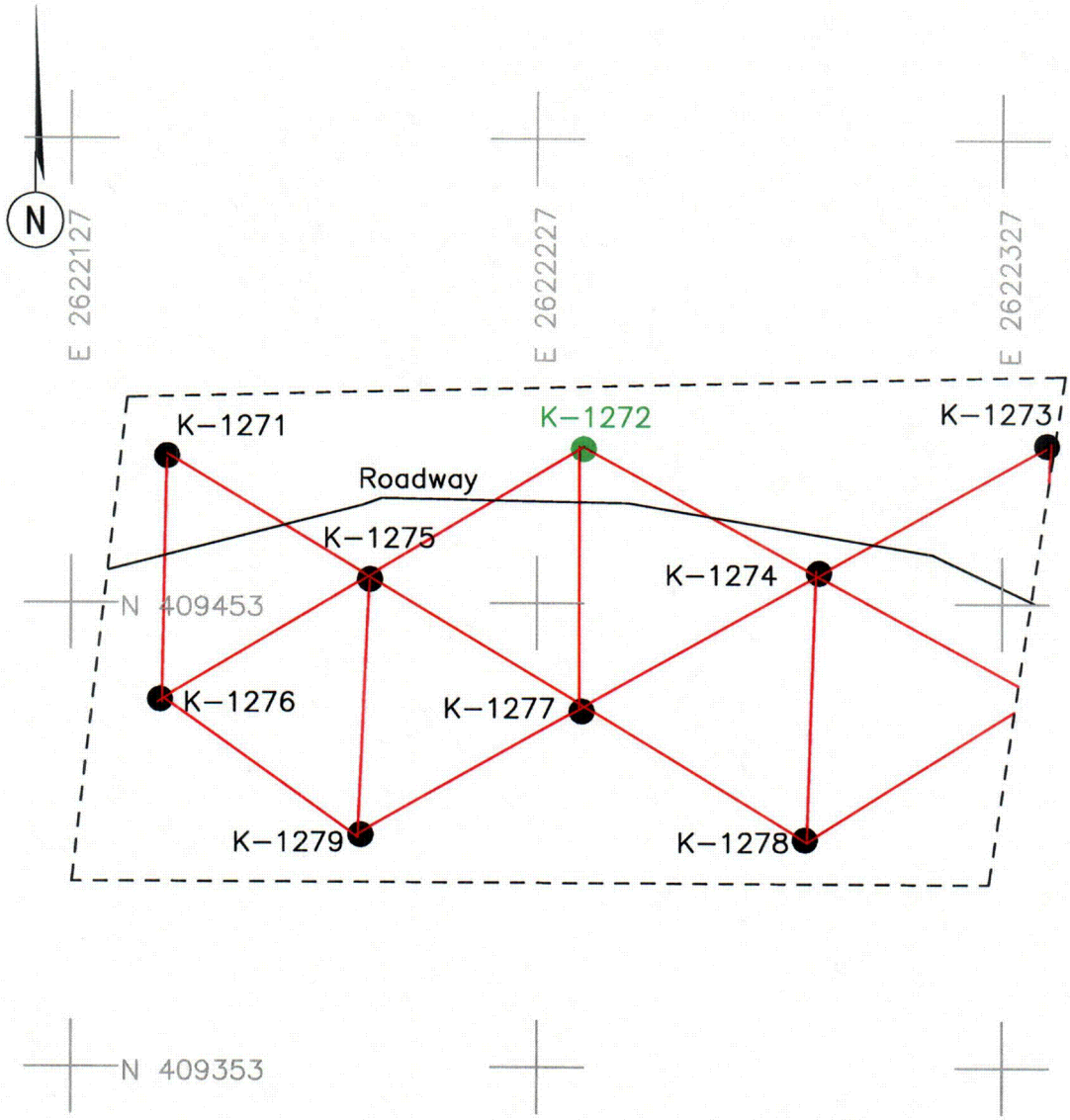
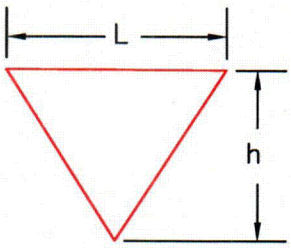
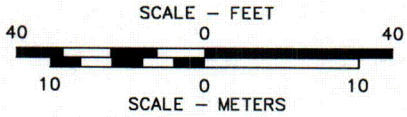




N = 9
L = 16.0m
h = 13.9m
AREA = 2,000m^2



K-1271
● SYSTEMATIC SOIL SAMPLING LOCATION BASED ON RANDOM START POINT AND AN EQUAL DISTANT TRIANGULAR GRID

K-1272
● RANDOM START POINT

FIGURE A-3
SYSTEMATIC SOIL SAMPLING LOCATIONS
SURVEY UNIT KAISER – FSSPOA-001
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFD	08/18/06
CHECKED	RFD	08/18/06
DRAWN	DEB	07/17/06

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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-FSSPOA-001

2. Description: Retention Pond Area, Overlying Excavation Bottom Survey Unit Kaiser-FSS-006

3. Net Th-232 Acceptance Criteria (pCi/g): 3.0

4. Dimensions (m): Post Operational Area – approximately 62 meters x 32 meters; Area, A (m^2): 2,000

5. Estimated of Gross Gamma Scan Background Readings (cpm)
Average: 15,000 Minimum: 10,000 Maximum: 30,000

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 m^2 Class 1 survey unit are:

- Gross Gamma Scan MDC (pCi/g): 3.1
- 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 m^2, recalculate the corresponding Triangular Grid Node Length (L_1) 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 m^2, recalculate the corresponding Triangular Grid Node Length (L_1) using the following formula $L_1 = (A/(0.866 \times N))^{1/2}$: N/A

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

10. Calculate the height (h) of the equilateral triangle with side length equal to L (or L_1) using the following formula: $h = ((L^2 - (L/2)^2)^{1/2}$: 13.9 m.

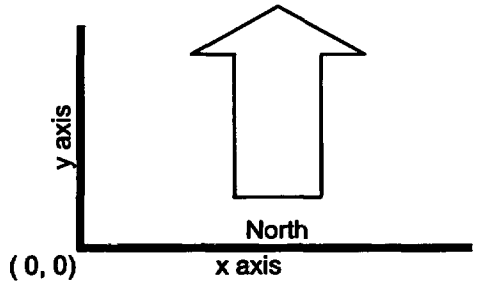
Soil Survey Unit Worksheet No. 2
Random Number Generator for Start Point
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

SURVEY UNIT: KAISER-FSSPOA-001

RANDOM START POINT

x axis (Meters)	y axis (Meters)
32	28

	x axis	y axis
lower bound	0	0
upper bound	62	32



ATTACHMENT C

Laboratory Analytical Results

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

Invoice # 11563
DJ - 12/6/05

December 7, 2005

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20050951

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples received in our laboratory on November 22, 2005 for the above captioned project. Five soil samples were received in good condition and analyzed by Gamma Spectroscopy without drying and grinding and Percent Moisture with a standard 20-work day turn. Results were faxed 12/7/05.

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

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID #OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20050951
Date Reported:	12/7/0
Date Received:	11/22/05
Page Number:	1 of 2

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	**20050951-01**						
Client ID:	**K-1271**						
Date Sampled:	**11/18/05 9:28:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.982 +/- 0.183	pCi/g	0.151		11/30/05	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	8.2	%		11/22/05	11/23/05	RT
Lab ID:	**20050951-02**						
Client ID:	**K-1272**						
Date Sampled:	**11/18/05 9:45:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.238 +/- 0.086	pCi/g	0.128		11/30/05	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	2.5	%		11/22/05	11/23/05	RT
Lab ID:	**20050951-03**						
Client ID:	**K-1273**						
Date Sampled:	**11/18/05 9:45:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.267 +/- 0.102	pCi/g	0.112		11/30/05	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	3.4	%		11/22/05	11/23/05	RT
Lab ID:	**20050951-04**						
Client ID:	**K-1291**						
Date Sampled:	**11/18/05 10:15:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	22.2 +/- 0.856	pCi/g	0.35		11/30/05	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	11.8	%		11/22/05	11/23/05	RT
Lab ID:	**20050951-05**						
Client ID:	**K-1289**						
Date Sampled:	**11/17/05 11:50:00 AM**						
Matrix:	**Swipe**						
		Radiochemical Analyses					

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20050951
Date Reported:	12/7/05
Date Received:	11/22/05
Page Number:	2 of 2

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Thorium 232	HASL 300	57.8 +/- 2.15	pCi/g	0.792		11/30/05	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	24.1	%		11/22/05	11/23/05	RT

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Am-241		89.0	101.0	12.2					11/29/05
Co-60		93.0	89.0	4.3					11/29/05
Cs-137		95.0	91.0	4.7					11/29/05
Percent Moisture					6.7				11/23/05

Lab Approval: _____

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company: Kaiser Alum & Chem Inc.
Name: DAVID R. WEYANT
Address: 7311 E. 41st St.
City: TULSA State: OK Zip: 74145
Phone: 724-934-3373 Fax #: 918-384-3171
Local: 918-584-0566
Cell: 724-799-0071

Bill To:
Company: Kaiser Alum & Chem
Name: DAVID R. WEYANT / PAUL HANO
Address: 7311 E. 41st St.
City: TULSA State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: Kaiser 4073
PROJECT #: PA-Hanna 4073
PROJECT NAME: Kaiser - Hanna Plaza.
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): 20 DAY.
SAMPLER: Signature DAVID R. WEYANT

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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 (L-232)	Plutonium to Chemistry Archive	MDC 0.05 pCi/g	Alpha 7216.92 Coft Coft					REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
	K-1271	11-16-05	9:25	Soil	1	Plastic	None	X	X	X	X					Grab
	K-1272		9:45		1			X	X	X	X					
	K-1273		9:45		1			X	X	X	X					
	K-1291		10:15		1			X	X	X	X					
	K-1299	11-17-05	11:50	Soil	1		None	X	X	X	X					Comp

RELINQUISHED BY: DAVID R. WEYANT DATE ____ TIME ____ RECEIVED BY: ____ DATE 11-22-05 TIME 8:00
RELINQUISHED BY: ____ DATE 11-22-05 TIME 0500 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. 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: 20050951
Sample Condition Upon Receipt: Good
Custody Seals Intact: Y N
Cooler Temperature: ____

SAMPLE LOGIN

Date Received: *11/22/05 11:12:13* **Lab Number:** 20050951 **Due:** 12/12/05

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20050951-01 A	K-1271	Soil	11/18/05	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20050951-02 A	K-1272	Soil	11/18/05	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20050951-03 A	K-1273	Soil	11/18/05	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20050951-04 A	K-1291	Soil	11/18/05	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20050951-05 A	K-1289	Swipe	11/17/05	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								

CONTAINER INSPECTION

 # Coolers 0 **Custody Seals Broken** ☐ **Temperature** **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ☑ **Labels in Tact** ☑ **Radiation Survey Complete** ☑

Anomalies

Inspected By: Michelle Sutton **DATE** 11/22/05

QA or Designee Review: Raymond Thomas **DATE** 11/22/05

Sample Custodian Review: [illegible] **DATE** 11/22/05

Project Notes:

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

K-1274 → 1279
PO A-001
Jr Jo42 ft 12179

June 29, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060500

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples received in our laboratory on June 13, 2006 for the above captioned project. Six soil samples were received in good condition and analyzed by Gamma Spectroscopy without drying and grinding and Percent Moisture with an expedited 5-work day turn. Results were faxed on 6/19/06.

At your request, none of the results are reported as ND.

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

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID #OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060500
Date Reported:	6/29/06
Date Received:	6/13/06
Page Number:	1 of 2

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	**20060500-01**						
Client ID:	**K-1274**						
Date Sampled:	**6/12/06 8:00:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.215 +/- 0.099	pCi/g	0.189		6/13/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	2.2	%		6/13/06	6/16/06	RT
Lab ID:	**20060500-02**						
Client ID:	**K-1275**						
Date Sampled:	**6/12/06 8:05:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.018 +/- 0.033	pCi/g	0.284		6/13/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	2.5	%		6/13/06	6/16/06	RT
Lab ID:	**20060500-03**						
Client ID:	**K-1276**						
Date Sampled:	**6/12/06 8:10:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.112 +/- 0.093	pCi/g	0.225		6/13/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	2.1	%		6/13/06	6/16/06	RT
Lab ID:	**20060500-04**						
Client ID:	**K-1277**						
Date Sampled:	**6/12/06 8:15:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.169 +/- 0.068	pCi/g	0.210		6/13/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	2.2	%		6/13/06	6/16/06	RT
Lab ID:	**20060500-05**						
Client ID:	**K-1278**						
Date Sampled:	**6/12/06 8:20:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060500
Date Reported:	6/29/06
Date Received:	6/13/06
Page Number:	2 of 2

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Thorium 232	HASL 300	0.022 +/- 0.006	pCi/g	0.102		6/13/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	3.1	%		6/13/06	6/16/06	RT

Lab ID: 20060500-06
Client ID: K-1279
Date Sampled: 6/12/06 8:25:00 AM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.122 +/- 0.104	pCi/g	0.234		6/13/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	3.2	%		6/13/06	6/16/06	RT

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Ac-228					NC				6/13/06
Am-241		92.0	100.0	8.6					6/13/06
Co-60		94.0	99.0	5.3					6/13/06
Cs-137		95.0	101.0	6.1					6/13/06
Percent Moisture					11.5				6/16/06

Lab Approval:

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company: KAISER ALUM & CHEM, INC.
Name: DAVID W. DUFFY
Address: 7311 E. 41st St.
City: TULSA State: OK Zip: 74145
Phone: 918-384-0506 Fax #: 918-384-3171

Bill To:
Company: KAISER/PEAN E & R
Name: PAUL HANDA/DAVE WRIGHT
Address: 7311 E. 41st St.
City: TULSA State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: KAISER - 4072
PROJECT #: PA - 4000 - 4072
PROJECT NAME: KAISER THORIUM REMED
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): 5 DAYS
SAMPLER: Signature / DW DUFFY

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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 (TH-232)	RETURN TO CLIENT FOR ARCHIVE	MDC <0.5 pCi/gm	ASTM E216, 92 MOIST CONTENT					REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
						PLASTIC 500										
1	K-1274	6-12-06	0800	SOIL	1	ML	NONE	X	X	X	X					
2	K-1275		0805					X	X	X	X					
3	K-1276a		0810					X	X	X	X					
4	K-1277		0815					X	X	X	X					
5	K-1278		0820					X	X	X	X					
6	K-1279		0825					X	X	X	X					

RELINQUISHED BY: DW DUFFY DATE: [illegible] TIME: [illegible] RECEIVED BY: [illegible] DATE: [illegible] TIME: [illegible]

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

My signature on the 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 RETENTION/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: 2006.500

Sample Condition Upon Receipt: GOOD
Custody Seals Intact: (Y) N
Cooler Temperature: NA

SAMPLE LOGIN

Date Received: *6/13/06 9:32:02 A* **Lab Number:** 20060500 **Due:** 6/19/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060500-01 A	K-1274	Soil	06/12/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060500-02 A	K-1275	Soil	06/12/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060500-03 A	K-1276	Soil	06/12/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060500-04 A	K-1277	Soil	06/12/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060500-05 A	K-1278	Soil	06/12/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060500-06 A	K-1279	Soil	06/12/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								

CONTAINER INSPECTION

 # Coolers 1 **Custody Seals Broken** ☐ **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ☑ **Labels in Tact** ☑ **Radiation Survey Complete** ☑

Anomalies

Inspected By: _____ **DATE** _____

QA or Designee Review: Raymond Thomas **DATE** 06/13/06

Sample Custodian Review: [illegible] **DATE** 06/13/06

Project Notes:

SUB-REPORT

SURVEY UNIT KAISER-FSSPOA-002

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1.0 BACKGROUND	1
2.0 SURVEY ACTIVITIES AND RESULTS	2
2.1 Gross Gamma Scan	2
2.2 Systematic Soil Sampling – Surface Soil	3
2.3 Wilcoxon Rank Sum (WRS) Testing	4
3.0 SUMMARY OF FINDINGS	5

ATTACHMENTS

ATTACHMENT A: Figure A-1 Gross Gamma Background and Scanning Survey Results
Figure A-2 Systematic Soil 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 VI - Post Operational Areas
Sub-Report No. POA-002
Survey Unit Kaiser-FSSPOA-002
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation
September 12, 2006

1.0 BACKGROUND

This sub-report documents the results of post operational 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-FSSPOA-002, a previously remediated and backfilled open land area used subsequently for material processing and storage. A plastic liner and several feet of clean imported borrow material (limestone screenings) were placed over the remediated and backfilled area prior to using it for material processing and storage. The limestone screening material and underlying plastic liner were removed under the guidance of a Health Physics Technician prior to conducting post-operational final status survey activities.

Survey Unit Kaiser-FSSPOA-002 is considered a Class 1 survey unit with an approximate surface area of 1,776 m^2. It overlies Excavation Bottom Survey Units Kaiser-FSS-006, Kaiser-FSS-010, and Kaiser-FSS-011. It is bounded to the south by Post Operational Survey Unit Kaiser-FSSPOA-003, to the east by Excavation Backfill Survey Unit Kaiser-FSSB-011, to the north by Post Operational Survey Unit Kaiser-FSSPOA-001, and to the west by Post Operational Survey Unit Kaiser-FSSPOA-007 **(Figure 3)**.

2.0 SURVEY ACTIVITIES AND RESULTS

This section of the sub-report presents the final status survey data for the surface soil of Survey Unit Kaiser-FSSPOA-002. The final status survey consisted of a gross gamma scan of the exposed surface soil of the survey unit and systematic soil sampling.

2.1 Gross Gamma Scan

The exposed surface soil of the Class 1 survey unit was surveyed through a 100 percent coverage gamma scan to confirm acceptable radiological conditions and identify any elevated areas. During the scanning of the soil, the detector was held close to the ground surface (1 to 2 inches) and moved in a serpentine pattern. Background measurements were obtained at 1-meter above the ground surface at 15 approximately equal-distant locations in the survey unit. The statistics for the 15 background measurements are provided below in **Table 1**. Background measurements ranged from 7,050 counts per minute (cpm) to 8,489 cpm.

A total of 1,738 measurements of gross count rate were made at two second intervals across the survey unit's 1,776 m^2 surface area. The results ranged from 5,958 cpm to 25,890 cpm. A statistical summary of the 100 percent coverage gamma scan of the survey unit is also provided below in **Table 1**.

Table 1 – Gross Gamma Scan Results Summary

Survey Area:	1,776 m^2	
Number of Scan Measurements (2-Second Intervals):	1,738	
Detector Swing Rate: (Swinging the detector a width of 1-meter side to side)	0.51 m/s (MARSSIM recommends 0.5 m/s)	
Results Summary:	**Background (Gross cpm)**	**Scan (Gross cpm)**
Minimum	7,050	5,958
Maximum	8,489	25,890
Average	7,551	7,848
Standard Deviation	426	1,137
Median	7,429	7,618

Contour maps of the gross gamma background and final (as-left condition) scanning survey results are presented on **Figure A-1** contained in **Attachment A**. The 100 percent coverage gross gamma scan did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site). As part of the gross gamma survey, one biased soil sample was collected at a location exhibiting a high scan rate **(Figure A-2, Attachment A)**. The biased soil sample was screened on-site in a lead cave. The result of the sample screening is presented below in **Table 2.** The sample screening level was below the $DCGL_W$ for the site.

Table 2 – Biased Soil Sample Screening Result

Soil Sample ID	Cave Counter Screening Results (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)
$DCGL_W$	*3.0*		
Site Background	*1.1*	*0.3*	
K-1765	0.485	1.27	1.51

2.2 Systematic Soil Sampling – Surface Soil

The final status survey also consisted of systematic soil sampling based on a random start point and an equal-distant triangular grid. The Minimum Number of Samples 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 1,776 m^2 along with the N of 9 was used to calculate the Triangular Grid Node Length (L) of 15.1 meters and the Height of the Equilateral Triangle (h) of 13.1 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-2** contained in **Attachment A**. The soil sample locations were demarcated in the field using a GPS unit. A total of 10 soil samples (identified as K-1772 through K-1781) were collected at the surface (0-6-inch depth interval) level using a clean, decontaminated sampling auger or sharpshooter shovel. The samples were 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 Sample Results

Soil Sample ID	Gross Th-232 (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)	Net Th-232 (pCi/g)	Net DCGL (pCi/g)
K-1772	0.265	0.072	0.215	0	3.0
K-1773	0.265	0.107	0.272	0	3.0
K-1774	0.021	0.075	0.133	0	3.0
K-1775	0.198	0.104	0.203	0	3.0
K-1776	0.208	0.068	0.290	0	3.0
K-1777	0.117	0.037	0.148	0	3.0
K-1778	0.088	0.060	0.099	0	3.0
K-1779	0.218	0.121	0.298	0	3.0
K-1780	0.209	0.147	0.221	0	3.0
K-1781	0.331	0.160	0.251	0	3.0
Average	***0.192***				
Standard Dev.	***0.092***				
Minimum	***0.021***				
Maximum	***0.331***				
Median	***0.209***				

All 10 systematic soil sample results (gross and net) were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$). The maximum gross Th-232

activity concentration was 0.331 pCi/g, which fell below the background Th-232 activity of 1.1 pCi/g for the site. The average gross Th-232 activity concentration was 0.192 pCi/g. The standard deviation of the 10 equal-distant samples was 0.092, which fell below the estimated standard deviation of 0.42 (based on the adjacent land final status survey results) used to calculate the minimum number of samples required.

2.3 Wilcoxon Rank Sum (WRS) Testing

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

If the difference (-0.49 pCi/g) between the maximum survey unit soil sample activity concentration (0.331 pCi/g) and the minimum reference background area soil sample activity concentration (0.82 pCi/g) is less than $DCGL_W$ (3.0 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	201	1.03	S1	K-1772	0.265
R2	336	1.36	S2	K-1773	0.265
R3	272	1.43	S3	K-1774	0.021
R4	255	1.42	S4	K-1775	0.198
R5	114	0.82	S5	K-1776	0.208
R6	145	0.86	S6	K-1777	0.117
R7	193	1.16	S7	K-1778	0.088
R8	12	0.96	S8	K-1779	0.218
R9	274	1.37	S9	K-1780	0.209
R10	244	1.50	S10	K-1781	0.331
	Average	***1.19***		***Average***	***0.192***
	Standard Dev.	***0.26***		***Standard Dev.***	***0.092***
	Minimum	***0.82***		***Minimum***	***0.021***
	Maximum	***1.50***		***Maximum***	***0.331***
	Median	***1.26***		***Median***	***0.209***

3.0 SUMMARY OF FINDINGS

Survey Unit Kaiser-FSSPOA-002 is a previously remediated and backfilled open land area used subsequently for material processing and storage. A plastic liner and several feet of clean imported borrow material (limestone screenings) were placed over the remediated area prior to using it for material processing and storage. The limestone screening material and plastic liner were removed under the guidance of a Health Physics Technician prior to conducting post-operational final status survey activities.

Survey Unit Kaiser-FSSPOA-002 is considered a Class 1 survey unit with an approximate surface area of 1,776 m^2. It overlies Excavation Bottom Survey Units Kaiser-FSS-006, Kaiser-FSS-010, and Kaiser-FSS-011. It is bounded to the south by Post Operational Survey Unit Kaiser-FSSPOA-003, to the east by Excavation Backfill Survey Unit Kaiser-FSSB-011, to the north by Post Operational Survey Unit Kaiser-FSSPOA-001, and to the west by Post Operational Survey Unit Kaiser-FSSPOA-007 **(Figure 3)**.

The acceptance criterion for open land areas (surface soil) at the Tulsa facility is the $DCGL_W$ of 3.0 pCi/g net Th-232 activity concentration. Final status survey activities for Survey Unit Kaiser-FSSPOA-002 consisted of a gross gamma scan of the exposed surface soil of the survey unit and systematic soil sampling. The results of the final status survey activities were as follows:

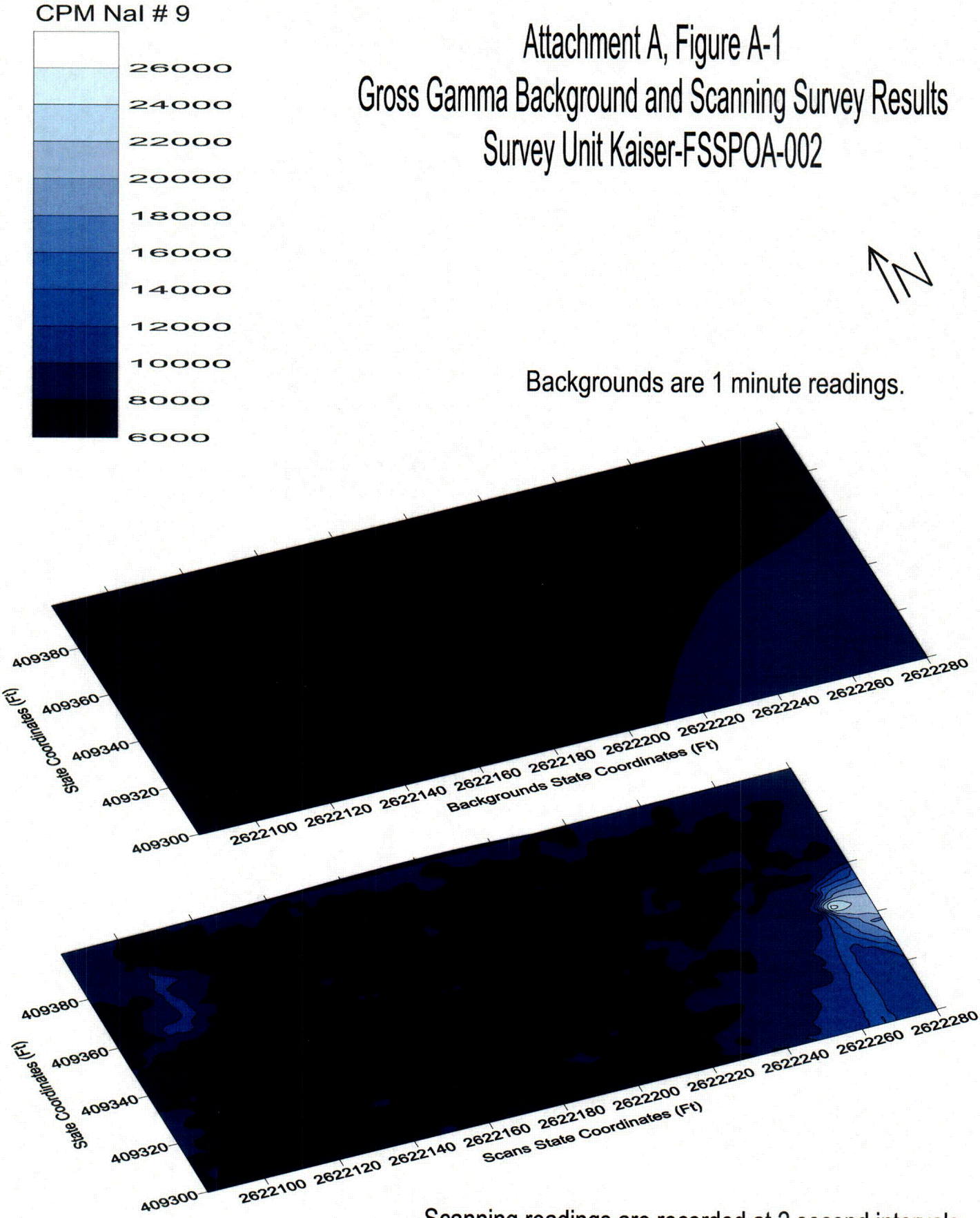
- The 100 percent coverage gamma scan (final as-left condition) did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site).
- All 10 systematic soil sample results (gross and net) were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$).
- The analytical results met 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-FSSPOA-002 meets the DP acceptance criteria.

ATTACHMENT A
TABLE OF CONTENTS

- **FIGURE A-1 Gross Gamma Background and Scanning Survey Results**
- **FIGURE A-2 Systematic Soil Sampling Locations**

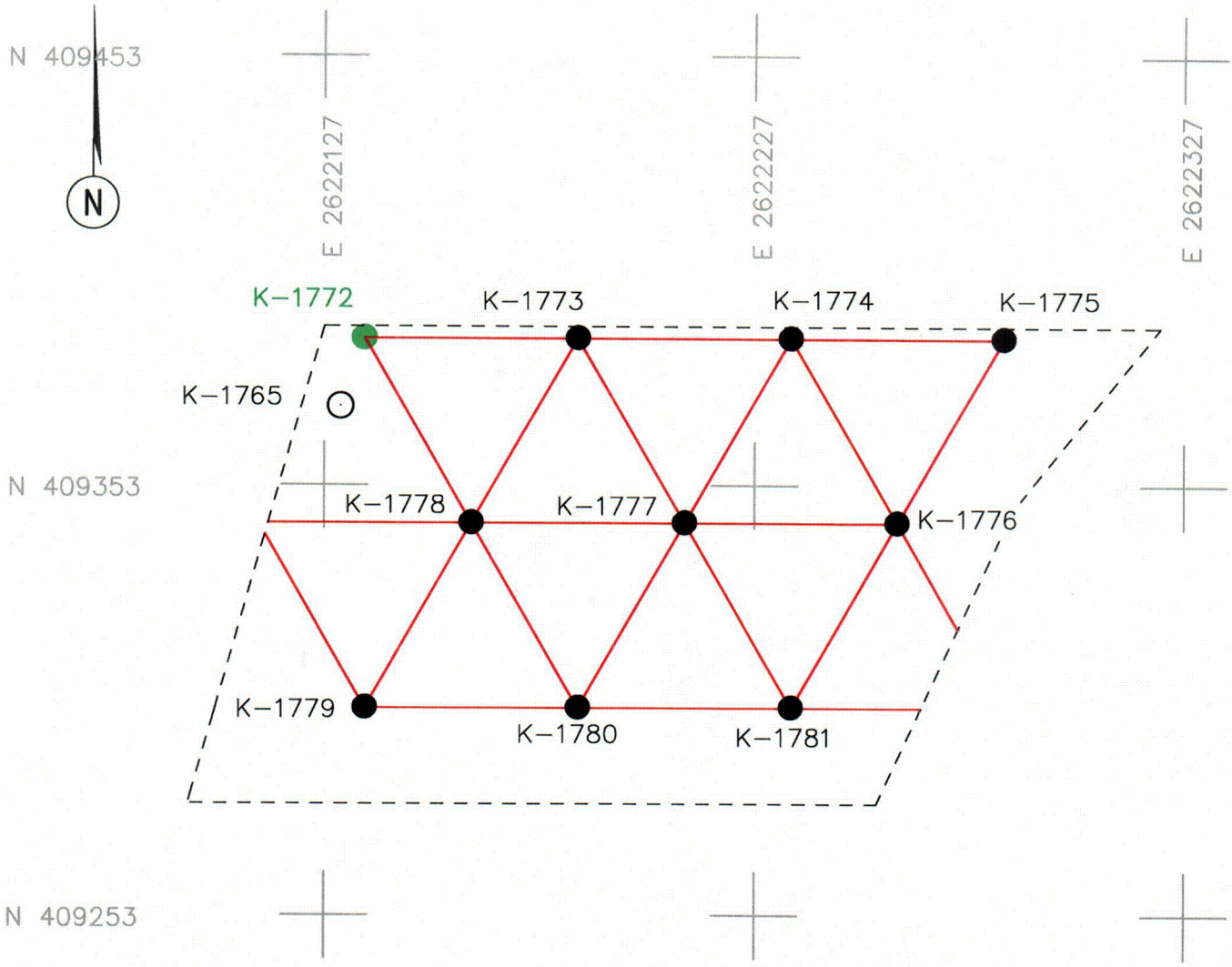
Attachment A, Figure A-1
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSPOA-002

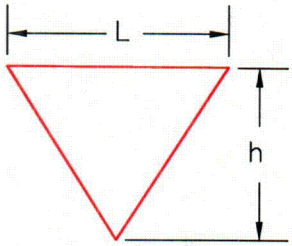


Backgrounds are 1 minute readings.

Scanning readings are recorded at 2 second intervals.

C-05





N = 9 (10 COLLECTED)
L = 15.1m
h = 13.1m
AREA = 1,776m^2

SCALE – FEET
40 0 40
10 0 10
SCALE – METERS

K–1773
● SYSTEMATIC SOIL SAMPLING LOCATION BASED ON RANDOM START POINT AND AN EQUAL DISTANT TRIANGULAR GRID

K–1772
● RANDOM START POINT

K–1765
○ BIASED SOIL SAMPLING LOCATION BASED ON GROSS GAMMA SCAN RESULTS

FIGURE A–2
SYSTEMATIC SOIL SAMPLING LOCATIONS
SURVEY UNIT KAISER – FSSPOA–002
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED RFD 9-14-06
CHECKED RFD 9-14-06
DRAWN DEB 07/17/06
DRAWING NUMBER
PA4072087B

Penn E&R
Environmental & Remediation, Inc.

H:\4000–PA\2\PA4072087B.dwg, 8/4/2006 11:57:10 AM

C-06

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-FSSPOA-002

2. Description: Retention Pond Area, Overlying Excavation Bottom Survey Units Kaiser-FSS-006, Kaiser-FSS-010, and Kaiser-FSS-011

3. Net Th-232 Acceptance Criteria (pCi/g): 3.0

4. Dimensions (m): Post Operational Area – approximately 33 meters x 53 meters; Area, A (m^2): 1,776

5. Estimated of Gross Gamma Scan Background Readings (cpm)
Average: 15,000 Minimum: 10,000 Maximum: 30,000

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 m^2 Class 1 survey unit are:

- Gross Gamma Scan MDC (pCi/g): 3.1
- 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 m^2, recalculate the corresponding Triangular Grid Node Length (L_1) for the Survey Unit Area (A), using the following formula: $L_1 = (A/(0.866 \times 9))^{1/2}$: 15.1 m

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

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

10. Calculate the height (h) of the equilateral triangle with side length equal to L (or L_1) using the following formula: $h = ((L^2 - (L/2)^2)^{1/2}$: 13.1 m.

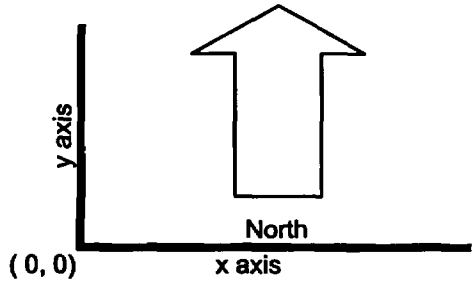
Soil Survey Unit Worksheet No. 2
Random Number Generator for Start Point
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

SURVEY UNIT: KAISER-FSSPOA-002

RANDOM START POINT

x axis (Meters)	y axis (Meters)
3	33

	x axis	y axis
lower bound	0	0
upper bound	33	53



ATTACHMENT C

Laboratory Analytical Results

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

K- 1772 → 1781
POA-002
INVOICE # 12175

June 27, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060511

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples received in our laboratory on June 16, 2006 for the above captioned project. Three soil samples were received in good condition and analyzed by Gamma Spectroscopy without drying and grinding and Percent Moisture with an expedited 5-work day turn. Results were faxed on 6/26/06.

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

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID #OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060511
Date Reported:	6/27/06
Date Received:	6/16/06
Page Number:	1 of 3

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	**20060511-01**						
Client ID:	**K-1772**						
Date Sampled:	**6/15/06 3:05:00 PM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.265 +/- 0.072	pCi/g	0.215		6/19/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	3.0	%		6/19/06	6/20/06	RS
Lab ID:	**20060511-02**						
Client ID:	**K-1773**						
Date Sampled:	**6/15/06 3:10:00 PM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.265 +/- 0.107	pCi/g	0.272		6/19/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	2.4	%		6/19/06	6/20/06	RS
Lab ID:	**20060511-03**						
Client ID:	**K-1774**						
Date Sampled:	**6/15/06 3:15:00 PM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.021 +/- 0.075	pCi/g	0.133		6/19/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	2.8	%		6/19/06	6/20/06	RS
Lab ID:	**20060511-04**						
Client ID:	**K-1775**						
Date Sampled:	**6/15/06 3:20:00 PM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.198 +/- 0.104	pCi/g	0.203		6/19/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	2.8	%		6/19/06	6/20/06	RS
Lab ID:	**20060511-05**						
Client ID:	**K-1776**						
Date Sampled:	**6/15/06 3:25:00 PM**						
Matrix:	**Soil**						
		Radiochemical Analyses					

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060511
Date Reported:	6/27/06
Date Received:	6/16/06
Page Number:	2 of 3

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Thorium 232	HASL 300	0.208 +/- 0.068	pCi/g	0.290		6/19/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	2.7	%		6/19/06	6/20/06	RS

Lab ID: 20060511-06
Client ID: K-1777
Date Sampled: 6/15/06 3:30:00 PM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.117 +/- 0.037	pCi/g	0.148		6/19/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	2.2	%		6/19/06	6/20/06	RS

Lab ID: 20060511-07
Client ID: K-1778
Date Sampled: 6/15/06 3:35:00 PM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.088 +/- 0.060	pCi/g	0.099		6/19/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	3.0	%		6/19/06	6/20/06	RS

Lab ID: 20060511-08
Client ID: K-1779
Date Sampled: 6/15/06 3:40:00 PM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.218 +/- 0.121	pCi/g	0.298		6/20/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	2.9	%		6/19/06	6/20/06	RS

Lab ID: 20060511-09
Client ID: K-1780
Date Sampled: 6/15/06 3:45:00 PM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.209 +/- 0.147	pCi/g	0.221		6/20/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	5.2	%		6/19/06	6/20/06	RS

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060511
Date Reported:	6/27/06
Date Received:	6/16/06
Page Number:	3 of 3

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	**20060511-10**						
Client ID:	**K-1781**						
Date Sampled:	**6/15/06 3:50:00 PM**						
Matrix:	Soil						
	Radiochemical Analyses						
Thorium 232	HASL 300	0.331 +/- 0.160	pCi/g	0.251		6/20/06	SD
	Inorganics Analyses						
Percent Moisture	ASTM D2216-92	2.1	%		6/19/06	6/20/06	RS

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Ac-228					NC				6/19/06
Am-241		101.0	99.0	2.5					6/19/06
Co-60		101.0	96.0	5.5					6/19/06
Cs-137		93.0	96.0	3.3					6/19/06
Percent Moisture					2.7				6/20/06

Lab Approval:

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company: Kaiser & Blum Chem Inc.
Name: David G. Weyant
Address: 7311 E. 41st St.
City: Tulsa State: OK Zip: 74145
Phone: 724-924-3572 Fax #: 918-584-3171
LOCAL: 918-384-0566 918-744-0071

Bill To:
Company: Kaiser/Blum & Assoc
Name: David G. Weyant/Pam Hanna
Address: 7311 E. 41st St.
City: Tulsa State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: Kaiser - 4072
PROJECT #: PA - 4000 - 4072
PROJECT NAME: Kaiser - Hartzim Tanks.
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): 5 DAY
SAMPLER: David G. Weyant
Signature: David G. Weyant

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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)	Gasoline Range (C7-C12)	Benzene, Toluene, Ethylbenzene, Xylenes	MTBE	Naphthalene					REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
	K-1772	6-15-06	15:05	Soil	1	Plastic	None	X	X	X	X					Grab
	K-1773		15:10		1			X	X	X	X					
	K-1774		15:15		1			X	X	X	X					
	K-1775		15:20		1			X	X	X	X					
	K-1776		15:25		1			X	X	X	X					
	K-1777		15:30		1			X	X	X	X					
	K-1778		15:35		1			X	X	X	X					
	K-1779		15:40		1			X	X	X	X					
	K-1780		15:45		1			X	X	X	X					
	K-1781		15:50		1			X	X	X	X					

RELINQUISHED BY: David G. Weyant DATE: 7/14 TIME: 2:15 RECEIVED BY: [illegible] DATE: 6/16/06 TIME: 2:15
RELINQUISHED BY: David G. Weyant 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: 20060511
Sample Condition Upon Receipt: Good
Custody Seals Intact: Y N
Cooler Temperature: NA

SAMPLE LOGIN

Date Received: *6/16/06 10:15:31* **Lab Number:** 20060511 **Due:** 6/23/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060511-01 A	K-1772	Soil	06/15/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060511-02 A	K-1773	Soil	06/15/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060511-03 A	K-1774	Soil	06/15/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060511-04 A	K-1775	Soil	06/15/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060511-05 A	K-1776	Soil	06/15/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060511-06 A	K-1777	Soil	06/15/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060511-07 A	K-1778	Soil	06/15/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060511-08 A	K-1779	Soil	06/15/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060511-09 A	K-1780	Soil	06/15/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060511-1[illegible]	K-1781	Soil	06/15/06	[illegible]c	16 oz	None	Yes	Yes

Gamma Spec - Thorium 232
Percent Moisture (LOD)

CONTAINER INSPECTION

 # Coolers 1 **Custody Seals Broken** ☐ **Temperature:** **C** **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ☑ **Labels in Tact** ☑ **Radiation Survey Complete** ☑

Anomalies

Inspected By: _____ **DATE** 6/16/06

QA or Designee Review: _____ **DATE** _____

Sample Custodian Review: _____ **DATE** 6/16/06

Project Notes:

SUB-REPORT

SURVEY UNIT KAISER-FSSPOA-003

TABLE OF CONTENTS

	Page
1.0 BACKGROUND	1
2.0 SURVEY ACTIVITIES AND RESULTS	2
2.1 Gross Gamma Scan	2
2.2 Systematic Soil Sampling – Surface Soil	3
2.3 Wilcoxon Rank Sum (WRS) Testing	4
3.0 SUMMARY OF FINDINGS	6

ATTACHMENTS

ATTACHMENT A: Figure A-1 Gross Gamma Background and Scanning Survey Results
Figure A-2 Gross Gamma Survey – Biased Soil Sampling Locations
Figure A-3 Systematic Soil 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 VI - Post Operational Areas
Sub-Report No. POA-003
Survey Unit Kaiser-FSSPOA-003
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation
September 12, 2006

1.0 BACKGROUND

This sub-report documents the results of post operational 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-FSSPOA-003, a previously remediated and backfilled open land area used subsequently for material processing and storage. A plastic liner and several feet of clean imported borrow material (limestone screenings) were placed over the remediated and backfilled area prior to using it for material processing and storage. The limestone screening material and underlying plastic liner were removed under the guidance of a Health Physics Technician prior to conducting post-operational final status survey activities.

Survey Unit Kaiser-FSSPOA-003 is considered a Class 1 survey unit with an approximate surface area of 1,604 m^2. It overlies Excavation Bottom Survey Units Kaiser-FSS-010 and Kaiser-FSS-011. It is bounded to the south by Post Operational Survey Unit Kaiser-FSSPOA-004, to the east by Excavation Backfill Survey Unit Kaiser-FSSB-015, to the north by Post Operational Survey Unit Kaiser-FSSPOA-002, and to the west by Post Operational Survey Unit Kaiser-FSSPOA-008 **(Figure 3)**.

2.0 SURVEY ACTIVITIES AND RESULTS

This section of the sub-report presents the final status survey data for the surface soil of Survey Unit Kaiser-FSSPOA-003. The final status survey consisted of a gross gamma scan of the exposed surface soil of the survey unit and systematic soil sampling.

2.1 Gross Gamma Scan

The exposed surface soil of the Class 1 survey unit was surveyed through a 100 percent coverage gamma scan to confirm acceptable radiological conditions and identify any elevated areas. During the scanning of the soil, the detector was held close to the ground surface (1 to 2 inches) and moved in a serpentine pattern. Background measurements were obtained at 1-meter above the ground surface at 20 approximately equal-distant locations in the survey unit. The statistics for the 20 background measurements are provided below in **Table 1**. Background measurements ranged from 5,906 counts per minute (cpm) to 9,171 cpm.

A total of 1,978 measurements of gross count rate were made at two second intervals across the survey unit's 1,604 m^2 surface area. The results ranged from 4,196 cpm to 28,138 cpm. A statistical summary of the 100 percent coverage gamma scan of the survey unit is also provided below in **Table 1**.

Table 1 – Gross Gamma Scan Results Summary

Survey Area:	1,604 m^2	
Number of Scan Measurements (2-Second Intervals):	1,978	
Detector Swing Rate: (Swinging the detector a width of 1-meter side to side)	0.41 m/s (MARSSIM recommends 0.5 m/s)	
Results Summary:	**Background (Gross cpm)**	**Scan (Gross cpm)**
Minimum	5,906	4,196
Maximum	9,171	28,138
Average	7,304	7,519
Standard Deviation	875	1,854
Median	6,945	7,190

Contour maps of the gross gamma background and final (as-left condition) scanning survey results are presented on **Figure A-1** contained in **Attachment A**. The 100 percent coverage gross gamma scan did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site). As part of the gross gamma survey, six biased soil samples were collected at locations exhibiting the highest scan rates **(Figure A-2, Attachment A)**. The biased soil samples were screened on-site in a lead cave. The results of the sample screening are presented below in **Table 2**. The sample screening levels were below the $DCGL_W$ for the site.

Table 2 – Biased Soil Sample Screening Results

Soil Sample ID	Cave Counter Screening Results (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)
$DCGL_W$	*3.0*		
Site Background	*1.1*	*0.3*	
K-1810	0.441	1.19	1.52
K-1811	1.11	1.20	1.50
K-1812	2.72	0.931	1.50
K-1815	2.02	0.961	1.50
K-1816	-0.117	0.911	1.50
K-1817	2.71	1.05	1.50

2.2 Systematic Soil Sampling – Surface Soil

The final status survey also consisted of systematic soil sampling based on a random start point and an equal-distant triangular grid. The Minimum Number of Samples 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 1,604 m^2 along with the N of 9 was used to calculate the Triangular Grid Node Length (L) of 14.3 meters and the Height of the Equilateral Triangle (h) of 12.4 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-3** contained in **Attachment A**. The soil sample locations were demarcated in the field using a GPS unit. A total of 9 soil samples (identified as K-1782 through K-1790) were collected at the surface (0-6-inch depth interval) level using a clean, decontaminated sampling auger or sharpshooter shovel. The samples were 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 Sample Results

Soil Sample ID	Gross Th-232 (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)	Net Th-232 (pCi/g)	Net DCGL (pCi/g)
K-1782	0.054	0.092	0.119	0	3.0
K-1783	0.215	0.138	0.260	0	3.0
K-1784	0.125	0.062	0.132	0	3.0
K-1785	0.148	0.087	0.261	0	3.0
K-1786	0.126	0.080	0.149	0	3.0
K-1787	0.564	0.178	0.494	0	3.0
K-1788	0.252	0.088	0.315	0	3.0
K-1789	0.095	0.059	0.151	0	3.0
K-1790	0.108	0.096	0.264	0	3.0
Average	***0.187***				
Standard Dev.	***0.154***				
Minimum	***0.054***				
Maximum	***0.564***				
Median	***0.126***				

All 9 systematic soil sample results (gross and net) were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$). The maximum gross Th-232 activity concentration was 0.564 pCi/g, which fell below the background Th-232 activity of 1.1 pCi/g for the site. The average gross Th-232 activity concentration was 0.187 pCi/g. The standard deviation of the 9 equal-distant samples was 0.154, which fell below the estimated standard deviation of 0.42 (based on the adjacent land final status survey results) used to calculate the minimum number of samples required.

2.3 Wilcoxon Rank Sum (WRS) Testing

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

If the difference (-0.31 pCi/g) between the maximum survey unit soil sample activity concentration (0.564 pCi/g) and the minimum reference background area soil sample activity concentration (0.87 pCi/g) is less than $DCGL_W$ (3.0 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	249	1.27	S1	K-1782	0.054
R2	74	0.87	S2	K-1783	0.215
R3	213	0.94	S3	K-1784	0.125
R4	240	1.08	S4	K-1785	0.148
R5	348	0.87	S5	K-1786	0.126
R6	101	0.91	S6	K-1787	0.564
R7	53	1.29	S7	K-1788	0.252
R8	90	1.37	S8	K-1789	0.095
R9	221	1.19	S9	K-1790	0.108
	Average	***1.09***		***Average***	***0.187***
	Standard Dev.	***0.20***		***Standard Dev.***	***0.154***
	Minimum	***0.87***		***Minimum***	***0.054***
	Maximum	***1.37***		***Maximum***	***0.564***
	Median	***1.08***		***Median***	***0.126***

3.0 SUMMARY OF FINDINGS

Survey Unit Kaiser-FSSPOA-003 is a previously remediated and backfilled open land area used subsequently for material processing and storage. A plastic liner and several feet of clean imported borrow material (limestone screenings) were placed over the remediated area prior to using it for material processing and storage. The limestone screening material and plastic liner were removed under the guidance of a Health Physics Technician prior to conducting post-operational final status survey activities.

Survey Unit Kaiser-FSSPOA-003 is considered a Class 1 survey unit with an approximate surface area of 1,604 m^2. It overlies Excavation Bottom Survey Units Kaiser-FSS-010 and Kaiser-FSS-011. It is bounded to the south by Post Operational Survey Unit Kaiser-FSSPOA-004, to the east by Excavation Backfill Survey Unit Kaiser-FSSB-015, to the north by Post Operational Survey Unit Kaiser-FSSPOA-002, and to the west by Post Operational Survey Unit Kaiser-FSSPOA-008 **(Figure 3)**.

The acceptance criterion for open land areas (surface soil) at the Tulsa facility is the $DCGL_W$ of 3.0 pCi/g net Th-232 activity concentration. Final status survey activities for Survey Unit Kaiser-FSSPOA-003 consisted of a gross gamma scan of the exposed surface soil of the survey unit and systematic soil sampling. The results of the final status survey activities were as follows:

- The 100 percent coverage gamma scan (final as-left condition) did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site).
- All 9 systematic soil sample results (gross and net) were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$).
- The analytical results met 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-FSSPOA-003 meets the DP acceptance criteria.

ATTACHMENT A
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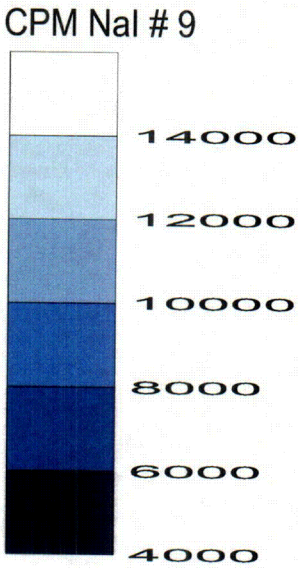
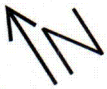
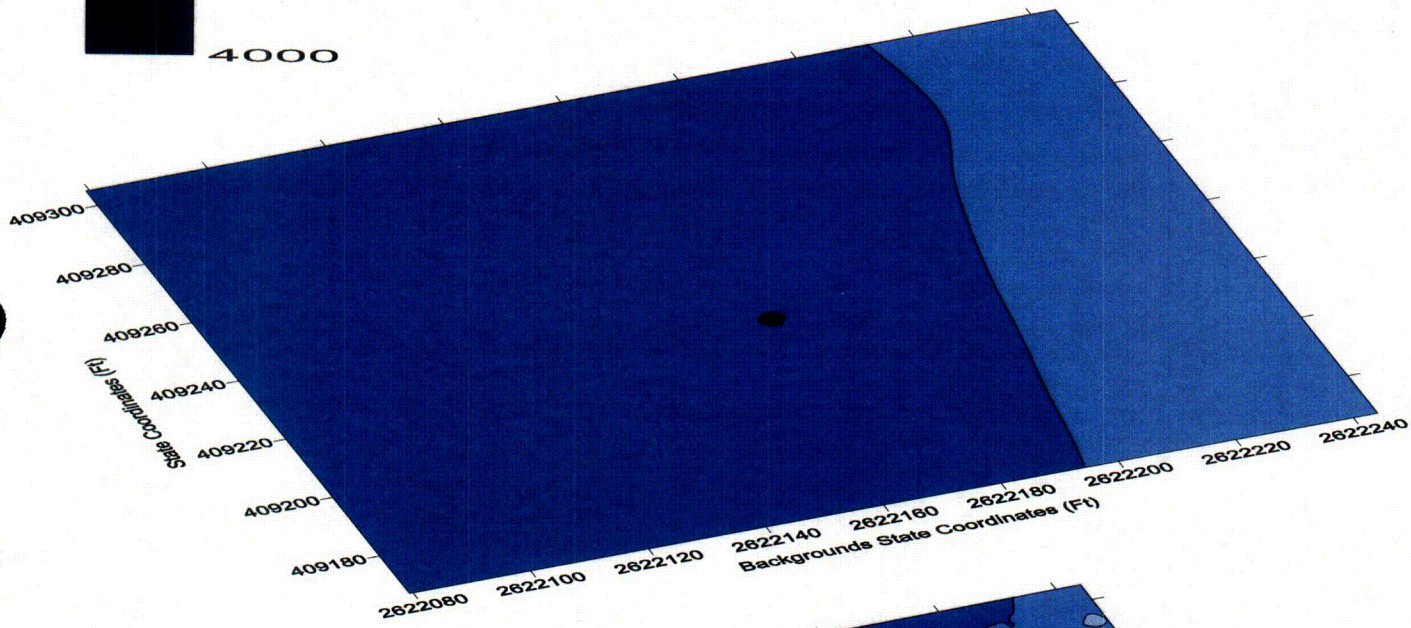
- **FIGURE A-1 Gross Gamma Background and Scanning Survey Results**
- **FIGURE A-2 Gross Gamma Survey - Biased Soil Sampling Locations**
- **FIGURE A-3 Systematic Soil Sampling Locations**

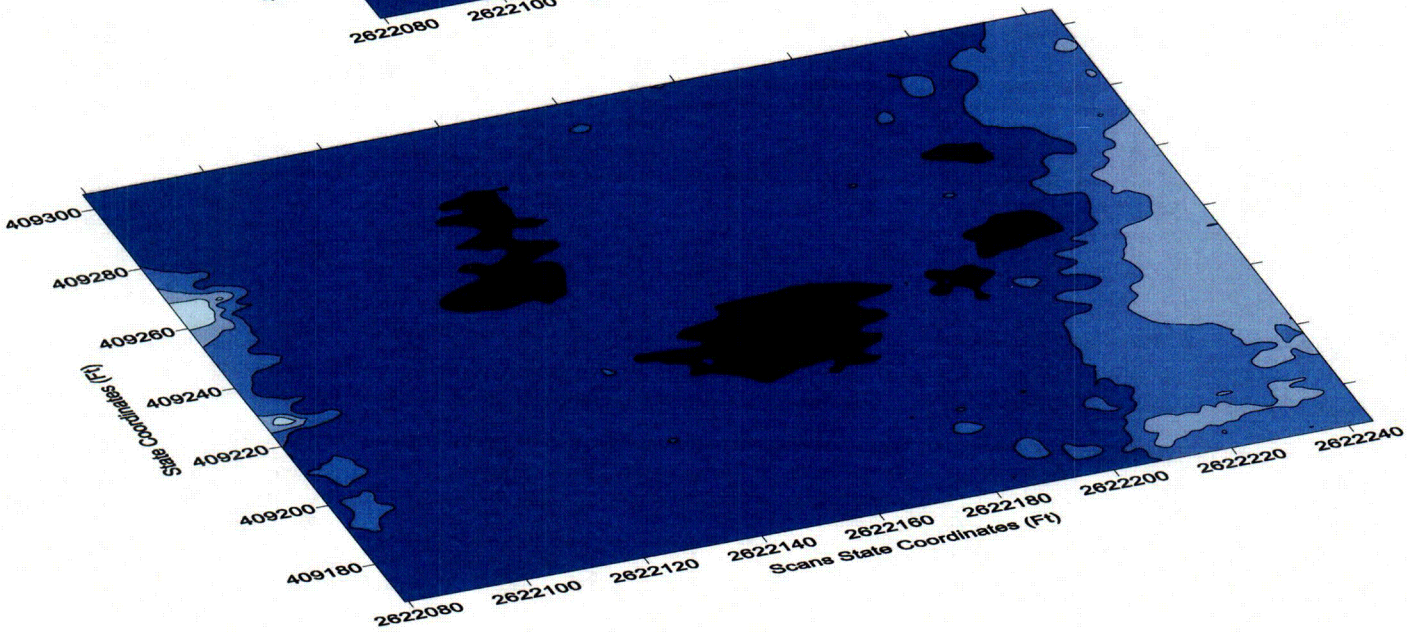
Attachment A, Figure A-1
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSPOA-003





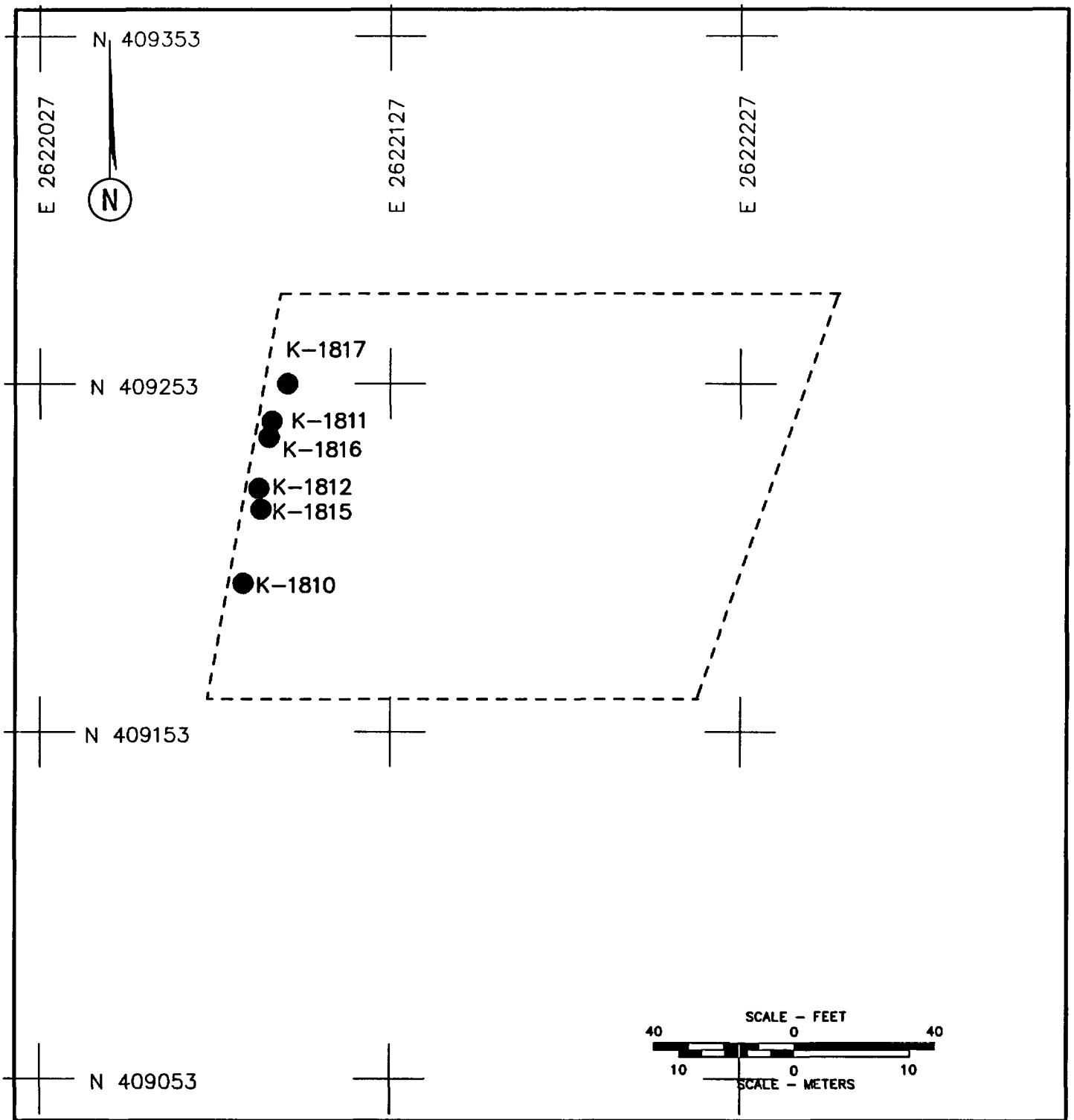
Backgrounds are 1 minute readings.





Scanning readings are recorded at 2 second intervals.

C-07



K-1817

● BIASED SOIL SAMPLING LOCATION BASED ON GROSS GAMMA SCAN RESULTS

FIGURE A-2
GROSS GAMMA SURVEY BIASED SOIL SAMPLING LOCATIONS
SURVEY UNIT KAISER - FSSPOA-003
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFD 08/18/06
CHECKED	RFD 08/18/06
DRAWN	DEB 07/17/06

DRAWING NUMBER
PA4072088B

Penn E&R
Environmental & Remediation, Inc.

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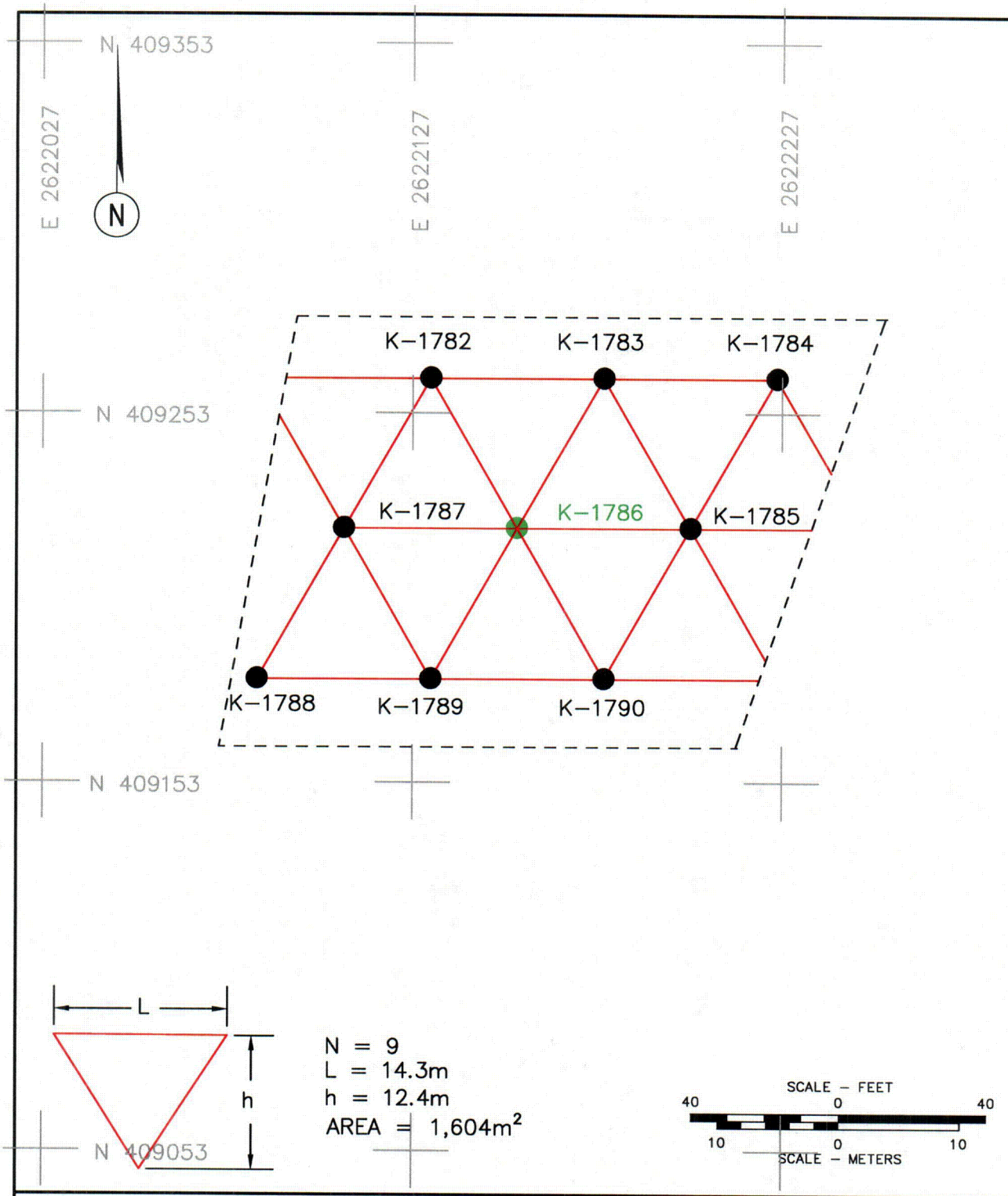

K-1782

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

K-1786

● RANDOM START POINT

FIGURE A-3
SYSTEMATIC SOIL SAMPLING LOCATIONS
SURVEY UNIT KAISER – FSSPOA-003
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFD	08/18/06
CHECKED	RFD	08/18/06
DRAWN	DEB	07/17/06

DRAWING NUMBER
PA4072088A

Penn E&R
Environmental & Remediation, Inc.

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C-08

ATTACHMENT B
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- **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-FSSPOA-003

2. Description: Retention Pond Area, Overlying Excavation Bottom Survey Units Kaiser-FSS-010 and Kaiser-FSS-011

3. Net Th-232 Acceptance Criteria (pCi/g): 3.0

4. Dimensions (m): Post Operational Area – approximately 47 meters x 34 meters; Area, A (m^2): 1,604

5. Estimated of Gross Gamma Scan Background Readings (cpm)
Average: 15,000 Minimum: 10,000 Maximum: 30,000

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 m^2 Class 1 survey unit are:

- Gross Gamma Scan MDC (pCi/g): 3.1
- 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 m^2, recalculate the corresponding Triangular Grid Node Length (L_1) for the Survey Unit Area (A), using the following formula: $L_1 = (A/(0.866 \times 9))^{1/2}$: 14.3 m

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

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

10. Calculate the height (h) of the equilateral triangle with side length equal to L (or L_1) using the following formula: $h = ((L^2 - (L/2)^2)^{1/2}$: 12.4 m.

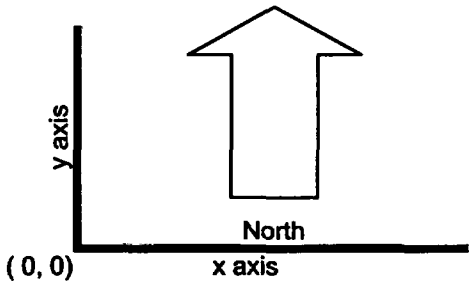
Soil Survey Unit Worksheet No. 2
Random Number Generator for Start Point
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

SURVEY UNIT: KAISER-FSSPOA-003

RANDOM START POINT

x axis (Meters)	y axis (Meters)
21	18

	x axis	y axis
lower bound	0	0
upper bound	47	34



ATTACHMENT C

Laboratory Analytical Results

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

K-1782 → 1790
POA-003
Invoice # 12167

June 29, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060537

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples received in our laboratory on June 21, 2006 for the above captioned project. Nine soil samples were received in good condition and analyzed by Gamma Spectroscopy without drying and grinding and Percent Moisture with an expedited 5-work day turn. Results were faxed on 6/28/06.

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

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID #OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060537
Date Reported:	6/29/06
Date Received:	6/21/06
Page Number:	1 of 3

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060537-01						
Client ID:	K-1782						
Date Sampled:	6/20/06 1:10:00 PM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.054 +/- 0.092	pCi/g	0.119		6/22/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	7.7	%		6/22/06	6/23/06	RS
Lab ID:	20060537-02						
Client ID:	K-1783						
Date Sampled:	6/20/06 1:15:00 PM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.215 +/- 0.138	pCi/g	0.260		6/23/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	2.7	%		6/22/06	6/23/06	RS
Lab ID:	20060537-03						
Client ID:	K-1784						
Date Sampled:	6/20/06 1:20:00 PM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.125 +/- 0.062	pCi/g	0.132		6/23/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	1.8	%		6/22/06	6/23/06	RS
Lab ID:	20060537-04						
Client ID:	K-1785						
Date Sampled:	6/20/06 1:25:00 PM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.148 +/- 0.087	pCi/g	0.261		6/23/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	3.0	%		6/22/06	6/23/06	RS
Lab ID:	20060537-05						
Client ID:	K-1786						
Date Sampled:	6/20/06 1:30:00 PM						
Matrix:	Soil						
		Radiochemical Analyses					

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060537
Date Reported:	6/29/06
Date Received:	6/21/06
Page Number:	2 of 3

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Thorium 232	HASL 300	0.126 +/- 0.080	pCi/g	0.149		6/23/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	5.0	%		6/22/06	6/23/06	RS

Lab ID: 20060537-06
Client ID: K-1787
Date Sampled: 6/20/06 1:35:00 PM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.564 +/- 0.178	pCi/g	0.494		6/28/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	1.9	%		6/22/06	6/23/06	RS

Lab ID: 20060537-07
Client ID: K-1788
Date Sampled: 6/20/06 1:40:00 PM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.252 +/- 0.088	pCi/g	0.315		6/28/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	1.7	%		6/22/06	6/23/06	RS

Lab ID: 20060537-08
Client ID: K-1789
Date Sampled: 6/20/06 1:45:00 PM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.095 +/- 0.059	pCi/g	0.151		6/26/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	1.9	%		6/22/06	6/23/06	RS

Lab ID: 20060537-09
Client ID: K-1790
Date Sampled: 6/20/06 1:50:00 PM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.108 +/- 0.096	pCi/g	0.264		6/26/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	2.2	%		6/22/06	6/23/06	RS

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060537
Date Reported:	6/29/06
Date Received:	6/21/06
Page Number:	3 of 3

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Ac-228					NC				6/28/06
Ac-228					NC				6/19/06
Am-241		95.0	84.0	13.0					6/28/06
Am-241		101.0	99.0	2.5					6/19/06
Co-60		95.0	86.0	9.9					6/28/06
Co-60		101.0	96.0	5.5					6/19/06
Cs-137		97.0	89.0	8.8					6/28/06
Cs-137		93.0	96.0	3.3					6/19/06
Percent Moisture					12.4				6/23/06

Lab Approval: _____

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To: LOCAL: 918-384-0566
Company: Kaiser Alumina Chem Inc.
Name: DAVID B. WEYANT
Address: 7311 E. 41st ST.
City: TULSA State: OK Zip: 74145
Phone: _____ Fax #: _____
CELL: 774-799-0071

Bill To:
Company: KAISER / Pfizer Spa
Name: PAT HANDA / DAVID WEYANT
Address: 7311 E. 41st ST.
City: TULSA State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: KAISER-4072
PROJECT #: PA-4000-4072
PROJECT NAME: KAISER ALUMINA PIA. PROJ.
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): 5 DAY
SAMPLER: DAVID B. WEYANT (Signature)

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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 (HL-272)	Pesticides to Limits for Archives	MOC Lab Oil (Oil)	ASTM Oil Content					REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
1	K-1782	6-2-2006	1310	Soil	1	Plastic	None	X	X	X	X		N			GRAB
2	K-1783		1315		1			X	X	X	X			A		
3	K-1784		1320		1			X	X	X	X					
4	K-1785		1325		1			X	X	X	X					
5	K-1786		1330		1			X	X	X	X					
6	K-1787		1335		1			X	X	X	X					
7	K-1788		1340		1			X	X	X	X					
8	K-1789		1345		1			X	X	X	X					
9	K-1790		1350		1			X	X	X	X					
			A						A				N		A	

RELINQUISHED BY: DAVID B. WEYANT DATE 6/2/06 TIME 1337 RECEIVED BY: Ron Stokes DATE 6/2/06 TIME 1337
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.

FOR LABORATORY USE ONLY: 20060537
Sample Condition Upon Receipt: Good
Custody Seals Intact: Y N
Cooler Temperature: N/A

SAMPLE LOGIN

Date Received: *6/21/06 8:06:19 A* **Lab Number:** 20060537 **Due:** 6/27/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060537-01 A	K-1782	Soil	06/20/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060537-02 A	K-1783	Soil	06/20/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060537-03 A	K-1784	Soil	06/20/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060537-04 A	K-1785	Soil	06/20/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060537-05 A	K-1786	Soil	06/20/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060537-06 A	K-1787	Soil	06/20/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060537-07 A	K-1788	Soil	06/20/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060537-08 A	K-1789	Soil	06/20/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060537-09 A	K-1790	Soil	06/20/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								

CONTAINER INSPECTION

Coolers 0 Custody Seals Broken ☐ Temperature: C Ice Radiation Survey: <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA Chain of Custody Record ☑ Labels in Tact ☑ Radiation Survey Complete ☑

Anomalies

Inspected By: _____ DATE 6-21-06

QA or Designee Review: _____ DATE 06/21/06

Sample Custodian Review: _____ DATE 6/21/06

Project Notes:

SUB-REPORT

SURVEY UNIT KAISER-FSSPOA-004

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1.0 BACKGROUND	1
2.0 SURVEY ACTIVITIES AND RESULTS	2
2.1 Gross Gamma Scan	2
2.2 Systematic Soil Sampling – Surface Soil	3
2.3 Wilcoxon Rank Sum (WRS) Testing	4
3.0 SUMMARY OF FINDINGS	5

ATTACHMENTS

ATTACHMENT A: Figure A-1 Gross Gamma Background and Scanning Survey Results
Figure A-2 Gross Gamma Survey – Biased Soil Sampling Locations
Figure A-3 Systematic Soil 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 VI - Post Operational Areas
Sub-Report No. POA-004
Survey Unit Kaiser-FSSPOA-004
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation
September 12, 2006

1.0 BACKGROUND

This sub-report documents the results of post operational 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-FSSPOA-004, a previously remediated and backfilled open land area used subsequently for material processing and storage. A plastic liner and several feet of clean imported borrow material (limestone screenings) were placed over the remediated and backfilled area prior to using it for material processing and storage. The limestone screening material and underlying plastic liner were removed under the guidance of a Health Physics Technician prior to conducting post-operational final status survey activities.

Survey Unit Kaiser-FSSPOA-004 is considered a Class 1 survey unit with an approximate surface area of 1,841 m^2. It overlies Excavation Bottom Survey Units Kaiser-FSS-001 through Kaiser-FSS-005, Kaiser-FSS-008, and Kaiser-FSS-009. It is bounded to the south by the Union Pacific Railroad right-of-way, to the east by Post Operational Survey Unit Kaiser-FSSPOA-005, to the north by Post Operational Survey Unit Kaiser-FSSPOA-003, and to the west by Post Operational Survey Unit Kaiser-FSSPOA-008 **(Figure 3)**.

2.0 SURVEY ACTIVITIES AND RESULTS

This section of the sub-report presents the final status survey data for the surface soil of Survey Unit Kaiser-FSSPOA-004. The final status survey consisted of a gross gamma scan of the exposed surface soil of the survey unit and systematic soil sampling.

2.1 Gross Gamma Scan

The exposed surface soil of the Class 1 survey unit was surveyed through a 100 percent coverage gamma scan to confirm acceptable radiological conditions and identify any elevated areas. During the scanning of the soil, the detector was held close to the ground surface (1 to 2 inches) and moved in a serpentine pattern. Background measurements were obtained at 1-meter above the ground surface at 19 approximately equal-distant locations in the survey unit. The statistics for the 19 background measurements are provided below in **Table 1**. Background measurements ranged from 6,336 counts per minute (cpm) to 9,012 cpm.

A total of 2,609 measurements of gross count rate were made at two second intervals across the survey unit's 1,841 m^2 surface area. The results ranged from 5,453 cpm to 16,730 cpm. A statistical summary of the 100 percent coverage gamma scan of the survey unit is also provided below in **Table 1**.

Table 1 – Gross Gamma Scan Results Summary

Survey Area:	1,841 m^2	
Number of Scan Measurements (2-Second Intervals):	2,609	
Detector Swing Rate: (Swinging the detector a width of 1-meter side to side)	0.35 m/s (MARSSIM recommends 0.5 m/s)	
Results Summary:	**Background (Gross cpm)**	**Scan (Gross cpm)**
Minimum	6,336	5,453
Maximum	9,012	16,730
Average	7,127	7,744
Standard Deviation	868	1,293
Median	6,940	7,375

Contour maps of the gross gamma background and final (as-left condition) scanning survey results are presented on **Figure A-1** contained in **Attachment A**. The 100 percent coverage gross gamma scan did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site). As part of the gross gamma survey, two biased soil samples were collected at locations exhibiting the highest scan rates **(Figure A-2, Attachment A)**. The biased soil samples were screened on-site in a lead cave. The results of the sample screening are presented below in **Table 2**. The sample screening levels were below the $DCGL_W$ for the site.

Table 2 – Biased Soil Sample Screening Results

Soil Sample ID	Cave Counter Screening Results (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)
$DCGL_W$	*3.0*		
Site Background	*1.1*	*0.3*	
K-1813	0.399	0.988	1.50
K-1814	0.620	1.01	1.50

2.2 Systematic Soil Sampling – Surface Soil

The final status survey also consisted of systematic soil sampling based on a random start point and an equal-distant triangular grid. The Minimum Number of Samples 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 1,841 m^2 along with the N of 9 was used to calculate the Triangular Grid Node Length (L) of 15.4 meters and the Height of the Equilateral Triangle (h) of 13.3 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-3** contained in **Attachment A**. The soil sample locations were demarcated in the field using a GPS unit. A total of 9 soil samples (identified as K-1791 through K-1799) were collected at the surface (0-6-inch depth interval) level using a clean, decontaminated sampling auger or sharpshooter shovel. The samples were 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 Sample Results

Soil Sample ID	Gross Th-232 (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)	Net Th-232 (pCi/g)	Net DCGL (pCi/g)
K-1791	0.095	0.072	0.169	0	3.0
K-1792	0.091	0.046	0.137	0	3.0
K-1793	0.064	0.1	0.241	0	3.0
K-1794	0.189	0.018	0.198	0	3.0
K-1795	0.199	0.045	0.211	0	3.0
K-1796	0.107	0.153	0.251	0	3.0
K-1797	0.465	0.105	0.205	0	3.0
K-1798	0.504	0.233	0.379	0	3.0
K-1799	0.122	0.07	0.126	0	3.0
Average	***0.204***				
Standard Dev.	***0.165***				
Minimum	***0.064***				
Maximum	***0.504***				
Median	***0.122***				

All 9 systematic soil sample results (gross and net) were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$). The maximum gross Th-232 activity concentration was 0.504 pCi/g, which fell below the background Th-232 activity of 1.1 pCi/g for the site. The average gross Th-232 activity concentration was 0.204 pCi/g. The standard deviation of the 9 equal-distant samples was 0.165, which fell below the estimated standard deviation of 0.42 (based on the adjacent land final status survey results) used to calculate the minimum number of samples required.

2.3 Wilcoxon Rank Sum (WRS) Testing

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

If the difference (0.044 pCi/g) between the maximum survey unit soil sample activity concentration (0.504 pCi/g) and the minimum reference background area soil sample activity concentration (0.46 pCi/g) is less than $DCGL_W$ (3.0 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	367	1.02	S1	K-1791	0.095
R2	289	1.19	S2	K-1792	0.091
R3	230	1.31	S3	K-1793	0.064
R4	255	1.42	S4	K-1794	0.189
R5	31	1.33	S5	K-1795	0.199
R6	124	1.07	S6	K-1796	0.107
R7	163	1.09	S7	K-1797	0.465
R8	230	1.31	S8	K-1798	0.504
R9	339	0.46	S9	K-1799	0.122
	Average	***1.13***		***Average***	***0.204***
	Standard Dev.	***0.29***		***Standard Dev.***	***0.165***
	Minimum	***0.46***		***Minimum***	***0.064***
	Maximum	***1.42***		***Maximum***	***0.504***
	Median	***1.19***		***Median***	***0.122***

3.0 SUMMARY OF FINDINGS

Survey Unit Kaiser-FSSPOA-004 is a previously remediated and backfilled open land area used subsequently for material processing and storage. A plastic liner and several feet of clean imported borrow material (limestone screenings) were placed over the remediated area prior to using it for material processing and storage. The limestone screening material and plastic liner were removed under the guidance of a Health Physics Technician prior to conducting post-operational final status survey activities.

Survey Unit Kaiser-FSSPOA-004 is considered a Class 1 survey unit with an approximate surface area of 1,841 m^2. It overlies Excavation Bottom Survey Units Kaiser-FSS-001 through Kaiser-FSS-005, Kaiser-FSS-008, and Kaiser-FSS-009. It is bounded to the south by the Union Pacific Railroad right-of-way, to the east by Post Operational Survey Unit Kaiser-FSSPOA-005, to the north by Post Operational Survey Unit Kaiser-FSSPOA-003, and to the west by Post Operational Survey Unit Kaiser-FSSPOA-008 **(Figure 3)**.

The acceptance criterion for open land areas (surface soil) at the Tulsa facility is the $DCGL_W$ of 3.0 pCi/g net Th-232 activity concentration. Final status survey activities for Survey Unit Kaiser-FSSPOA-004 consisted of a gross gamma scan of the exposed surface soil of the survey unit and systematic soil sampling. The results of the final status survey activities were as follows:

- The 100 percent coverage gamma scan (final as-left condition) did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site).
- All 9 systematic soil sample results (gross and net) were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$).
- The analytical results met 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-FSSPOA-005 meets the DP acceptance criteria.

ATTACHMENT A
TABLE OF CONTENTS

- **FIGURE A-1 Gross Gamma Background and Scanning Survey Results**
- **FIGURE A-2 Gross Gamma Survey - Biased Soil Sampling Locations**
- **FIGURE A-3 Systematic Soil Sampling Locations**

Attachment A, Figure A-1
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSPOA-004

CPM NaI # 9

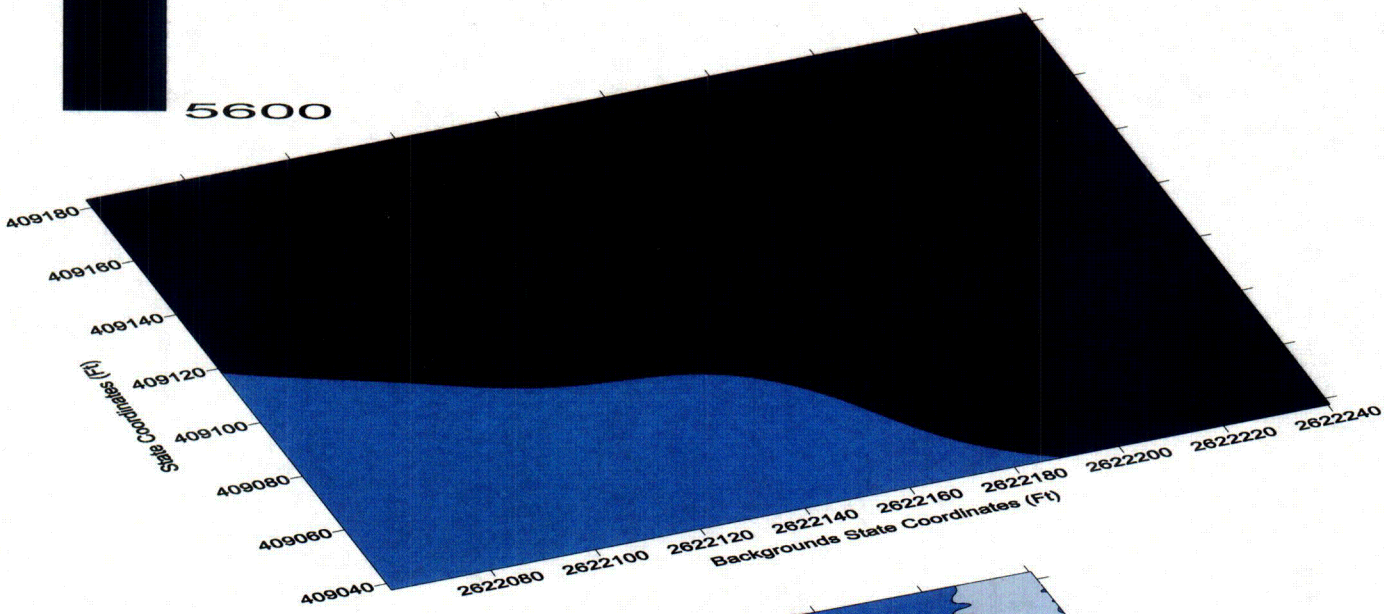
9600

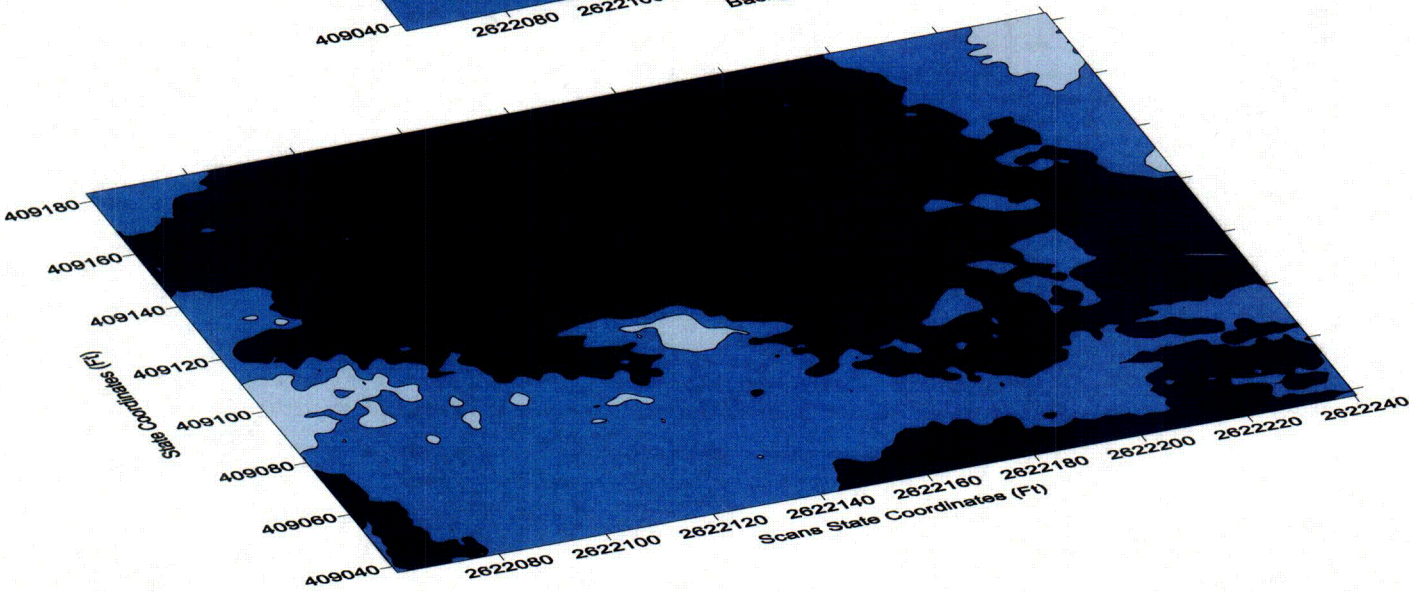
7600

5600

N

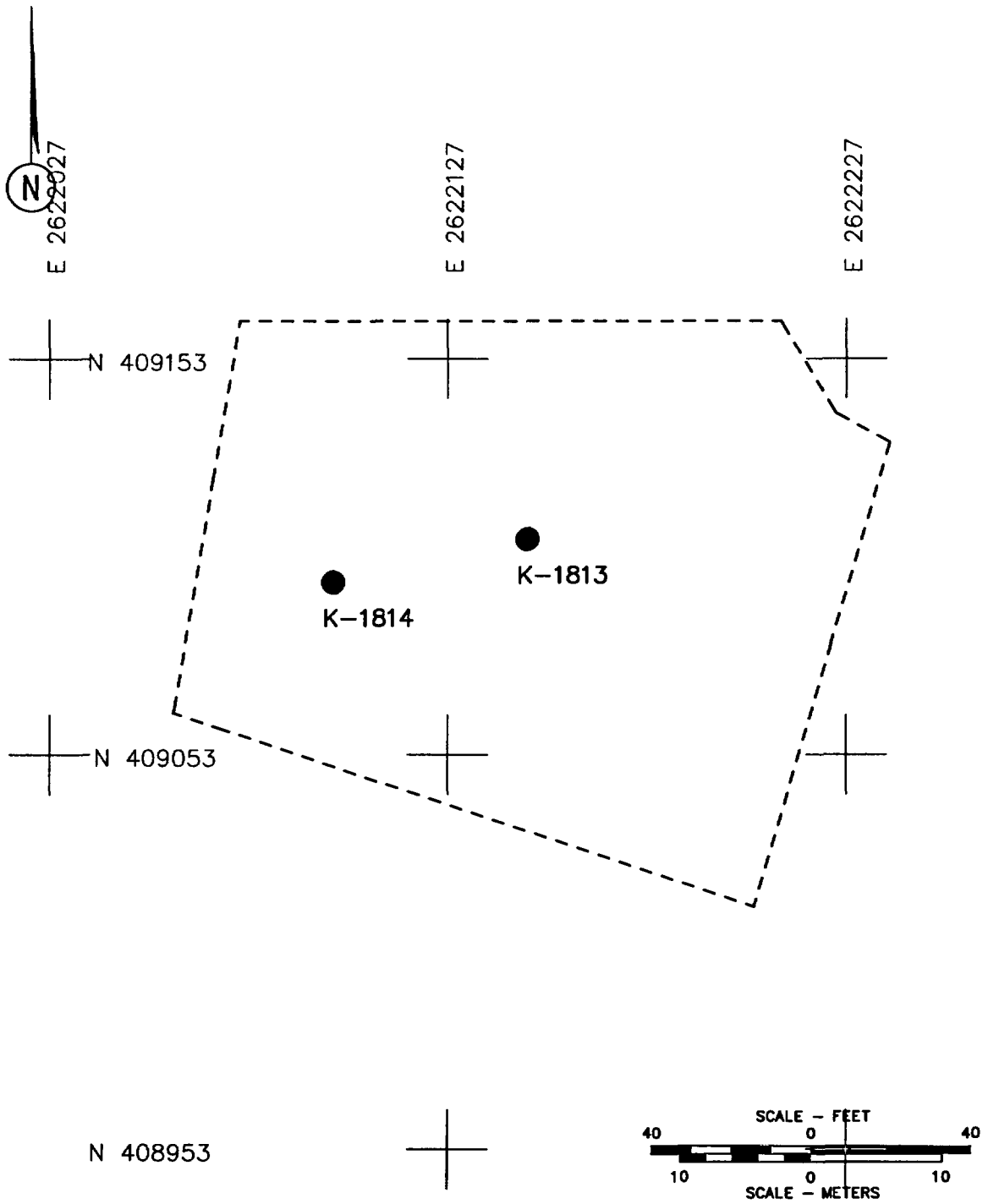
Backgrounds are 1 minute readings.





Scanning readings are recorded at 2 second intervals.

C-09



K-1813
● BIASED SOIL SAMPLING LOCATION BASED ON GROSS GAMMA SCAN RESULTS

FIGURE A-2
GROSS GAMMA SURVEY BIASED SOIL SAMPLING LOCATIONS
SURVEY UNIT KAISER FSSPOA-004
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFD 08/18/06
CHECKED	RFD 08/18/06
DRAWN	DEB 07/17/06

DRAWING NUMBER
PA4072089B

Penn E&R
Environmental & Remediation, Inc.

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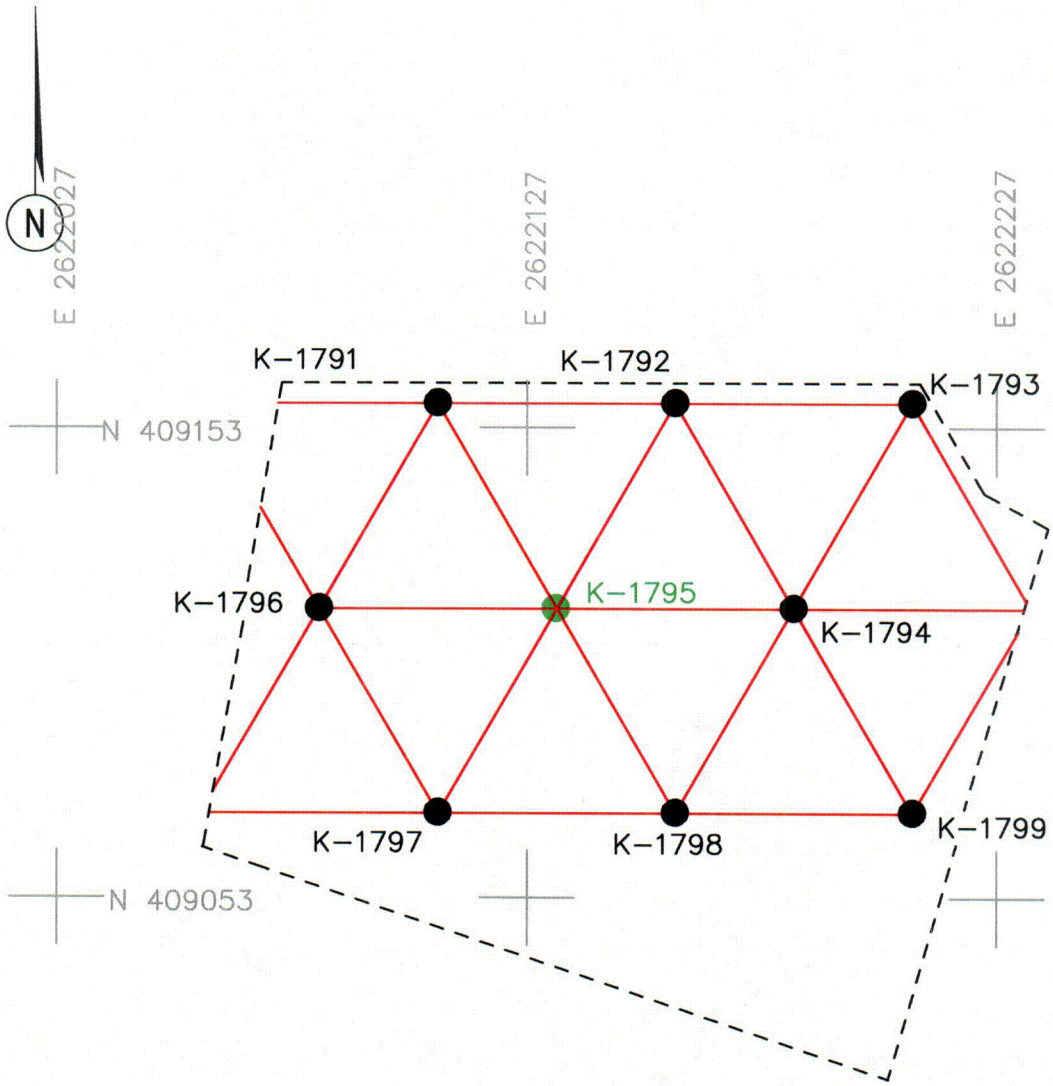
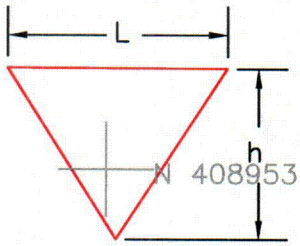
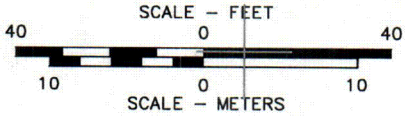




N = 9
L = 15.4m
h = 13.3m
AREA = 1,841m^2



K-1791
● SYSTEMATIC SOIL SAMPLING LOCATION BASED ON RANDOM START POINT AND AN EQUAL DISTANT TRIANGULAR GRID

K-1795
● RANDOM START POINT

FIGURE A-3
SYSTEMATIC SOIL SAMPLING LOCATIONS
SURVEY UNIT KAISER - FSSPOA-004
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFD	08/18/06
CHECKED	RFD	08/18/06
DRAWN	DEB	07/17/06

DRAWING NUMBER
PA4072089A

Penn E&R
Environmental & Remediation, Inc.

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C-10

ATTACHMENT B
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- **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-FSSPOA-004

2. Description: Retention Pond Area, Overlying Excavation Bottom Survey Unit Kaiser-FSS-009

3. Net Th-232 Acceptance Criteria (pCi/g): 3.0

4. Dimensions (m): Post Operational Area – approximately 48 meters x 38 meters; Area, A (m^2): 1,841

5. Estimated of Gross Gamma Scan Background Readings (cpm)
Average: 15,000 Minimum: 10,000 Maximum: 30,000

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 m^2 Class 1 survey unit are:

- Gross Gamma Scan MDC (pCi/g): 3.1
- 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 m^2, recalculate the corresponding Triangular Grid Node Length (L_1) for the Survey Unit Area (A), using the following formula: $L_1 = (A/(0.866 \times 9))^{1/2}$: 15.4 m

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

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

10. Calculate the height (h) of the equilateral triangle with side length equal to L (or L_1) using the following formula: $h = ((L^2 - (L/2)^2)^{1/2}$: 13.3 m.

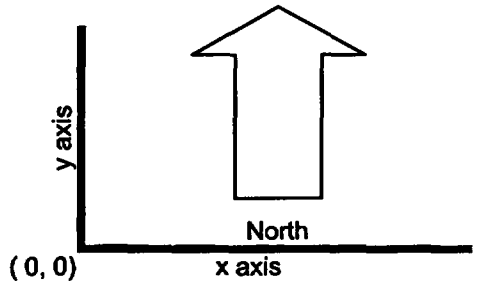
Soil Survey Unit Worksheet No. 2
Random Number Generator for Start Point
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

SURVEY UNIT: KAISER-FSSPOA-004

RANDOM START POINT

x axis (Meters)	y axis (Meters)
20	30

	x axis	y axis
lower bound	0	0
upper bound	48	38



ATTACHMENT C

Laboratory Analytical Results

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

K-1791 → K1799
POA-004
INVOICE # 12168
DATE: 6-29-06

June 29, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060540

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples received in our laboratory on June 22, 2006 for the above captioned project. Nine soil samples were received in good condition and analyzed by Gamma Spectroscopy without drying and grinding and Percent Moisture with an expedited 5-work day turn. Results were faxed on 6/28/06.

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

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID #OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060540
Date Reported:	6/29/06
Date Received:	6/20/06
Page Number:	1 of 3

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060540-01						
Client ID:	K-1791						
Date Sampled:	6/21/06 2:30:00 PM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.095 +/- 0.072	pCi/g	0.169		6/28/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	2.7	%		6/22/06	6/23/06	RS
Lab ID:	20060540-02						
Client ID:	K-1792						
Date Sampled:	6/21/06 2:35:00 PM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.091 +/- 0.046	pCi/g	0.137		6/26/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	3.4	%		6/22/06	6/23/06	RS
Lab ID:	20060540-03						
Client ID:	K-1793						
Date Sampled:	6/21/06 2:40:00 PM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.064 +/- 0.100	pCi/g	0.241		6/26/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	3.5	%		6/22/06	6/23/06	RS
Lab ID:	20060540-04						
Client ID:	K-1794						
Date Sampled:	6/21/06 2:45:00 PM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.189 +/- 0.018	pCi/g	0.198		6/28/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	3.6	%		6/22/06	6/23/06	RS
Lab ID:	20060540-05						
Client ID:	K-1795						
Date Sampled:	6/21/06 2:50:00 PM						
Matrix:	Soil						
		Radiochemical Analyses					

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060540
Date Reported:	6/29/06
Date Received:	6/20/06
Page Number:	2 of 3

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Thorium 232	HASL 300	0.199 +/- 0.045	pCi/g	0.211		6/26/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	2.6	%		6/22/06	6/23/06	RS

Lab ID: 20060540-06
Client ID: K-1796
Date Sampled: 6/21/06 2:55:00 PM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.107 +/- 0.153	pCi/g	0.251		6/28/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	3.6	%		6/22/06	6/23/06	RS

Lab ID: 20060540-07
Client ID: K-1797
Date Sampled: 6/21/06 3:00:00 PM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.465 +/- 0.105	pCi/g	0.205		6/26/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	4.1	%		6/22/06	6/23/06	RS

Lab ID: 20060540-08
Client ID: K-1798
Date Sampled: 6/21/06 3:05:00 PM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.504 +/- 0.233	pCi/g	0.379		6/28/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	3.7	%		6/22/06	6/23/06	RS

Lab ID: 20060540-09
Client ID: K-1799
Date Sampled: 6/21/06 3:10:00 PM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.122 +/- 0.070	pCi/g	0.126		6/26/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-92	4.1	%		6/22/06	6/23/06	RS

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060540
Date Reported:	6/29/06
Date Received:	6/20/06
Page Number:	3 of 3

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Ac-228					NC				6/28/06
Am-241		95.0	84.0	13.0					6/28/06
Co-60		95.0	86.0	9.9					6/28/06
Cs-137		97.0	89.0	8.8					6/28/06
Percent Moisture					12.4				6/23/06

Lab Approval: _____

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company: Kaiser Alum & Chem Corp
Name: David E. Wright
Address: 7711 E. 41st St.
City: Tulsa State: OK Zip: 74145
Phone: 724-934-3370 Fax #: 918-384-3171
Local: 918-384-0106
Cell: 724-799-0071

Bill To:
Company: Kaiser / Paul Dana
Name: Paul Dana / David Wright
Address: 7711 E. 41st St.
City: Tulsa State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: Kaiser - 4472
PROJECT #: [illegible] - 4472
PROJECT NAME: Kaiser - [illegible]
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): 5 DAY
SAMPLER: [illegible] Signature: David Wright

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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)	[illegible]	[illegible]	[illegible]	[illegible]					REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
1	K-1791	6-21-06	1430	Soil	1	Plastic	none	X	X	X	X					Grab
2	K-1792		1435		1			X	X	X	X					
3	K-1793		1440		1			X	X	X	X					
4	K-1794		1445		1			X	X	X	X					
5	K-1795		1450		1			X	X	X	X					
6	K-1796		1455		1			X	X	X	X					
7	K-1797		1500		1			X	X	X	X					
8	K-1798		1505		1			X	X	X	X					
9	K-1799		1510		1			X	X	X	X					

RELINQUISHED BY: [illegible] DATE: [illegible] TIME: [illegible] RECEIVED BY: [illegible] DATE: [illegible] TIME: [illegible]

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.

FOR LABORATORY USE ONLY: 20060940

Sample Condition Upon Receipt: Good

Custody Seals Intact: (Y) N

Cooler Temperature: [illegible]

SAMPLE LOGIN

6/22/06

Date Received: ~~6/20/06~~ 10:01:42 | Lab Number: 20060540 | Due: 6/28/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060540-01 A	K-1791	Soil	06/21/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060540-02 A	K-1792	Soil	06/21/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060540-03 A	K-1793	Soil	06/21/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060540-04 A	K-1794	Soil	06/21/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060540-05 A	K-1795	Soil	06/21/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060540-06 A	K-1796	Soil	06/21/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060540-07 A	K-1797	Soil	06/21/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060540-08 A	K-1798	Soil	06/21/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060540-09 A	K-1799	Soil	06/21/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								

CONTAINER INSPECTION

 # Coolers 1 **Custody Seals Broken** ☐ **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ☑ **Labels in Tact** ☑ **Radiation Survey Complete** ☐

Anomalies

Inspected By: _____ **DATE** 6/22/06

QA or Designee Review: _____ **DATE** 6-22-06

Sample Custodian Review: _____ **DATE** 6/22/06

Project Notes:

SUB-REPORT

SURVEY UNIT KAISER-FSSPOA-005

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2.0 SURVEY ACTIVITIES AND RESULTS	2
2.1 Gross Gamma Scan	2
2.2 Systematic Soil Sampling – Surface Soil	3
2.3 Wilcoxon Rank Sum (WRS) Testing	4
3.0 SUMMARY OF FINDINGS	6

ATTACHMENTS

ATTACHMENT A: Figure A-1 Gross Gamma Background and Scanning Survey Results
Figure A-2 Gross Gamma Survey – Biased Soil Sampling Locations
Figure A-3 Systematic Soil 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 VI - Post Operational Areas
Sub-Report No. POA-005
Survey Unit Kaiser-FSSPOA-005
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation
September 12, 2006

1.0 BACKGROUND

This sub-report documents the results of post operational 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-FSSPOA-005, a previously remediated and backfilled open land area used subsequently for material processing and storage. A plastic liner and several feet of clean imported borrow material (limestone screenings) were placed over the remediated and backfilled area prior to using it for material processing and storage. The limestone screening material and underlying plastic liner were removed under the guidance of a Health Physics Technician prior to conducting post-operational final status survey activities.

Survey Unit Kaiser-FSSPOA-005 is considered a Class 1 survey unit with an approximate surface area of 1,660 m^2. It overlies Excavation Bottom Survey Units Kaiser-FSS-007 and Kaiser-FSS-012. It is bounded to the south by the Union Pacific Railroad right-of-way, to the east by Post Operational Survey Unit Kaiser-FSSPOA-006, to the north by Backfill Units Kaiser-FSSB-014 and Kaiser-FSSB-015, and to the west by Post Operational Survey Unit Kaiser-FSSPOA-004 **(Figure 3)**.

2.0 SURVEY ACTIVITIES AND RESULTS

This section of the sub-report presents the final status survey data for the surface soil of Survey Unit Kaiser-FSSPOA-005. The final status survey consisted of a gross gamma scan of the exposed surface soil of the survey unit and systematic soil sampling.

2.1 Gross Gamma Scan

The exposed surface soil of the Class 1 survey unit was surveyed through a 100 percent coverage gamma scan to confirm acceptable radiological conditions and identify any elevated areas. During the scanning of the soil, the detector was held close to the ground surface (1 to 2 inches) and moved in a serpentine pattern. Background measurements were obtained at 1-meter above the ground surface at 16 approximately equal-distant locations in the survey unit. The statistics for the 16 background measurements are provided below in **Table 1**. Background measurements ranged from 6,944 counts per minute (cpm) to 11,515 cpm.

A total of 2,159 measurements of gross count rate were made at two second intervals across the survey unit's 1,660 m^2 surface area. The results ranged from 5,268 cpm to 19,679 cpm. A statistical summary of the 100 percent coverage gamma scan of the survey unit is also provided below in **Table 1**.

Table 1 – Gross Gamma Scan Results Summary

Survey Area:	1,660 m^2	
Number of Scan Measurements (2-Second Intervals):	2,159	
Detector Swing Rate: (Swinging the detector a width of 1-meter side to side)	0.38 m/s (MARSSIM recommends 0.5 m/s)	
Results Summary:	**Background (Gross cpm)**	**Scan (Gross cpm)**
Minimum	6,944	5,268
Maximum	11,515	19,679
Average	9,894	9,990
Standard Deviation	1,378	2,387
Median	10,270	10,376

Contour maps of the gross gamma background and final (as-left condition) scanning survey results are presented on **Figure A-1** contained in **Attachment A**. The 100 percent coverage gross gamma scan did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site). As part of the gross gamma survey, four biased soil samples were collected at locations exhibiting the highest scan rates **(Figure A-2, Attachment A)**. The biased soil samples were screened on-site in a lead cave. The results of the sample screenings are presented below in **Table 2.** The sample screening levels were below the $DCGL_W$ for the site.

Table 2 – Biased Soil Sample Screening Results

Soil Sample ID	Cave Counter Screening Results (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)
$DCGL_W$	*3.0*		
Site Background	*1.1*	*0.3*	
K-1887	1.48	1.02	1.51
K-1888	0.758	1.14	1.51
K-1889	0.801	1.09	1.51
K-1890	2.86	1.08	1.51

2.2 Systematic Soil Sampling – Surface Soil

The final status survey also consisted of systematic soil sampling based on a random start point and an equal-distant triangular grid. The Minimum Number of Samples 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 1,660 m^2 along with the N of 9 was used to calculate the Triangular Grid Node Length (L) of 14.6 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-3** contained in **Attachment A**. The soil sample locations were demarcated in the field using a GPS unit. A total of 10 soil samples (identified as K-1818 through K-1827) were collected at the surface (0-6-inch depth interval) level using a clean, decontaminated sampling auger or sharpshooter shovel. The samples were 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 Sample Results

Soil Sample ID	Gross Th-232 (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)	Net Th-232 (pCi/g)	Net DCGL (pCi/g)
K-1818	0.656	0.154	0.405	0	3.0
K-1819	1.02	0.232	0.649	0	3.0
K-1820	0.751	0.132	0.302	0	3.0
K-1821	0.794	0.069	0.221	0	3.0
K-1822	0.794	0.239	0.485	0	3.0
K-1823	0.717	0.134	0.240	0	3.0
K-1824	0.956	0.154	0.335	0	3.0
K-1825	0.535	0.129	0.405	0	3.0
K-1826	0.708	0.099	0.245	0	3.0
K-1827	0.829	0.203	0.423	0	3.0
Average	***0.776***				
Standard Dev.	***0.140***				
Minimum	***0.535***				
Maximum	***1.02***				
Median	***0.773***				

All 10 systematic soil sample results (gross and net) were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$). The maximum gross Th-232 activity concentration was 1.02 pCi/g, which fell below the background Th-232 activity of 1.1 pCi/g for the site. The average gross Th-232 activity concentration was 0.776 pCi/g. The standard deviation of the 10 equal-distant samples was 0.140, which fell below the estimated standard deviation of 0.42 (based on the adjacent land final status survey results) used to calculate the minimum number of samples required.

2.3 Wilcoxon Rank Sum (WRS) Testing

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

If the difference (0.18 pCi/g) between the maximum survey unit soil sample activity concentration (1.02 pCi/g) and the minimum reference background area soil sample activity concentration (0.84 pCi/g) is less than $DCGL_W$ (3.0 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	212	1.29	S1	K-1818	0.656
R2	368	1.26	S2	K-1819	1.02
R3	202	1.51	S3	K-1820	0.751
R4	219	1.01	S4	K-1821	0.794
R5	59	0.96	S5	K-1822	0.794
R6	360	1.08	S6	K-1823	0.717
R7	140	1.42	S7	K-1824	0.956
R8	264	1.41	S8	K-1825	0.535
R9	273	0.84	S9	K-1826	0.708
R10	297	0.85	S10	K-1827	0.829
	Average	***1.16***		***Average***	***0.776***
	Standard Dev.	***0.25***		***Standard Dev.***	***0.140***
	Minimum	***0.84***		***Minimum***	***0.535***
	Maximum	***1.51***		***Maximum***	***1.02***
	Median	***1.17***		***Median***	***0.773***

3.0 SUMMARY OF FINDINGS

Survey Unit Kaiser-FSSPOA-005 is a previously remediated and backfilled open land area used subsequently for material processing and storage. A plastic liner and several feet of clean imported borrow material (limestone screenings) were placed over the remediated area prior to using it for material processing and storage. The limestone screening material and plastic liner were removed under the guidance of an Health Physics Technician prior to conducting post-operational final status survey activities.

Survey Unit Kaiser-FSSPOA-005 is considered a Class 1 survey unit with an approximate surface area of 1,660 m^2. It overlies Excavation Bottom Survey Units Kaiser-FSS-007 and Kaiser-FSS-012. It is bounded to the south by the Union Pacific Railroad right-of-way, to the east by Post Operational Survey Unit Kaiser-FSSPOA-006, to the north by Backfill Units Kaiser-FSSB-014 and Kaiser-FSSB-015, and to the west by Post Operational Survey Unit Kaiser-FSSPOA-004 **(Figure 3)**.

The acceptance criterion for open land areas (surface soil) at the Tulsa facility is the $DCGL_W$ of 3.0 pCi/g net Th-232 activity concentration. Final status survey activities for Survey Unit Kaiser-FSSPOA-005 consisted of a gross gamma scan of the exposed surface soil of the survey unit and systematic soil sampling. The results of the final status survey activities were as follows:

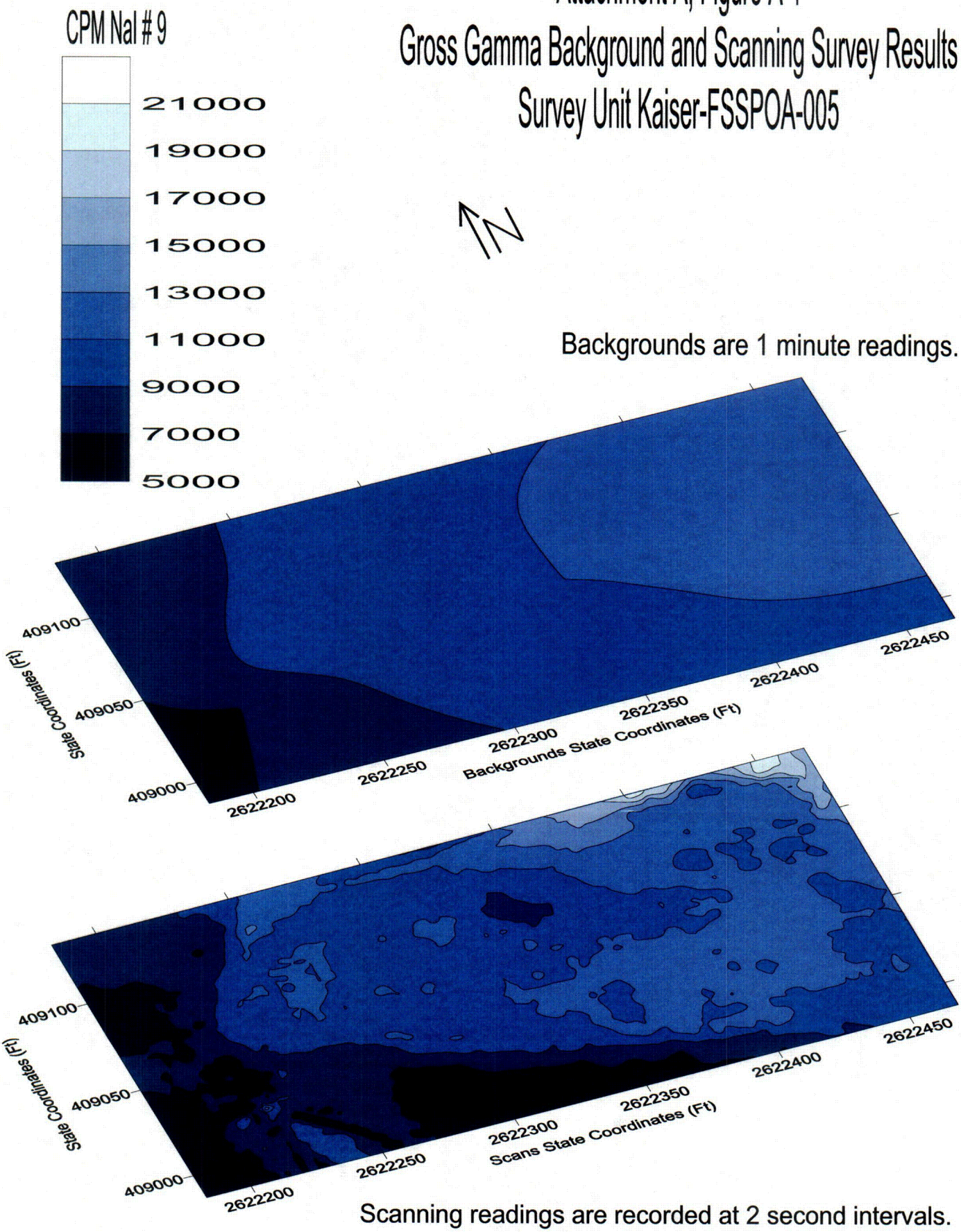
- The 100 percent coverage gamma scan (final as-left condition) did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site).
- All 10 systematic soil sample results (gross and net) were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$).
- The analytical results met 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-FSSPOA-005 meets the DP acceptance criteria.

ATTACHMENT A
TABLE OF CONTENTS

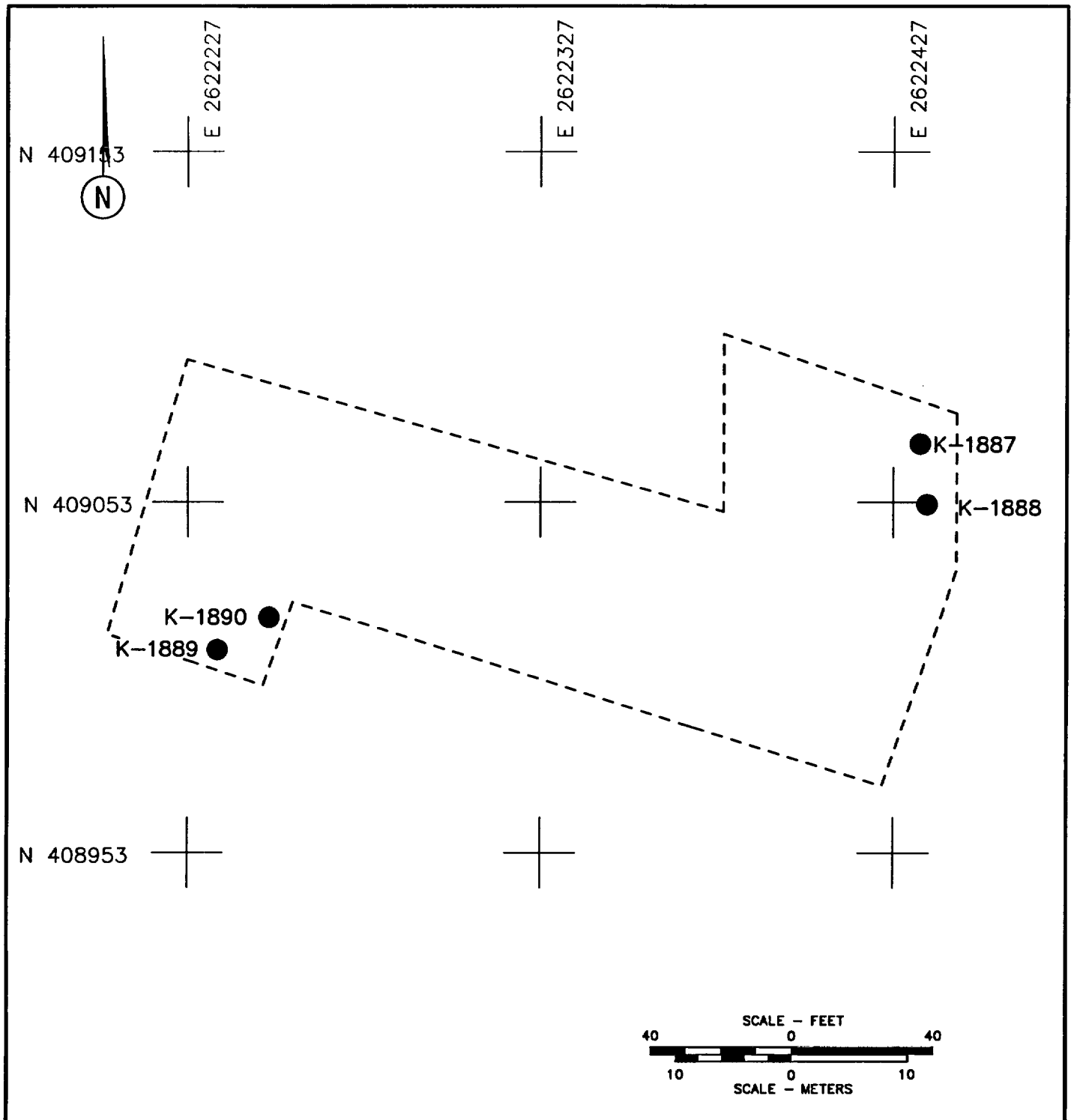
- **FIGURE A-1 Gross Gamma Background and Scanning Survey Results**
- **FIGURE A-2 Gross Gamma Survey - Biased Soil Sampling Locations**
- **FIGURE A-3 Systematic Soil Sampling Locations**

Attachment A, Figure A-1
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSPOA-005



Scanning readings are recorded at 2 second intervals.

C-11



K-1887
● BIASED SOIL SAMPLING LOCATION BASED ON GROSS GAMMA SCAN RESULTS

FIGURE A-2
GROSS GAMMA SURVEY BIASED SOIL SAMPLING LOCATIONS
SURVEY UNIT KAISER - FSSPOA-005
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFD	08/18/06
CHECKED	RFD	08/18/06
DRAWN	DEB	07/17/06

DRAWING NUMBER
PA4072090B

Penn E&R
Environmental & Remediation, Inc.

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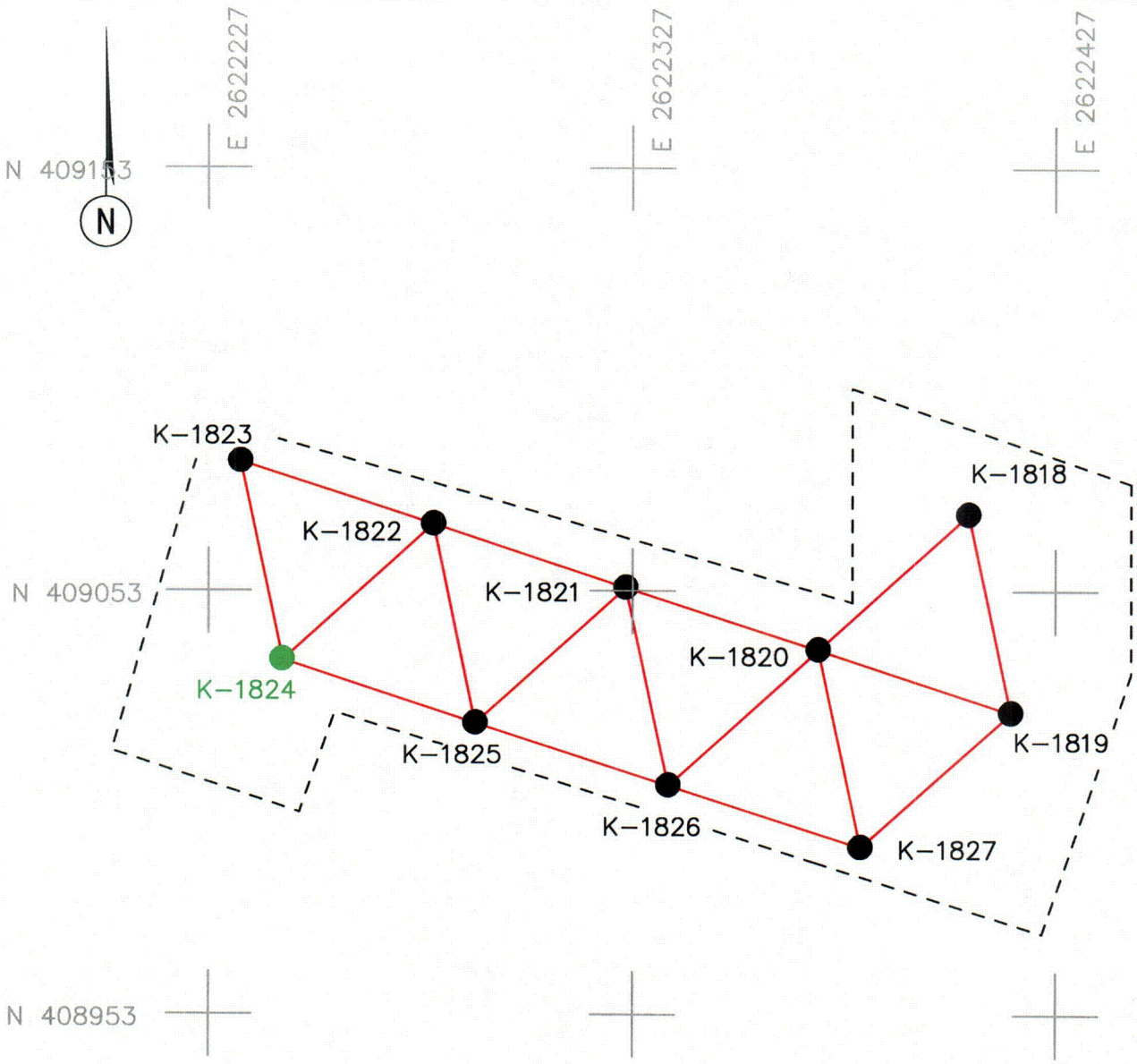

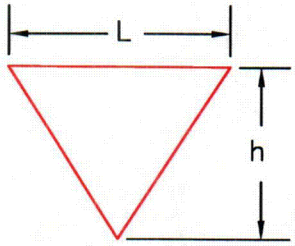

N = 9
L = 14.6m
h = 12.6m
AREA = 1,660m^2

SCALE – FEET
40 0 40
10 0 10
SCALE – METERS

K–1823
● SYSTEMATIC SOIL SAMPLING LOCATION BASED ON RANDOM START POINT AND AN EQUAL DISTANT TRIANGULAR GRID

K–1824
● RANDOM START POINT

FIGURE A–3
SYSTEMATIC SOIL SAMPLING LOCATIONS
SURVEY UNIT KAISER – FSSPOA–005
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFD	08/18/06
CHECKED	RFD	08/18/06
DRAWN	DEB	07/17/06

DRAWING NUMBER
PA4072090A

Penn E&R
Environmental & Remediation, Inc.

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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-FSSPOA-005

2. Description: Retention Pond Area, Overlying Excavation Bottom Survey Unit Kaiser-FSS-012

3. Net Th-232 Acceptance Criteria (pCi/g): 3.0

4. Dimensions (m): Post Operational Area – approximately 65 meters x 26 meters; Area, A (m^2): 1,660

5. Estimated of Gross Gamma Scan Background Readings (cpm)
Average: 15,000 Minimum: 10,000 Maximum: 30,000

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 m^2 Class 1 survey unit are:

- Gross Gamma Scan MDC (pCi/g): 3.1
- 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 m^2, recalculate the corresponding Triangular Grid Node Length (L_1) for the Survey Unit Area (A), using the following formula: $L_1 = (A/(0.866 \times 9))^{1/2}$: 14.6 m

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

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

10. Calculate the height (h) of the equilateral triangle with side length equal to L (or L_1) using the following formula: $h = ((L^2 - (L/2)^2)^{1/2}$: 12.6 m.

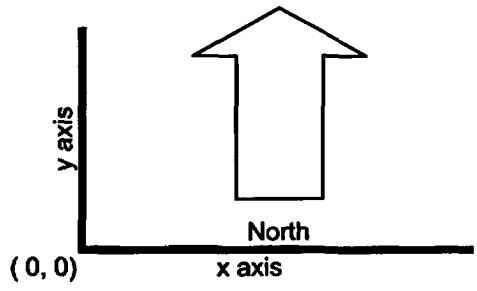
Soil Survey Unit Worksheet No. 2
Random Number Generator for Start Point
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

SURVEY UNIT: KAISER-FSSPOA-005

RANDOM START POINT

x axis (Meters)	y axis (Meters)
10	10

	x axis	y axis
lower bound	0	0
upper bound	65	26



ATTACHMENT C

Laboratory Analytical Results

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

POA-005
Invoice # 12216
7-12-06

July 5, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060555

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples received in our laboratory on June 28, 2006 for the above captioned project. Ten soil samples were received in good condition and analyzed by Gamma Spectroscopy without drying and grinding and Percent Moisture with an expedited 6 work day turn. Results were faxed on 7/7/06.

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

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID #OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060555
Date Reported:	7/7/06
Date Received:	6/28/06
Page Number:	1 of 3

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060555-01						
Client ID:	K-1818						
Date Sampled:	6/27/06 11:05:00 AM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.656 +/- 0.154	pCi/g	0.405		6/30/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	7.2	%		6/29/06	6/30/06	RS
Lab ID:	20060555-02						
Client ID:	K-1819						
Date Sampled:	6/27/06 11:10:00 AM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	1.02 +/- 0.232	pCi/g	0.649		6/30/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	7.9	%		6/29/06	6/30/06	RS
Lab ID:	20060555-03						
Client ID:	K-1820						
Date Sampled:	6/27/06 11:15:00 AM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.751 +/- 0.132	pCi/g	0.302		6/30/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	6.3	%		6/29/06	6/30/06	RS
Lab ID:	20060555-04						
Client ID:	K-1821						
Date Sampled:	6/27/06 11:20:00 AM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.794 +/- 0.069	pCi/g	0.221		6/30/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	19.9	%		6/29/06	6/30/06	RS
Lab ID:	20060555-05						
Client ID:	K-1822						
Date Sampled:	6/27/06 11:25:00 AM						
Matrix:	Soil						
		Radiochemical Analyses					

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060555
Date Reported:	7/7/06
Date Received:	6/28/06
Page Number:	2 of 3

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Thorium 232	HASL 300	0.794 +/- 0.239	pCi/g	0.485		6/30/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	10.0	%		6/29/06	6/30/06	RS

Lab ID: 20060555-06
Client ID: K-1823
Date Sampled: 6/27/06 11:30:00 AM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.717 +/- 0.134	pCi/g	0.240		6/30/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	8.6	%		6/29/06	6/30/06	RS

Lab ID: 20060555-07
Client ID: K-1824
Date Sampled: 6/27/06 11:35:00 AM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.956 +/- 0.154	pCi/g	0.335		6/30/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	8.2	%		6/29/06	6/30/06	RS

Lab ID: 20060555-08
Client ID: K-1825
Date Sampled: 6/27/06 11:40:00 AM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.535 +/- 0.129	pCi/g	0.405		6/30/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	3.8	%		6/29/06	6/30/06	RS

Lab ID: 20060555-09
Client ID: K-1826
Date Sampled: 6/27/06 11:45:00 AM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.708 +/- 0.099	pCi/g	0.245		6/30/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	9.0	%		6/29/06	6/30/06	RS

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060555
Date Reported:	7/7/06
Date Received:	6/28/06
Page Number:	3 of 3

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060555-10						
Client ID:	K-1827						
Date Sampled:	6/27/06 11:50:00 AM						
Matrix:	Soil						
	Radiochemical Analyses						
Thorium 232	HASL 300	0.829 +/- 0.203	pCi/g	0.423		7/3/06	SD
	Inorganics Analyses						
Percent Moisture	ASTM D2216-98	15.7	%		6/29/06	6/30/06	RS

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Ac-228					NC				7/3/06
Am-241		92.0	87.0	5.6					7/3/06
Co-60		90.0	117.0	26.0					7/3/06
Cs-137		92.0	101.0	8.8					7/3/06
Percent Moisture					31.5				6/30/06

Lab Approval:

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHI:

CHAIN OF CUSTODY

Results To:
LOCAL: 918-784-0566
724-794-0071
Company: KAISER ALUM & CHEM INC.
Name: DAVID R. WEYANT
Address: 7311 E. 41ST ST.
City: TULSA State: OK Zip: 74145
Phone: 918-494-6622 Fax #: 918-784-0171

Bill To:
Company: KAISER / BENEFIT
Name: DAVID WEYANT
Address: 7311 E. 41ST ST.
City: TULSA State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: KAISER - 4072
PROJECT #: DA - 4072 - 4072
PROJECT NAME: KAISER - TULSA PROJ.
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): 5 DAY
SAMPLER: DAVID R. WEYANT (Signature)

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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)	[illegible]	[illegible]	MDC COLIS	ASTM 2716.92					REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
	K-1618	6-27-06	1105	Soil	1	Plastic	NONE	X	X	X	X					Grab
	K-1619		1110		1			X	X	X	X					
	K-1620		1115		1			X	X	X	X					
	K-1621		1120		1			X	X	X	X		ND			
	K-1622		1125		1			X	X	X	X				Δ	
	K-1623		1130		1			X	X	X	X					
	K-1624		1135		1			X	X	X	X					
	K-1625		1140		1			X	X	X	X					
	K-1626		1145		1			X	X	X	X					
	K-1627		1150		1			X	X	X	X					

RELINQUISHED BY: DAVID R. WEYANT DATE 6/27/06 TIME 1515 RECEIVED BY: [illegible] DATE 6/27/06 TIME 1515

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.

FOR LABORATORY USE ONLY: [illegible]

Sample Condition Upon Receipt: [illegible]

Custody Seals Intact Y N

Cooler Temperature: N/A

SAMPLE LOGIN

Date Received: *6/28/06 9:19:52 A* **Lab Number:** 20060555 **Due:** 7/5/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060555-01 A	K-1818	Soil	06/27/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060555-02 A	K-1819	Soil	06/27/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060555-03 A	K-1820	Soil	06/27/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060555-04 A	K-1821	Soil	06/27/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060555-05 A	K-1822	Soil	06/27/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060555-06 A	K-1823	Soil	06/27/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060555-07 A	K-1824	Soil	06/27/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060555-08 A	K-1825	Soil	06/27/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060555-09 A	K-1826	Soil	06/27/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060555 A	K-1827	Soil	06/27/06	Plastic	16 oz	None	Yes	Yes

Gamma Spec - Thorium 232
Percent Moisture (LOD)

CONTAINER INSPECTION

 # Coolers 0 **Custody Seals Broken** ☐ **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ☑ **Labels in Tact** ☑ **Radiation Survey Complete** ☑

Anomalies

Inspected By: _____ **DATE** _____

QA or Designee Review: Raymond Thomas **DATE** 06/28/06

Sample Custodian Review: D Gregory **DATE** 6/28/06

Project Notes:

SUB-REPORT

SURVEY UNIT KAISER-FSSPOA-006

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2.0 SURVEY ACTIVITIES AND RESULTS	2
2.1 Gross Gamma Scan	2
2.2 Systematic Soil Sampling – Surface Soil	2
2.3 Wilcoxon Rank Sum (WRS) Testing	3
3.0 SUMMARY OF FINDINGS	5

ATTACHMENTS

ATTACHMENT A: Figure A-1 Gross Gamma Background and Scanning Survey Results
Figure A-2 Systematic Soil 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 VI - Post Operational Areas
Sub-Report No. POA-006
Survey Unit Kaiser-FSSPOA-006
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation
September 12, 2006

1.0 BACKGROUND

This sub-report documents the results of post operational 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-FSSPOA-006, a previously remediated and backfilled open land area subsequently used for the construction of a sump associated with the asphalt decontamination pad. The sump was decommissioned at the end of the Thorium Remediation Project.

Survey Unit Kaiser-FSSPOA-006 is considered a Class 1 survey unit with an approximate surface area of 111 m^2. It overlies backfilled (clean import material) Excavation Bottom Survey Unit Kaiser-FSS-012. It is bounded to the south by Post Operational Survey Unit Kaiser-FSSPOA-009, to the east by Excavation Bottom Survey Unit Kaiser-FSS-030, and to the north and west by Post Operational Survey Unit Kaiser-FSSPOA-005 **(Figure 3)**.

2.0 SURVEY ACTIVITIES AND RESULTS

This section of the sub-report presents the final status survey data for the surface soil of Survey Unit Kaiser-FSSPOA-006. The final status survey consisted of a gross gamma scan of the exposed surface soil of the survey unit and systematic soil sampling.

2.1 Gross Gamma Scan

The exposed surface soil of the Class 1 survey unit was surveyed through a 100 percent coverage gamma scan to confirm acceptable radiological conditions and identify any elevated areas. During the scanning of the soil, the detector was held close to the ground surface (1 to 2 inches) and moved in a serpentine pattern. Background measurements were obtained at 1-meter above the ground surface at 4 approximately equal-distant locations in the survey unit. The statistics for the 4 background measurements are provided below in **Table 1**. Background measurements ranged from 7,300 counts per minute (cpm) to 11,265 cpm.

A total of 432 measurements of gross count rate were made at two second intervals across the survey unit's 111 m^2 surface area. The results ranged from 6,881 cpm to 15,866 cpm. A statistical summary of the 100 percent coverage gamma scan of the survey unit is also provided below in **Table 1**.

Table 1 – Gross Gamma Scan Results Summary

Survey Area:	111 m^2	
Number of Scan Measurements (2-Second Intervals):	432	
Detector Swing Rate: (Swinging the detector a width of 1-meter side to side)	0.13 m/s (MARSSIM recommends 0.5 m/s)	
Results Summary:	**Background (Gross cpm)**	**Scan (Gross cpm)**
Minimum	7,300	6,881
Maximum	11,265	15,866
Average	9,694	11,222
Standard Deviation	1,873	1,920
Median	10,105	11,743

Contour maps of the gross gamma background and final (as-left condition) scanning survey results are presented on **Figure A-1** contained in **Attachment A**. The 100 percent coverage gross gamma scan did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site).

2.2 Systematic Soil Sampling – Surface Soil

The final status survey also consisted of systematic soil sampling based on a random start point and an equal-distant triangular grid. The Minimum Number of Samples 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 111 m^2 along with the N of 9 was used to calculate the Triangular Grid Node Length (L) of 3.8 meters and the Height of the Equilateral Triangle (h) of 3.3 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-2** contained in **Attachment A**. The soil sample locations were demarcated in the field using a GPS unit. A total of 9 soil samples (identified as K-1937 through K-1945) were collected at the surface (0-6-inch depth interval) level using a clean, decontaminated sampling auger or sharpshooter shovel. The samples were forwarded to Outreach for analysis of Th-232 activity concentration. Analytical results are provided below in **Table 2**. Analytical data reports are contained in **Attachment C**.

Table 2 – Systematic Soil Sample Results

Soil Sample ID	Gross Th-232 (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)	Net Th-232 (pCi/g)	Net DCGL (pCi/g)
K-1937	1.31	0.193	0.283	0.21	3.0
K-1938	0.401	0.171	0.398	0	3.0
K-1939	0.891	0.185	0.337	0	3.0
K-1940	0.726	0.229	0.401	0	3.0
K-1941	0.696	0.129	0.272	0	3.0
K-1942	0.546	0.164	0.323	0	3.0
K-1943	0.807	0.226	0.411	0	3.0
K-1944	1.71	0.195	0.340	0.61	3.0
K-1945	0.455	0.116	0.324	0	3.0
Average	***0.838***				
Standard Dev.	***0.42***				
Minimum	***0.401***				
Maximum	***1.71***				
Median	***0.726***				

All 9 systematic soil sample results (gross and net) were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$). The maximum gross Th-232 activity concentration was 1.71 pCi/g, which fell slightly above the background Th-232 activity of 1.1 pCi/g for the site. The average gross Th-232 activity concentration was 0.838 pCi/g. The standard deviation of the 9 equal-distant samples was 0.42, which was equal to the estimated standard deviation of 0.42 (based on the adjacent land final status survey results) used to calculate the minimum number of samples required.

2.3 Wilcoxon Rank Sum (WRS) Testing

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

If the difference (1.01 pCi/g) between the maximum survey unit soil sample activity concentration (1.71 pCi/g) and the minimum reference background area soil sample activity concentration (0.70 pCi/g) is less than $DCGL_W$ (3.0 pCi/g), then the survey unit meets the release criterion. **Table 3** presents a summary of the data used to complete the statistical evaluation of the survey unit.

Table 3 – 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	347	0.90	S1	K-1937	1.31
R2	166	1.32	S2	K-1938	0.401
R3	185	0.90	S3	K-1939	0.891
R4	5	0.90	S4	K-1940	0.726
R5	27	1.24	S5	K-1941	0.696
R6	366	0.99	S6	K-1942	0.546
R7	269	0.97	S7	K-1943	0.807
R8	139	0.70	S8	K-1944	1.71
R9	24	0.85	S9	K-1945	0.455
	Average	***0.97***		***Average***	***0.838***
	Std. Dev.	***0.19***		***Std. Dev.***	***0.42***
	Minimum	***0.70***		***Minimum***	***0.401***
	Maximum	***1.32***		***Maximum***	***1.71***
	Median	***0.90***		***Median***	***0.726***

3.0 SUMMARY OF FINDINGS

Survey Unit Kaiser-FSSPOA-006 is previously remediated and backfilled open land area subsequently used for the construction of a sump associated with the asphalt decontamination pad. The sump was decommissioned at the end of the Thorium Remediation Project. Survey Unit Kaiser-FSSPOA-006 is considered a Class 1 survey unit with an approximate surface area of 111 m^2. It overlies backfilled (clean import material) Excavation Bottom Survey Unit Kaiser-FSS-012. It is bounded to the south by Post Operational Survey Unit Kaiser-FSSPOA-009, to the east by Excavation Bottom Survey Unit Kaiser-FSS-030, and to the north and west by Post Operational Survey Unit Kaiser-FSSPOA-005 **(Figure 3)**.

The acceptance criterion for open land areas (surface soil) at the Tulsa facility is the $DCGL_W$ of 3.0 pCi/g net Th-232 activity concentration. Final status survey activities for Survey Unit Kaiser-FSSPOA-006 consisted of a gross gamma scan of the exposed surface soil of the survey unit and systematic soil sampling. The results of the final status survey activities were as follows:

- The 100 percent coverage gamma scan (final as-left condition) did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site).
- All 9 systematic soil sample results (gross and net) were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$).
- The analytical results met 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-FSSPOA-006 meets the DP acceptance criteria.

ATTACHMENT A
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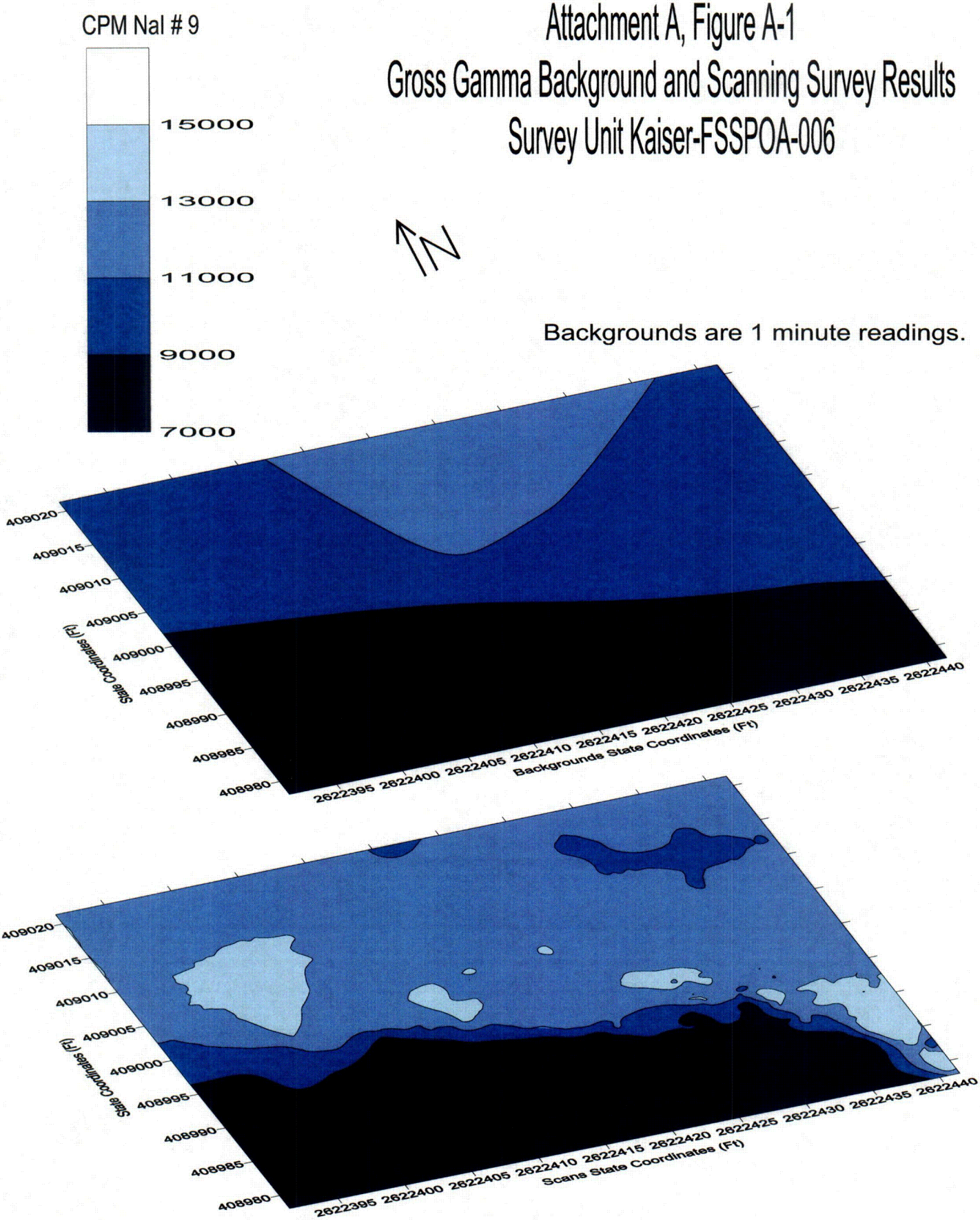
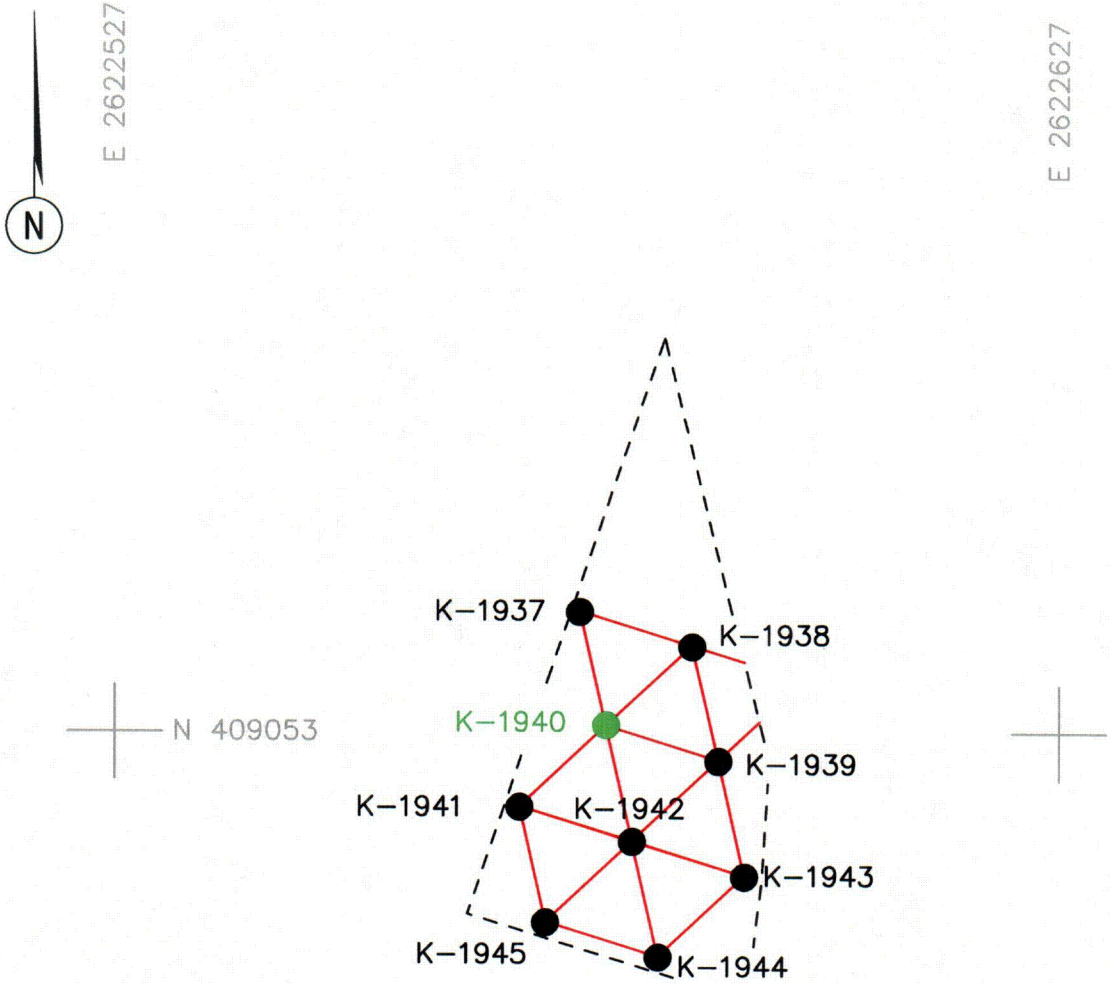
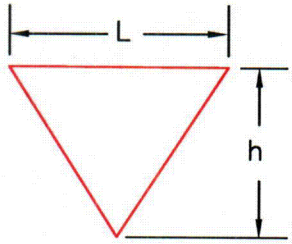
- **FIGURE A-1 Gross Gamma Background and Scanning Survey Results**
- **FIGURE A-2 Systematic Soil Sampling Locations**

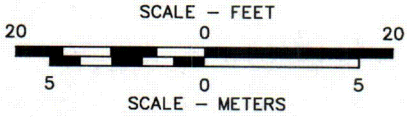
Attachment A, Figure A-1
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSPOA-006







N = 9
L = 3.8m
h = 3.3m
AREA = 111m^2



K–1937
● SYSTEMATIC SOIL SAMPLING LOCATION BASED ON RANDOM START POINT AND AN EQUAL DISTANT TRIANGULAR GRID

K–1940
● RANDOM START POINT

FIGURE A–2
SYSTEMATIC SOIL SAMPLING LOCATIONS
SURVEY UNIT KAISER–FSSPOA–006
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFD	08/31/06
CHECKED	RFD	08/31/06
DRAWN	DEB	08/03/06

DRAWING NUMBER
PA4072096

Penn E&R
Environmental & Remediation, Inc.

C-14

ATTACHMENT B
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- **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-FSSPOA-006

2. Description: Asphalt Decontamination Pad Sump Area

3. Net Th-232 Acceptance Criteria (pCi/g): 3.0

4. Dimensions (m): Post Operational Area – approximately 9.5 meters x 12 meters; Area, A (m^2): 111

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

Average: 15,000 Minimum: 10,000 Maximum: 30,000

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 m^2 Class 1 survey unit are:

- Gross Gamma Scan MDC (pCi/g): 3.1
- 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 m^2, recalculate the corresponding Triangular Grid Node Length (L_1) for the Survey Unit Area (A), using the following formula: $L_1 = (A/(0.866 \times 9))^{1/2}$: 3.8 m

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

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

10. Calculate the height (h) of the equilateral triangle with side length equal to L (or L_1) using the following formula: $h = ((L^2 - (L/2)^2)^{1/2}$: 3.3 m.

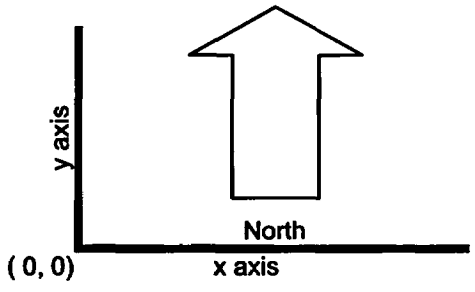
Soil Survey Unit Worksheet No. 2
Random Number Generator for Start Point
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

SURVEY UNIT: KAISER-FSSPOA-006

RANDOM START POINT

x axis (Meters)	y axis (Meters)
2	7

	x axis	y axis
lower bound	0	0
upper bound	9.5	12



ATTACHMENT C

Laboratory Analytical Results

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

Invoice # 12319
K-1937 → 1945
POA- 06

August 10, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060662

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples received in our laboratory on August 7, 2006 for the above captioned project. Nine soil samples were received in good condition and analyzed by Gamma Spectroscopy without drying and grinding and Percent Moisture with an expedited 5-work day. Results were faxed on 8/10/06.

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

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID #OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060661
Date Reported:	8/10/06
Date Received:	8/7/06
Page Number:	1 of 3

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060661-01						
Client ID:	K-1937						
Date Sampled:	8/4/06 10:45:00 AM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	1.31 +/- 0.193	pCi/g	0.283		8/7/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	3.4	%		8/7/06	8/8/06	RS
Lab ID:	20060661-02						
Client ID:	K-1938						
Date Sampled:	8/4/06 10:50:00 AM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.401 +/- 0.171	pCi/g	0.398		8/7/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	3.9	%		8/7/06	8/8/06	RS
Lab ID:	20060661-03						
Client ID:	K-1939						
Date Sampled:	8/4/06 10:55:00 AM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.891 +/- 0.185	pCi/g	0.337		8/7/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	17.3	%		8/7/06	8/8/06	RS
Lab ID:	20060661-04						
Client ID:	K-1940						
Date Sampled:	8/4/06 11:00:00 AM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.726 +/- 0.229	pCi/g	0.401		8/7/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	15.4	%		8/7/06	8/8/06	RS
Lab ID:	20060661-05						
Client ID:	K-1941						
Date Sampled:	8/4/06 11:05:00 AM						
Matrix:	Soil						
		Radiochemical Analyses					

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060661
Date Reported:	8/10/06
Date Received:	8/7/06
Page Number:	2 of 3

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Thorium 232	HASL 300	0.696 +/- 0.129	pCi/g	0.272		8/7/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	12.6	%		8/7/06	8/8/06	RS

Lab ID: 20060661-06
Client ID: K-1942
Date Sampled: 8/4/06 11:10:00 AM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.546 +/- 0.164	pCi/g	0.323		8/7/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	4.1	%		8/7/06	8/8/06	RS

Lab ID: 20060661-07
Client ID: K-1943
Date Sampled: 8/4/06 11:15:00 AM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.807 +/- 0.226	pCi/g	0.411		8/8/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	15.8	%		8/7/06	8/8/06	RS

Lab ID: 20060661-08
Client ID: K-1944
Date Sampled: 8/4/06 11:20:00 AM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	1.71 +/- 0.195	pCi/g	0.340		8/7/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	1.0	%		8/7/06	8/8/06	RS

Lab ID: 20060661-09
Client ID: K-1945
Date Sampled: 8/4/06 11:25:00 AM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.455 +/- 0.116	pCi/g	0.324		8/8/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	4.8	%		8/7/06	8/8/06	RS

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060661
Date Reported:	8/10/06
Date Received:	8/7/06
Page Number:	3 of 3

QC Report

Parameter	Blank	LCS	LCSD		DUP	MS	MSD		Date
		%REC	%REC	RPD	RPD	%REC	%REC	RPD	
Ac-228					15.6				8/7/06
Am-241		91.0	82.0	10.7					8/7/06
Co-60		94.0	95.0	1.3					8/7/06
Cs-137		95.0	93.0	2.3					8/7/06
Percent Moisture					11.4				8/8/06

Lab Approval:

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To: Company Kaiser-Alumina Chem Inc.
Name David G. Weyand
Address 7711 E. 41st St.
City Tulsa State OK Zip 74145
Phone 724-934-3373 Fax # 918-384-7171

Local: 918-384-0161
Cell: 724-799-0071

Bill To:
Company Kaiser / Bill & R
Name Bill Vinzant / David Weyand
Address 7711 E. 41st St.
City Tulsa State OK Zip 74145

ANALYSIS REQUESTED

PO # Kaiser-4072
PROJECT # PA-4000-4072
PROJECT NAME Kaiser-Floyd, Tomo.
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY) 5 DAY
SAMPLER David G. Weyand / David Dollins
Signature

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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 (EL-777)	Radium 226 Ra 228 Analysis	NDC < 0.05 pCi/g	Asta Radium 226, 92 Radium Content					REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
	K-1937	8-4-06	1045	Soil	1	Plastic	None	X	X	X	X					Grab
	K-1938		1050		1			X	X	X	X					
	K-1939		1055		1			X	X	X	X					
	K-1940		1100		1			X	X	X	X					
	K-1941		1105		1			X	X	X	X					
	K-1942		1110		1			X	X	X	X					
	K-1943		1115		1			X	X	X	X					
	K-1944		1120		1			X	X	X	X					
	K-1945		1125		1			X	X	X	X					

RELINQUISHED BY: David Dollins DATE / / TIME / / RECEIVED BY: [illegible] DATE / / TIME / /
RELINQUISHED BY: David Dollins 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 Good
Custody Seals Intact Y N
Cooler Temperature NA

SAMPLE LOGIN

Date Received: *8/7/06 1:37:09 P* **Lab Number:** 20060661 **Due:** 8/14/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060661-01 A	K-1937	Soil	08/04/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060661-02 A	K-1938	Soil	08/04/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060661-03 A	K-1939	Soil	08/04/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060661-04 A	K-1940	Soil	08/04/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060661-05 A	K-1941	Soil	08/04/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060661-06 A	K-1942	Soil	08/04/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060661-07 A	K-1943	Soil	08/04/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060661-08 A	K-1944	Soil	08/04/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060661-09 A	K-1945	Soil	08/04/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								

CONTAINER INSPECTION

 # Coolers 0 **Custody Seals Broken** ☐ **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ☑ **Labels in Tact** ☑ **Radiation Survey Complete** ☑

Anomalies

Inspected By: _____ **DATE** _____

QA or Designee Review: _____ **DATE** _____

Sample Custodian Review: _____ **DATE** _____

Project Notes:

SUB-REPORT

SURVEY UNIT KAISER-FSSPOA-007

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2.0 SURVEY ACTIVITIES AND RESULTS	2
2.1 Gross Gamma Scan	2
2.2 Random Soil Sampling – Surface Soil	2
2.3 Wilcoxon Rank Sum (WRS) Testing	3
3.0 SUMMARY OF FINDINGS	5

ATTACHMENTS

ATTACHMENT A: Figure A-1 Gross Gamma Background and Scanning Survey Results
Figure A-2 Random Soil Sampling Locations

ATTACHMENT B: Soil Survey Unit Worksheet No. 1

ATTACHMENT C: Laboratory Analytical Results

Final Status Survey Report
Volume VI - Post Operational Areas
Sub-Report No. POA-007
Survey Unit Kaiser-FSSPOA-007
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation
September 12, 2006

1.0 BACKGROUND

This sub-report documents the results of post operational 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-FSSPOA-007, the northern half of the non-impacted former freshwater pond area. It should be noted that during the start up of the Thorium Remediation Project, a geo-synthetic liner was placed over the ground surface of the south-central portion of this non-impacted site area and a Water Treatment System was constructed on the liner. The Water Treatment System was decommissioned at the end of the Thorium Remediation Project and the liner subsequently removed. The final status survey of the south central portion of the northern half of the former freshwater pond was separated from Survey Unit Kaiser-FSSPOA-007 and is addressed under Survey Unit Kaiser-FSSPOA-012.

Survey Unit Kaiser-FSSPOA-007 is considered a Class 3 survey unit with an approximate surface area of 5,220 m^2. It is bounded to the south by Post Operational Survey Unit Kaiser-FSSPOA-008, to the east by Post Operational Survey Units Kaiser-FSSPOA-001 and Kaiser-FSSPOA-002, and to the north and west by Fulton Creek **(Figure 3)**.

2.0 SURVEY ACTIVITIES AND RESULTS

This section of the sub-report presents the final status survey data for the surface soil of Survey Unit Kaiser-FSSPOA-007. The final status survey consisted of a judgmental gross gamma scan of the exposed surface soil of the survey unit and random soil sampling.

2.1 Gross Gamma Scan

The exposed surface soil of the Class 3 survey unit was surveyed through an approximate 95 percent coverage gamma scan to confirm acceptable radiological conditions and identify any elevated areas. During the scanning of the soil, the detector was held close to the ground surface (1 to 2 inches) and moved in a serpentine pattern. Background measurements were obtained at 1-meter above the ground surface at 31 approximately equal-distant locations in the survey unit. The statistics for the 31 background measurements are provided below in **Table 1**. Background measurements ranged from 8,282 counts per minute (cpm) to 14,369 cpm.

A total of 4,885 measurements of gross count rate were made at two second intervals across the survey unit's 5,220 m^2 surface area. The results ranged from 7,350 cpm to 12,996 cpm. A statistical summary of the gamma scan of the survey unit is also provided below in **Table 1**.

Table 1 – Gross Gamma Scan Results Summary

Survey Area:	5,220 m^2	
Number of Scan Measurements (2-Second Intervals):	4,885	
Detector Swing Rate: (Swinging the detector a width of 1-meter side to side)	0.51 m/s (MARSSIM recommends 0.5 m/s)	
Results Summary:	**Background (Gross cpm)**	**Scan (Gross cpm)**
Minimum	8,282	7,350
Maximum	14,369	12,996
Average	9,805	10,179
Standard Deviation	1,160	1,139
Median	9,690	10,069

Contour maps of the gross gamma background and final (as-left condition) scanning survey results are presented on **Figure A-1** contained in **Attachment A**. The gross gamma scan did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site).

2.2 Random Soil Sampling – Surface Soil

As required by MARSSIM for Class 3 survey units, random soil samples were taken as part of the final survey. The Minimum Number of Samples Required (N) based on the scan MDC was determined to be 9 as documented on Soil Survey Unit Worksheet No. 1 **(Attachment B)**.

A layout of the soil sampling locations is provided on **Figure A-2** contained in **Attachment A**. The soil sample locations were demarcated in the field using a GPS unit. A total of 9 soil samples (identified as K-1894 through K-1897 and K-1948 through K-1952) were collected at the surface (0-6-inch depth interval) level using a clean, decontaminated sampling auger or sharpshooter shovel. The samples were forwarded to Outreach for analysis of Th-232 activity concentration. Analytical results are provided below in **Table 2**. Analytical data reports are contained in **Attachment C**.

Table 2 – Random Soil Sample Results

Soil Sample ID	Gross Th-232 (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)	Net Th-232 (pCi/g)	Net DCGL (pCi/g)
K-1894	1.07	0.235	0.405	0	3.0
K-1895	1.06	0.196	0.525	0	3.0
K-1896	1.09	0.186	0.326	0	3.0
K-1897	1.17	0.219	0.288	0.07	3.0
K-1948	0.989	0.138	0.319	0	3.0
K-1949	0.551	0.111	0.278	0	3.0
K-1950	0.985	0.249	0.466	0	3.0
K-1951	0.445	0.196	0.357	0	3.0
K-1952	0.760	0.156	0.296	0	3.0
Average	***0.902***				
Standard Dev.	***0.257***				
Minimum	***0.445***				
Maximum	***1.17***				
Median	***0.989***				

All 9 random soil sample results (gross and net) were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$). The maximum gross Th-232 activity concentration was 1.17 pCi/g, which fell slightly above the background Th-232 activity of 1.1 pCi/g for the site. The average gross Th-232 activity concentration was 0.902 pCi/g. The standard deviation of the 9 random samples was 0.257, which fell below the estimated standard deviation of 0.42 (based on the adjacent land final status survey results) used to calculate the minimum number of samples required.

2.3 Wilcoxon Rank Sum (WRS) Testing

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

If the difference (0.68 pCi/g) between the maximum survey unit soil sample activity concentration (1.17 pCi/g) and the minimum reference background area soil sample activity concentration (0.49 pCi/g) is less than $DCGL_W$ (3.0 pCi/g), then the survey unit meets the release

criterion. **Table 3** presents a summary of the data used to complete the statistical evaluation of the survey unit.

Table 3 – 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	280	1.17	S1	K-1894	1.07
R2	355	0.96	S2	K-1895	1.06
R3	190	0.49	S3	K-1896	1.09
R4	214	1.45	S4	K-1897	1.17
R5	227	2.25	S5	K-1948	0.989
R6	110	1.26	S6	K-1949	0.551
R7	135	0.99	S7	K-1950	0.985
R8	7	0.70	S8	K-1951	0.445
R9	292	0.93	S9	K-1952	0.760
	Average	***1.13***		***Average***	***0.902***
	Standard Dev.	***0.51***		***Standard Dev.***	***0.257***
	Minimum	***0.49***		***Minimum***	***0.445***
	Maximum	***2.25***		***Maximum***	***1.17***
	Median	***0.99***		***Median***	***0.989***

3.0 SUMMARY OF FINDINGS

Survey Unit Kaiser-FSSPOA-007 consists of the northern half of the non-impacted former freshwater pond area. It should be noted that during the start up of the Thorium Remediation Project, a geo-synthetic liner was placed over the ground surface of the south-central portion of this non-impacted site area and a Water Treatment System was constructed on the liner. The Water Treatment Systems was decommissioned at the end of the Thorium Remediation Project and the liner subsequently removed. The final status survey of the south central portion of the northern half of the former freshwater pond was separated from Survey Unit Kaiser-FSSPOA-007 and is addressed under Survey Unit Kaiser-FSSPOA-012.

Survey Unit Kaiser-FSSPOA-007 is considered a Class 3 survey unit with an approximate surface area of 5,220 m^2. It is bounded to the south by Post Operational Survey Unit Kaiser-FSSPOA-008, to the east by Post Operational Survey Units Kaiser-FSSPOA-001 and Kaiser-FSSPOA-002, and to the north and west by Fulton Creek (**Figure 3**).

The acceptance criterion for open land areas (surface soil) at the Tulsa facility is the $DCGL_W$ of 3.0 pCi/g net Th-232 activity concentration. Final status survey activities for Survey Unit Kaiser-FSSPOA-007 consisted of a judgmental gross gamma scan of the exposed surface soil of the survey unit and random soil sampling. The results of the final status survey activities were as follows:

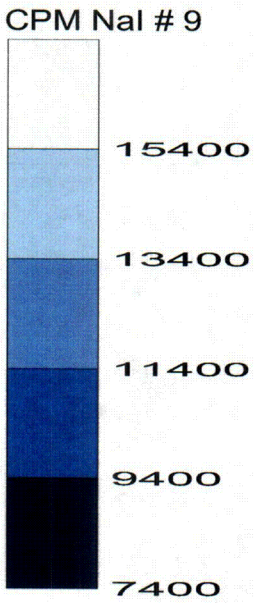
- The approximate 95 percent coverage gamma scan (final as-left condition) did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site).
- All 9 random soil sample results (gross and net) were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$).
- The analytical results met 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-FSSPOA-007 meets the DP acceptance criteria.

ATTACHMENT A
TABLE OF CONTENTS

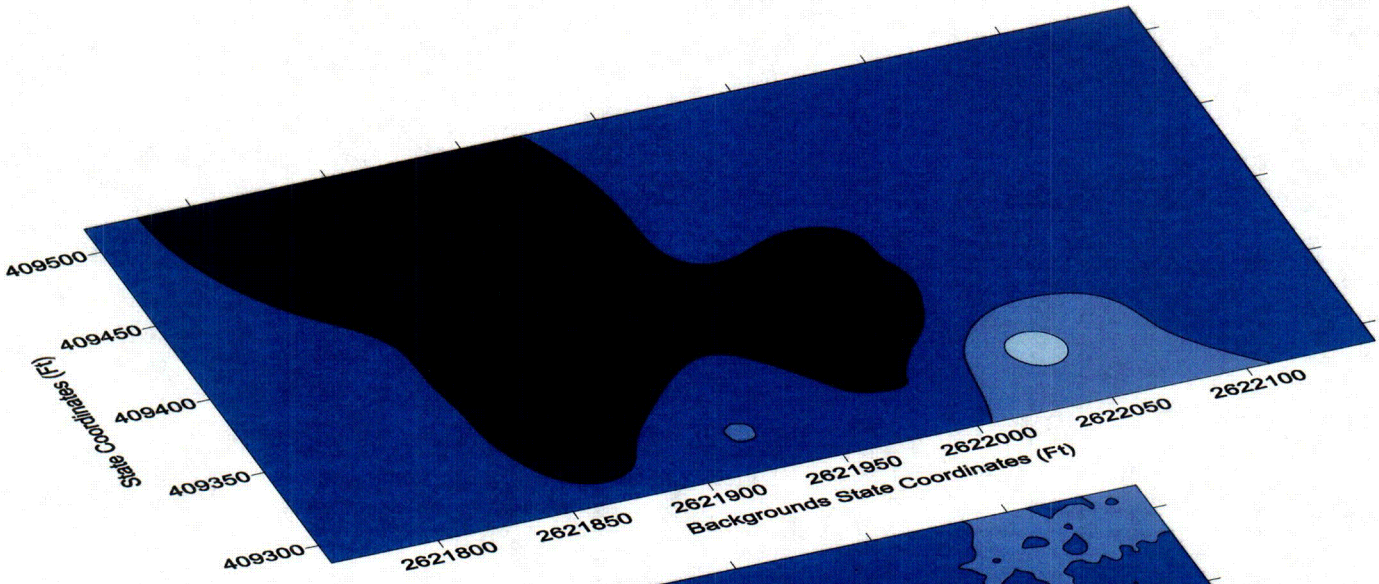
- **FIGURE A-1 Gross Gamma Background and Scanning Survey Results**
- **FIGURE A-2 Random Soil Sampling Locations**

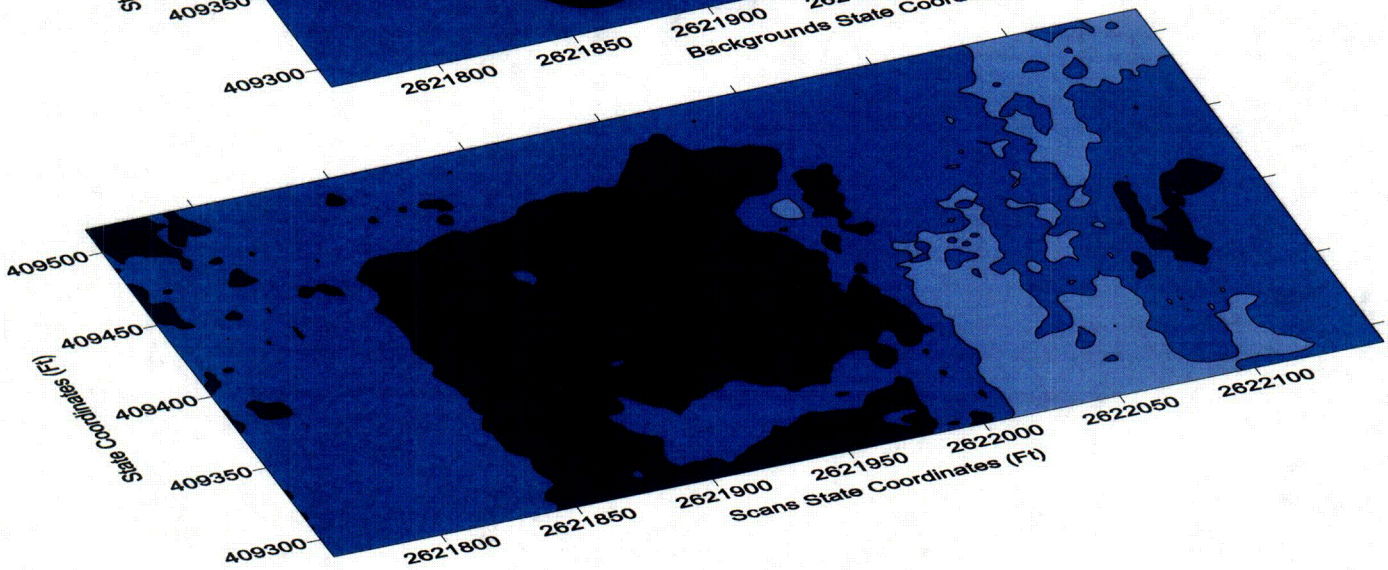
Attachment A, Figure A-1
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSPOA-007



N

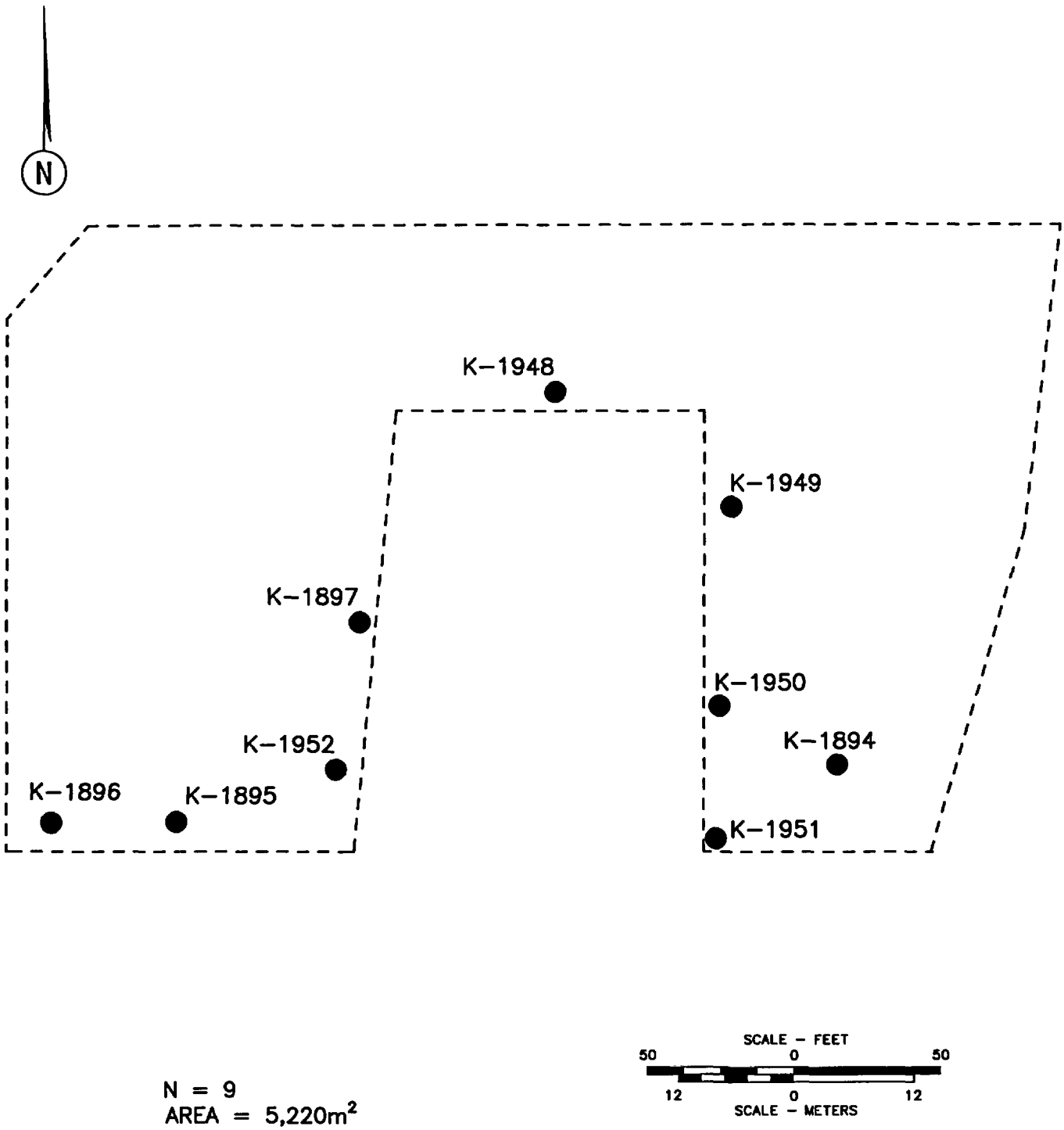
Backgrounds are 1 minute readings.





Scanning readings are recorded at 2 second intervals.

C-15



K-1894 ● CLASS 3 SURVEY RANDOM SOIL SAMPLING LOCATION

FIGURE A-2
RANDOM SOIL SAMPLING LOCATIONS
SURVEY UNIT KAISER-FSSPOA-007
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFD	08/31/06
CHECKED	RFD	08/31/06
DRAWN	DEB	08/15/06

DRAWING NUMBER
PA4072101

Penn E&R
Environmental & Remediation, Inc.

ATTACHMENT B
TABLE OF CONTENTS

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

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-FSSPOA-007

2. Description: Northern half of the non-impacted former freshwater pond

3. Net Th-232 Acceptance Criteria (pCi/g): 3.0

4. Dimensions (m): Post Operational Area – approximately 104 meters x 50 meters; Area, A (m^2): 5,220

5. Estimated of Gross Gamma Scan Background Readings (cpm)
Average: 15,000 Minimum: 10,000 Maximum: 30,000

6. Based on the maximum background gross gamma scan reading, the scan MDC (Minimum Detectable Concentration of Th-232) and the corresponding N (Minimum Number of Required Samples) are:

- Gross Gamma Scan MDC (pCi/g): 3.1
- Minimum Number of Samples (N): 9

ATTACHMENT C

Laboratory Analytical Results

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

INVOICE # 12301
8-7-06

K-1877 (GA)
K-1894 POA-007
K-1924 (GA)

August 7, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060631

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples received in our laboratory on July 31, 2006 for the above captioned project. Three soil samples were received in good condition and analyzed by Gamma Spectroscopy without drying and grinding and Percent Moisture with an expedited 1-work day turn and 5-work day turn. 1-work day results were faxed on 8/2/06 all others on 8/3/06.

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

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID #OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060631
Date Reported:	8/7/06
Date Received:	7/31/06
Page Number:	1 of 2

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	**20060631-01**						
Client ID:	**K-1877**						
Date Sampled:	**7/29/06 4:22:00 PM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	81.1 +/- 5.17	pCi/g	0.852		7/31/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	48.6	%		8/1/06	8/2/06	RS
Lab ID:	**20060631-02**						
Client ID:	**K-1894**						
Date Sampled:	**7/28/06 8:25:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	1.07 +/- 0.235	pCi/g	0.405		7/31/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	8.8	%		8/1/06	8/2/06	RS
Lab ID:	**20060631-03**						
Client ID:	**K-1924**						
Date Sampled:	**7/29/06 4:29:00 PM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.801 +/- 0.169	pCi/g	0.326		7/31/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	14.6	%		8/1/06	8/2/06	RS

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060631
Date Reported:	8/7/06
Date Received:	7/31/06
Page Number:	2 of 2

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Ac-228					12.0				7/31/06
Am-241		122.0	84.0	36.1					7/31/06
Co-60		97.0	99.0	2.1					7/31/06
Cs-137		94.0	94.0	0.7					7/31/06
Percent Moisture					4.8				8/2/06

Lab Approval:

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company: Kaiser Alm & Chem Inc.
Name: David A. Wayne
Address: 7311 E. 41st St.
City: Tulsa State: OK Zip: 74145
Phone: 774-9743-20 Fax #: 918-664-7171

Local: 918-384-0566
Cell: 774-799-0071

Bill To:
Company: Kaiser / Prosser
Name: Bill Vinyard / Dave Wayne
Address: 7311 E. 41st St.
City: Tulsa State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: Kaiser - 4072
PROJECT #: PA - 4000 - 4072
PROJECT NAME: Kaiser Alm Plant Prod.
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): *10 DAY T.A.T. / **5 DAY T.A.T.
SAMPLER: David Wayne
Signature: David Wayne

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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.	Radium 226	Radium 228	Radon 222	Alpha Counting					REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
	K-1977**	7-29-06	16:22	Soil	1	Plastic	None	X	X	X	X						Comp
	K-1994-*	7-28-06	08:25		1			X	X	X	X						Grab
	K-1974**	7-29-06	16:29		1			X	X	X	X						Comp

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

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 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 RETENTION/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: NA

SAMPLE LOGIN

Date Received: *7/31/06 10:32:41* **Lab Number:** 20060631 **Due:** 8/4/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060631-01 A	K-1877	Soil	07/29/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060631-02 A	K-1894	Soil	07/28/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060631-03 A	K-1924	Soil	07/29/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								

CONTAINER INSPECTION

 # Coolers 1 **Custody Seals Broken** **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ✓ **Labels in Tact** ✓ **Radiation Survey Complete**

Anomalies

Inspected By: _____ **DATE** 7/31/06

QA or Designee Review: _____ **DATE** 7/31/06

Sample Custodian Review: _____ **DATE** 7/31/06

Project Notes:

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

K- 1895 → 1896
K-1936 PO A-007
QA
Invoice # 12317

August 10, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060662

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples received in our laboratory on August 7, 2006 for the above captioned project. Three soil samples were received in good condition and analyzed by Gamma Spectroscopy without drying and grinding and Percent Moisture with an expedited 5-work day. Results were faxed on 8/10/06.

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

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID #OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060662
Date Reported:	8/10/06
Date Received:	8/7/06
Page Number:	1 of 2

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	**20060662-01**						
Client ID:	**K-1895**						
Date Sampled:	**8/3/06 9:50:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	1.06 +/- 0.196	pCi/g	0.525		8/7/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	5.1	%		8/7/06	8/8/06	RS
Lab ID:	**20060662-02**						
Client ID:	**K-1896**						
Date Sampled:	**8/3/06 10:00:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	1.09 +/- 0.186	pCi/g	0.326		8/7/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	9.9	%		8/7/06	8/8/06	RS
Lab ID:	**20060662-03**						
Client ID:	**K-1936**						
Date Sampled:	**8/3/06 2:35:00 PM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.719 +/- 0.084	pCi/g	0.288		8/7/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	12.6	%		8/7/06	8/8/06	RS

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060662
Date Reported:	8/10/06
Date Received:	8/7/06
Page Number:	2 of 2

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Ac-228					15.6				8/7/06
Am-241		91.0	82.0	10.7					8/7/06
Co-60		94.0	95.0	1.3					8/7/06
Cs-137		95.0	93.0	2.3					8/7/06
Percent Moisture					11.4				8/8/06

Lab Approval:

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company: KAISER - ALUM & CHEM INC.
Name: DAVID R. WEBAND
Address: 7211 E. 41ST ST.
City: TULSA State: OK Zip: 74145
Phone: 724-9934-3530 Fax #: 918-294-3171
Loc N: 918-294-066
Cell: 724-799-0071

Bill To:
Company: KAISER / ALUM & CHEM
Name: PAUL HAAS / DAVE WEBAND
Address: 7211 E. 41ST ST.
City: TULSA State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: KAISER - 4672
PROJECT #: PA - 4000 - 4672
PROJECT NAME: KAISER - ALUM. CHEM.
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): 5 DAY
SAMPLER: Signature

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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 (EL-232)	PETROLEUM HYDROCARBON ANALYSIS	MDC CONS	ASTM D7346.92 METHOD C.O.S					REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
	K-1996	8-3-06	0900	SOIL	1	PLASTIC	NONE	X	X	X	X					GRAB
	K-1996		1000		1			X	X	X	X					
	K-1996		14:30		1			X	X	X	X					COMP

RELINQUISHED BY: _____ DATE 8/7/06 TIME 1100 RECEIVED BY: _____ DATE 8/7/06 TIME 1100

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.

FOR LABORATORY USE ONLY:

Sample Condition Upon Receipt: Good

Custody Seals Intact: Y N

Cooler Temperature: NA

SAMPLE LOGIN

Date Received: *8/7/06 1:39:56 P* **Lab Number:** 20060662 **Due:** 8/14/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060662-01 A	K-1895	Soil	08/03/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060662-02 A	K-1896	Soil	08/03/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060662-03 A	K-1936	Soil	08/03/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								

CONTAINER INSPECTION

 # Coolers 0 **Custody Seals Broken** **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ✓ **Labels in Tact** ✓ **Radiation Survey Complete** ✓

Anomalies

Inspected By: _____ **DATE** _____

QA or Designee Review: [illegible] **DATE** 08/07/06

Sample Custodian Review: [illegible] **DATE** 8/7/06

Project Notes:

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

POA-007 h-1948 → 1952

Invoice # 12364

August 21, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060705

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples received in our laboratory on August 17, 2006 for the above captioned project. Five soil samples were received in good condition and analyzed by Gamma Spectroscopy without drying and grinding and Percent Moisture with an expedited 2-work day. Results were faxed early on 818/06.

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

ACCREDITED IN ACCORDANCE WITH
CERT. ID #OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060705
Date Reported:	8/21/06
Date Received:	8/17/06
Page Number:	1 of 2

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060705-01						
Client ID:	K-1948						
Date Sampled:	8/16/06 9:35:00 AM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.989 +/- 0.138	pCi/g	0.319		8/17/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	6.3	%		8/17/06	8/18/06	RS
Lab ID:	20060705-02						
Client ID:	K-1949						
Date Sampled:	8/16/06 9:40:00 AM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.551 +/- 0.111	pCi/g	0.278		8/18/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	13.4	%		8/17/06	8/18/06	RS
Lab ID:	20060705-03						
Client ID:	K-1950						
Date Sampled:	8/16/06 9:45:00 AM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.985 +/- 0.249	pCi/g	0.466		8/17/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	5.0	%		8/17/06	8/18/06	RS
Lab ID:	20060705-04						
Client ID:	K-1951						
Date Sampled:	8/16/06 9:50:00 AM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.455 +/- 0.196	pCi/g	0.357		8/17/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	8.5	%		8/17/06	8/18/06	RS
Lab ID:	20060705-05						
Client ID:	K-1952						
Date Sampled:	8/16/06 9:55:00 AM						
Matrix:	Soil						
		Radiochemical Analyses					

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060705
Date Reported:	8/21/06
Date Received:	8/17/06
Page Number:	2 of 2

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Thorium 232	HASL 300	0.760 +/- 0.156	pCi/g	0.296		8/17/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	16.4	%		8/17/06	8/18/06	RS

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Ac-228					8.4				8/17/06
Am-241		100.0	113.0	11.7					8/17/06
Co-60		100.0	96.0	4.3					8/17/06
Cs-137		93.0	95.0	3.9					8/17/06
Percent Moisture					13.2				8/18/06

Lab Approval:

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To: local: 918-384-0506 (cell: 724-799-0071)
Company: Kaiser Alum & Chem Corp.
Name: David D. Weyant
Address: 7311 E. 41st St.
City: Tulsa State: OK Zip: 74145
Phone: 724-934-3220 Fax #: 918-384-3171

Bill To:
Company: Kaiser Alum & Chem
Name: Bill Wendel / David Weyant
Address: 7311 E. 41st St.
City: Tulsa State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: Kaiser-4072
PROJECT #: PA-4000-4072
PROJECT NAME: Kaiser - Tulsa Alum Plant
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): Day 8-18-06
SAMPLER: David Weyant (Signature)

CLIENT SAMPLE ID	OUTREACH SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER SIZE / PLASTIC OR GLASS	PRESERVATIVE # (1. HNO_3 pH<2, 2. Ice at 4°C, 3. HCl pH<2, 4. H_2SO_4 pH<2, 5. NaOH pH>10)	Gamma (EL-222)	Radium 226 & 228	Lab Backgrnd	Mo, Cu, Pb	Asbestos 21 Bulk Mold Control				REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
	K-1948	8-16-06	0935	Soil	1	Plastic 500mg	None	X	X	X	X					Grab
	K-1949		0940		1			X	X	X	X					
	K-1950		0945		1			X	X	X	X					
	K-1951		0950		1			X	X	X	X					
	K-1952		0955		1			X	X	X	X					

RELINQUISHED BY: David D. Weyant DATE 8/16/06 TIME 1600 RECEIVED BY: Ken Gibson DATE 8/16/06 TIME 1600

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

FOR LABORATORY USE ONLY: 20060768
Sample Condition Upon Receipt: Good
Custody Seals Intact: Y N
Cooler Temperature: NA

SAMPLE LOGIN

Date Received: *8/17/06 9:58:16 A* **Lab Number:** 20060705 **Due:** 8/18/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060705-01 A	K-1948	Soil	08/16/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060705-02 A	K-1949	Soil	08/16/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060705-03 A	K-1950	Soil	08/16/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060705-04 A	K-1951	Soil	08/16/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060705-05 A	K-1952	Soil	08/16/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								

CONTAINER INSPECTION

 # Coolers 0 **Custody Seals Broken** ☐ **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ☑ **Labels in Tact** ☑ **Radiation Survey Complete** ☑

Anomalies

Inspected By: _____ **DATE** 8/17/06

QA or Designee Review: _____ **DATE** _____

Sample Custodian Review: _____ **DATE** 8/17/06

Project Notes:

SUB-REPORT

SURVEY UNIT KAISER-FSSPOA-008

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1.0 BACKGROUND	1
2.0 SURVEY ACTIVITIES AND RESULTS	2
2.1 Gross Gamma Scan	2
2.2 Random Soil Sampling – Surface Soil	2
2.3 Wilcoxon Rank Sum (WRS) Testing	3
3.0 SUMMARY OF FINDINGS	5

ATTACHMENTS

ATTACHMENT A: Figure A-1 Gross Gamma Background and Scanning Survey Results
Figure A-2 Random Soil Sampling Locations

ATTACHMENT B: Soil Survey Unit Worksheet No. 1

ATTACHMENT C: Laboratory Analytical Results

Final Status Survey Report
Volume VI - Post Operational Areas
Sub-Report No. POA-008
Survey Unit Kaiser-FSSPOA-008
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation
September 12, 2006

1.0 BACKGROUND

This sub-report documents the results of post operational 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-FSSPOA-008, the southern half of the non-impacted former freshwater pond area. This area was only used for the temporary storage of clean import borrow material for the ultimate backfill of the site.

Survey Unit Kaiser-FSSPOA-008 is considered a Class 3 survey unit with an approximate surface area of 4,375 m^2. It is bounded to the south by the Union Pacific Railroad right-of-way, to the east by Post Operational Survey Units Kaiser-FSSPOA-003 and Kaiser-FSSPOA-004, to the north by Post Operational Survey Units Kaiser-FSSPOA-007 and Kaiser-FSSPOA-012, and to the west by Fulton Creek **(Figure 3)**.

2.0 SURVEY ACTIVITIES AND RESULTS

This section of the sub-report presents the final status survey data for the surface soil of Survey Unit Kaiser-FSSPOA-008. The final status survey consisted of a judgmental gross gamma scan of the exposed surface soil of the survey unit and random soil sampling.

2.1 Gross Gamma Scan

The exposed surface soil of the Class 3 survey unit was surveyed through an approximate 95 percent coverage gamma scan to confirm acceptable radiological conditions and identify any elevated areas. During the scanning of the soil, the detector was held close to the ground surface (1 to 2 inches) and moved in a serpentine pattern. Background measurements were obtained at 1-meter above the ground surface at 25 approximately equal-distant locations in the survey unit. The statistics for the 25 background measurements are provided below in **Table 1**. Background measurements ranged from 10,272 counts per minute (cpm) to 16,148 cpm.

A total of 5,067 measurements of gross count rate were made at two second intervals across the survey unit's 4,375 m^2 surface area. The results ranged from 5,853 cpm to 31,955 cpm. A statistical summary of the gamma scan of the survey unit is also provided below in **Table 1**.

Table 1 – Gross Gamma Scan Results Summary

Survey Area:	4,375 m^2	
Number of Scan Measurements (2-Second Intervals):	5,067	
Detector Swing Rate: (Swinging the detector a width of 1-meter side to side)	0.41 m/s (MARSSIM recommends 0.5 m/s)	
Results Summary:	**Background (Gross cpm)**	**Scan (Gross cpm)**
Minimum	10,272	5,853
Maximum	16,148	31,955
Average	12,910	12,181
Standard Deviation	1,588	2,164
Median	13,393	12,059

Contour maps of the gross gamma background and final (as-left condition) scanning survey results are presented on **Figure A-1** contained in **Attachment A**. The gross gamma scan did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site).

2.2 Random Soil Sampling – Surface Soil

As required by MARSSIM for Class 3 survey units, random soil samples were taken as part of the final survey. The Minimum Number of Samples Required (N) based on the scan MDC was determined to be 9 as documented on Soil Survey Unit Worksheet No. 1 (**Attachment B**).

A layout of the soil sampling locations is provided on **Figure A-2** contained in **Attachment A.** The soil sample locations were demarcated in the field using a GPS unit. A total of 9 soil samples (identified as K-1903 through K-1911) were collected at the surface (0-6-inch depth interval) level using a clean, decontaminated sampling auger or sharpshooter shovel. The samples were forwarded to Outreach for analysis of Th-232 activity concentration. Analytical results are provided below in **Table 2.** Analytical data reports are contained in **Attachment C.**

Table 2 – Random Soil Sample Results

Soil Sample ID	Gross Th-232 (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)	Net Th-232 (pCi/g)	Net DCGL (pCi/g)
K-1903	0.719	0.156	0.417	0	3.0
K-1904	1.14	0.257	0.271	0.04	3.0
K-1905	1.30	0.241	0.262	0.20	3.0
K-1906	1.10	0.267	0.332	0	3.0
K-1907	1.02	0.486	0.658	0	3.0
K-1908	1.19	0.204	0.220	0.09	3.0
K-1909	1.14	0.285	0.545	0.04	3.0
K-1910	1.23	0.164	0.398	0.13	3.0
K-1911	1.30	0.219	0.333	0.20	3.0
Average	***1.13***				
Standard Dev.	***0.178***				
Minimum	***0.719***				
Maximum	***1.30***				
Median	***1.14***				

All 9 random soil sample results (gross and net) were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$). The maximum gross Th-232 activity concentration was 1.30 pCi/g, which fell slightly above the background Th-232 activity of 1.1 pCi/g for the site. The average gross Th-232 activity concentration was 1.13 pCi/g. The standard deviation of the 9 random samples was 0.178, which fell below the estimated standard deviation of 0.42 (based on the adjacent land final status survey results) used to calculate the minimum number of samples required.

2.3 Wilcoxon Rank Sum (WRS) Testing

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

If the difference (0.76 pCi/g) between the maximum survey unit soil sample activity concentration (1.30 pCi/g) and the minimum reference background area soil sample activity concentration (0.54 pCi/g) is less than $DCGL_W$ (3.0 pCi/g), then the survey unit meets the release criterion. **Table 3** presents a summary of the data used to complete the statistical evaluation of the survey unit.

Table 3 – 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	239	1.29	S1	K-1903	0.719
R2	185	0.90	S2	K-1904	1.14
R3	144	1.28	S3	K-1905	1.30
R4	20	1.38	S4	K-1906	1.10
R5	221	1.19	S5	K-1907	1.02
R6	105	0.95	S6	K-1908	1.19
R7	165	0.54	S7	K-1909	1.14
R8	223	1.02	S8	K-1910	1.23
R9	185	0.90	S9	K-1911	1.30
	Average	***1.05***		***Average***	***1.13***
	Std. Dev.	***0.26***		***Std. Dev.***	***0.178***
	Minimum	***0.54***		***Minimum***	***0.719***
	Maximum	***1.38***		***Maximum***	***1.30***
	Median	***1.02***		***Median***	***1.14***

3.0 SUMMARY OF FINDINGS

Survey Unit Kaiser-FSSPOA-008, the southern half of the non-impacted former freshwater pond area was only used for the temporary storage of clean import borrow material for the ultimate backfill of the site.

Survey Unit Kaiser-FSSPOA-008 is considered a Class 3 survey unit with an approximate surface area of 4,375 m^2. It is bounded to the south by the Union Pacific Railroad right-of-way, to the east by Post Operational Survey Units Kaiser-FSSPOA-003 and Kaiser-FSSPOA-004, to the north by Post Operational Survey Units Kaiser-FSSPOA-007 and Kaiser-FSSPOA-012, and to the west by Fulton Creek **(Figure 3)**.

The acceptance criterion for open land areas (surface soil) at the Tulsa facility is the $DCGL_W$ of 3.0 pCi/g net Th-232 activity concentration. Final status survey activities for Survey Unit Kaiser-FSSPOA-008 consisted of a judgmental gross gamma scan of the exposed surface soil of the survey unit and random soil sampling. The results of the final status survey activities were as follows:

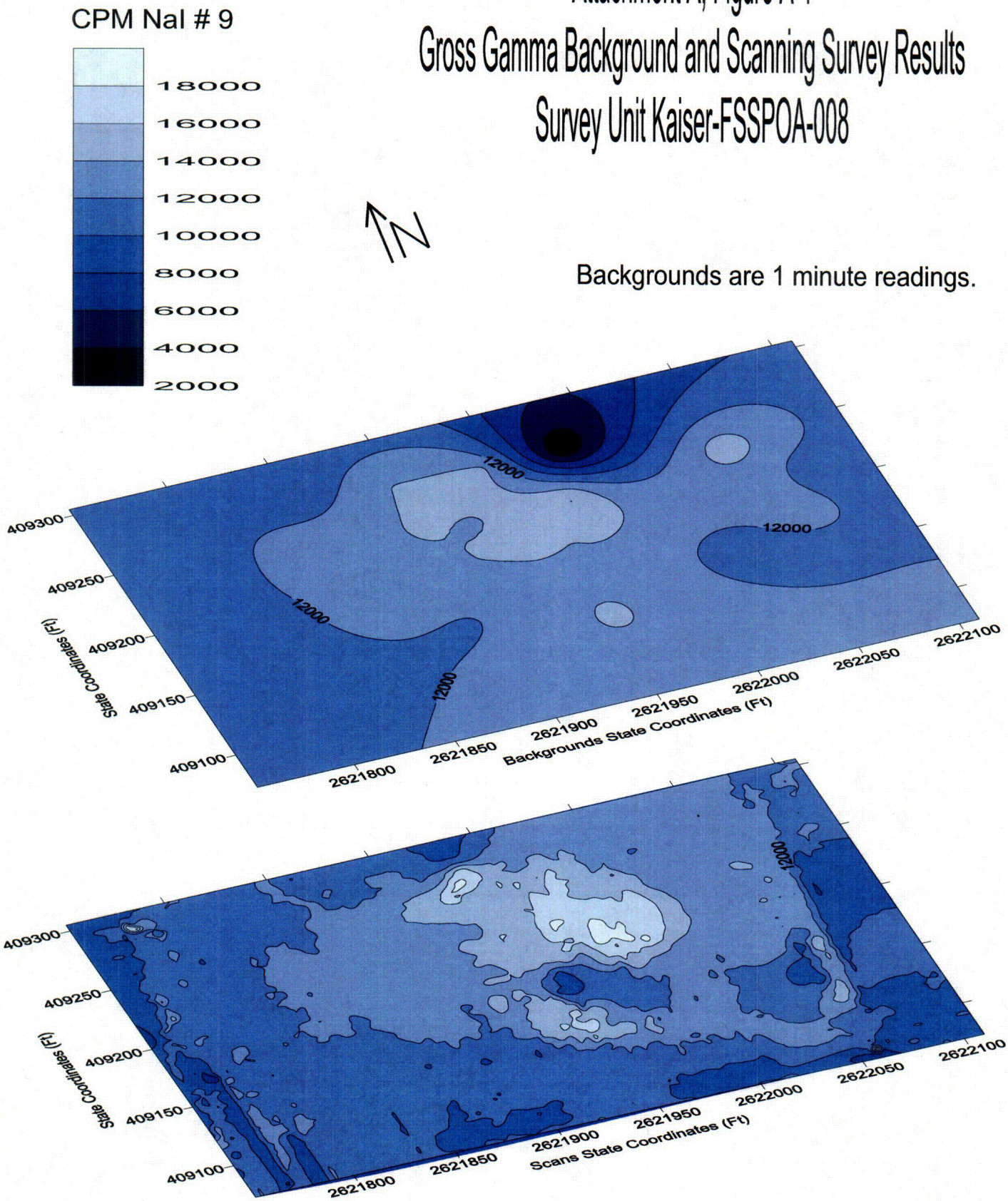
- The approximate 95 percent coverage gamma scan (final as-left condition) did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site).
- All 9 random soil sample results (gross and net) were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$).
- The analytical results met 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-FSSPOA-008 meets the DP acceptance criteria.

ATTACHMENT A
TABLE OF CONTENTS

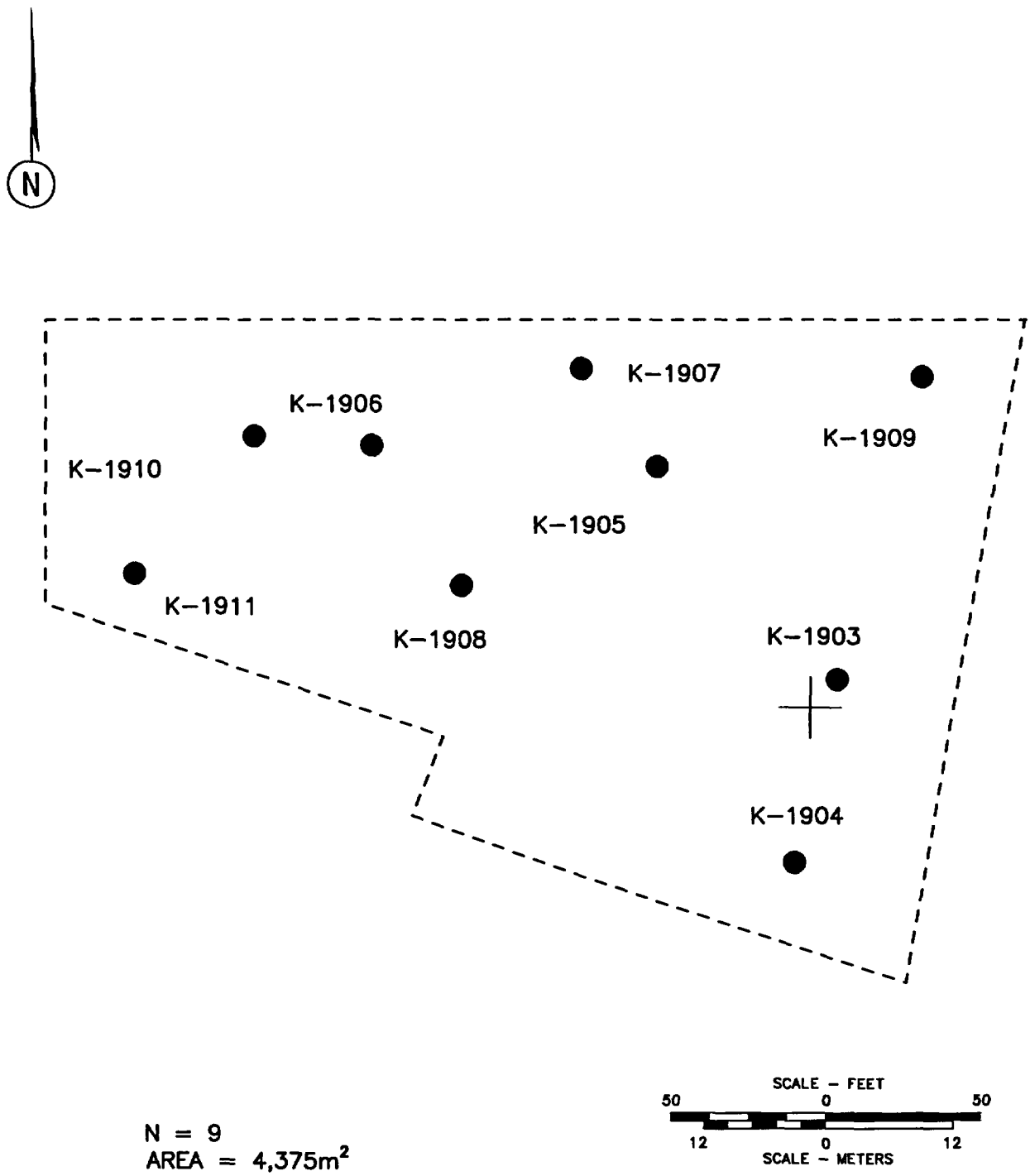
- **FIGURE A-1 Gross Gamma Background and Scanning Survey Results**
- **FIGURE A-2 Random Soil Sampling Locations**

Attachment A, Figure A-1
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSPOA-008



Backgrounds are 1 minute readings.

Scanning readings are recorded at 2 second intervals.



N = 9
AREA = 4,375m^2

K-1903 ● CLASS 3 SURVEY RANDOM SOIL SAMPLING LOCATION

FIGURE A-2
RANDOM SOIL SAMPLING LOCATIONS
SURVEY UNIT KAISER-FSSPOA-008
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFB 9-14-06
CHECKED	RFB 9-14-06
DRAWN	DEB 08/15/06
DRAWING NUMBER	PA4072102

Penn E&R
Environmental & Remediation, Inc.

ATTACHMENT B
TABLE OF CONTENTS

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

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-FSSPOA-008

2. Description: Southern half of the non-impacted former freshwater pond

3. Net Th-232 Acceptance Criteria (pCi/g): 3.0

4. Dimensions (m): Post Operational Area – approximately 90 meters x 49 meters; Area, A (m^2): 4,375

5. Estimated of Gross Gamma Scan Background Readings (cpm)
Average: 15,000 Minimum: 10,000 Maximum: 30,000

6. Based on the maximum background gross gamma scan reading, the scan MDC (Minimum Detectable Concentration of Th-232) and the corresponding N (Minimum Number of Required Samples) are:

- Gross Gamma Scan MDC (pCi/g): 3.1
- Minimum Number of Samples (N): 9

ATTACHMENT C

Laboratory Analytical Results

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

Invoice # 12305
8-7-06
K-1760(QA)
K-1912 → 1923 POA-011
K-1903 → 1905 POA-008

August 2, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060621

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples received in our laboratory on July 27, 2006 for the above captioned project. Sixteen soil samples were received in good condition and analyzed by Gamma Spectroscopy without drying and grinding and Percent Moisture with an expedited 5 work day turn. Results were faxed on 8/2/06.

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

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID #OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060621
Date Reported:	8/2/06
Date Received:	7/27/06
Page Number:	1 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	**20060621-01**						
Client ID:	**K-1760**						
Date Sampled:	**7/26/06 3:10:00 PM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	62.2 +/- 3.95	pCi/g	1.62		7/27/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	48.2	%		7/28/06	7/31/06	RS
Lab ID:	**20060621-02**						
Client ID:	**K-1912**						
Date Sampled:	**7/26/06 2:10:00 PM**						
Matrix:	**Ballast**						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.656 +/- 0.160	pCi/g	0.466		7/27/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	0.1	%		7/28/06	7/31/06	RS
Lab ID:	**20060621-03**						
Client ID:	**K-1913**						
Date Sampled:	**7/26/06 2:15:00 PM**						
Matrix:	**Ballast**						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.216 +/- 0.158	pCi/g	0.180		7/27/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	0.1	%		7/28/06	7/31/06	RS
Lab ID:	**20060621-04**						
Client ID:	**K-1914**						
Date Sampled:	**7/26/06 2:20:00 PM**						
Matrix:	**Ballast**						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.460 +/- 0.106	pCi/g	0.193		7/27/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	0.4	%		7/28/06	7/31/06	RS
Lab ID:	**20060621-05**						
Client ID:	**K-1915**						
Date Sampled:	**7/26/06 2:25:00 PM**						
Matrix:	**Ballast**						
		Radiochemical Analyses					

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060621
Date Reported:	8/2/06
Date Received:	7/27/06
Page Number:	2 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Thorium 232	HASL 300	0.194 +/- 0.182	pCi/g	0.333		7/27/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	0.1	%		7/28/06	7/31/06	RS

Lab ID: 20060621-06
Client ID: K-1916
Date Sampled: 7/26/06 2:30:00 PM
Matrix: Ballast

		Radiochemical Analyses					
Thorium 232	HASL 300	0.303 +/- 0.083	pCi/g	0.172		7/27/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	0.1	%		7/28/06	7/31/06	RS

Lab ID: 20060621-07
Client ID: K-1917
Date Sampled: 7/26/06 2:35:00 PM
Matrix: Ballast

		Radiochemical Analyses					
Thorium 232	HASL 300	0.679 +/- 0.086	pCi/g	0.177		7/27/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	3.1	%		7/28/06	7/31/06	RS

Lab ID: 20060621-08
Client ID: K-1918
Date Sampled: 7/26/06 2:40:00 PM
Matrix: Ballast

		Radiochemical Analyses					
Thorium 232	HASL 300	0.197 +/- 0.085	pCi/g	0.219		7/27/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	0.1	%		7/28/06	7/31/06	RS

Lab ID: 20060621-09
Client ID: K-1919
Date Sampled: 7/26/06 2:45:00 PM
Matrix: Ballast

		Radiochemical Analyses					
Thorium 232	HASL 300	0.231 +/- 0.144	pCi/g	0.279		7/27/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	0.2	%		7/28/06	7/31/06	RS

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060621
Date Reported:	8/2/06
Date Received:	7/27/06
Page Number:	3 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060621-10						
Client ID:	K-1920						
Date Sampled:	7/26/06 2:50:00 PM						
Matrix:	Ballast						
	Radiochemical Analyses						
Thorium 232	HASL 300	0.453 +/- 0.101	pCi/g	0.242		7/27/06	SD
	Inorganics Analyses						
Percent Moisture	ASTM D2216-98	0.1	%		7/28/06	7/31/06	RS
Lab ID:	20060621-11						
Client ID:	K-1921						
Date Sampled:	7/26/06 2:55:00 PM						
Matrix:	Ballast						
	Radiochemical Analyses						
Thorium 232	HASL 300	0.549 +/- 0.092	pCi/g	0.280		7/27/06	SD
	Inorganics Analyses						
Percent Moisture	ASTM D2216-98	0.1	%		7/28/06	7/31/06	RS
Lab ID:	20060621-12						
Client ID:	K-1922						
Date Sampled:	7/26/06 3:00:00 PM						
Matrix:	Ballast						
	Radiochemical Analyses						
Thorium 232	HASL 300	0.067 +/- 0.054	pCi/g	0.347		7/27/06	SD
	Inorganics Analyses						
Percent Moisture	ASTM D2216-98	0.1	%		7/28/06	7/31/06	RS
Lab ID:	20060621-13						
Client ID:	K-1923						
Date Sampled:	7/26/06 3:05:00 PM						
Matrix:	Ballast						
	Radiochemical Analyses						
Thorium 232	HASL 300	0.485 +/- 0.157	pCi/g	0.295		7/27/06	SD
	Inorganics Analyses						
Percent Moisture	ASTM D2216-98	0.7	%		7/28/06	7/31/06	RS
Lab ID:	20060621-14						
Client ID:	K-1903						
Date Sampled:	7/25/06 3:25:00 PM						
Matrix:	Soil						
	Radiochemical Analyses						

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060621
Date Reported:	8/2/06
Date Received:	7/27/06
Page Number:	4 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Thorium 232	HASL 300	0.719 +/- 0.156	pCi/g	0.417		7/27/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	2.1	%		7/28/06	7/31/06	RS

Lab ID: 20060621-15
Client ID: K-1904
Date Sampled: 7/25/06 3:30:00 PM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	1.14 +/- 0.257	pCi/g	0.271		7/27/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	2.8	%		7/28/06	7/31/06	RS

Lab ID: 20060621-16
Client ID: K-1905
Date Sampled: 7/26/06 9:30:00 AM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	1.30 +/- 0.241	pCi/g	0.262		7/27/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	4.0	%		7/28/06	7/31/06	RS

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Ac-228					3.4				7/27/06
Am-241		89.0	90.0	0.9					7/27/06
Co-60		95.0	95.0	0.3					7/27/06
Cs-137		95.0	100.0	5.8					7/27/06
Percent Moisture					0.2				7/31/06

Lab Approval:

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company: Kaiser Alum & Chem Corp.
Name: David R. Wieland
Address: 7311 E. 41st St.
City: Tulsa State: OK Zip: 74145
Phone: 774-934-3533 Fax #: 918-384-3171
Local: 918-384-0506
Cell: 714-794-0471

Bill To:
Company: Kaiser/Penn Eng
Name: Bill Winzeat / Dave Wieland
Address: 7311 E. 41st St.
City: Tulsa State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: Kaiser-4072
PROJECT #: PA-4000-4072
PROJECT NAME: Kaiser-Trenton Alumina
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): 5 DAY
SAMPLER: David R. Wieland (Signature)

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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 (Lab-Specific)	Gamma + Radium (Filter for Radium)	ADC Volt Pulse	ASTM 7241.92 Radium (Gamma)					REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
-01	K-1766	7-26-01	13:10	Soil	1	Plastic	None	X	X	X	X					Comp
-02	K-1912		14:10	Ballast	1			X	X	X	X					Grab
-03	K-1913		14:15		1			X	X	X	X					
-04	K-1914		14:20		1			X	X	X	X					
-05	K-1915		14:25		1			X	X	X	X					
-06	K-1916		14:30		1			X	X	X	X					
-07	K-1917		14:35		1			X	X	X	X					
-08	K-1918		14:40		1			X	X	X	X					
-09	K-1919		14:45		1			X	X	X	X					
-10	K-1920		14:50		1			X	X	X	X					
-11	K-1921		14:55		1			X	X	X	X					
-12	K-1922		15:00		1			X	X	X	X					
-13	K-1923		15:05		1			X	X	X	X					

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

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 leg[illegible]le for any reasonable attorney and/or collection fees and all related costs necessary to remit the entire balance to [illegible]ch Technologies, Inc. (Outreach Laboratory).

SAMPLE RE[illegible] DISPOSAL: All non-hazardous samples shall be disposed of 30 days after issue of final report. All others will be [illegible]d at client's expense.

FOR LABORATORY USE ONLY:

Sample Condition Upon Receipt: Good
Custody Seals Intact: Y N
Cooler Temperature: NA

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company: Kaiser - Alum & Chem Corp
Name: David R. Weyant
Address: 7311 E. 41st St.
City: Tulsa State: OK Zip: 74145
Phone: 724-939-3530 Fax #: 918-384-2171

LOCAL: 918-384-0566
CELL: 724-799-0071

Bill To:
Company: Kaiser Alum & Chem Corp
Name: Bill Wiegand / David Weyant
Address: 7311 E. 41st St.
City: Tulsa State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: Kaiser - 4072
PROJECT #: PA - Hom - 4072
PROJECT NAME: Kaiser Thorium Remo.
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): 5 DAY
SAMPLER: Signature
Name: David Weyant / David Weyant

PRESERVATIVE #: 1. HNO_3 pH<2 2. Ice <6°C 3. HCl pH<2 4. H_2SO_4 pH<2 5. NaOH pH>11

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER SIZE / PLASTIC OR GLASS	PRESERVATIVE #	Gamma Spec (HL-7270)	Radiochem Uranium Isotopic Analysis	MDC Soil Dust Filter	ASTM 2216-92 Moisture Content					REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
-14	K-1903	7-25-06	1525	Soil	1	Plastic	None	X	X	X	X					Grab
-15	K-1904	7-25-06	1530		1			X	X	X	X					
-16	K-1905	7-26-06	0930		1			X	X	X	X					

RELINQUISHED BY: [signature] DATE: 7/27/06 TIME: 810 RECEIVED BY: [signature] DATE: 7/27/06 TIME: 810
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.

FOR LABORATORY USE ONLY: 20060621-2
Sample Condition Upon Receipt: Good
Custody Seals Intact: Y N
Cooler Temperature: NA

SAMPLE LOGIN

Date Received: *7/27/06 8:24:25 A* **Lab Number:** 20060621 **Due:** 8/2/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060621-01 A	K-1760	Soil	07/26/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060621-02 A	K-1912	Ballast	07/26/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060621-03 A	K-1913	Ballast	07/26/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060621-04 A	K-1914	Ballast	07/26/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060621-05 A	K-1915	Ballast	07/26/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060621-06 A	K-1916	Ballast	07/26/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060621-07 A	K-1917	Ballast	07/26/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060621-08 A	K-1918	Ballast	07/26/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060621-09 A	K-1919	Ballast	07/26/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060621-1	K-1920	Ballast	07/26/06	Plastic	16 oz	None	Yes	Yes

Gamma Spec - Thorium 232 Percent Moisture (LOD)								
20060621-11 A	K-1921 Gamma Spec - Thorium 232 Percent Moisture (LOD)	Ballast	07/26/06	Plastic	16 oz	None	Yes	Yes
20060621-12 A	K-1922 Gamma Spec - Thorium 232 Percent Moisture (LOD)	Ballast	07/26/06	Plastic	16 oz	None	Yes	Yes
20060621-13 A	K-1923 Gamma Spec - Thorium 232 Percent Moisture (LOD)	Ballast	07/26/06	Plastic	16 oz	None	Yes	Yes
20060621-14 A	K-1903 Gamma Spec - Thorium 232 Percent Moisture (LOD)	Soil	07/25/06	Plastic	16 oz	None	Yes	Yes
20060621-15 A	K-1904 Gamma Spec - Thorium 232 Percent Moisture (LOD)	Soil	07/25/06	Plastic	16 oz	None	Yes	Yes
20060621-16 A	K-1905 Gamma Spec - Thorium 232 Percent Moisture (LOD)	Soil	07/26/06	Plastic	16 oz	None	Yes	Yes

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

K-1909 → 1911 PO A- 008
Invoice # 12298
8-7-06

August 7, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060648

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples received in our laboratory on August 3, 2006 for the above captioned project. Three soil samples were received in good condition and analyzed by Gamma Spectroscopy without drying and grinding and Percent Moisture with an expedited 5 work day turn. Results were faxed on 8/3/06.

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

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID #OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060648
Date Reported:	8/7/06
Date Received:	8/3/06
Page Number:	1 of 2

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	**20060648-01**						
Client ID:	**K-1909**						
Date Sampled:	**8/2/06 9:15:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	1.14 +/- 0.285	pCi/g	0.545		8/3/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	8.3	%		8/3/06	8/4/06	RS
Lab ID:	**20060648-02**						
Client ID:	**K-1910**						
Date Sampled:	**8/2/06 9:25:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	1.23 +/- 0.164	pCi/g	0.398		8/3/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	9.5	%		8/3/06	8/4/06	RS
Lab ID:	**20060648-03**						
Client ID:	**K-1911**						
Date Sampled:	**8/2/06 9:35:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	1.30 +/- 0.219	pCi/g	0.333		8/3/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	3.1	%		8/3/06	8/4/06	RS

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060648
Date Reported:	8/7/06
Date Received:	8/3/06
Page Number:	2 of 2

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Ac-228					12.0				7/31/06
Am-241		122.0	84.0	36.1					7/31/06
Co-60		97.0	99.0	2.1					7/31/06
Cs-137		94.0	94.0	0.7					7/31/06
Percent Moisture					9.0				8/4/06

Lab Approval:

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company: KAISER ALUM & CHEM INC.
Name: DAVID B. WEYANT
Address: 7311 E. 41ST ST.
City: TULSA State: OK Zip: 74145
Phone: 724-934-3530 Fax #: 918-384-3171
LOCAL: 918-384-0506
CELL: 724-799-0071

Bill To:
Company: KAISER/PENN E&R
Name: BILL VINCENT/DAVE WEYANT
Address: 7311 E. 41ST ST
City: TULSA State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: KAISER/4072
PROJECT #: PA-4000-4072
PROJECT NAME: KAISER-THORIUM PROJECT
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): 5 DAYS
SAMPLER: Signature BW DUFFEY

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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 (TH-232)	RADIUM 226 TO CLIENT FOR ARCHIVE	MDC 0.1 pCi/gm	ASTM 2216.92 MOISTURE CONT					REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
						PLASTIC										
	K-1909	8-2-06	0915	SOIL	1	500ml	NONE	X	X	X	X					GRAB
	K-1910	8-2-06	0925	↓	↓	↓	↓	X	X	X	X					↓
	K-1911	8-2-06	0935	↓	↓	↓	↓	X	X	X	X					↓

RELINQUISHED BY: BW DUFFEY DATE 8/4/06 TIME 900 RECEIVED BY: [signature] DATE 8/5/06 TIME 900

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

My signature on the 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: 20060648
Sample Condition Upon Receipt: Good
Custody Seals Intact: (Y) N
Cooler Temperature: RA

SAMPLE LOGIN

Date Received: *8/3/06 9:10:54 A* **Lab Number:** 20060648 **Due:** 8/9/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060648-01 A	K-1909	Soil	08/02/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060648-02 A	K-1910	Soil	08/02/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060648-03 A	K-1911	Soil	08/02/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								

CONTAINER INSPECTION

 # Coolers 0 **Custody Seals Broken** **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ☑ **Labels in Tact** ☑ **Radiation Survey Complete** ☑

Anomalies

Inspected By: _____ **DATE** _____

QA or Designee Review: [signature] **DATE** 08/03/06

Sample Custodian Review: [signature] **DATE** 8/3/06

Project Notes:

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

Invoice # 12299
8-7-06
K-1906 → 1908 PDA-009
K-1925 QA

August 7, 2006

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

OK ✓ David Q. Weyant
DAVID Q. WEYANT
PENN E&R

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060642

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples received in our laboratory on August 2, 2006 for the above captioned project. Four soil samples were received in good condition and analyzed by Gamma Spectroscopy without drying and grinding and Percent Moisture with an expedited 2-work day turn. Results were faxed on 8/3/06.

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

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID #OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060642
Date Reported:	8/7/06
Date Received:	8/2/06
Page Number:	1 of 2

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060642-01						
Client ID:	K-1906						
Date Sampled:	8/1/06 1:20:00 PM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	1.10 +/- 0.267	pCi/g	0.332		8/2/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	4.3	%		8/2/06	8/3/06	RS
Lab ID:	20060642-02						
Client ID:	K-1907						
Date Sampled:	8/1/06 1:30:00 PM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	1.02 +/- 0.486	pCi/g	0.658		8/2/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	6.2	%		8/2/06	8/3/06	RS
Lab ID:	20060642-03						
Client ID:	K-1908						
Date Sampled:	8/1/06 1:40:00 PM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	1.19 +/- 0.204	pCi/g	0.220		8/2/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	4.2	%		8/2/06	8/3/06	RS
Lab ID:	20060642-04						
Client ID:	K-1925						
Date Sampled:	8/1/06 4:25:00 PM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	3.61 +/- 0.411	pCi/g	0.616		8/2/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	15.2	%		8/2/06	8/3/06	RS

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060642
Date Reported:	8/7/06
Date Received:	8/2/06
Page Number:	2 of 2

QC Report

Parameter	Blank	LCS	LCSD		DUP	MS	MSD		Date
		%REC	%REC	RPD	RPD	%REC	%REC	RPD	
Ac-228					12.0				7/31/06
Am-241		122.0	84.0	36.1					7/31/06
Co-60		97.0	99.0	2.1					7/31/06
Cs-137		94.0	94.0	0.7					7/31/06
Percent Moisture					11.8				8/3/06

Lab Approval:

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company
Name
Address
City State Zip
Phone Fax #

Bill To:
Company
Name
Address
City State Zip

ANALYSIS REQUESTED

PO #
PROJECT #
PROJECT NAME
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY)
SAMPLER
Signature

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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									REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
								X	X	X	X					
								X	X	X	X					
								X	X	X	X					
								X	X	X	X					

RELINQUISHED BY: DATE TIME RECEIVED BY: DATE TIME

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 [illegible] 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 [illegible] any reasonable attorney and/or collection fees and all related costs necessary to remit the entire balance to O[illegible] 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 return[illegible] client's expense.

FOR LABORATORY USE ONLY: 20060642

Sample Condition Upon Receipt Good

Custody Seals Intact Y N

Cooler Temperature NA

SAMPLE LOGIN

Date Received: *8/2/06 9:23:09 A* **Lab Number:** 20060642 **Due:** 8/3/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060642-01 A	K-1906	Soil	08/01/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060642-02 A	K-1907	Soil	08/01/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060642-03 A	K-1908	Soil	08/01/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060642-04 A	K-1925	Soil	08/01/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								

CONTAINER INSPECTION

 # Coolers 1 **Custody Seals Broken** ☐ **Temperature:** C Ice **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ☑ **Labels in Tact** ☑ **Radiation Survey Complete** ☑

Anomalies

Inspected By: _____ **DATE** 8/2/06

QA or Designee Review: _____ **DATE** _____

Sample Custodian Review: _____ **DATE** 8/2/06

Project Notes:

SUB-REPORT

SURVEY UNIT KAISER-FSSPOA-009

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Figure A-2 Systematic Sampling Locations
Alpha Scan MDC Calculation Form
Total Alpha Contamination Survey Data Conversion Form
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Alpha Scan MDC Calculation Form
Total Alpha Contamination Survey Data Conversion Form
Table D-1 Gross Alpha Scan Results Summary

ATTACHMENT E: Figure E-1 Systematic Sampling Locations
Alpha Scan MDC Calculation Form
Total Alpha Contamination Survey Data Conversion Form
Table E-1 Gross Alpha Scan Results Summary

ATTACHMENT F: Figure F-1 Systematic Sampling Locations
Alpha Scan MDC Calculation Form
Total Alpha Contamination Survey Data Conversion Form
Table F-1 Gross Alpha Scan Results Summary

ATTACHMENT G: Figure G-1 Systematic Sampling Locations
Alpha Scan MDC Calculation Form
Total Alpha Contamination Survey Data Conversion Form
Table G-1 Gross Alpha Scan Results Summary

ATTACHMENT H: Figure H-1 Systematic Sampling Locations
Alpha Scan MDC Calculation Form
Total Alpha Contamination Survey Data Conversion Form
Table H-1 Gross Alpha Scan Results Summary

ATTACHMENT I: Laboratory Analytical Results

Final Status Survey Report
Volume VI - Post Operational Areas
Sub-Report No. POA-009
Survey Unit Kaiser-FSSPOA-009
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation
September 12, 2006

1.0 BACKGROUND

This sub-report documents the results of post operational 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-FSSPOA-009, the asphalt loading pad associated with the railroad spur constructed for the load-out of exempt radiological materials to be disposed at the U.S. Ecology, Grandview, Idaho facility.

The asphalt loading pad is approximately 70.5 meters in length and 10.5 meters in width (area of 740 m^2). It overlies Excavation Bottom Survey Unit Kaiser-FSS-007. It is bounded to the south by Post Operational Survey Unit Kaiser-FSSPOA-011, to the east by Post Operational Survey Unit Kaiser-FSSPOA-010, to the north by Post Operational Survey Units Kaiser-FSSPOA-005 and Kaiser-FSSPOA-006, and to the west by Post Operational Survey Unit Kaiser-FSSPOA-005 **(Figure 3)**.

For final status surveying purposes, the asphalt pad's structural surface was divided into eight Class 1 sub-units of areas less than or equal to 100 m^2. These eight sub-units are identified as Kaiser-FSSPOA-009A through Kaiser-FSSPOA-009H.

2.0 SURVEY ACTIVITIES AND RESULTS

This section of the sub-report presents the final status survey data for the asphalt structural surface of Survey Unit Kaiser-FSSPOA-009 by survey sub-unit. The final status survey of each survey sub-unit consisted of a gross alpha scan of the structural surface and systematic measurements of total and removable alpha contamination. The supporting documentation for the final status survey of each sub-unit is contained in **Attachments A** through **H** and includes the following:

- Gross Alpha Scan Grid Layout Figures
- Systematic Sampling Location Figures
- Alpha Scan MDC Calculation Sheets
- Gross Alpha Scan Results Summary Tables
- Total Alpha Contamination Survey Data Conversion Forms

2.1 Gross Alpha Scan of Structural Surface

The structural surface of each of the eight Class 1 survey sub-units was surveyed through a 100 percent coverage gross alpha scan, to confirm acceptable radiological conditions and identify any elevated areas. The structural surface of each sub-unit was generally divided into 1-meter by 1-meter grids for recording the results of the 100 percent coverage gross alpha scan **(Figure A-1, Attachment A)**. Minimum, maximum, and average scan rates for alpha activity in gross cpm were recorded for each grid. The results of the scanning activities are summarized in **Tables A-1** (Sub-unit Kaiser FSSPOA-009A) through **H-1** (Sub-unit Kaiser-FSSPOA-009H) contained in **Attachments A** through **H** respectively. The 100 percent coverage gross alpha scan of the structural surface did not indicate the presence of small areas of elevated activity (above the DCGL-GA for the site).

2.2 Systematic Measurements of Total and Removable Alpha Contamination

The final status survey also consisted of systematic measurements of total and removable alpha contamination based on a random start point and an equal-distant triangular grid. Since the DCGL values for total and removable contamination contained in the DPA have been revised (and approved by the NRC), the minimum number of sample points for measurement of total and removable alpha contamination has been recalculated. Since scanning measures total alpha contamination, the minimum number of sample points required (N) is re-determined if the alpha scan minimum detectable concentration (MDC) is greater than the total contamination DCGL.

<u>Determination of the Minimum Number of Sample Points (N)</u>

Paramount to determining the minimum number of sample points is the determination of the relative shift, delta over sigma (Δ/σ). Delta is equal to the difference between the DCGL and 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. The estimate of sigma used in the determination 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 (total) alpha activity concentration of 944 dpm/100cm^2 is the revised 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.

Adjusting N Based on Scan Minimum Detectable Contamination (MDC)

The scan of structural surfaces is used to detect elevated areas. The total contamination DCGL value applicable to final status surveys of structures for the Tulsa site is the DCGL-GA (DCGL gross alpha) and the value is 944 dpm/100cm^2 of total alpha contamination. Since the background count rate for gross alpha is usually very low, e.g., 1 count per minute (cpm), MARSSIM provides guidance for determining the scanning MDC for gross alpha based on the probability of detecting very small increments in gross alpha count rate, i.e., one of two counts. 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:

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

where:

$P(n \geq 1)$	=	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).

Increase the value of G until the corresponding probability equals the desired confidence level, e.g., 95 percent, and the resulting dpm is the MDC. (The dpm value may be divided by the active area of the detector, e.g., 100 cm^2 to yield an MDC result in dpm/100cm^2.) This method of determining the alpha scan MDC is not background dependent (assuming the background alpha count rate is low). However, the calculated MDC is dependent on the scan speed. Using this formula and typical alpha efficiencies for gas proportional detectors, the calculated scan MDC ranges from 400 to 1,180 dpm/100cm^2 based on scan speeds of a third of a detector width to one detector width per second. *This range of MDC values is the same magnitude as the DCGL-GA and does not result in an increase in the minimum number of samples required.*

The Minimum Number of Samples Required (N) was determined to be 9. However, the minimum number of sample points used for each survey sub-unit was 14. The Survey Unit Area (A) of each sub-unit along with the N of 14 were used to calculate the applicable Triangular Grid Node Length (L) and the Height of the Equilateral Triangle (h). This information is provided on each survey sub-unit's appropriate systematic sampling locations figure.

2.2.1 Total and Removable Alpha Contamination Measurement Results – Sub-Unit Kaiser-FSSPOA-009A

A layout of the total and removable alpha contamination measurement locations for Survey Sub-Unit Kaiser-FSSPOA-009A is provided on **Figure A-2** contained in **Attachment A**. At each of the 14 locations, a measurement (static count with a gas proportional detector) of total alpha contamination (identified as MARSSIM-001 through MARSSIM-014) and a smear sample for determination of removable alpha contamination (identified as K-SS-379 through K-SS-392) were collected on the structural surface. The smear samples were forwarded to Outreach for analysis of alpha activity (per the 100 cm^2 surface area sampled). Total alpha contamination measurement results are provided below in **Table 1**.

Table 1 – Systematic Total Alpha Contamination Measurement Results

Sample ID	DCGL-GA ($dpm/100cm^2$)	Total Contamination ($dpm/100cm^2$)	Std. Error ($dpm/100cm^2$)	MDC ($dpm/100cm^2$)
MARSSIM-001	944	48.1	36.6	47.6
MARSSIM-002	944	69.5	42.2	47.6
MARSSIM-003	944	21.4	28.2	47.6
MARSSIM-004	944	32.1	31.8	47.6
MARSSIM-005	944	26.7	30.0	47.6
MARSSIM-006	944	26.7	30.0	47.6
MARSSIM-007	944	26.7	30.0	47.6
MARSSIM-008	944	64.2	40.9	47.6
MARSSIM-009	944	26.7	30.0	47.6
MARSSIM-010	944	48.1	36.6	47.6
MARSSIM-011	944	101.6	49.4	47.6
MARSSIM-012	944	42.8	35.1	47.6
MARSSIM-013	944	48.1	36.6	47.6
MARSSIM-014	944	48.1	36.6	47.6
Average		***45.1***		
Standard Dev.		***21.9***		
Minimum		***21.4***		
Maximum		***101.6***		
Median		***45.5***		

All 14 total alpha contamination measurements for Survey Sub-Unit Kaiser-FSSPOA-009A were below the DCGL-GA of 944 $dpm/100cm^2$. The maximum total alpha contamination was 101.6 $dpm/100cm^2$. The average total alpha contamination was 45.1 $dpm/100cm^2$.

The standard deviation of the 14 equal-distant samples was 21.9, less than the estimated standard deviation of 45.9 (based on the Flux Building Survey Unit FB-001 final status survey results) used to calculate the minimum number of samples (N) required.

Analytical results of the smear samples are provided below in **Table 2**. The analytical data report is contained in **Attachment I**.

Table 2 – Systematic Removable Alpha Contamination Smear Sample Results

Sample ID	DCGL-GA (dpm/100cm^2)	Removable Contamination (dpm/100cm^2)	Std. Error (dpm/100cm^2)	MDC (dpm/100cm^2)
MARSSIM-001 (K-SS-379)	94.4	0.520	0.554	0.466
MARSSIM-002 (K-SS-380)	94.4	0	0.416	0.453
MARSSIM-003 (K-SS-381)	94.4	0.039	0.526	0.560
MARSSIM-004 (K-SS-382)	94.4	0.071	0.546	0.574
MARSSIM-005 (K-SS-383)	94.4	1.03	0.550	0.269
MARSSIM-006 (K-SS-384)	94.4	0.071	0.355	0.359
MARSSIM-007 (K-SS-385)	94.4	0.808	0.663	0.542
MARSSIM-008 (K-SS-386)	94.4	1.26	1.13	1.07
MARSSIM-009 (K-SS-387)	94.4	0	0.422	0.466
MARSSIM-010 (K-SS-388)	94.4	0.664	0.575	0.453
MARSSIM-011 (K-SS-389)	94.4	0.832	0.680	0.560
MARSSIM-012 (K-SS-390)	94.4	0.193	0.571	0.574
MARSSIM-013 (K-SS-391)	94.4	0.193	0.394	0.359
MARSSIM-014 (K-SS-392)	94.4	0.	0.459	0.542
Average		***0.406***		
Standard Dev.		***0.437***		
Minimum		***0***		
Maximum		***1.26***		
Median		***0.193***		

All 14 smear sample results for Survey Sub-Unit Kaiser-FSSPOA-009A were below the removable contamination DCGL-GA of 94.4 dpm/100cm^2 (10% of the total contamination DCGL-GA value). The maximum removable alpha contamination result was 1.26 dpm/100cm^2. The average removable alpha contamination result was 0.406 dpm/100cm^2, less than 1% of the DCGL-GA value.

Wilcoxon Rank Sum (WRS) Testing

The total alpha contamination results were evaluated using the procedure contained in **Appendix C, Volume VI** of this Final Status Survey Report (Wilcoxon Rank Sum Test). The evaluation showed that the survey sub-unit total alpha contamination results meet the DP statistical criterion based on the first statistical test described below.

If the difference (100.8 dpm/100cm^2) between the maximum survey unit total alpha contamination result (101.6 dpm/100cm^2) and the minimum reference background area total alpha contamination result (0.772 dpm/100cm^2) is less than DCGL-GA (944 dpm/100cm^2), then the survey unit meets the release criterion. **Table 3** presents a summary of the data used to complete the statistical evaluation of the survey unit.

Table 3 – Reference Area and Survey Unit Total Alpha Contamination Results

Reference Group	Sample ID	Total Alpha Contamination (dpm/100cm^2)	Survey Unit Group	Sample ID	Total Alpha Contamination (dpm/100cm^2)
R1	Asphalt	8.88	S1	MARSSIM-001	48.1
R2	Asphalt	1.93	S2	MARSSIM-002	69.5
R3	Asphalt	5.40	S3	MARSSIM-003	21.4
R4	Asphalt	7.72	S4	MARSSIM-004	32.1
R5	Asphalt	4.25	S5	MARSSIM-005	26.7
R6	Asphalt	3.09	S6	MARSSIM-006	26.7
R7	Asphalt	5.40	S7	MARSSIM-007	26.7
R8	Asphalt	1.93	S8	MARSSIM-008	64.2
R9	Asphalt	0.772	S9	MARSSIM-009	26.7
R10	Asphalt	4.25	S10	MARSSIM-010	48.1
R11	Asphalt	5.40	S11	MARSSIM-011	101.6
R12	Asphalt	7.72	S12	MARSSIM-012	42.8
R13	Asphalt	3.09	S13	MARSSIM-013	48.1
R14	Asphalt	1.93	S14	MARSSIM-014	48.1
	Average:	***4.41***		***Average:***	***45.1***
	Standard Dev.	***2.48***		***Standard Dev.***	***21.9***
	Minimum:	***0.772***		***Minimum:***	***21.4***
	Maximum:	***8.88***		***Maximum:***	***101.6***
	Median:	***4.25***		***Median:***	***45.5***

2.2.2 Total and Removable Alpha Contamination Measurement Results – Sub-Unit Kaiser-FSSPOA-009B

A layout of the total and removable alpha contamination measurement locations for Survey Sub-Unit Kaiser-FSSPOA-009B is provided on **Figure B-1** contained in **Attachment B**. At each of the 14 locations, a measurement (static count with a gas proportional detector) of total alpha contamination (identified as MARSSIM-001 through MARSSIM-014) and a smear sample for determination of removable alpha contamination (identified as K-SS-273 through K-SS-286) were collected on the structural surface. The smear samples were forwarded to Outreach for analysis of alpha activity (per the 100 cm^2 surface area sampled). Total alpha contamination measurement results are provided below in **Table 4**.

Table 4 – Systematic Total Alpha Contamination Measurement Results

Sample ID	DCGL-GA (dpm/100cm^2)	Total Contamination (dpm/100cm^2)	Std. Error (dpm/100cm^2)	MDC (dpm/100cm^2)
MARSSIM-001	944	19.7	15.5	23.2
MARSSIM-002	944	5.76	12.5	23.2
MARSSIM-003	944	22.8	16.0	23.2
MARSSIM-004	944	18.2	15.2	23.2
MARSSIM-005	944	13.5	14.2	23.2
MARSSIM-006	944	25.9	16.6	23.2
MARSSIM-007	944	32.1	17.7	23.2
MARSSIM-008	944	5.76	12.5	23.2
MARSSIM-009	944	5.76	12.5	23.2

Sample ID	DCGL-GA (dpm/100cm^2)	Total Contamination (dpm/100cm^2)	Std. Error (dpm/100cm^2)	MDC (dpm/100cm^2)
MARSSIM-010	944	21.3	15.8	23.2
MARSSIM-011	944	33.7	18.0	23.2
MARSSIM-012	944	58.5	21.7	23.2
MARSSIM-013	944	70.9	23.3	23.2
MARSSIM-014	944	58.5	21.7	23.2
Average		***28.0***		
Standard Dev.		***20.9***		
Minimum		***5.76***		
Maximum		***70.9***		
Median		***22.0***		

All 14 total alpha contamination measurements for Survey Sub-Unit Kaiser-FSSPOA-009B were below the DCGL-GA of 944 dpm/100cm^2. The maximum total alpha contamination was 70.9 dpm/100cm^2. The average total alpha contamination was 28.0 dpm/100cm^2.

The standard deviation of the 14 equal-distant samples was 20.9, less than the estimated standard deviation of 45.9 (based on the Flux Building Survey Unit FB-001 final status survey results) used to calculate the minimum number of samples (N) required.

Analytical results of the smear samples are provided below in **Table 5**. The analytical data report is contained in **Attachment I**.

Table 5 – Systematic Removable Alpha Contamination Smear Sample Results

Sample ID	DCGL-GA (dpm/100cm^2)	Removable Contamination (dpm/100cm^2)	Std. Error (dpm/100cm^2)	MDC (dpm/100cm^2)
MARSSIM-001 (K-SS-273)	94.4	0	0.459	0.542
MARSSIM-002 (K-SS-274)	94.4	0	0.348	0.466
MARSSIM-003 (K-SS-275)	94.4	0	0.380	0.453
MARSSIM-004 (K-SS-276)	94.4	0	0.437	0.560
MARSSIM-005 (K-SS-277)	94.4	0	0.411	0.574
MARSSIM-006 (K-SS-278)	94.4	0	0.244	0.269
MARSSIM-007 (K-SS-279)	94.4	0.071	0.355	0.359
MARSSIM-008 (K-SS-280)	94.4	0.337	0.514	0.466
MARSSIM-009 (K-SS-281)	94.4	0	0.341	0.453
MARSSIM-010 (K-SS-282)	94.4	0	0.469	0.560
MARSSIM-011 (K-SS-283)	94.4	0.417	0.399	0.269
MARSSIM-012 (K-SS-284)	94.4	0.193	0.394	0.359
MARSSIM-013 (K-SS-285)	94.4	0.015	0.504	0.542
MARSSIM-014 (K-SS-286)	94.4	0	0.368	0.466
Average		***0.074***		
Standard Dev.		***0.140***		
Minimum		***0***		
Maximum		***0.417***		
Median		***0***		

All 14 smear sample results for Survey Sub-Unit Kaiser-FSSPOA-009B were below the removable contamination DCGL-GA of 94.4 dpm/100cm^2 (10% of the total contamination DCGL-GA value). The maximum removable alpha contamination result was 0.417 dpm/100cm^2. The average removable alpha contamination result was 0.074 dpm/100cm^2, less than 1% of the DCGL-GA value.

Wilcoxon Rank Sum (WRS) Testing

The total alpha contamination results were evaluated using the procedure contained in **Appendix C, Volume VI** of this Final Status Survey Report (Wilcoxon Rank Sum Test). The evaluation showed that the survey sub-unit total alpha contamination results meet the DP statistical criterion based on the first statistical test described below.

If the difference (70.1 dpm/100cm^2) between the maximum survey unit total alpha contamination result (70.9 dpm/100cm^2) and the minimum reference background area total alpha contamination result (0.772 dpm/100cm^2) is less than DCGL-GA (944 dpm/100cm^2), then the survey unit meets the release criterion. **Table 6** presents a summary of the data used to complete the statistical evaluation of the survey unit.

Table 6 – Reference Area and Survey Unit Total Alpha Contamination Results

Reference Group	Sample ID	Total Alpha Contamination (dpm/100cm^2)	Survey Unit Group	Sample ID	Total Alpha Contamination (dpm/100cm^2)
R1	Asphalt	8.88	S1	MARSSIM-001	19.7
R2	Asphalt	1.93	S2	MARSSIM-002	5.76
R3	Asphalt	5.40	S3	MARSSIM-003	22.8
R4	Asphalt	7.72	S4	MARSSIM-004	18.2
R5	Asphalt	4.25	S5	MARSSIM-005	13.5
R6	Asphalt	3.09	S6	MARSSIM-006	25.9
R7	Asphalt	5.40	S7	MARSSIM-007	32.1
R8	Asphalt	1.93	S8	MARSSIM-008	5.76
R9	Asphalt	0.772	S9	MARSSIM-009	5.76
R10	Asphalt	4.25	S10	MARSSIM-010	21.3
R11	Asphalt	5.40	S11	MARSSIM-011	33.7
R12	Asphalt	7.72	S12	MARSSIM-012	58.5
R13	Asphalt	3.09	S13	MARSSIM-013	70.9
R14	Asphalt	1.93	S14	MARSSIM-014	58.5
	Average:	***4.41***		***Average:***	***28.0***
	Standard Dev.	***2.48***		***Standard Dev.***	***20.9***
	Minimum:	***0.772***		***Minimum:***	***5.76***
	Maximum:	***8.88***		***Maximum:***	***70.9***
	Median:	***4.25***		***Median:***	***22.0***

2.2.3 Total and Removable Alpha Contamination Measurement Results – Sub-Unit Kaiser-FSSPOA-009C

A layout of the total and removable alpha contamination measurement locations for Survey Sub-Unit Kaiser-FSSPOA-009C is provided on **Figure C-1** contained in **Attachment C**. At each of the 14 locations, a measurement (static count with a gas proportional detector) of total alpha contamination (identified as MARSSIM-001 through MARSSIM-014) and a smear sample for determination of removable alpha contamination (identified as K-SS-288 through K-SS-301) were collected on the structural surface. The smear samples were forwarded to Outreach for analysis of alpha activity (per the 100 cm^2 surface area sampled). Total alpha contamination measurement results are provided below in **Table 7**.

Table 7 – Systematic Total Alpha Contamination Measurement Results

Sample ID	DCGL-GA ($dpm/100cm^2$)	Total Contamination ($dpm/100cm^2$)	Std. Error ($dpm/100cm^2$)	MDC ($dpm/100cm^2$)
MARSSIM-001	944	17.3	16.4	26.3
MARSSIM-002	944	17.3	16.4	26.3
MARSSIM-003	944	43.6	20.7	26.3
MARSSIM-004	944	25.0	17.8	26.3
MARSSIM-005	944	28.1	18.3	26.3
MARSSIM-006	944	29.7	18.5	26.3
MARSSIM-007	944	43.6	20.7	26.3
MARSSIM-008	944	32.8	19.0	26.3
MARSSIM-009	944	29.7	18.5	26.3
MARSSIM-010	944	52.9	22.0	26.3
MARSSIM-011	944	3.32	13.7	26.3
MARSSIM-012	944	85.5	26.0	26.3
MARSSIM-013	944	70.0	24.2	26.3
MARSSIM-014	944	37.4	19.7	26.3
Average		***36.9***		
Standard Dev.		***21.6***		
Minimum		***3.32***		
Maximum		***85.5***		
Median		***31.2***		

All 14 total alpha contamination measurements for Survey Sub-Unit Kaiser-FSSPOA-009C were below the DCGL-GA of 944 $dpm/100cm^2$. The maximum total alpha contamination was 85.5 $dpm/100cm^2$. The average total alpha contamination was 36.9 $dpm/100cm^2$.

The standard deviation of the 14 equal-distant samples was 21.6, less than the estimated standard deviation of 45.9 (based on the Flux Building Survey Unit FB-001 final status survey results) used to calculate the minimum number of samples (N) required.

Analytical results of the smear samples are provided below in **Table 8**. The analytical data report is contained in **Attachment I**.

Table 8 – Systematic Removable Alpha Contamination Smear Sample Results

Sample ID	DCGL-GA (dpm/100cm^2)	Removable Contamination (dpm/100cm^2)	Std. Error (dpm/100cm^2)	MDC (dpm/100cm^2)
MARSSIM-001 (K-SS-288)	94.4	0	0.498	0.560
MARSSIM-002 (K-SS-289)	94.4	0	0.461	0.574
MARSSIM-003 (K-SS-290)	94.4	0.417	0.399	0.269
MARSSIM-004 (K-SS-291)	94.4	0.071	0.355	0.359
MARSSIM-005 (K-SS-292)	94.4	0	0.475	0.542
MARSSIM-006 (K-SS-293)	94.4	0.215	0.485	0.466
MARSSIM-007 (K-SS-294)	94.4	0.176	0.465	0.453
MARSSIM-008 (K-SS-295)	94.4	0	0.512	0.560
MARSSIM-009 (K-SS-296)	94.4	0	0.445	0.574
MARSSIM-010 (K-SS-297)	94.4	0.356	0.381	0.269
MARSSIM-011 (K-SS-298)	94.4	1.05	0.596	0.359
MARSSIM-012 (K-SS-299)	94.4	0	0.489	0.542
MARSSIM-013 (K-SS-300)	94.4	0.032	0.439	0.466
MARSSIM-014 (K-SS-301)	94.4	0	0.416	0.453
Average		***0.166***		
Standard Dev.		***0.291***		
Minimum		***0***		
Maximum		***1.05***		
Median		***0.016***		

All 14 smear sample results for Survey Sub-Unit Kaiser-FSSPOA-009C were below the removable contamination DCGL-GA of 94.4 dpm/100cm^2 (10% of the total contamination DCGL-GA value). The maximum removable alpha contamination result was 1.05 dpm/100cm^2. The average removable alpha contamination result was 0.166 dpm/100cm^2, less than 1% of the DCGL-GA value.

Wilcoxon Rank Sum (WRS) Testing

The total alpha contamination results were evaluated using the procedure contained in **Appendix C, Volume VI** of this Final Status Survey Report (Wilcoxon Rank Sum Test). The evaluation showed that the survey sub-unit total alpha contamination results meet the DP statistical criterion based on the first statistical test described below.

If the difference (84.7 dpm/100cm^2) between the maximum survey unit total alpha contamination result (85.5 dpm/100cm^2) and the minimum reference background area total alpha contamination result (0.772 dpm/100cm^2) is less than DCGL-GA (944 dpm/100cm^2), then the survey unit meets the release criterion. **Table 9** presents a summary of the data used to complete the statistical evaluation of the survey unit.

Table 9 – Reference Area and Survey Unit Total Alpha Contamination Results

Reference Group	Sample ID	Total Alpha Contamination (dpm/100cm^2)	Survey Unit Group	Sample ID	Total Alpha Contamination (dpm/100cm^2)
R1	Asphalt	8.88	S1	MARSSIM-001	17.3
R2	Asphalt	1.93	S2	MARSSIM-002	17.3
R3	Asphalt	5.40	S3	MARSSIM-003	43.6
R4	Asphalt	7.72	S4	MARSSIM-004	25.0
R5	Asphalt	4.25	S5	MARSSIM-005	28.1
R6	Asphalt	3.09	S6	MARSSIM-006	29.7
R7	Asphalt	5.40	S7	MARSSIM-007	43.6
R8	Asphalt	1.93	S8	MARSSIM-008	32.8
R9	Asphalt	0.772	S9	MARSSIM-009	29.7
R10	Asphalt	4.25	S10	MARSSIM-010	52.9
R11	Asphalt	5.40	S11	MARSSIM-011	3.32
R12	Asphalt	7.72	S12	MARSSIM-012	85.5
R13	Asphalt	3.09	S13	MARSSIM-013	70.0
R14	Asphalt	1.93	S14	MARSSIM-014	37.4
	Average:	***4.41***		***Average:***	***36.9***
	Standard Dev.	***2.48***		***Standard Dev.***	***21.6***
	Minimum:	***0.772***		***Minimum:***	***3.32***
	Maximum:	***8.88***		***Maximum:***	***85.5***
	Median:	***4.25***		***Median:***	***31.2***

2.2.4 Total and Removable Alpha Contamination Measurement Results – Sub-Unit Kaiser-FSSPOA-009D

A layout of the total and removable alpha contamination measurement locations for Survey Sub-Unit Kaiser-FSSPOA-009D is provided on **Figure D-1** contained in **Attachment D**. At each of the 14 locations, a measurement (static count with a gas proportional detector) of total alpha contamination (identified as MARSSIM-001 through MARSSIM-014) and a smear sample for determination of removable alpha contamination (identified as K-SS-303 through K-SS-316) were collected on the structural surface. The smear samples were forwarded to Outreach for analysis of alpha activity (per the 100 cm^2 surface area sampled). Total alpha contamination measurement results are provided below in **Table 10**.

Table 10 – Systematic Total Alpha Contamination Measurement Results

Sample ID	DCGL-GA (dpm/100cm^2)	Total Contamination (dpm/100cm^2)	Std. Error (dpm/100cm^2)	MDC (dpm/100cm^2)
MARSSIM-001	944	37.1	17.6	20.6
MARSSIM-002	944	29.4	16.3	20.6
MARSSIM-003	944	41.8	18.4	20.6
MARSSIM-004	944	26.3	15.7	20.6
MARSSIM-005	944	37.1	17.6	20.6
MARSSIM-006	944	29.4	16.3	20.6
MARSSIM-007	944	30.9	16.5	20.6
MARSSIM-008	944	41.8	18.4	20.6
MARSSIM-009	944	20.0	14.5	20.6

Sample ID	DCGL-GA (dpm/100cm^2)	Total Contamination (dpm/100cm^2)	Std. Error (dpm/100cm^2)	MDC (dpm/100cm^2)
MARSSIM-010	944	44.9	18.9	20.6
MARSSIM-011	944	80.5	23.9	20.6
MARSSIM-012	944	86.7	24.6	20.6
MARSSIM-013	944	75.9	23.3	20.6
MARSSIM-014	944	92.9	25.4	20.6
Average		***48.2***		
Standard Dev.		***24.7***		
Minimum		***20.1***		
Maximum		***92.9***		
Median		***39.4***		

All 14 total alpha contamination measurements for Survey Sub-Unit Kaiser-FSSPOA-009D were below the DCGL-GA of 944 dpm/100cm^2. The maximum total alpha contamination was 92.9 dpm/100cm^2. The average total alpha contamination was 48.2 dpm/100cm^2.

The standard deviation of the 14 equal-distant samples was 24.7, less than the estimated standard deviation of 45.9 (based on the Flux Building Survey Unit FB-001 final status survey results) used to calculate the minimum number of samples (N) required.

Analytical results of the smear samples are provided below in **Table 11**. The analytical data report is contained in **Attachment I**.

Table 11 – Systematic Removable Alpha Contamination Smear Sample Results

Sample ID	DCGL-GA (dpm/100cm^2)	Removable Contamination (dpm/100cm^2)	Std. Error (dpm/100cm^2)	MDC (dpm/100cm^2)
MARSSIM-001 (K-SS-303)	94.4	0	0.484	0.560
MARSSIM-002 (K-SS-304)	94.4	0.071	0.546	0.574
MARSSIM-003 (K-SS-305)	94.4	0.417	0.399	0.269
MARSSIM-004 (K-SS-306)	94.4	0.193	0.394	0.359
MARSSIM-005 (K-SS-307)	94.4	0	0.427	0.542
MARSSIM-006 (K-SS-308)	94.4	0.093	0.455	0.466
MARSSIM-007 (K-SS-309)	94.4	0.237	0.480	0.453
MARSSIM-008 (K-SS-310)	94.4	0.100	0.539	0.560
MARSSIM-009 (K-SS-311)	94.4	0	0.505	0.574
MARSSIM-010 (K-SS-312)	94.4	0.783	0.495	0.269
MARSSIM-011 (K-SS-313)	94.4	0	0.289	0.359
MARSSIM-012 (K-SS-314)	94.4	0	0.489	0.542
MARSSIM-013 (K-SS-315)	94.4	0.093	0.455	0.466
MARSSIM-014 (K-SS-316)	94.4	0.237	0.480	0.453
Average		***0.159***		
Standard Dev.		***0.218***		
Minimum		***0***		
Maximum		***0.783***		
Median		***0.093***		

All 14 smear sample results for Survey Sub-Unit Kaiser-FSSPOA-009D were below the removable contamination DCGL-GA of 94.4 dpm/100cm^2 (10% of the total contamination DCGL-GA value). The maximum removable alpha contamination result was 0.783 dpm/100cm^2. The average removable alpha contamination result was 0.159 dpm/100cm^2, less than 1% of the DCGL-GA value.

Wilcoxon Rank Sum (WRS) Testing

The total alpha contamination results were evaluated using the procedure contained in **Appendix C, Volume VI** of this Final Status Survey Report (Wilcoxon Rank Sum Test). The evaluation showed that the survey sub-unit total alpha contamination results meet the DP statistical criterion based on the first statistical test described below.

If the difference (92.1 dpm/100cm^2) between the maximum survey unit total alpha contamination result (92.9 dpm/100cm^2) and the minimum reference background area total alpha contamination result (0.772 dpm/100cm^2) is less than DCGL-GA (944 dpm/100cm^2), then the survey unit meets the release criterion. **Table 12** presents a summary of the data used to complete the statistical evaluation of the survey unit.

Table 12 – Reference Area and Survey Unit Total Alpha Contamination Results

Reference Group	Sample ID	Total Alpha Contamination (dpm/100cm^2)	Survey Unit Group	Sample ID	Total Alpha Contamination (dpm/100cm^2)
R1	Asphalt	8.88	S1	MARSSIM-001	37.1
R2	Asphalt	1.93	S2	MARSSIM-002	29.4
R3	Asphalt	5.40	S3	MARSSIM-003	41.8
R4	Asphalt	7.72	S4	MARSSIM-004	26.3
R5	Asphalt	4.25	S5	MARSSIM-005	37.1
R6	Asphalt	3.09	S6	MARSSIM-006	29.4
R7	Asphalt	5.40	S7	MARSSIM-007	30.9
R8	Asphalt	1.93	S8	MARSSIM-008	41.8
R9	Asphalt	0.772	S9	MARSSIM-009	20.0
R10	Asphalt	4.25	S10	MARSSIM-010	44.9
R11	Asphalt	5.40	S11	MARSSIM-011	80.5
R12	Asphalt	7.72	S12	MARSSIM-012	86.7
R13	Asphalt	3.09	S13	MARSSIM-013	75.9
R14	Asphalt	1.93	S14	MARSSIM-014	92.9
	Average:	***4.41***		***Average:***	***48.2***
	Standard Dev.	***2.48***		***Standard Dev.***	***24.7***
	Minimum:	***0.772***		***Minimum:***	***20.1***
	Maximum:	***8.88***		***Maximum:***	***92.9***
	Median:	***4.25***		***Median:***	***39.4***

2.2.5 Total and Removable Alpha Contamination Measurement Results – Sub-Unit Kaiser-FSSPOA-009E

A layout of the total and removable alpha contamination measurement locations for Survey Sub-Unit Kaiser-FSSPOA-009E is provided on **Figure E-1** contained in **Attachment E**. At each of the 14 locations, a measurement (static count with a gas proportional detector) of total alpha contamination (identified as MARSSIM-001 through MARSSIM-014) and a smear sample for determination of removable alpha contamination (identified as K-SS-318 through K-SS-331) were collected on the structural surface. The smear samples were forwarded to Outreach for analysis of alpha activity (per the 100 cm^2 surface area sampled). Total alpha contamination measurement results are provided below in **Table 13**.

Table 13 – Systematic Total Alpha Contamination Measurement Results

Sample ID	DCGL-GA ($dpm/100cm^2$)	Total Contamination ($dpm/100cm^2$)	Std. Error ($dpm/100cm^2$)	MDC ($dpm/100cm^2$)
MARSSIM-001	944	36.0	19.5	26.3
MARSSIM-002	944	26.7	18.0	26.3
MARSSIM-003	944	57.7	22.6	26.3
MARSSIM-004	944	45.3	20.9	26.3
MARSSIM-005	944	18.9	16.7	26.3
MARSSIM-006	944	40.7	20.2	26.3
MARSSIM-007	944	56.2	22.4	26.3
MARSSIM-008	944	26.7	18.0	26.3
MARSSIM-009	944	34.4	19.3	26.3
MARSSIM-010	944	53.1	22.0	26.3
MARSSIM-011	944	81.0	25.5	26.3
MARSSIM-012	944	65.5	23.6	26.3
MARSSIM-013	944	84.1	25.8	26.3
MARSSIM-014	944	53.1	22.0	26.3
Average		***48.5***		
Standard Dev.		***19.7***		
Minimum		***18.9***		
Maximum		***84.1***		
Median		***49.2***		

All 14 total alpha contamination measurements for Survey Sub-Unit Kaiser-FSSPOA-009E were below the DCGL-GA of 944 $dpm/100cm^2$. The maximum total alpha contamination was 84.1 $dpm/100cm^2$. The average total alpha contamination was 48.5 $dpm/100cm^2$.

The standard deviation of the 14 equal-distant samples was 19.7, less than the estimated standard deviation of 45.9 (based on the Flux Building Survey Unit FB-001 final status survey results) used to calculate the minimum number of samples (N) required.

Analytical results of the smear samples are provided below in **Table 14**. The analytical data report is contained in **Attachment I**.

Table 14 – Systematic Removable Alpha Contamination Smear Sample Results

Sample ID	DCGL-GA (dpm/100cm^2)	Removable Contamination (dpm/100cm^2)	Std. Error (dpm/100cm^2)	MDC (dpm/100cm^2)
MARSSIM-001 (K-SS-318)	94.4	0	0.512	0.560
MARSSIM-002 (K-SS-319)	94.4	0	0.411	0.574
MARSSIM-003 (K-SS-320)	94.4	0.539	0.434	0.269
MARSSIM-004 (K-SS-321)	94.4	0.193	0.394	0.359
MARSSIM-005 (K-SS-322)	94.4	0.015	0.504	0.542
MARSSIM-006 (K-SS-323)	94.4	0.032	0.439	0.466
MARSSIM-007 (K-SS-324)	94.4	0	0.399	0.453
MARSSIM-008 (K-SS-325)	94.4	0	0.512	0.560
MARSSIM-009 (K-SS-326)	94.4	0	0.461	0.574
MARSSIM-010 (K-SS-327)	94.4	0.295	0.362	0.269
MARSSIM-011 (K-SS-328)	94.4	0.315	0.428	0.359
MARSSIM-012 (K-SS-329)	94.4	0	0.427	0.542
MARSSIM-013 (K-SS-330)	94.4	0	0.387	0.466
MARSSIM-014 (K-SS-331)	94.4	0.115	0.449	0.453
Average		***0.107***		
Standard Dev.		***0.168***		
Minimum		***0***		
Maximum		***0.539***		
Median		***0.008***		

All 14 smear sample results for Survey Sub-Unit Kaiser-FSSPOA-009E were below the removable contamination DCGL-GA of 94.4 dpm/100cm^2 (10% of the total contamination DCGL-GA value). The maximum removable alpha contamination result was 0.539 dpm/100cm^2. The average removable alpha contamination result was 0.107 dpm/100cm^2, less than 1% of the DCGL-GA value.

Wilcoxon Rank Sum (WRS) Testing

The total alpha contamination results were evaluated using the procedure contained in **Appendix C, Volume VI** of this Final Status Survey Report (Wilcoxon Rank Sum Test). The evaluation showed that the survey sub-unit total alpha contamination results meet the DP statistical criterion based on the first statistical test described below.

If the difference (83.3 dpm/100cm^2) between the maximum survey unit total alpha contamination result (84.1 dpm/100cm^2) and the minimum reference background area total alpha contamination result (0.772 dpm/100cm^2) is less than DCGL-GA (944 dpm/100cm^2), then the survey unit meets the release criterion. **Table 15** presents a summary of the data used to complete the statistical evaluation of the survey unit.

Table 15 – Reference Area and Survey Unit Total Alpha Contamination Results

Reference Group	Sample ID	Total Alpha Contamination (dpm/100cm^2)	Survey Unit Group	Sample ID	Total Alpha Contamination (dpm/100cm^2)
R1	Asphalt	8.88	S1	MARSSIM-001	36.0
R2	Asphalt	1.93	S2	MARSSIM-002	26.7
R3	Asphalt	5.40	S3	MARSSIM-003	57.7
R4	Asphalt	7.72	S4	MARSSIM-004	45.3
R5	Asphalt	4.25	S5	MARSSIM-005	18.9
R6	Asphalt	3.09	S6	MARSSIM-006	40.7
R7	Asphalt	5.40	S7	MARSSIM-007	56.2
R8	Asphalt	1.93	S8	MARSSIM-008	26.7
R9	Asphalt	0.772	S9	MARSSIM-009	34.4
R10	Asphalt	4.25	S10	MARSSIM-010	53.1
R11	Asphalt	5.40	S11	MARSSIM-011	81.0
R12	Asphalt	7.72	S12	MARSSIM-012	65.5
R13	Asphalt	3.09	S13	MARSSIM-013	84.1
R14	Asphalt	1.93	S14	MARSSIM-014	53.1
	Average:	***4.41***		***Average:***	***48.5***
	Standard Dev.	***2.48***		***Standard Dev.***	***19.7***
	Minimum:	***0.772***		***Minimum:***	***18.9***
	Maximum:	***8.88***		***Maximum:***	***84.1***
	Median:	***4.25***		***Median:***	***49.2***

2.2.6 Total and Removable Alpha Contamination Measurement Results – Sub-Unit Kaiser-FSSPOA-009F

A layout of the total and removable alpha contamination measurement locations for Survey Sub-Unit Kaiser-FSSPOA-009F is provided on **Figure F-1** contained in **Attachment F**. At each of the 14 locations, a measurement (static count with a gas proportional detector) of total alpha contamination (identified as MARSSIM-001 through MARSSIM-014) and a smear sample for determination of removable alpha contamination (identified as K-SS-333 through K-SS-346) were collected on the structural surface. The smear samples were forwarded to Outreach for analysis of alpha activity (per the 100 cm^2 surface area sampled). Total alpha contamination measurement results are provided below in **Table 16**.

Table 16 – Systematic Total Alpha Contamination Measurement Results

Sample ID	DCGL-GA (dpm/100cm^2)	Total Contamination (dpm/100cm^2)	Std. Error (dpm/100cm^2)	MDC (dpm/100cm^2)
MARSSIM-001	944	8.42	10.7	18.2
MARSSIM-002	944	31.7	15.9	18.2
MARSSIM-003	944	28.6	15.3	18.2
MARSSIM-004	944	27.0	15.0	18.2
MARSSIM-005	944	23.9	14.4	18.2
MARSSIM-006	944	39.4	17.3	18.2
MARSSIM-007	944	30.1	15.6	18.2
MARSSIM-008	944	11.5	11.6	18.2
MARSSIM-009	944	3.77	9.35	18.2

Sample ID	DCGL-GA (dpm/100cm^2)	Total Contamination (dpm/100cm^2)	Std. Error (dpm/100cm^2)	MDC (dpm/100cm^2)
MARSSIM-010	944	30.1	15.6	18.2
MARSSIM-011	944	87.5	24.2	18.2
MARSSIM-012	944	101	25.9	18.2
MARSSIM-013	944	62.7	20.9	18.2
MARSSIM-014	944	84.4	23.8	18.2
Average		***40.8***		
Standard Dev.		***30.9***		
Minimum		***3.77***		
Maximum		***101***		
Median		***49.2***		

All 14 total alpha contamination measurements for Survey Sub-Unit Kaiser-FSSPOA-009F were below the DCGL-GA of 944 dpm/100cm^2. The maximum total alpha contamination was 101 dpm/100cm^2. The average total alpha contamination was 40.8 dpm/100cm^2.

The standard deviation of the 14 equal-distant samples was 30.9, less than the estimated standard deviation of 45.9 (based on the Flux Building Survey Unit FB-001 final status survey results) used to calculate the minimum number of samples (N) required.

Analytical results of the smear samples are provided below in **Table 17**. The analytical data report is contained in **Attachment I**.

Table 17 – Systematic Removable Alpha Contamination Smear Sample Results

Sample ID	DCGL-GA (dpm/100cm^2)	Removable Contamination (dpm/100cm^2)	Std. Error (dpm/100cm^2)	MDC (dpm/100cm^2)
MARSSIM-001 (K-SS-333)	94.4	0.234	0.341	0.269
MARSSIM-002 (K-SS-334)	94.4	0.071	0.355	0.359
MARSSIM-003 (K-SS-335)	94.4	0	0.459	0.542
MARSSIM-004 (K-SS-336)	94.4	0	0.913	1.07
MARSSIM-005 (K-SS-337)	94.4	0	0.422	0.466
MARSSIM-006 (K-SS-338)	94.4	0	0.416	0.453
MARSSIM-007 (K-SS-339)	94.4	0	0.403	0.560
MARSSIM-008 (K-SS-340)	94.4	0	0.455	0.574
MARSSIM-009 (K-SS-341)	94.4	0.295	0.362	0.269
MARSSIM-010 (K-SS-342)	94.4	0.132	0.375	0.359
MARSSIM-011 (K-SS-343)	94.4	3.55	1.04	0.542
MARSSIM-012 (K-SS-344)	94.4	0.102	1.00	1.07
MARSSIM-013 (K-SS-345)	94.4	0.093	0.455	0.466
MARSSIM-014 (K-SS-346)	94.4	0.115	0.449	0.453
Average		***0.328***		
Standard Dev.		***0.932***		
Minimum		***0***		
Maximum		***3.55***		
Median		***0.082***		

All 14 smear sample results for Survey Sub-Unit Kaiser-FSSPOA-009F were below the removable contamination DCGL-GA of 94.4 dpm/100cm^2 (10% of the total contamination DCGL-GA value). The maximum removable alpha contamination result was 3.55 dpm/100cm^2. The average removable alpha contamination result was 0.328 dpm/100cm^2, less than 1% of the DCGL-GA value.

Wilcoxon Rank Sum (WRS) Testing

The total alpha contamination results were evaluated using the procedure contained in **Appendix C, Volume VI** of this Final Status Survey Report (Wilcoxon Rank Sum Test). The evaluation showed that the survey sub-unit total alpha contamination results meet the DP statistical criterion based on the first statistical test described below.

If the difference (100 dpm/100cm^2) between the maximum survey unit total alpha contamination result (101 dpm/100cm^2) and the minimum reference background area total alpha contamination result (0.772 dpm/100cm^2) is less than DCGL-GA (944 dpm/100cm^2), then the survey unit meets the release criterion. **Table 18** presents a summary of the data used to complete the statistical evaluation of the survey unit.

Table 18 – Reference Area and Survey Unit Total Alpha Contamination Results

Reference Group	Sample ID	Total Alpha Contamination (dpm/100cm^2)	Survey Unit Group	Sample ID	Total Alpha Contamination (dpm/100cm^2)
R1	Asphalt	8.88	S1	MARSSIM-001	8.42
R2	Asphalt	1.93	S2	MARSSIM-002	31.7
R3	Asphalt	5.40	S3	MARSSIM-003	28.6
R4	Asphalt	7.72	S4	MARSSIM-004	27.0
R5	Asphalt	4.25	S5	MARSSIM-005	23.9
R6	Asphalt	3.09	S6	MARSSIM-006	39.4
R7	Asphalt	5.40	S7	MARSSIM-007	30.1
R8	Asphalt	1.93	S8	MARSSIM-008	11.5
R9	Asphalt	0.772	S9	MARSSIM-009	3.77
R10	Asphalt	4.25	S10	MARSSIM-010	30.1
R11	Asphalt	5.40	S11	MARSSIM-011	87.5
R12	Asphalt	7.72	S12	MARSSIM-012	101
R13	Asphalt	3.09	S13	MARSSIM-013	62.7
R14	Asphalt	1.93	S14	MARSSIM-014	84.4
	Average:	***4.41***		***Average:***	***40.8***
	Standard Dev.	***2.48***		***Standard Dev.***	***30.9***
	Minimum:	***0.772***		***Minimum:***	***3.77***
	Maximum:	***8.88***		***Maximum:***	***101***
	Median:	***4.25***		***Median:***	***30.1***

2.2.7 Total and Removable Alpha Contamination Measurement Results – Sub-Unit Kaiser-FSSPOA-009G

A layout of the total and removable alpha contamination measurement locations for Survey Sub-Unit Kaiser-FSSPOA-009G is provided on **Figure G-1** contained in **Attachment G**. At each of the 14 locations, a measurement (static count with a gas proportional detector) of total alpha contamination (identified as MARSSIM-001 through MARSSIM-014) and a smear sample for determination of removable alpha contamination (identified as K-SS-348 through K-SS-361) were collected on the structural surface. The smear samples were forwarded to Outreach for analysis of alpha activity (per the 100 cm^2 surface area sampled). Total alpha contamination measurement results are provided below in **Table 19**.

Table 19 – Systematic Total Alpha Contamination Measurement Results

Sample ID	DCGL-GA ($dpm/100cm^2$)	Total Contamination ($dpm/100cm^2$)	Std. Error ($dpm/100cm^2$)	MDC ($dpm/100cm^2$)
MARSSIM-001	944	23.6	14.1	17.4
MARSSIM-002	944	25.1	14.4	17.4
MARSSIM-003	944	20.5	13.4	17.4
MARSSIM-004	944	31.3	15.6	17.4
MARSSIM-005	944	18.9	13.0	17.4
MARSSIM-006	944	26.7	14.7	17.4
MARSSIM-007	944	8.1	10.3	17.4
MARSSIM-008	944	32.9	15.9	17.4
MARSSIM-009	944	36.0	16.5	17.4
MARSSIM-010	944	53.1	19.3	17.4
MARSSIM-011	944	73.2	22.2	17.4
MARSSIM-012	944	70.1	21.8	17.4
MARSSIM-013	944	54.6	19.6	17.4
MARSSIM-014	944	76.3	22.6	17.4
Average		***39.3***		
Standard Dev.		***22.1***		
Minimum		***8.09***		
Maximum		***76.3***		
Median		***32.1***		

All 14 total alpha contamination measurements for Survey Sub-Unit Kaiser-FSSPOA-009G were below the DCGL-GA of 944 $dpm/100cm^2$. The maximum total alpha contamination was 76.3 $dpm/100cm^2$. The average total alpha contamination was 39.3 $dpm/100cm^2$.

The standard deviation of the 14 equal-distant samples was 22.1, less than the estimated standard deviation of 45.9 (based on the Flux Building Survey Unit FB-001 final status survey results) used to calculate the minimum number of samples (N) required.

Analytical results of the smear samples are provided below in **Table 20**. The analytical data report is contained in **Attachment I**.

Table 20 – Systematic Removable Alpha Contamination Smear Sample Results

Sample ID	DCGL-GA (dpm/100cm^2)	Removable Contamination (dpm/100cm^2)	Std. Error (dpm/100cm^2)	MDC (dpm/100cm^2)
MARSSIM-001 (K-SS-348)	94.4	0	0.498	0.560
MARSSIM-002 (K-SS-349)	94.4	0.132	0.559	0.574
MARSSIM-003 (K-SS-350)	94.4	0.295	0.362	0.269
MARSSIM-004 (K-SS-351)	94.4	0.376	0.445	0.359
MARSSIM-005 (K-SS-352)	94.4	0	0.192	0.542
MARSSIM-006 (K-SS-353)	94.4	0	0.432	1.07
MARSSIM-007 (K-SS-354)	94.4	0	0.387	0.466
MARSSIM-008 (K-SS-355)	94.4	0.054	0.433	0.453
MARSSIM-009 (K-SS-356)	94.4	0.100	0.539	0.560
MARSSIM-010 (K-SS-357)	94.4	0	0.519	0.574
MARSSIM-011 (K-SS-358)	94.4	0.478	0.417	0.269
MARSSIM-012 (K-SS-359)	94.4	0.315	0.428	0.359
MARSSIM-013 (K-SS-360)	94.4	0	0.475	0.542
MARSSIM-014 (K-SS-361)	94.4	0	0.959	1.07
Average		***0.125***		
Standard Dev.		***0.168***		
Minimum		***0***		
Maximum		***0.478***		
Median		***0.027***		

All 14 smear sample results for Survey Sub-Unit Kaiser-FSSPOA-009G were below the removable contamination DCGL-GA of 94.4 dpm/100cm^2 (10% of the total contamination DCGL-GA value). The maximum removable alpha contamination result was 0.478 dpm/100cm^2. The average removable alpha contamination result was 0.125 dpm/100cm^2, less than 1% of the DCGL-GA value.

Wilcoxon Rank Sum (WRS) Testing

The total alpha contamination results were evaluated using the procedure contained in **Appendix C, Volume VI** of this Final Status Survey Report (Wilcoxon Rank Sum Test). The evaluation showed that the survey sub-unit total alpha contamination results meet the DP statistical criterion based on the first statistical test described below.

If the difference (75.5 dpm/100cm^2) between the maximum survey unit total alpha contamination result (76.3 dpm/100cm^2) and the minimum reference background area total alpha contamination result (0.772 dpm/100cm^2) is less than DCGL-GA (944 dpm/100cm^2), then the survey unit meets the release criterion. **Table 21** presents a summary of the data used to complete the statistical evaluation of the survey unit.

Table 21 – Reference Area and Survey Unit Total Alpha Contamination Results

Reference Group	Sample ID	Total Alpha Contamination (dpm/100cm^2)	Survey Unit Group	Sample ID	Total Alpha Contamination (dpm/100cm^2)
R1	Asphalt	8.88	S1	MARSSIM-001	23.6
R2	Asphalt	1.93	S2	MARSSIM-002	25.1
R3	Asphalt	5.40	S3	MARSSIM-003	20.5
R4	Asphalt	7.72	S4	MARSSIM-004	31.3
R5	Asphalt	4.25	S5	MARSSIM-005	18.9
R6	Asphalt	3.09	S6	MARSSIM-006	26.7
R7	Asphalt	5.40	S7	MARSSIM-007	8.1
R8	Asphalt	1.93	S8	MARSSIM-008	32.9
R9	Asphalt	0.772	S9	MARSSIM-009	36.0
R10	Asphalt	4.25	S10	MARSSIM-010	53.1
R11	Asphalt	5.40	S11	MARSSIM-011	73.2
R12	Asphalt	7.72	S12	MARSSIM-012	70.1
R13	Asphalt	3.09	S13	MARSSIM-013	54.6
R14	Asphalt	1.93	S14	MARSSIM-014	76.3
	Average:	***4.41***		***Average:***	***39.3***
	Standard Dev.	***2.48***		***Standard Dev.***	***22.1***
	Minimum:	***0.772***		***Minimum:***	***8.09***
	Maximum:	***8.88***		***Maximum:***	***76.3***
	Median:	***4.25***		***Median:***	***32.1***

2.2.8 Total and Removable Alpha Contamination Measurement Results – Sub-Unit Kaiser-FSSPOA-009H

A layout of the total and removable alpha contamination measurement locations for Survey Sub-Unit Kaiser-FSSPOA-009H is provided on **Figure H-1** contained in **Attachment H**. At each of the 15 locations, a measurement (static count with a gas proportional detector) of total alpha contamination (identified as MARSSIM-001 through MARSSIM-015) and a smear sample for determination of removable alpha contamination (identified as K-SS-363 through K-SS-377) were collected on the structural surface. The smear samples were forwarded to Outreach for analysis of alpha activity (per the 100 cm^2 surface area sampled). Total alpha contamination measurement results are provided below in **Table 22**.

Table 22 – Systematic Total Alpha Contamination Measurement Results

Sample ID	DCGL-GA (dpm/100cm^2)	Total Contamination (dpm/100cm^2)	Std. Error (dpm/100cm^2)	MDC (dpm/100cm^2)
MARSSIM-001	944	23.2	15.1	20.5
MARSSIM-002	944	21.6	14.8	20.5
MARSSIM-003	944	10.8	12.4	20.5
MARSSIM-004	944	29.4	16.3	20.5
MARSSIM-005	944	12.3	12.8	20.5
MARSSIM-006	944	26.3	15.7	20.5
MARSSIM-007	944	35.6	17.4	20.5
MARSSIM-008	944	18.5	14.1	20.5
MARSSIM-009	944	74.3	23.1	20.5

Sample ID	DCGL-GA (dpm/100cm^2)	Total Contamination (dpm/100cm^2)	Std. Error (dpm/100cm^2)	MDC (dpm/100cm^2)
MARSSIM-010	944	61.9	21.4	20.5
MARSSIM-011	944	51.1	19.8	20.5
MARSSIM-012	944	40.2	18.1	20.5
MARSSIM-013	944	97.6	25.9	20.5
MARSSIM-014	944	68.1	22.3	20.5
MARSSIM-015	944	60.4	21.2	20.5
Average		***42.1***		
Standard Dev.		***25.7***		
Minimum		***10.8***		
Maximum		***97.6***		
Median		***35.6***		

All 15 total alpha contamination measurements for Survey Sub-Unit Kaiser-FSSPOA-009H were below the DCGL-GA of 944 dpm/100cm^2. The maximum total alpha contamination was 97.6 dpm/100cm^2. The average total alpha contamination was 42.1 dpm/100cm^2.

The standard deviation of the 15 equal-distant samples was 25.7, less than the estimated standard deviation of 45.9 (based on the Flux Building Survey Unit FB-001 final status survey results) used to calculate the minimum number of samples (N) required.

Analytical results of the smear samples are provided below in **Table 23**. The analytical data report is contained in **Attachment I**.

Table 23 – Systematic Removable Alpha Contamination Smear Sample Results

Sample ID	DCGL-GA (dpm/100cm^2)	Removable Contamination (dpm/100cm^2)	Std. Error (dpm/100cm^2)	MDC (dpm/100cm^2)
MARSSIM-001 (K-SS-363)	94.4	0.193	0.394	0.359
MARSSIM-002 (K-SS-364)	94.4	0.198	0.545	0.542
MARSSIM-003 (K-SS-365)	94.4	0	0.913	1.07
MARSSIM-004 (K-SS-366)	94.4	0	0.422	0.466
MARSSIM-005 (K-SS-367)	94.4	0	0.416	0.453
MARSSIM-006 (K-SS-368)	94.4	0.100	0.539	0.560
MARSSIM-007 (K-SS-369)	94.4	0	0.214	0.574
MARSSIM-008 (K-SS-370)	94.4	0.325	0.216	0.269
MARSSIM-009 (K-SS-371)	94.4	0.197	0.207	0.359
MARSSIM-010 (K-SS-372)	94.4	0.015	0.504	0.542
MARSSIM-011 (K-SS-373)	94.4	0.712	1.07	1.07
MARSSIM-012 (K-SS-374)	94.4	0.398	0.528	0.466
MARSSIM-013 (K-SS-375)	94.4	0.054	0.433	0.453
MARSSIM-014 (K-SS-376)	94.4	0.405	0.602	0.560
MARSSIM-015 (K-SS-377)	94.4	1.23	0.755	0.574
Average		***0.255***		
Standard Dev.		***0.338***		
Minimum		***0***		
Maximum		***1.23***		
Median		***0.193***		

All 15 smear sample results for Survey Sub-Unit Kaiser-FSSPOA-009H were below the removable contamination DCGL-GA of 94.4 dpm/100cm^2 (10% of the total contamination DCGL-GA value). The maximum removable alpha contamination result was 1.23 dpm/100cm^2. The average removable alpha contamination result was 0.255 dpm/100cm^2, less than 1% of the DCGL-GA value.

Wilcoxon Rank Sum (WRS) Testing

The total alpha contamination results were evaluated using the procedure contained in **Appendix C, Volume VI** of this Final Status Survey Report (Wilcoxon Rank Sum Test). The evaluation showed that the survey sub-unit total alpha contamination results meet the DP statistical criterion based on the first statistical test described below.

If the difference (96.8 dpm/100cm^2) between the maximum survey unit total alpha contamination result (97.6 dpm/100cm^2) and the minimum reference background area total alpha contamination result (0.772 dpm/100cm^2) is less than DCGL-GA (944 dpm/100cm^2), then the survey unit meets the release criterion. **Table 24** presents a summary of the data used to complete the statistical evaluation of the survey unit.

Table 24 – Reference Area and Survey Unit Total Alpha Contamination Results

Reference Group	Sample ID	Total Alpha Contamination (dpm/100cm^2)	Survey Unit Group	Sample ID	Total Alpha Contamination (dpm/100cm^2)
R1	Asphalt	8.88	S1	MARSSIM-001	23.2
R2	Asphalt	1.93	S2	MARSSIM-002	21.6
R3	Asphalt	5.40	S3	MARSSIM-003	10.8
R4	Asphalt	7.72	S4	MARSSIM-004	29.4
R5	Asphalt	4.25	S5	MARSSIM-005	12.3
R6	Asphalt	3.09	S6	MARSSIM-006	26.3
R7	Asphalt	5.40	S7	MARSSIM-007	35.6
R8	Asphalt	1.93	S8	MARSSIM-008	18.5
R9	Asphalt	0.772	S9	MARSSIM-009	74.3
R10	Asphalt	4.25	S10	MARSSIM-010	61.9
R11	Asphalt	5.40	S11	MARSSIM-011	51.1
R12	Asphalt	7.72	S12	MARSSIM-012	40.2
R13	Asphalt	3.09	S13	MARSSIM-013	97.6
R14	Asphalt	1.93	S14	MARSSIM-014	68.1
R15	Asphalt	5.40	S15	MARSSIM-015	60.4
	Average:	***4.48***		***Average:***	***42.1***
	Standard Dev.	***2.40***		***Standard Dev.***	***25.7***
	Minimum:	***0.772***		***Minimum:***	***10.8***
	Maximum:	***8.88***		***Maximum:***	***97.6***
	Median:	***4.25***		***Median:***	***35.6***

3.0 SUMMARY OF FINDINGS

Survey Unit Kaiser-FSSPOA-009 consists of the asphalt loading pad associated with the railroad spur constructed for the load-out of exempt radiological materials to be disposed at the U.S. Ecology, Grandview, Idaho facility.

The asphalt loading pad is approximately 70.5 meters in length and 10.5 meters in width (area of 740 m^2). It overlies Excavation Bottom Survey Unit Kaiser-FSS-007. It is bounded to the south by Post Operational Survey Unit Kaiser-FSSPOA-011, to the east by Post Operational Survey Unit Kaiser-FSSPOA-010, to the north by Post Operational Survey Units Kaiser-FSSPOA-006 and Kaiser-FSSPOA-006, and to the west by Post Operational Survey Unit Kaiser-FSSPOA-005 **(Figure 3)**.

For final status surveying purposes, the asphalt pad's structural surface was divided into eight Class 1 sub-units of areas less than or equal to 100 m^2. These eight sub-units are identified as Kaiser-FSSPOA-009A through Kaiser-FSSPOA-009H.

The acceptance criterion for structures remaining at the Tulsa facility is the DCGL-GA of 944 dpm/100cm^2 for total alpha contamination and 94.4 dpm/100cm^2 for removable alpha contamination. The final status survey of each survey sub-unit consisted of a gross alpha scan of the structural surface and systematic measurements of total and removable alpha contamination. The results of the final status survey activities for all 8 survey sub-units were as follows:

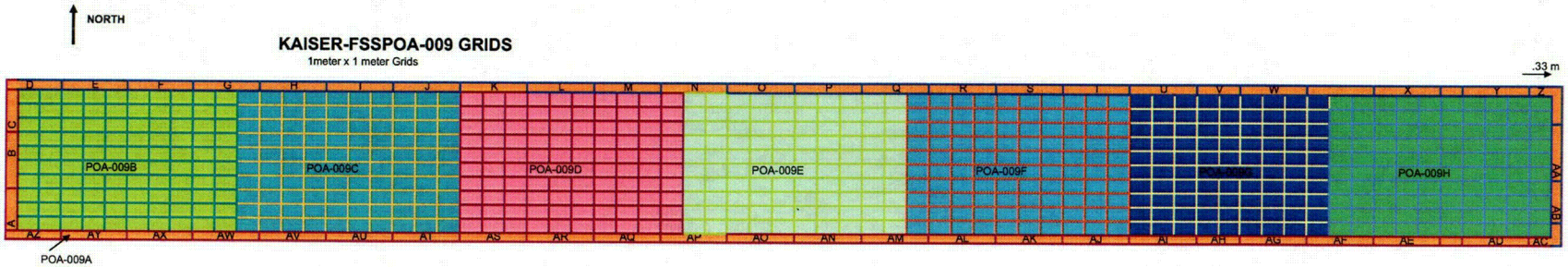
- The 100 percent coverage gross alpha scan of the structural surface did not indicate the presence of small areas of elevated activity (above the DCGL-GA for the site).
- All systematic measurements of total alpha contamination were below the DCGL-GA of 944 dpm/100cm^2.
- All smear sample results were below the DCGL-GA of 94.4 dpm/100cm^2 for removable alpha contamination.
- The total alpha contamination results meet the DP statistical criterion based on the first statistical evaluation of the data (WRS Test procedure).

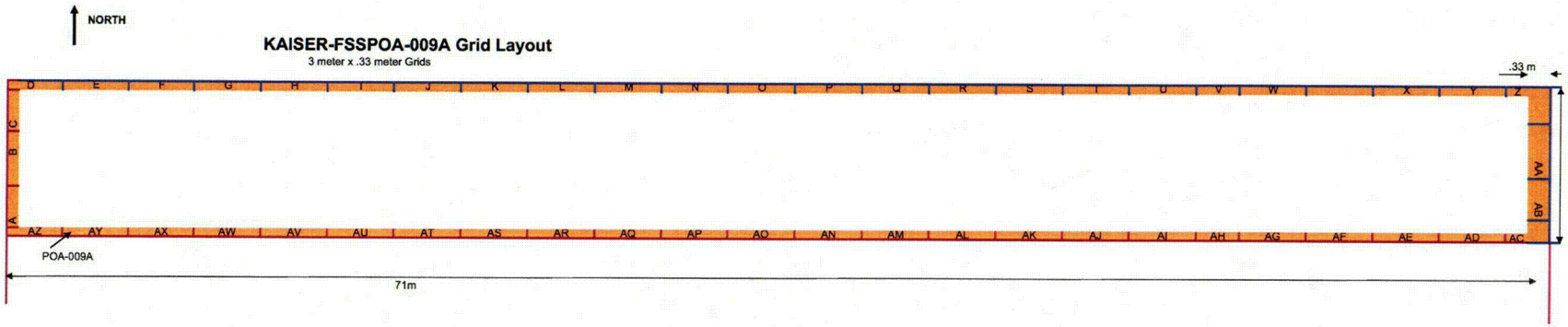
The results of the final status survey activities show that Survey Unit Kaiser-FSSPOA-009 meets the DP acceptance criteria.

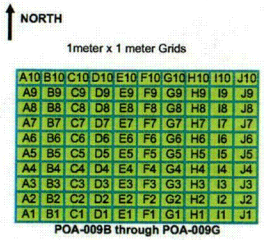
ATTACHMENT A
TABLE OF CONTENTS

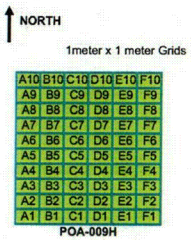
- **FIGURE A-1** Gross Alpha Scan Grid Layout
- **FIGURE A-2** Systematic Sampling Locations
- Alpha Scan MDC Calculation Form
- Total Alpha Contamination Survey Data Conversion Form
- **TABLE A-1** Gross Alpha Scan Results Summary, Part I
- **TABLE A-2** Gross Alpha Scan Results Summary, Part II

Attachment A, Figure A-1
Gross Alpha Scan Grid Layout
Survey Unit Kaiser-FSSPOA-009
Final Status Survey
Thorium Remediation Project
Kaiser Aluminum & Chemical Corporation
Tulsa, Oklahoma Facility

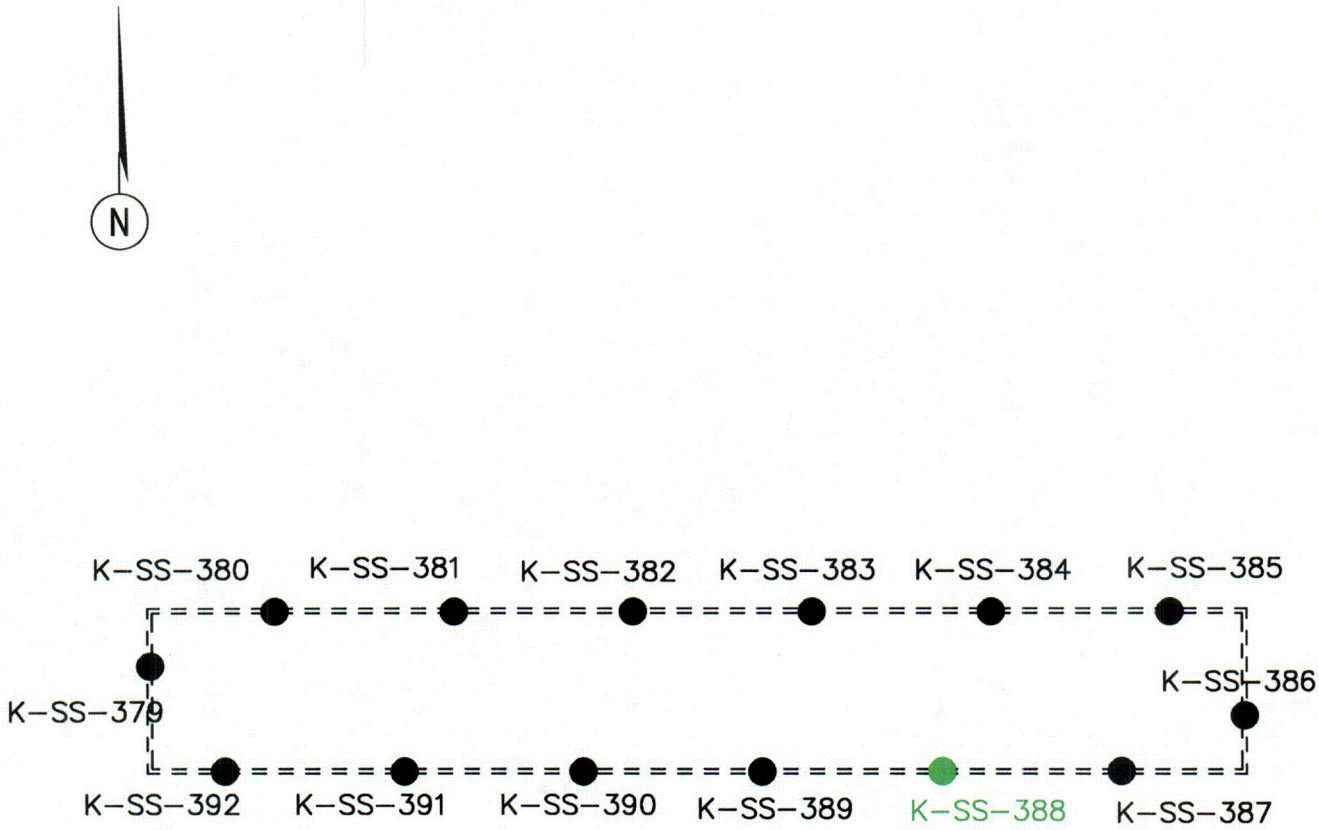


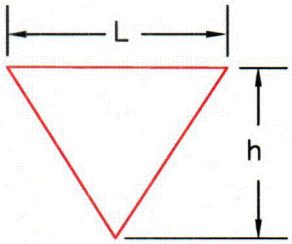






C-17





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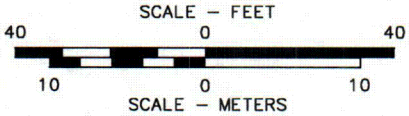

● SYSTEMATIC SAMPLING LOCATION BASED ON RANDOM START POINT AND AN EQUAL DISTANT TRIANGULAR GRID

● RANDOM START POINT

FIGURE A-2
SYSTEMATIC SAMPLING LOCATIONS
SURVEY UNIT KAISER-FSSPOA-009
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFD	08/31/06
CHECKED	RFD	08/31/06
DRAWN	DEB	08/01/06

DRAWING NUMBER
PA4072095

Penn E&R
Environmental & Remediation, Inc.

C-18

Daily Alpha Scan MDC

KAISER-FSSPOA-009A

Instrument Serial Number:	193686	Cal. Due:	3/2/2007
Detector Serial Number:	PR190485	Cal. Due:	3/2/2007
Radiation Detected:	Alpha		For < 3 count background

Probability of observing 2 or more counts:

$$P(n \geq 2) = 1 - \left(1 + \frac{(GE+B)d}{60v}\right)\left(e^{-\frac{(GE+B)d}{60v}}\right)$$

Probability of observing a single count:

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

	D Date	G Activity (dpm)	d Detector Width (cm)	E Instrument Efficiency (cpm)	v Scan Speed (cm/s)	B Background Countrate (cpm)	P Probability (-)
1	7/29/2006	400	11.7	0.1484	3.90	N/A	0.95
2	7/29/2006	800	11.7	0.1484	7.80	N/A	0.95
3	7/29/2006	1180	11.7	0.1484	11.70	N/A	0.95
4	8/2/2006	400	11.7	0.1484	3.90	N/A	0.95
5	8/2/2006	800	11.7	0.1484	7.80	N/A	0.95
6	8/2/2006	1180	11.7	0.1484	11.70	N/A	0.95
7							
8							
9							
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12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

Comments: Instrument Model and Detector Model/Type: Ludlum Model 2360 Alpha-Beta Scaler/Rate Meter with Model 43-68 100 cm² Gas Proportional Alpha-Beta Detector

Prepared By:	David B. Weyant	Date:	8/18/06
Reviewed By:	Andrew J. Lombardo	Date:	8/18/06

Notes:

1.) Instrument Efficiency is the 4π instrument efficiency.

Total Alpha Contamination
Survey Unit Kaiser-FSSPOA-009A
Survey Data Conversion Form
Form ESC/HPM/M-3-2-2

Date of Survey:	8/10/2006	Type of Radiation:	Alpha
Instrument Serial #:	193686	Calibration Due Date:	3/2/2007
Detector Serial #:	PR190485	Calibration Due Date:	3/2/2007
E_s (Surface Efficiency):	0.25	E_i (Insturment Efficiency):	0.2968
BKG Counts:	42	BKG Count Time (min):	28
Active Area of Detector Probe (cm^2):	126	MDC ($dpm/100cm^2$):	47.6

FSS Swipe Number	Survey Location	Survey Point Count Time (min)	Gross Counts (cts)	Gross Count Rate (cpm)	Net Count Rate (cpm)	Total Contamination ($dpm/100cm^2$)	95% CL Uncertainty ($dpm/100cm^2$)
K-SS-379	MARSSIM-001	2	12	6	4.50	48.1	36.6
K-SS-380	MARSSIM-002	2	16	8	6.50	69.5	42.2
K-SS-381	MARSSIM-003	2	7	4	2.00	21.4	28.2
K-SS-382	MARSSIM-004	2	9	5	3.00	32.1	31.8
K-SS-383	MARSSIM-005	2	8	4	2.50	26.7	30.0
K-SS-384	MARSSIM-006	2	8	4	2.50	26.7	30.0
K-SS-385	MARSSIM-007	2	8	4	2.50	26.7	30.0
K-SS-386	MARSSIM-008	2	15	8	6.00	64.2	40.9
K-SS-387	MARSSIM-009	2	8	4	2.50	26.7	30.0
K-SS-388	MARSSIM-010	2	12	6	4.50	48.1	36.6
K-SS-389	MARSSIM-011	2	22	11	9.50	101.6	49.4
K-SS-390	MARSSIM-012	2	11	6	4.00	42.8	35.1
K-SS-391	MARSSIM-013	2	12	6	4.50	48.1	36.6
K-SS-392	MARSSIM-014	2	12	6	4.50	48.1	36.6

Comments: 14 consecutive 2-minute background counts used.
Instrument Model and Detector Model/Type: Ludlum Model 2360 Alpha-Beta Scaler/Rate Meter with Model 43 - 68 100cm² Gas Proportional Alpha-Beta Detector

Prepared By: David B. Weyant	Date: 8/10/2006
Reviewed By: Andrew J. Lombardo	Date: 8/10/2006

Attachment A, Table A-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009A / Part I
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009A for 7-29-06**

asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter
with 43-68 100cm² Gas Proportional Detector
s/n: 193686/PR190485

Cal Due: 3/2/2007

Alpha Eff: 14.84%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad Outer Ring	A	0	-43	10	171	5	64	2.0	7/29/2006
Aspalt Pad Outer Ring	B	0	-43	20	385	5	64	2.0	7/29/2006
Aspalt Pad Outer Ring	C	0	-43	5	64	0	-43	2.0	7/29/2006
Aspalt Pad Outer Ring	D	0	-43	5	64	0	-43	2.0	7/29/2006
Aspalt Pad Outer Ring	E	0	-43	10	171	0	-43	2.0	7/29/2006
Aspalt Pad Outer Ring	F	0	-43	10	171	0	-43	2.0	7/29/2006
Aspalt Pad Outer Ring	G	0	-43	5	64	0	-43	2.0	7/29/2006
Aspalt Pad Outer Ring	H	0	-43	5	64	0	-43	2.0	7/29/2006
Aspalt Pad Outer Ring	I	0	-43	5	64	0	-43	2.0	7/29/2006
Aspalt Pad Outer Ring	J	0	-43	5	64	0	-43	2.0	7/29/2006
Aspalt Pad Outer Ring	K	0	-43	5	64	0	-43	2.0	7/29/2006
Aspalt Pad Outer Ring	L	0	-43	5	64	0	-43	2.0	7/29/2006
Aspalt Pad Outer Ring	M	0	-43	10	171	0	-43	2.0	7/29/2006
Aspalt Pad Outer Ring	N	0	-43	10	171	0	-43	2.0	7/29/2006
Aspalt Pad Outer Ring	O	0	-43	5	64	0	-43	2.0	7/29/2006

Notes:

1. The weighted cpm is determined by the surveyor. Since alpha counts (clicks on audible) are infrequent, and 1 count may equal 10 cpm, the surveyor determines the "weighted average".
2. The acceptance criteria for Total Contamination is 944 dpm/100cm².
3. Scans are used to identify elevated area above the acceptance criteria.
4. Compliance is demonstrated by static counts and smear (sample) results.
5. Background is an average of five (5) two minute readings taken at equally spaced distances across survey unit.

Attachment A, Table A-2
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009A / Part II
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number: KAISER-FSSPOA-009A for 8-1-06

asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter
with 43-68 100cm² Gas Proportional Detector
s/n: 193686/PR190485

Cal Due: 3/2/2007

Alpha Eff: 14.84%

Location	Grid	Scan cpm min	Scan dpm/100cm² min	Scan cpm max	Scan dpm/100cm² max	weighted cpm ave	weighted dpm/100cm² ave	Bgrd cpm (2min)	Date
Aspalt Pad Outer Ring	P	0	-45	5	62	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	Q	0	-45	10	169	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	R	0	-45	5	62	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	S	0	-45	5	62	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	T	0	-45	10	169	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	U	0	-45	10	169	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	V	0	-45	5	62	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	W	0	-45	10	169	5	62	2.1	8/1/2006
Aspalt Pad Outer Ring	X	0	-45	20	383	5	62	2.1	8/1/2006
Aspalt Pad Outer Ring	Y	0	-45	20	383	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	Z	0	-45	5	62	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	AA	0	-45	5	62	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	AB	0	-45	5	62	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	AC	0	-45	5	62	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	AD	0	-45	10	169	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	AE	0	-45	20	383	5	62	2.1	8/1/2006
Aspalt Pad Outer Ring	AF	0	-45	10	169	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	AG	0	-45	20	383	5	62	2.1	8/1/2006
Aspalt Pad Outer Ring	AH	0	-45	20	383	5	62	2.1	8/1/2006
Aspalt Pad Outer Ring	AI	0	-45	10	169	5	62	2.1	8/1/2006
Aspalt Pad Outer Ring	AJ	0	-45	20	383	5	62	2.1	8/1/2006
Aspalt Pad Outer Ring	AK	0	-45	20	383	5	62	2.1	8/1/2006

Attachment A, Table A-2
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009A / Part II
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number: KAISER-FSSPOA-009A for 8-1-06

asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter
with 43-68 100cm² Gas Proportional Detector
s/n: 193686/PR190485

Cal Due: 3/2/2007

Alpha Eff: 14.84%

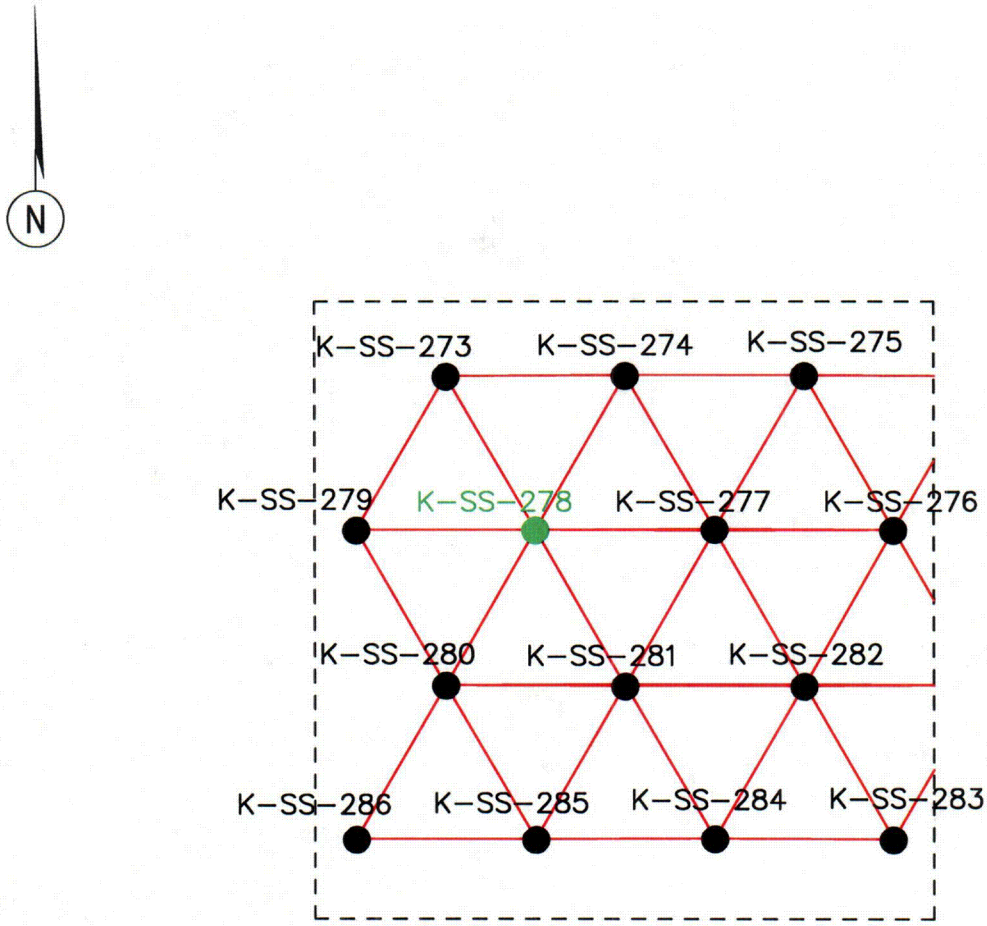
		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad Outer Ring	AL	0	-45	20	383	5	62	2.1	8/1/2006
Aspalt Pad Outer Ring	AM	0	-45	5	62	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	AN	0	-45	5	62	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	AO	0	-45	10	169	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	AP	0	-45	10	169	5	62	2.1	8/1/2006
Aspalt Pad Outer Ring	AQ	0	-45	10	169	5	62	2.1	8/1/2006
Aspalt Pad Outer Ring	AR	0	-45	10	169	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	AS	0	-45	5	62	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	AT	0	-45	5	62	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	AU	0	-45	10	169	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	AV	0	-45	20	383	5	62	2.1	8/1/2006
Aspalt Pad Outer Ring	AW	0	-45	5	62	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	AX	0	-45	20	383	5	62	2.1	8/1/2006
Aspalt Pad Outer Ring	AY	0	-45	5	62	0	-45	2.1	8/1/2006
Aspalt Pad Outer Ring	AZ	0	-45	5	62	0	-45	2.1	8/1/2006

Notes:

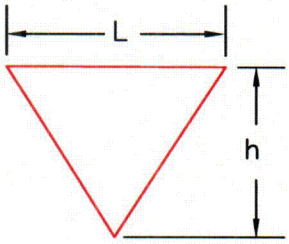
1. The weighted cpm is determined by the surveyor. Since alpha counts (clicks on audible) are infrequent, and 1 count may equal 10 cpm, the surveyor determines the "weighted average".
2. The acceptance criteria for Total Contamination is 944 dpm/100cm².
3. Scans are used to identify elevated area above the acceptance criteria.
4. Compliance is demonstrated by static counts and smear (sample) results.
5. Background is an average of nine (9) two minute readings taken at equally spaced distances across survey unit.

ATTACHMENT B
TABLE OF CONTENTS

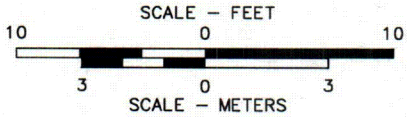
- **FIGURE B-1** Systematic Sampling Locations
- Alpha Scan MDC Calculation Form
- Total Alpha Contamination Survey Data Conversion Form
- **TABLE B-1** Gross Alpha Scan Results Summary



SUB-UNIT KAISER-FSSPOA-009 B



N = 14
L = 2.9m
h = 2.5m
AREA = 100m^2



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

● RANDOM START POINT

FIGURE B-1
SYSTEMATIC SAMPLING LOCATIONS
SURVEY UNIT KAISER-FSSPOA-009
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFD	08/31/06
CHECKED	RFD	08/31/06
DRAWN	DEB	08/01/06

DRAWING NUMBER
PA4072094B

Penn E&R
Environmental & Remediation, Inc.

Daily Alpha Scan MDC

KAISER-FSSPOA-009B through KAISER-FSSPOA-009H

Instrument Serial Number:	177171	Cal. Due:	7/24/2007
Detector Serial Number:	PR124946	Cal. Due:	7/24/2007
Radiation Detected:	Alpha		For < 3 count background

Probability of observing 2 or more counts:

$$P(n \geq 2) = 1 - \left(1 + \frac{(GE+B)d}{60v}\right)\left(e^{\frac{(GE+B)d}{60v}}\right)$$

Probability of observing a single count:

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

	D Date	G Activity (dpm)	d Detector Width (cm)	E Instrument Efficiency (cpm)	v Scan Speed (cm/s)	B Background Countrate (cpm)	P Probability (-)
1	7/29/2006	540	16.0	0.1108	5.33	N/A	0.95
2	7/29/2006	1080	16.0	0.1108	10.7	N/A	0.95
3	7/31/2006	540	16.0	0.1108	5.33	N/A	0.95
4	7/31/2006	1080	16.0	0.1108	10.7	N/A	0.95
5	8/1/2006	540	16.0	0.1108	5.33	N/A	0.95
6	8/1/2006	1080	16.0	0.1108	10.7	N/A	0.95
7	8/2/2006	540	16.0	0.1108	5.33	N/A	0.95
8	8/2/2006	1080	16.0	0.1108	10.7	N/A	0.95
9	8/3/2006	540	16.0	0.1108	5.33	N/A	0.95
10	8/3/2006	1080	16.0	0.1108	10.7	N/A	0.95
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Comments: Survey Sub-Units Kaiser-FSSPOA-009B through Kaiser-FSSPOA-009H
Floor monitor scanning at 1/2 detector width per second or less.
Instrument Model and Detector Model/Type: Ludlum 2360 Alpha-Beta Scaler/Rate Meter with Model 43-37 582cm² Gas Proportional Alpha-Beta Detector

Prepared By:	David B. Weyant	Date:	8/18/06
Reviewed By:	Andrew J. Lombardo	Date:	8/18/06

Notes:
1.) Instrument Efficiency is the 4π instrument efficiency.

Total Alpha Contamination
Survey Unit Kaiser-FSSPOA-009B
Survey Data Conversion Form
Form ESC/HPM/M-3-2-2

Date of Survey:	8/3/2006	Type of Radiation:	Alpha
Instrument Serial #:	177171	Calibration Due Date:	7/24/2007
Detector Serial #:	PR12946	Calibration Due Date:	7/24/2007
E_s (Surface Efficiency):	0.25	E_i (Insturment Efficiency):	0.2216
BKG Counts:	172	BKG Count Time (min):	28
Active Area of Detector Probe (cm^2):	582	MDC ($dpm/100cm^2$):	23.2

FSS Swipe Number	Survey Location	Survey Point Count Time (min)	Gross Counts (cts)	Gross Count Rate (cpm)	Net Count Rate (cpm)	Total Contamination ($dpm/100cm^2$)	95% CL Uncertainty ($dpm/100cm^2$)
K-SS-273	MARSSIM-001	2	25	13	6.36	19.7	15.5
K-SS-274	MARSSIM-002	2	16	8	1.86	5.76	12.5
K-SS-275	MARSSIM-003	2	27	14	7.36	22.8	16.0
K-SS-276	MARSSIM-004	2	24	12	5.86	18.2	15.2
K-SS-277	MARSSIM-005	2	21	11	4.36	13.5	14.2
K-SS-278	MARSSIM-006	2	29	15	8.36	25.9	16.6
K-SS-279	MARSSIM-007	2	33	17	10.4	32.1	17.7
K-SS-280	MARSSIM-008	2	16	8	1.86	5.76	12.5
K-SS-281	MARSSIM-009	2	16	8	1.86	5.76	12.5
K-SS-282	MARSSIM-010	2	26	13	6.86	21.3	15.8
K-SS-283	MARSSIM-011	2	34	17	10.9	33.7	18.0
K-SS-284	MARSSIM-012	2	50	25	18.9	58.5	21.7
K-SS-285	MARSSIM-013	2	58	29	22.9	70.9	23.3
K-SS-286	MARSSIM-014	2	50	25	18.9	58.5	21.7

Comments: 14 consecutive 2-minute background counts used.
Instrument Model and Detector Model/Type: Ludlum 2360 Alpha-Beta Scaler/Rate Meter with Model 43-37 582cm² Gas Proportional Alpha-Beta Detector

Prepared By: David B. Weyant	Date: 8/3/2006
Reviewed By: Andrew J. Lombardo	Date: 8/10/2006

Attachment B, Table B-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009B
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009B**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with
43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	A1	0	-35	40	213	4	-10	5.6	7/29/2006
Aspalt Pad	A2	0	-35	20	89	2	-22	5.6	7/29/2006
Aspalt Pad	A3	0	-35	40	213	1	-29	5.6	7/29/2006
Aspalt Pad	A4	0	-35	40	213	2	-22	5.6	7/29/2006
Aspalt Pad	A5	0	-35	80	461	5	-4	5.6	7/29/2006
Aspalt Pad	A6	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	A7	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	A8	0	-35	20	89	1	-29	5.6	7/29/2006
Aspalt Pad	A9	0	-35	20	89	1	-29	5.6	7/29/2006
Aspalt Pad	A10	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	B1	0	-35	60	337	3	-16	5.6	7/29/2006
Aspalt Pad	B2	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	B3	0	-35	60	337	2	-22	5.6	7/29/2006
Aspalt Pad	B4	0	-35	40	213	2	-22	5.6	7/29/2006
Aspalt Pad	B5	0	-35	60	337	4	-10	5.6	7/29/2006
Aspalt Pad	B6	0	-35	10	27	1	-29	5.6	7/29/2006
Aspalt Pad	B7	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	B8	0	-35	60	337	3	-16	5.6	7/29/2006
Aspalt Pad	B9	0	-35	40	213	2	-22	5.6	7/29/2006

Attachment B, Table B-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009B
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number KAISER-FSSPOA-009B

asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with
43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	B10	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	C1	0	-35	20	89	1	-29	5.6	7/29/2006
Aspalt Pad	C2	0	-35	40	213	3	-16	5.6	7/29/2006
Aspalt Pad	C3	0	-35	60	337	3	-16	5.6	7/29/2006
Aspalt Pad	C4	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	C5	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	C6	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	C7	0	-35	60	337	2	-22	5.6	7/29/2006
Aspalt Pad	C8	0	-35	30	151	1	-29	5.6	7/29/2006
Aspalt Pad	C9	0	-35	50	275	4	-10	5.6	7/29/2006
Aspalt Pad	C10	0	-35	20	89	1	-29	5.6	7/29/2006
Aspalt Pad	D1	0	-35	40	213	3	-16	5.6	7/29/2006
Aspalt Pad	D2	0	-35	20	89	2	-22	5.6	7/29/2006
Aspalt Pad	D3	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	D4	0	-35	10	27	1	-29	5.6	7/29/2006
Aspalt Pad	D5	0	-35	10	27	1	-29	5.6	7/29/2006
Aspalt Pad	D6	0	-35	20	89	2	-22	5.6	7/29/2006
Aspalt Pad	D7	0	-35	10	27	1	-29	5.6	7/29/2006
Aspalt Pad	D8	0	-35	10	27	0	-35	5.6	7/29/2006

Attachment B, Table B-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009B
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number: KAISER-FSSPOA-009B
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with
43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

Location	Grid	Scan cpm min	Scan dpm/100cm² min	Scan cpm max	Scan dpm/100cm² max	weighted cpm ave	weighted dpm/100cm² ave	Bgrd cpm (2min)	Date
Aspalt Pad	D9	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	D10	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	E1	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	E2	0	-35	40	213	1	-29	5.6	7/29/2006
Aspalt Pad	E3	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	E4	0	-35	40	213	3	-16	5.6	7/29/2006
Aspalt Pad	E5	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	E6	0	-35	10	27	1	-29	5.6	7/29/2006
Aspalt Pad	E7	0	-35	20	89	1	-29	5.6	7/29/2006
Aspalt Pad	E8	0	-35	20	89	1	-29	5.6	7/29/2006
Aspalt Pad	E9	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	E10	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	F1	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	F2	0	-35	10	27	1	-29	5.6	7/29/2006
Aspalt Pad	F3	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	F4	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	F5	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	F6	0	-35	10	27	1	-29	5.6	7/29/2006
Aspalt Pad	F7	0	-35	40	213	2	-22	5.6	7/29/2006

Attachment B, Table B-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009B
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number KAISER-FSSPOA-009B
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with
43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	F8	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	F9	0	-35	20	89	2	-22	5.6	7/29/2006
Aspalt Pad	F10	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	G1	0	-35	10	27	1	-29	5.6	7/29/2006
Aspalt Pad	G2	0	-35	40	213	2	-22	5.6	7/29/2006
Aspalt Pad	G3	0	-35	20	89	1	-29	5.6	7/29/2006
Aspalt Pad	G4	0	-35	10	27	1	-29	5.6	7/29/2006
Aspalt Pad	G5	0	-35	20	89	1	-29	5.6	7/29/2006
Aspalt Pad	G6	0	-35	60	337	4	-10	5.6	7/29/2006
Aspalt Pad	G7	0	-35	60	337	3	-16	5.6	7/29/2006
Aspalt Pad	G8	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	G9	0	-35	10	27	1	-29	5.6	7/29/2006
Aspalt Pad	G10	0	-35	40	213	2	-22	5.6	7/29/2006
Aspalt Pad	H1	0	-35	10	27	1	-29	5.6	7/29/2006
Aspalt Pad	H2	0	-35	10	27	1	-29	5.6	7/29/2006
Aspalt Pad	H3	0	-35	20	89	3	-16	5.6	7/29/2006
Aspalt Pad	H4	0	-35	10	27	1	-29	5.6	7/29/2006
Aspalt Pad	H5	0	-35	20	89	2	-22	5.6	7/29/2006
Aspalt Pad	H6	0	-35	10	27	0	-35	5.6	7/29/2006

Attachment B, Table B-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009B
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number KAISER-FSSPOA-009B
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with
43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	H7	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	H8	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	H9	0	-35	20	89	2	-22	5.6	7/29/2006
Aspalt Pad	H10	0	-35	20	89	2	-22	5.6	7/29/2006
Aspalt Pad	I1	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	I2	0	-35	60	337	4	-10	5.6	7/29/2006
Aspalt Pad	I3	0	-35	10	27	1	-29	5.6	7/29/2006
Aspalt Pad	I4	0	-35	10	27	1	-29	5.6	7/29/2006
Aspalt Pad	I5	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	I6	0	-35	40	213	3	-16	5.6	7/29/2006
Aspalt Pad	I7	0	-35	40	213	3	-16	5.6	7/29/2006
Aspalt Pad	I8	0	-35	40	213	4	-10	5.6	7/29/2006
Aspalt Pad	I9	0	-35	60	337	5	-4	5.6	7/29/2006
Aspalt Pad	I10	0	-35	60	337	4	-10	5.6	7/29/2006
Aspalt Pad	J1	0	-35	20	89	2	-22	5.6	7/29/2006
Aspalt Pad	J2	0	-35	20	89	2	-22	5.6	7/29/2006
Aspalt Pad	J3	0	-35	10	27	1	-29	5.6	7/29/2006
Aspalt Pad	J4	0	-35	10	27	1	-29	5.6	7/29/2006
Aspalt Pad	J5	0	-35	10	27	1	-29	5.6	7/29/2006

Attachment B, Table B-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009B
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009B**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with
43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

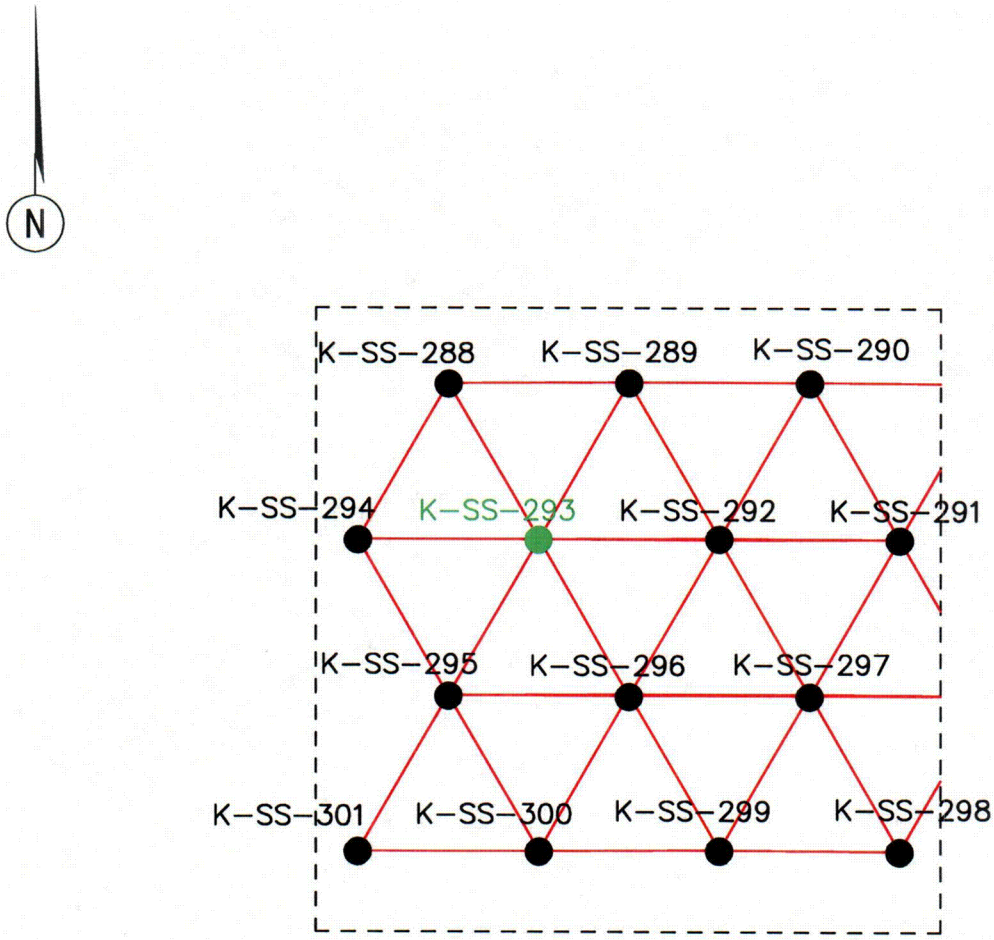
		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	J6	0	-35	10	27	1	-29	5.6	7/29/2006
Aspalt Pad	J7	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	J8	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	J9	0	-35	10	27	0	-35	5.6	7/29/2006
Aspalt Pad	J10	0	-35	10	27	0	-35	5.6	7/29/2006

Notes:

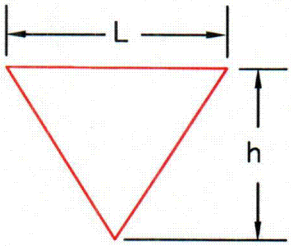
1. The weighted cpm is determined by the surveyor. Since alpha counts (clicks on audible) are infrequent, and 1 count may equal 10 cpm, the surveyor determines the "weighted average".
2. The acceptance criteria for Total Contamination is 944 dpm/100cm².
3. Scans are used to identify elevated area above the acceptance criteria.
4. Compliance is demonstrated by static counts and smear (sample) results.
5. Background is an average of sixteen (16) two minute readings taken at equally spaced distances across survey unit.

ATTACHMENT C
TABLE OF CONTENTS

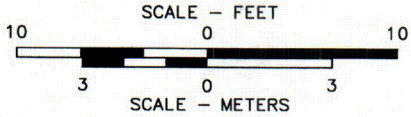
- **FIGURE C-1** Systematic Sampling Locations
- Alpha Scan MDC Calculation Form
- Total Alpha Contamination Survey Data Conversion Form
- **TABLE C-1** Gross Alpha Scan Results Summary



SUB-UNIT KAISER-FSSPOA-009 C



N = 14
L = 2.9m
h = 2.5m
AREA = 100m^2



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

● RANDOM START POINT

FIGURE C-1
SYSTEMATIC SAMPLING LOCATIONS
SURVEY UNIT KAISER-FSSPOA-009
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFD	08/31/06
CHECKED	RFD	08/31/06
DRAWN	DEB	08/01/06

DRAWING NUMBER
PA4072094C

Penn E&R
Environmental & Remediation, Inc.

C-20

Daily Alpha Scan MDC

KAISER-FSSPOA-009B through KAISER-FSSPOA-009H

Instrument Serial Number:	177171	Cal. Due:	7/24/2007
Detector Serial Number:	PR124946	Cal. Due:	7/24/2007
Radiation Detected:	Alpha		For < 3 count background

Probability of observing 2 or more counts:

$$P(n \geq 2) = 1 - \left(1 + \frac{(GE+B)d}{60v}\right)\left(e^{-\frac{(GE+B)d}{60v}}\right)$$

Probability of observing a single count:

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

	D Date	G Activity (dpm)	d Detector Width (cm)	E Instrument Efficiency (cpm)	v Scan Speed (cm/s)	B Background Countrate (cpm)	P Probability (-)
1	7/29/2006	540	16.0	0.1108	5.33	N/A	0.95
2	7/29/2006	1080	16.0	0.1108	10.7	N/A	0.95
3	7/31/2006	540	16.0	0.1108	5.33	N/A	0.95
4	7/31/2006	1080	16.0	0.1108	10.7	N/A	0.95
5	8/1/2006	540	16.0	0.1108	5.33	N/A	0.95
6	8/1/2006	1080	16.0	0.1108	10.7	N/A	0.95
7	8/2/2006	540	16.0	0.1108	5.33	N/A	0.95
8	8/2/2006	1080	16.0	0.1108	10.7	N/A	0.95
9	8/3/2006	540	16.0	0.1108	5.33	N/A	0.95
10	8/3/2006	1080	16.0	0.1108	10.7	N/A	0.95
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Comments: Survey Sub-Units Kaiser-FSSPOA-009B through Kaiser-FSSPOA-009H
Floor monitor scanning at 1/2 detector width per second or less.
Instrument Model and Detector Model/Type: Ludlum 2360 Alpha-Beta Scaler/Rate Meter with Model 43-37 582cm² Gas Proportional Alpha-Beta Detector

Prepared By:	David B. Weyant	Date:	8/18/06
Reviewed By:	Andrew J. Lombardo	Date:	8/18/06

Notes:
1.) Instrument Efficiency is the 4π instrument efficiency.

Total Alpha Contamination Form
Survey Unit Kaiser-FSSPOA-009C
Survey Data Conversion Form
Form ESC/HPM/M-3-2-2

Date of Survey:	8/4/2006	Type of Radiation:	Alpha
Instrument Serial #:	177171	Calibration Due Date:	7/24/2007
Detector Serial #:	PR12946	Calibration Due Date:	7/24/2007
E_s (Surface Efficiency):	0.25	E_i (Insturment Efficiency):	0.2216
BKG Counts:	236	BKG Count Time (min):	28
Active Area of Detector Probe (cm^2):	582	MDC ($dpm/100cm^2$):	26.3

FSS Swipe Number	Survey Location	Survey Point Count Time (min)	Gross Counts (cts)	Gross Count Rate (cpm)	Net Count Rate (cpm)	Total Contamination ($dpm/100cm^2$)	95% CL Uncertainty ($dpm/100cm^2$)
K-SS-288	MARSSIM-001	2	28	14	5.57	17.3	16.4
K-SS-289	MARSSIM-002	2	28	14	5.57	17.3	16.4
K-SS-290	MARSSIM-003	2	45	23	14.1	43.6	20.7
K-SS-291	MARSSIM-004	2	33	17	8.07	25.0	17.8
K-SS-292	MARSSIM-005	2	35	18	9.07	28.1	18.3
K-SS-293	MARSSIM-006	2	36	18	9.57	29.7	18.5
K-SS-294	MARSSIM-007	2	45	23	14.1	43.6	20.7
K-SS-295	MARSSIM-008	2	38	19	10.6	32.8	19.0
K-SS-296	MARSSIM-009	2	36	18	9.57	29.7	18.5
K-SS-297	MARSSIM-010	2	51	26	17.1	52.9	22.0
K-SS-298	MARSSIM-011	2	19	10	1.07	3.32	13.7
K-SS-299	MARSSIM-012	2	72	36	27.6	85.5	26.0
K-SS-300	MARSSIM-013	2	62	31	22.6	70.0	24.2
K-SS-301	MARSSIM-014	2	41	21	12.1	37.4	19.7

Comments: 14 consecutive 2-minute background counts used.
Instrument Model and Detector Model/Type: Ludlum 2360 Alpha-Beta Scaler/Rate Meter with Model 43-37 582cm² Gas Proportional Alpha-Beta Detector

Prepared By: David B. Weyant	Date: 8/8/2006
Reviewed By: Andrew J. Lombardo	Date: 8/10/2006

Attachment C, Table C-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009C
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009C**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	A1	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	A2	0	-33	20	91	4	-9	5.4	7/31/2006
Aspalt Pad	A3	0	-33	40	215	2	-21	5.4	7/31/2006
Aspalt Pad	A4	0	-33	60	339	5	-2	5.4	7/31/2006
Aspalt Pad	A5	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	A6	0	-33	10	29	1	-27	5.4	7/31/2006
Aspalt Pad	A7	0	-33	10	29	1	-27	5.4	7/31/2006
Aspalt Pad	A8	0	-33	10	29	1	-27	5.4	7/31/2006
Aspalt Pad	A9	0	-33	10	29	0	-33	5.4	7/31/2006
Aspalt Pad	A10	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	B1	0	-33	60	339	4	-9	5.4	7/31/2006
Aspalt Pad	B2	0	-33	70	401	5	-2	5.4	7/31/2006
Aspalt Pad	B3	0	-33	20	91	2	-21	5.4	7/31/2006
Aspalt Pad	B4	0	-33	70	401	5	-2	5.4	7/31/2006
Aspalt Pad	B5	0	-33	20	91	2	-21	5.4	7/31/2006
Aspalt Pad	B6	0	-33	20	91	2	-21	5.4	7/31/2006
Aspalt Pad	B7	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	B8	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	B9	0	-33	10	29	0	-33	5.4	7/31/2006

Attachment C, Table C-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009C
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009C**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	B10	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	C1	0	-33	10	29	1	-27	5.4	7/31/2006
Aspalt Pad	C2	0	-33	40	215	2	-21	5.4	7/31/2006
Aspalt Pad	C3	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	C4	0	-33	40	215	2	-21	5.4	7/31/2006
Aspalt Pad	C5	0	-33	40	215	2	-21	5.4	7/31/2006
Aspalt Pad	C6	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	C7	0	-33	60	339	4	-9	5.4	7/31/2006
Aspalt Pad	C8	0	-33	10	29	0	-33	5.4	7/31/2006
Aspalt Pad	C9	0	-33	40	215	2	-21	5.4	7/31/2006
Aspalt Pad	C10	0	-33	60	339	6	4	5.4	7/31/2006
Aspalt Pad	D1	0	-33	80	463	7	10	5.4	7/31/2006
Aspalt Pad	D2	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	D3	0	-33	40	215	2	-21	5.4	7/31/2006
Aspalt Pad	D4	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	D5	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	D6	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	D7	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	D8	0	-33	40	215	1	-27	5.4	7/31/2006

Attachment C, Table C-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009C
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009C**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	D9	0	-33	10	29	1	-27	5.4	7/31/2006
Aspalt Pad	D10	0	-33	20	91	2	-21	5.4	7/31/2006
Aspalt Pad	E1	0	-33	80	463	10	29	5.4	7/31/2006
Aspalt Pad	E2	0	-33	60	339	8	16	5.4	7/31/2006
Aspalt Pad	E3	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	E4	0	-33	20	91	2	-21	5.4	7/31/2006
Aspalt Pad	E5	0	-33	40	215	2	-21	5.4	7/31/2006
Aspalt Pad	E6	0	-33	10	29	0	-33	5.4	7/31/2006
Aspalt Pad	E7	0	-33	40	215	2	-21	5.4	7/31/2006
Aspalt Pad	E8	0	-33	40	215	2	-21	5.4	7/31/2006
Aspalt Pad	E9	0	-33	40	215	1	-27	5.4	7/31/2006
Aspalt Pad	E10	0	-33	20	91	1	-27	5.4	7/31/2006
Aspalt Pad	F1	0	-33	60	339	8	16	5.4	7/31/2006
Aspalt Pad	F2	0	-33	20	91	3	-15	5.4	7/31/2006
Aspalt Pad	F3	0	-33	60	339	6	4	5.4	7/31/2006
Aspalt Pad	F4	0	-33	60	339	5	-2	5.4	7/31/2006
Aspalt Pad	F5	0	-33	40	215	2	-21	5.4	7/31/2006
Aspalt Pad	F6	0	-33	60	339	5	-2	5.4	7/31/2006
Aspalt Pad	F7	0	-33	40	215	3	-15	5.4	7/31/2006

Attachment C, Table C-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009C
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009C**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
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Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	F8	0	-33	60	339	6	4	5.4	7/31/2006
Aspalt Pad	F9	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	F10	0	-33	10	29	2	-21	5.4	7/31/2006
Aspalt Pad	G1	0	-33	80	463	8	16	5.4	7/31/2006
Aspalt Pad	G2	0	-33	60	339	5	-2	5.4	7/31/2006
Aspalt Pad	G3	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	G4	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	G5	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	G6	0	-33	80	463	7	10	5.4	7/31/2006
Aspalt Pad	G7	0	-33	40	215	2	-21	5.4	7/31/2006
Aspalt Pad	G8	0	-33	20	91	1	-27	5.4	7/31/2006
Aspalt Pad	G9	0	-33	60	339	5	-2	5.4	7/31/2006
Aspalt Pad	G10	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	H1	0	-33	80	463	10	29	5.4	7/31/2006
Aspalt Pad	H2	0	-33	60	339	6	4	5.4	7/31/2006
Aspalt Pad	H3	0	-33	60	339	5	-2	5.4	7/31/2006
Aspalt Pad	H4	0	-33	40	215	4	-9	5.4	7/31/2006
Aspalt Pad	H5	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	H6	0	-33	40	215	2	-21	5.4	7/31/2006

Attachment C, Table C-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009C
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009C**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

Location	Grid	Scan cpm min	Scan dpm/100cm² min	Scan cpm max	Scan dpm/100cm² max	weighted cpm ave	weighted dpm/100cm² ave	Bgrd cpm (2min)	Date
Aspalt Pad	H7	0	-33	40	215	2	-21	5.4	7/31/2006
Aspalt Pad	H8	0	-33	10	29	1	-27	5.4	7/31/2006
Aspalt Pad	H9	0	-33	40	215	2	-21	5.4	7/31/2006
Aspalt Pad	H10	0	-33	20	91	1	-27	5.4	7/31/2006
Aspalt Pad	I1	0	-33	60	339	8	16	5.4	7/31/2006
Aspalt Pad	I2	0	-33	60	339	8	16	5.4	7/31/2006
Aspalt Pad	I3	0	-33	40	215	4	-9	5.4	7/31/2006
Aspalt Pad	I4	0	-33	20	91	3	-15	5.4	7/31/2006
Aspalt Pad	I5	0	-33	20	91	2	-21	5.4	7/31/2006
Aspalt Pad	I6	0	-33	10	29	1	-27	5.4	7/31/2006
Aspalt Pad	I7	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	I8	0	-33	10	29	0	-33	5.4	7/31/2006
Aspalt Pad	I9	0	-33	10	29	0	-33	5.4	7/31/2006
Aspalt Pad	I10	0	-33	40	215	2	-21	5.4	7/31/2006
Aspalt Pad	J1	0	-33	60	339	5	-2	5.4	7/31/2006
Aspalt Pad	J2	0	-33	40	215	3	-15	5.4	7/31/2006
Aspalt Pad	J3	0	-33	50	277	4	-9	5.4	7/31/2006
Aspalt Pad	J4	0	-33	60	339	4	-9	5.4	7/31/2006
Aspalt Pad	J5	0	-33	20	91	2	-21	5.4	7/31/2006

Attachment C, Table C-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009C
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009C**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	J6	0	-33	10	29	2	-21	5.4	7/31/2006
Aspalt Pad	J7	0	-33	30	153	3	-15	5.4	7/31/2006
Aspalt Pad	J8	0	-33	20	91	2	-21	5.4	7/31/2006
Aspalt Pad	J9	0	-33	10	29	2	-21	5.4	7/31/2006
Aspalt Pad	J10	0	-33	40	215	3	-15	5.4	7/31/2006

Notes:

1. The weighted cpm is determined by the surveyor. Since alpha counts (clicks on audible) are infrequent, and 1 count may equal 10 cpm, the surveyor determines the "weighted average".
2. The acceptance criteria for Total Contamination is 944 dpm/100cm^2.
3. Scans are used to identify elevated area above the acceptance criteria.
4. Compliance is demonstrated by static counts and smear (sample) results.
5. Background is an average of fourteen (14) two minute readings taken at equally spaced distances across survey unit.

ATTACHMENT D
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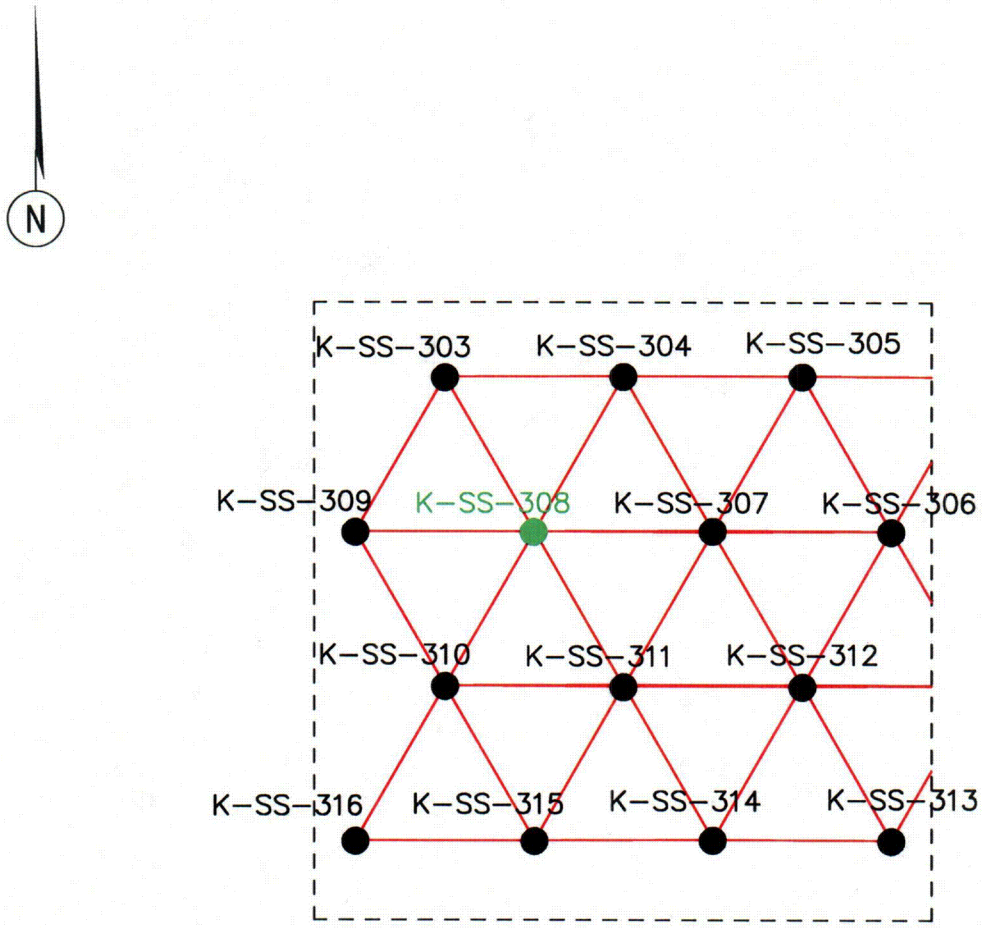
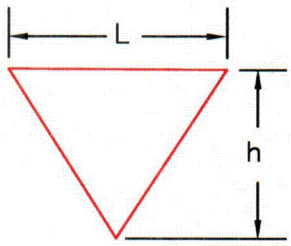
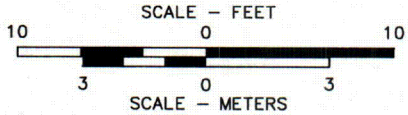
- **FIGURE D-1** Systematic Sampling Locations
- Alpha Scan MDC Calculation Form
- Total Alpha Contamination Survey Data Conversion Form
- **TABLE D-1** Gross Alpha Scan Results Summary



SUB-UNIT KAISER-FSSPOA-009 D



N = 14
L = 2.9m
h = 2.5m
AREA = 100m^2



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

● RANDOM START POINT

FIGURE D-1
SYSTEMATIC SAMPLING LOCATIONS
SURVEY UNIT KAISER-FSSPOA-009
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFD	08/31/06
CHECKED	RFD	08/31/06
DRAWN	DEB	08/01/06

DRAWING NUMBER
PA4072094D

Penn E&R
Environmental & Remediation, Inc.

Daily Alpha Scan MDC

KAISER-FSSPOA-009B through KAISER-FSSPOA-009H

Instrument Serial Number:	177171	Cal. Due:	7/24/2007
Detector Serial Number:	PR124946	Cal. Due:	7/24/2007
Radiation Detected:	Alpha		For < 3 count background

Probability of observing 2 or more counts:

$$P(n \geq 2) = 1 - \left(1 + \frac{(GE+B)d}{60v}\right)\left(e^{\frac{(GE+B)d}{60v}}\right)$$

Probability of observing a single count:

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

	D Date	G Activity (dpm)	d Detector Width (cm)	E Instrument Efficiency (cpm)	v Scan Speed (cm/s)	B Background Countrate (cpm)	P Probability (-)
1	7/29/2006	540	16.0	0.1108	5.33	N/A	0.95
2	7/29/2006	1080	16.0	0.1108	10.7	N/A	0.95
3	7/31/2006	540	16.0	0.1108	5.33	N/A	0.95
4	7/31/2006	1080	16.0	0.1108	10.7	N/A	0.95
5	8/1/2006	540	16.0	0.1108	5.33	N/A	0.95
6	8/1/2006	1080	16.0	0.1108	10.7	N/A	0.95
7	8/2/2006	540	16.0	0.1108	5.33	N/A	0.95
8	8/2/2006	1080	16.0	0.1108	10.7	N/A	0.95
9	8/3/2006	540	16.0	0.1108	5.33	N/A	0.95
10	8/3/2006	1080	16.0	0.1108	10.7	N/A	0.95
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Comments: Survey Sub-Units Kaiser-FSSPOA-009B through Kaiser-FSSPOA-009H
Floor monitor scanning at 1/2 detector width per second or less.
Instrument Model and Detector Model/Type: Ludlum 2360 Alpha-Beta Scaler/Rate Meter with Model 43-37 582cm² Gas Proportional Alpha-Beta Detector

Prepared By:	David B. Weyant	Date:	8/18/06
Reviewed By:	Andrew J. Lombardo	Date:	8/18/06

Notes:
1.) Instrument Efficiency is the 4π instrument efficiency.

Total Alpha Contamination
Survey Unit Kaiser-FSSPOA-009D
Survey Data Conversion Form
Form ESC/HPM/M-3-2-2

Date of Survey:	8/5/2006	Type of Radiation:	Alpha
Instrument Serial #:	177171	Calibration Due Date:	7/24/2007
Detector Serial #:	PR12946	Calibration Due Date:	7/24/2007
E_s (Surface Efficiency):	0.25	E_i (Insturment Efficiency):	0.2216
BKG Counts:	127	BKG Count Time (min):	28
Active Area of Detector Probe (cm^2):	582	MDC ($dpm/100cm^2$):	20.6

FSS Swipe Number	Survey Location	Survey Point Count Time (min)	Gross Counts (cts)	Gross Count Rate (cpm)	Net Count Rate (cpm)	Total Contamination ($dpm/100cm^2$)	95% CL Uncertainty ($dpm/100cm^2$)
K-SS-303	MARSSIM-001	2	33	17	12.0	37.1	17.6
K-SS-304	MARSSIM-002	2	28	14	9.46	29.4	16.3
K-SS-305	MARSSIM-003	2	36	18	13.5	41.8	18.4
K-SS-306	MARSSIM-004	2	26	13	8.46	26.3	15.7
K-SS-307	MARSSIM-005	2	33	17	12.0	37.1	17.6
K-SS-308	MARSSIM-006	2	28	14	9.46	29.4	16.3
K-SS-309	MARSSIM-007	2	29	15	10.0	30.9	16.5
K-SS-310	MARSSIM-008	2	36	18	13.5	41.8	18.4
K-SS-311	MARSSIM-009	2	22	11	6.46	20.0	14.5
K-SS-312	MARSSIM-010	2	38	19	14.5	44.9	18.9
K-SS-313	MARSSIM-011	2	61	31	26.0	80.5	23.9
K-SS-314	MARSSIM-012	2	65	33	28.0	86.7	24.6
K-SS-315	MARSSIM-013	2	58	29	24.5	75.9	23.3
K-SS-316	MARSSIM-014	2	69	35	30.0	92.9	25.4

Comments: 14 consecutive 2-minute background counts used.
Instrument Model and Detector Model/Type: Ludlum 2360 Alpha-Beta Scaler/Rate Meter with Model 43-37 582cm² Gas Proportional Alpha-Beta Detector

Prepared By: David B. Weyant	Date: 8/8/2006
Reviewed By: Andrew J. Lombardo	Date: 8/10/2006

Attachment D, Table D-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009D
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009D**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	A1	0	-32	10	30	1	-26	5.2	7/31/2006
Aspalt Pad	A2	0	-32	60	340	6	5	5.2	7/31/2006
Aspalt Pad	A3	0	-32	60	340	6	5	5.2	7/31/2006
Aspalt Pad	A4	0	-32	60	340	10	30	5.2	7/31/2006
Aspalt Pad	A5	0	-32	40	216	3	-14	5.2	7/31/2006
Aspalt Pad	A6	0	-32	40	216	4	-7	5.2	7/31/2006
Aspalt Pad	A7	0	-32	10	30	2	-20	5.2	7/31/2006
Aspalt Pad	A8	0	-32	60	340	5	-1	5.2	7/31/2006
Aspalt Pad	A9	0	-32	40	216	2	-20	5.2	7/31/2006
Aspalt Pad	A10	0	-32	20	92	3	-14	5.2	7/31/2006
Aspalt Pad	B1	0	-32	80	464	8	18	5.2	7/31/2006
Aspalt Pad	B2	0	-32	60	340	6	5	5.2	7/31/2006
Aspalt Pad	B3	0	-32	40	216	4	-7	5.2	7/31/2006
Aspalt Pad	B4	0	-32	40	216	3	-14	5.2	7/31/2006
Aspalt Pad	B5	0	-32	40	216	3	-14	5.2	7/31/2006
Aspalt Pad	B6	0	-32	30	154	2	-20	5.2	7/31/2006
Aspalt Pad	B7	0	-32	40	216	3	-14	5.2	7/31/2006
Aspalt Pad	B8	0	-32	20	92	2	-20	5.2	7/31/2006
Aspalt Pad	B9	0	-32	20	92	2	-20	5.2	7/31/2006

Attachment D, Table D-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009D
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009D**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	B10	0	-32	10	30	1	-26	5.2	7/31/2006
Aspalt Pad	C1	0	-32	80	464	8	18	5.2	7/31/2006
Aspalt Pad	C2	0	-32	40	216	4	-7	5.2	7/31/2006
Aspalt Pad	C3	0	-32	20	92	1	-26	5.2	7/31/2006
Aspalt Pad	C4	0	-32	20	92	3	-14	5.2	7/31/2006
Aspalt Pad	C5	0	-32	40	216	5	-1	5.2	7/31/2006
Aspalt Pad	C6	0	-32	20	92	3	-14	5.2	7/31/2006
Aspalt Pad	C7	0	-32	60	340	5	-1	5.2	7/31/2006
Aspalt Pad	C8	0	-32	40	216	3	-14	5.2	7/31/2006
Aspalt Pad	C9	0	-32	40	216	2	-20	5.2	7/31/2006
Aspalt Pad	C10	0	-32	20	92	2	-20	5.2	7/31/2006
Aspalt Pad	D1	0	-32	60	340	7	11	5.2	7/31/2006
Aspalt Pad	D2	0	-32	40	216	4	-7	5.2	7/31/2006
Aspalt Pad	D3	0	-32	40	216	3	-14	5.2	7/31/2006
Aspalt Pad	D4	0	-32	60	340	5	-1	5.2	7/31/2006
Aspalt Pad	D5	0	-32	20	92	2	-20	5.2	7/31/2006
Aspalt Pad	D6	0	-32	30	154	4	-7	5.2	7/31/2006
Aspalt Pad	D7	0	-32	30	154	3	-14	5.2	7/31/2006
Aspalt Pad	D8	0	-32	50	278	5	-1	5.2	7/31/2006

Attachment D, Table D-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009D
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009D**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	D9	0	-32	40	216	5	-1	5.2	7/31/2006
Aspalt Pad	D10	0	-32	60	340	7	11	5.2	7/31/2006
Aspalt Pad	E1	0	-32	40	216	3	-14	5.2	7/31/2006
Aspalt Pad	E2	0	-32	30	154	3	-14	5.2	7/31/2006
Aspalt Pad	E3	0	-32	40	216	5	-1	5.2	7/31/2006
Aspalt Pad	E4	0	-32	50	278	7	11	5.2	7/31/2006
Aspalt Pad	E5	0	-32	40	216	4	-7	5.2	7/31/2006
Aspalt Pad	E6	0	-32	20	92	2	-20	5.2	7/31/2006
Aspalt Pad	E7	0	-32	50	278	5	-1	5.2	7/31/2006
Aspalt Pad	E8	0	-32	20	92	1	-26	5.2	7/31/2006
Aspalt Pad	E9	0	-32	40	216	6	5	5.2	7/31/2006
Aspalt Pad	E10	0	-32	30	154	2	-20	5.2	7/31/2006
Aspalt Pad	F1	0	-32	60	340	8	18	5.2	7/31/2006
Aspalt Pad	F2	0	-32	60	340	6	5	5.2	7/31/2006
Aspalt Pad	F3	0	-32	20	92	1	-26	5.2	7/31/2006
Aspalt Pad	F4	0	-32	10	30	0	-32	5.2	7/31/2006
Aspalt Pad	F5	0	-32	40	216	4	-7	5.2	7/31/2006
Aspalt Pad	F6	0	-32	60	340	5	-1	5.2	7/31/2006
Aspalt Pad	F7	0	-32	20	92	2	-20	5.2	7/31/2006

Attachment D, Table D-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009D
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009D**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	F8	0	-32	40	216	5	-1	5.2	7/31/2006
Aspalt Pad	F9	0	-32	40	216	2	-20	5.2	7/31/2006
Aspalt Pad	F10	0	-32	40	216	3	-14	5.2	7/31/2006
Aspalt Pad	G1	0	-32	60	340	7	11	5.2	7/31/2006
Aspalt Pad	G2	0	-32	40	216	5	-1	5.2	7/31/2006
Aspalt Pad	G3	0	-32	50	278	3	-14	5.2	7/31/2006
Aspalt Pad	G4	0	-32	40	216	3	-14	5.2	7/31/2006
Aspalt Pad	G5	0	-32	20	92	2	-20	5.2	7/31/2006
Aspalt Pad	G6	0	-32	20	92	1	-26	5.2	7/31/2006
Aspalt Pad	G7	0	-32	40	216	4	-7	5.2	7/31/2006
Aspalt Pad	G8	0	-32	50	278	5	-1	5.2	7/31/2006
Aspalt Pad	G9	0	-32	40	216	3	-14	5.2	7/31/2006
Aspalt Pad	G10	0	-32	30	154	2	-20	5.2	7/31/2006
Aspalt Pad	H1	0	-32	60	340	6	5	5.2	7/31/2006
Aspalt Pad	H2	0	-32	60	340	5	-1	5.2	7/31/2006
Aspalt Pad	H3	0	-32	60	340	4	-7	5.2	7/31/2006
Aspalt Pad	H4	0	-32	40	216	3	-14	5.2	7/31/2006
Aspalt Pad	H5	0	-32	40	216	2	-20	5.2	7/31/2006
Aspalt Pad	H6	0	-32	20	92	3	-14	5.2	7/31/2006

Attachment D, Table D-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009D
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009D**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

Location	Grid	Scan cpm min	Scan dpm/100cm² min	Scan cpm max	Scan dpm/100cm² max	weighted cpm ave	weighted dpm/100cm² ave	Bgrd cpm (2min)	Date
Aspalt Pad	H7	0	-32	10	30	0	-32	5.2	7/31/2006
Aspalt Pad	H8	0	-32	20	92	2	-20	5.2	7/31/2006
Aspalt Pad	H9	0	-32	10	30	1	-26	5.2	7/31/2006
Aspalt Pad	H10	0	-32	20	92	2	-20	5.2	7/31/2006
Aspalt Pad	I1	0	-32	60	340	6	5	5.2	7/31/2006
Aspalt Pad	I2	0	-32	80	464	10	30	5.2	7/31/2006
Aspalt Pad	I3	0	-32	60	340	7	11	5.2	7/31/2006
Aspalt Pad	I4	0	-32	60	340	6	5	5.2	7/31/2006
Aspalt Pad	I5	0	-32	40	216	6	5	5.2	7/31/2006
Aspalt Pad	I6	0	-32	60	340	8	18	5.2	7/31/2006
Aspalt Pad	I7	0	-32	40	216	5	-1	5.2	7/31/2006
Aspalt Pad	I8	0	-32	60	340	7	11	5.2	7/31/2006
Aspalt Pad	I9	0	-32	40	216	4	-7	5.2	7/31/2006
Aspalt Pad	I10	0	-32	20	92	1	-26	5.2	7/31/2006
Aspalt Pad	J1	0	-32	60	340	6	5	5.2	7/31/2006
Aspalt Pad	J2	0	-32	60	340	4	-7	5.2	7/31/2006
Aspalt Pad	J3	0	-32	40	216	3	-14	5.2	7/31/2006
Aspalt Pad	J4	0	-32	20	92	1	-26	5.2	7/31/2006
Aspalt Pad	J5	0	-32	40	216	4	-7	5.2	7/31/2006

Attachment D, Table D-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009D
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009D**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	J6	0	-32	10	30	1	-26	5.2	7/31/2006
Aspalt Pad	J7	0	-32	10	30	1	-26	5.2	7/31/2006
Aspalt Pad	J8	0	-32	20	92	2	-20	5.2	7/31/2006
Aspalt Pad	J9	0	-32	40	216	5	-1	5.2	7/31/2006
Aspalt Pad	J10	0	-32	60	340	6	5	5.2	7/31/2006

Notes:

1. The weighted cpm is determined by the surveyor. Since alpha counts (clicks on audible) are infrequent, and 1 count may equal 10 cpm, the surveyor determines the "weighted average".
2. The acceptance criteria for Total Contamination is 944 dpm/100cm^2.
3. Scans are used to identify elevated area above the acceptance criteria.
4. Compliance is demonstrated by static counts and smear (sample) results.
5. Background is an average of fourteen (14) two minute readings taken at equally spaced distances across survey unit.

ATTACHMENT E
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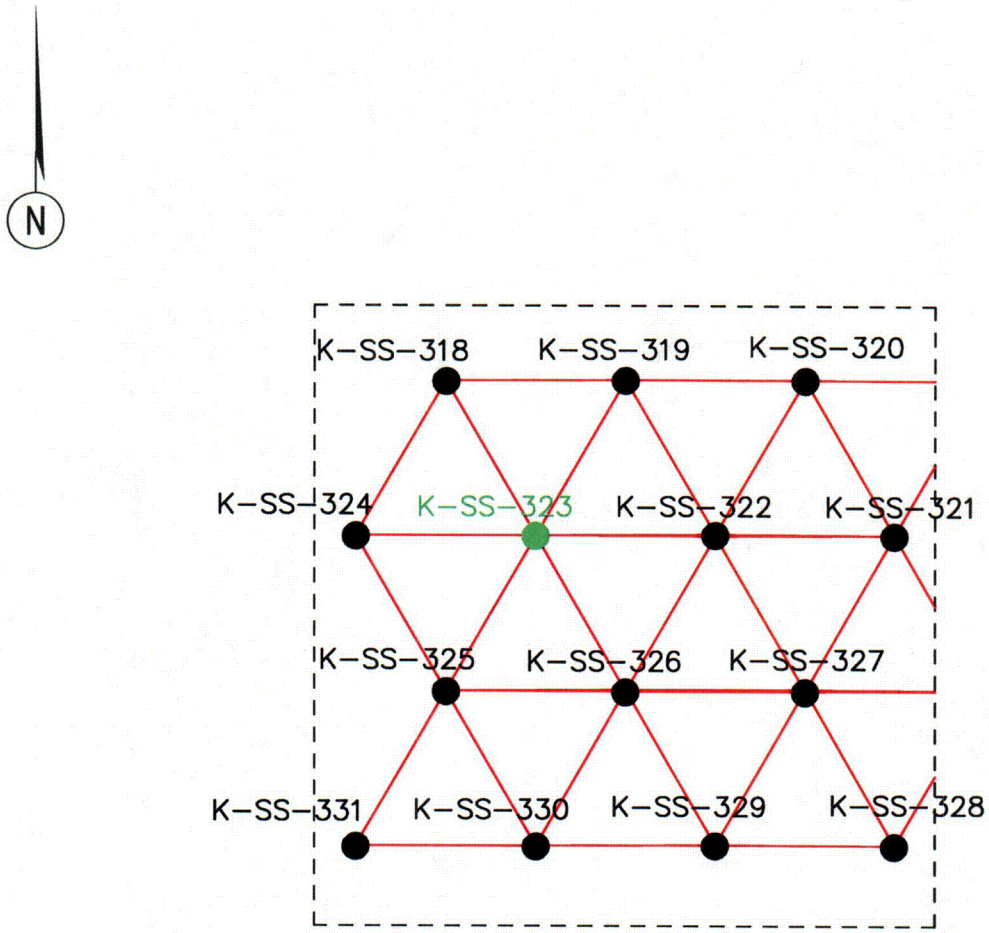
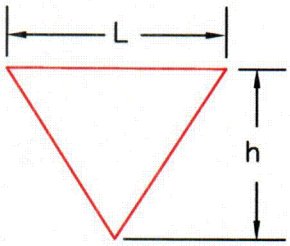
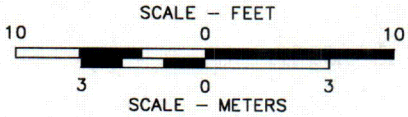
- **FIGURE E-1** Systematic Sampling Locations
- Alpha Scan MDC Calculation Form
- Total Alpha Contamination Survey Data Conversion Form
- **TABLE E-1** Gross Alpha Scan Results Summary



SUB-UNIT KAISER-FSSPOA-009 E



N = 14
L = 2.9m
h = 2.5m
AREA = 100m^2



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

● RANDOM START POINT

FIGURE E-1
SYSTEMATIC SAMPLING LOCATIONS
SURVEY UNIT KAISER-FSSPOA-009
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFD	08/31/06
CHECKED	RFD	08/31/06
DRAWN	DEB	08/01/06

DRAWING NUMBER
PA4072094E

Penn E&R
Environmental & Remediation, Inc.

C-22

Daily Alpha Scan MDC

KAISER-FSSPOA-009B through KAISER-FSSPOA-009H

Instrument Serial Number:	177171	Cal. Due:	7/24/2007
Detector Serial Number:	PR124946	Cal. Due:	7/24/2007
Radiation Detected:	Alpha		For < 3 count background

Probability of observing 2 or more counts:

$$P(n \geq 2) = 1 - \left(1 + \frac{(GE+B)d}{60v}\right)\left(e^{-\frac{(GE+B)d}{60v}}\right)$$

Probability of observing a single count:

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

	D Date	G Activity (dpm)	d Detector Width (cm)	E Instrument Efficiency (cpm)	v Scan Speed (cm/s)	B Background Countrate (cpm)	P Probability (-)
1	7/29/2006	540	16.0	0.1108	5.33	N/A	0.95
2	7/29/2006	1080	16.0	0.1108	10.7	N/A	0.95
3	7/31/2006	540	16.0	0.1108	5.33	N/A	0.95
4	7/31/2006	1080	16.0	0.1108	10.7	N/A	0.95
5	8/1/2006	540	16.0	0.1108	5.33	N/A	0.95
6	8/1/2006	1080	16.0	0.1108	10.7	N/A	0.95
7	8/2/2006	540	16.0	0.1108	5.33	N/A	0.95
8	8/2/2006	1080	16.0	0.1108	10.7	N/A	0.95
9	8/3/2006	540	16.0	0.1108	5.33	N/A	0.95
10	8/3/2006	1080	16.0	0.1108	10.7	N/A	0.95
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Comments: Survey Sub-Units Kaiser-FSSPOA-009B through Kaiser-FSSPOA-009H

Floor monitor scanning at 1/2 detector width per second or less.

Instrument Model and Detector Model/Type: Ludlum 2360 Alpha-Beta Scaler/Rate Meter with Model 43-37 582cm² Gas Proportional Alpha-Beta Detector

Prepared By:	David B. Weyant	Date:	8/18/06
Reviewed By:	Andrew J. Lombardo	Date:	8/18/06

Notes:

1.) Instrument Efficiency is the 4π instrument efficiency.

Total Alpha Contamination
Survey Unit Kaiser-FSSPOA-009E
Survey Data Conversion Form
Form ESC/HPM/M-3-2-2

Date of Survey:	8/5/2006	Type of Radiation:	Alpha
Instrument Serial #:	177171	Calibration Due Date:	7/24/2007
Detector Serial #:	PR12946	Calibration Due Date:	7/24/2007
E_s (Surface Efficiency):	0.25	E_i (Insturment Efficiency):	0.2216
BKG Counts:	235	BKG Count Time (min):	28
Active Area of Detector Probe (cm^2):	582	MDC ($dpm/100cm^2$):	26.3

FSS Swipe Number	Survey Location	Survey Point Count Time (min)	Gross Counts (cts)	Gross Count Rate (cpm)	Net Count Rate (cpm)	Total Contamination ($dpm/100cm^2$)	95% CL Uncertainty ($dpm/100cm^2$)
K-SS-318	MARSSIM-001	2	40	20	11.6	36.0	19.5
K-SS-319	MARSSIM-002	2	34	17	8.61	26.7	18.0
K-SS-320	MARSSIM-003	2	54	27	18.6	57.7	22.6
K-SS-321	MARSSIM-004	2	46	23	14.6	45.3	20.9
K-SS-322	MARSSIM-005	2	29	15	6.11	18.9	16.7
K-SS-323	MARSSIM-006	2	43	22	13.1	40.7	20.2
K-SS-324	MARSSIM-007	2	53	27	18.1	56.2	22.4
K-SS-325	MARSSIM-008	2	34	17	8.61	26.7	18.0
K-SS-326	MARSSIM-009	2	39	20	11.1	34.4	19.3
K-SS-327	MARSSIM-010	2	51	26	17.1	53.1	22.0
K-SS-328	MARSSIM-011	2	69	35	26.1	81.0	25.5
K-SS-329	MARSSIM-012	2	59	30	21.1	65.5	23.6
K-SS-330	MARSSIM-013	2	71	36	27.1	84.1	25.8
K-SS-331	MARSSIM-014	2	51	26	17.1	53.1	22.0

Comments: 14 consecutive 2-minute background counts used.
Instrument Model and Detector Model/Type: Ludlum 2360 Alpha-Beta Scaler/Rate Meter with Model 43-37 582cm² Gas Proportional Alpha-Beta Detector

Prepared By: David B. Weyant	Date: 8/8/2006
Reviewed By: Andrew J. Lombardo	Date: 8/10/2006

Attachment E, Table E-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009E
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number KAISER-FSSPOA-009E
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	A1	0	-25	40	224	2	-12	4.0	8/1/2006
Aspalt Pad	A2	0	-25	40	224	3	-6	4.0	8/1/2006
Aspalt Pad	A3	0	-25	60	348	5	6	4.0	8/1/2006
Aspalt Pad	A4	0	-25	40	224	3	-6	4.0	8/1/2006
Aspalt Pad	A5	0	-25	40	224	3	-6	4.0	8/1/2006
Aspalt Pad	A6	0	-25	40	224	4	0	4.0	8/1/2006
Aspalt Pad	A7	0	-25	20	99	2	-12	4.0	8/1/2006
Aspalt Pad	A8	0	-25	10	37	1	-18	4.0	8/1/2006
Aspalt Pad	A9	0	-25	20	99	1	-18	4.0	8/1/2006
Aspalt Pad	A10	0	-25	20	99	1	-18	4.0	8/1/2006
Aspalt Pad	B1	0	-25	20	99	2	-12	4.0	8/1/2006
Aspalt Pad	B2	0	-25	20	99	3	-6	4.0	8/1/2006
Aspalt Pad	B3	0	-25	20	99	2	-12	4.0	8/1/2006
Aspalt Pad	B4	0	-25	20	99	2	-12	4.0	8/1/2006
Aspalt Pad	B5	0	-25	40	224	3	-6	4.0	8/1/2006
Aspalt Pad	B6	0	-25	10	37	0	-25	4.0	8/1/2006
Aspalt Pad	B7	0	-25	10	37	1	-18	4.0	8/1/2006
Aspalt Pad	B8	0	-25	30	161	3	-6	4.0	8/1/2006

Attachment E, Table E-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009E
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009E**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	B9	0	-25	40	224	3	-6	4.0	8/1/2006
Aspalt Pad	B10	0	-25	10	37	1	-18	4.0	8/1/2006
Aspalt Pad	C1	0	-25	60	348	5	6	4.0	8/1/2006
Aspalt Pad	C2	0	-25	60	348	5	6	4.0	8/1/2006
Aspalt Pad	C3	0	-25	40	224	5	6	4.0	8/1/2006
Aspalt Pad	C4	0	-25	40	224	4	0	4.0	8/1/2006
Aspalt Pad	C5	0	-25	10	37	1	-18	4.0	8/1/2006
Aspalt Pad	C6	0	-25	40	224	3	-6	4.0	8/1/2006
Aspalt Pad	C7	0	-25	10	37	2	-12	4.0	8/1/2006
Aspalt Pad	C8	0	-25	80	472	10	37	4.0	8/1/2006
Aspalt Pad	C9	0	-25	40	224	3	-6	4.0	8/1/2006
Aspalt Pad	C10	0	-25	40	224	3	-6	4.0	8/1/2006
Aspalt Pad	D1	0	-25	40	224	6	13	4.0	8/1/2006
Aspalt Pad	D2	0	-25	40	224	2	-12	4.0	8/1/2006
Aspalt Pad	D3	0	-25	40	224	2	-12	4.0	8/1/2006
Aspalt Pad	D4	0	-25	40	224	2	-12	4.0	8/1/2006
Aspalt Pad	D5	0	-25	40	224	3	-6	4.0	8/1/2006
Aspalt Pad	D6	0	-25	20	99	3	-6	4.0	8/1/2006

Attachment E, Table E-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009E
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009E**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	D7	0	-25	40	224	2	-12	4.0	8/1/2006
Aspalt Pad	D8	0	-25	80	472	9	31	4.0	8/1/2006
Aspalt Pad	D9	0	-25	10	37	0	-25	4.0	8/1/2006
Aspalt Pad	D10	0	-25	10	37	0	-25	4.0	8/1/2006
Aspalt Pad	E1	0	-25	60	348	7	19	4.0	8/1/2006
Aspalt Pad	E2	0	-25	80	472	8	25	4.0	8/1/2006
Aspalt Pad	E3	0	-25	40	224	5	6	4.0	8/1/2006
Aspalt Pad	E4	0	-25	40	224	4	0	4.0	8/1/2006
Aspalt Pad	E5	0	-25	20	99	2	-12	4.0	8/1/2006
Aspalt Pad	E6	0	-25	40	224	2	-12	4.0	8/1/2006
Aspalt Pad	E7	0	-25	10	37	0	-25	4.0	8/1/2006
Aspalt Pad	E8	0	-25	60	348	6	13	4.0	8/1/2006
Aspalt Pad	E9	0	-25	20	99	1	-18	4.0	8/1/2006
Aspalt Pad	E10	0	-25	10	37	1	-18	4.0	8/1/2006
Aspalt Pad	F1	0	-25	40	224	3	-6	4.0	8/1/2006
Aspalt Pad	F2	0	-25	40	224	4	0	4.0	8/1/2006
Aspalt Pad	F3	0	-25	40	224	3	-6	4.0	8/1/2006
Aspalt Pad	F4	0	-25	40	224	3	-6	4.0	8/1/2006

Attachment E, Table E-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009E
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009E**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	F5	0	-25	20	99	2	-12	4.0	8/1/2006
Aspalt Pad	F6	0	-25	10	37	1	-18	4.0	8/1/2006
Aspalt Pad	F7	0	-25	10	37	0	-25	4.0	8/1/2006
Aspalt Pad	F8	0	-25	40	224	2	-12	4.0	8/1/2006
Aspalt Pad	F9	0	-25	40	224	3	-6	4.0	8/1/2006
Aspalt Pad	F10	0	-25	20	99	2	-12	4.0	8/1/2006
Aspalt Pad	G1	0	-25	40	224	2	-12	4.0	8/1/2006
Aspalt Pad	G2	0	-25	40	224	3	-6	4.0	8/1/2006
Aspalt Pad	G3	0	-25	60	348	6	13	4.0	8/1/2006
Aspalt Pad	G4	0	-25	40	224	3	-6	4.0	8/1/2006
Aspalt Pad	G5	0	-25	20	99	3	-6	4.0	8/1/2006
Aspalt Pad	G6	0	-25	40	224	2	-12	4.0	8/1/2006
Aspalt Pad	G7	0	-25	20	99	1	-18	4.0	8/1/2006
Aspalt Pad	G8	0	-25	10	37	0	-25	4.0	8/1/2006
Aspalt Pad	G9	0	-25	10	37	0	-25	4.0	8/1/2006
Aspalt Pad	G10	0	-25	60	348	7	19	4.0	8/1/2006
Aspalt Pad	H1	0	-25	60	348	8	25	4.0	8/1/2006
Aspalt Pad	H2	0	-25	60	348	8	25	4.0	8/1/2006

Attachment E, Table E-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009E
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009E**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	H3	0	-25	20	99	2	-12	4.0	8/1/2006
Aspalt Pad	H4	0	-25	60	348	6	13	4.0	8/1/2006
Aspalt Pad	H5	0	-25	40	224	2	-12	4.0	8/1/2006
Aspalt Pad	H6	0	-25	20	99	3	-6	4.0	8/1/2006
Aspalt Pad	H7	0	-25	20	99	3	-6	4.0	8/1/2006
Aspalt Pad	H8	0	-25	40	224	2	-12	4.0	8/1/2006
Aspalt Pad	H9	0	-25	10	37	0	-25	4.0	8/1/2006
Aspalt Pad	H10	0	-25	60	348	6	13	4.0	8/1/2006
Aspalt Pad	I1	0	-25	80	472	15	68	4.0	8/1/2006
Aspalt Pad	I2	0	-25	40	224	4	0	4.0	8/1/2006
Aspalt Pad	I3	0	-25	60	348	6	13	4.0	8/1/2006
Aspalt Pad	I4	0	-25	20	99	3	-6	4.0	8/1/2006
Aspalt Pad	I5	0	-25	40	224	4	0	4.0	8/1/2006
Aspalt Pad	I6	0	-25	20	99	3	-6	4.0	8/1/2006
Aspalt Pad	I7	0	-25	40	224	3	-6	4.0	8/1/2006
Aspalt Pad	I8	0	-25	40	224	4	0	4.0	8/1/2006
Aspalt Pad	I9	0	-25	40	224	3	-6	4.0	8/1/2006
Aspalt Pad	I10	0	-25	60	348	4	0	4.0	8/1/2006

Attachment E, Table E-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009E
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009E**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

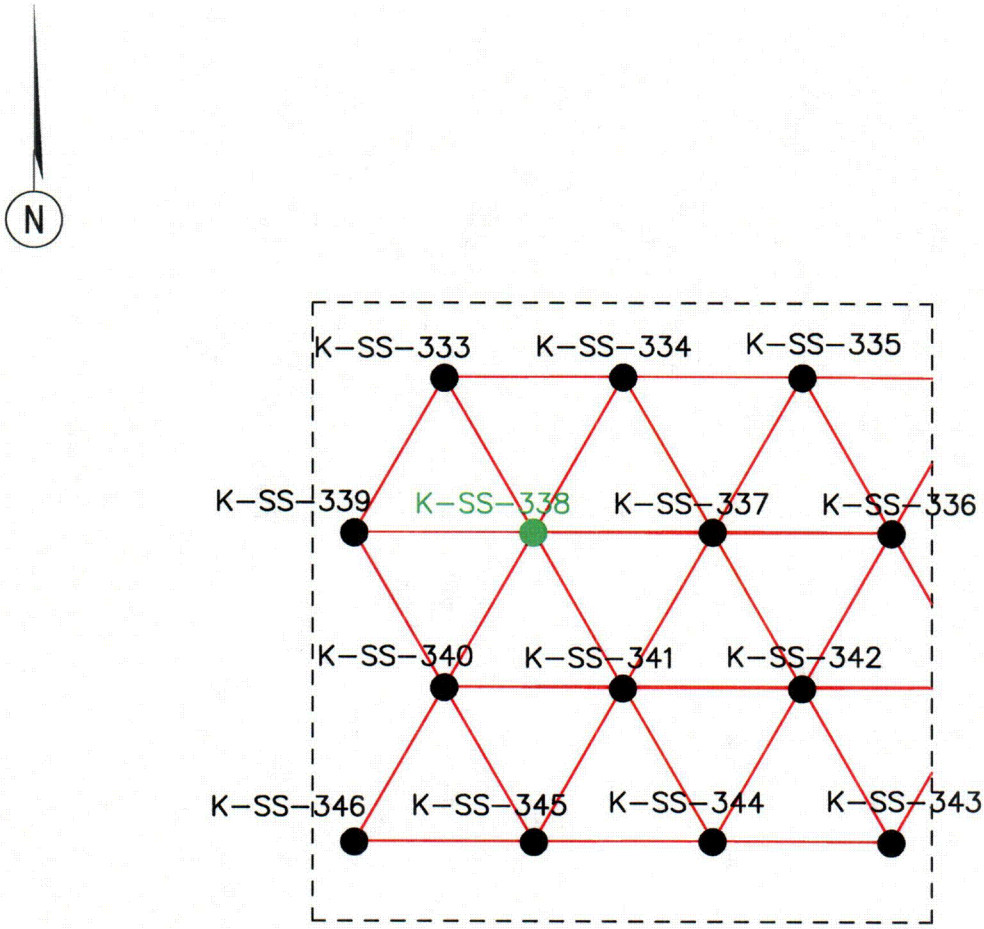
		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	J1	0	-25	60	348	8	25	4.0	8/1/2006
Aspalt Pad	J2	0	-25	40	224	5	6	4.0	8/1/2006
Aspalt Pad	J3	0	-25	40	224	4	0	4.0	8/1/2006
Aspalt Pad	J4	0	-25	40	224	5	6	4.0	8/1/2006
Aspalt Pad	J5	0	-25	20	99	3	-6	4.0	8/1/2006
Aspalt Pad	J6	0	-25	40	224	3	-6	4.0	8/1/2006
Aspalt Pad	J7	0	-25	10	37	1	-18	4.0	8/1/2006
Aspalt Pad	J8	0	-25	40	224	3	-6	4.0	8/1/2006
Aspalt Pad	J9	0	-25	40	224	4	0	4.0	8/1/2006
Aspalt Pad	J10	0	-25	50	286	4	0	4.0	8/1/2006

Notes:

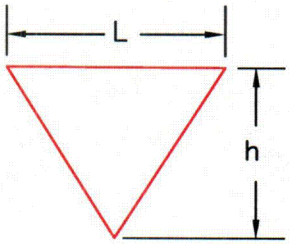
1. The weighted cpm is determined by the surveyor. Since alpha counts (clicks on audible) are infrequent, and 1 count may equal 10 cpm, the surveyor determines the "weighted average".
2. The acceptance criteria for Total Contamination is 944 dpm/100cm².
3. Scans are used to identify elevated area above the acceptance criteria.
4. Compliance is demonstrated by static counts and smear (sample) results.
5. Background is an average of fifteen (15) two minute readings taken at equally spaced distances across survey unit.

ATTACHMENT F
TABLE OF CONTENTS

- **FIGURE F-1** Systematic Sampling Locations
- Alpha Scan MDC Calculation Form
- Total Alpha Contamination Survey Data Conversion Form
- **TABLE F-1** Gross Alpha Scan Results Summary



SUB-UNIT KAISER-FSSPOA-009 F



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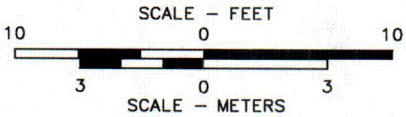
L = 2.9m
h = 2.5m
AREA = 100m^2



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

● RANDOM START POINT

FIGURE F-1
SYSTEMATIC SAMPLING LOCATIONS
SURVEY UNIT KAISER-FSSPOA-009
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFD	08/31/06
CHECKED	RFD	08/31/06
DRAWN	DEB	08/01/06

DRAWING NUMBER
PA4072094F

Penn E&R
Environmental & Remediation, Inc.

C-23

Daily Alpha Scan MDC

KAISER-FSSPOA-009B through KAISER-FSSPOA-009H

Instrument Serial Number:	177171	Cal. Due:	7/24/2007
Detector Serial Number:	PR124946	Cal. Due:	7/24/2007
Radiation Detected:	Alpha		For < 3 count background

Probability of observing 2 or more counts:

$$P(n \geq 2) = 1 - \left(1 + \frac{(GE+B)d}{60v}\right)\left(e^{-\frac{(GE+B)d}{60v}}\right)$$

Probability of observing a single count:

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

	D Date	G Activity (dpm)	d Detector Width (cm)	E Instrument Efficiency (cpm)	v Scan Speed (cm/s)	B Background Countrate (cpm)	P Probability (-)
1	7/29/2006	540	16.0	0.1108	5.33	N/A	0.95
2	7/29/2006	1080	16.0	0.1108	10.7	N/A	0.95
3	7/31/2006	540	16.0	0.1108	5.33	N/A	0.95
4	7/31/2006	1080	16.0	0.1108	10.7	N/A	0.95
5	8/1/2006	540	16.0	0.1108	5.33	N/A	0.95
6	8/1/2006	1080	16.0	0.1108	10.7	N/A	0.95
7	8/2/2006	540	16.0	0.1108	5.33	N/A	0.95
8	8/2/2006	1080	16.0	0.1108	10.7	N/A	0.95
9	8/3/2006	540	16.0	0.1108	5.33	N/A	0.95
10	8/3/2006	1080	16.0	0.1108	10.7	N/A	0.95
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Comments: Survey Sub-Units Kaiser-FSSPOA-009B through Kaiser-FSSPOA-009H

Floor monitor scanning at 1/2 detector width per second or less.

Instrument Model and Detector Model/Type: Ludlum 2360 Alpha-Beta Scaler/Rate Meter with Model 43-37 582cm² Gas Proportional Alpha-Beta Detector

Prepared By:	David B. Weyant	Date:	8/18/06
Reviewed By:	Andrew J. Lombardo	Date:	8/18/06

Notes:

1.) Instrument Efficiency is the 4π instrument efficiency.

Total Alpha Contamination
Survey Unit Kaiser-FSSPOA-009F
Survey Data Conversion Form
Form ESC/HPM/M-3-2-2

Date of Survey:	8/7/2006	Type of Radiation:	Alpha
Instrument Serial #:	177171	Calibration Due Date:	7/24/2007
Detector Serial #:	PR12946	Calibration Due Date:	7/24/2007
E_s (Surface Efficiency):	0.25	E_i (Insturment Efficiency):	0.2216
BKG Counts:	92	BKG Count Time (min):	28
Active Area of Detector Probe (cm^2):	582	MDC ($dpm/100cm^2$):	18.2

FSS Swipe Number	Survey Location	Survey Point Count Time (min)	Gross Counts (cts)	Gross Count Rate (cpm)	Net Count Rate (cpm)	Total Contamination ($dpm/100cm^2$)	95% CL Uncertainty ($dpm/100cm^2$)
K-SS-333	MARSSIM-001	2	12	6	2.71	8.42	10.7
K-SS-334	MARSSIM-002	2	27	14	10.2	31.7	15.9
K-SS-335	MARSSIM-003	2	25	13	9.21	28.6	15.3
K-SS-336	MARSSIM-004	2	24	12	8.71	27.0	15.0
K-SS-337	MARSSIM-005	2	22	11	7.71	23.9	14.4
K-SS-338	MARSSIM-006	2	32	16	12.7	39.4	17.3
K-SS-339	MARSSIM-007	2	26	13	9.71	30.1	15.6
K-SS-340	MARSSIM-008	2	14	7	3.71	11.5	11.6
K-SS-341	MARSSIM-009	2	9	5	1.21	3.77	9.35
K-SS-342	MARSSIM-010	2	26	13	9.71	30.1	15.6
K-SS-343	MARSSIM-011	2	63	32	28.2	87.5	24.2
K-SS-344	MARSSIM-012	2	72	36	32.7	101	25.9
K-SS-345	MARSSIM-013	2	47	24	20.2	62.7	20.9
K-SS-346	MARSSIM-014	2	61	31	27.2	84.4	23.8

Comments: 14 consecutive 2-minute background counts used.
Instrument Model and Detector Model/Type: Ludlum 2360 Alpha-Beta Scaler/Rate Meter with Model 43-37 582cm² Gas Proportional Alpha-Beta Detector

Prepared By: David B. Weyant	Date: 8/8/2006
Reviewed By: Andrew J. Lombardo	Date: 8/10/2006

Attachment F, Table F-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009F
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009F**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	A1	0	-33	40	215	4	-8	5.3	8/2/2006
Aspalt Pad	A2	0	-33	20	91	1	-27	5.3	8/2/2006
Aspalt Pad	A3	0	-33	10	29	1	-27	5.3	8/2/2006
Aspalt Pad	A4	0	-33	20	91	2	-21	5.3	8/2/2006
Aspalt Pad	A5	0	-33	10	29	0	-33	5.3	8/2/2006
Aspalt Pad	A6	0	-33	20	91	1	-27	5.3	8/2/2006
Aspalt Pad	A7	0	-33	40	215	4	-8	5.3	8/2/2006
Aspalt Pad	A8	0	-33	40	215	3	-14	5.3	8/2/2006
Aspalt Pad	A9	0	-33	10	29	0	-33	5.3	8/2/2006
Aspalt Pad	A10	0	-33	40	215	5	-2	5.3	8/2/2006
Aspalt Pad	B1	0	-33	60	339	7	10	5.3	8/2/2006
Aspalt Pad	B2	0	-33	40	215	3	-14	5.3	8/2/2006
Aspalt Pad	B3	0	-33	40	215	4	-8	5.3	8/2/2006
Aspalt Pad	B4	0	-33	20	91	2	-21	5.3	8/2/2006
Aspalt Pad	B5	0	-33	10	29	1	-27	5.3	8/2/2006
Aspalt Pad	B6	0	-33	40	215	3	-14	5.3	8/2/2006
Aspalt Pad	B7	0	-33	20	91	2	-21	5.3	8/2/2006
Aspalt Pad	B8	0	-33	20	91	1	-27	5.3	8/2/2006
Aspalt Pad	B9	0	-33	50	277	5	-2	5.3	8/2/2006

Attachment F, Table F-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009F
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009F**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	B10	0	-33	20	91	2	-21	5.3	8/2/2006
Aspalt Pad	C1	0	-33	10	29	1	-27	5.3	8/2/2006
Aspalt Pad	C2	0	-33	40	215	5	-2	5.3	8/2/2006
Aspalt Pad	C3	0	-33	10	29	2	-21	5.3	8/2/2006
Aspalt Pad	C4	0	-33	10	29	2	-21	5.3	8/2/2006
Aspalt Pad	C5	0	-33	10	29	0	-33	5.3	8/2/2006
Aspalt Pad	C6	0	-33	20	91	3	-14	5.3	8/2/2006
Aspalt Pad	C7	0	-33	20	91	3	-14	5.3	8/2/2006
Aspalt Pad	C8	0	-33	20	91	2	-21	5.3	8/2/2006
Aspalt Pad	C9	0	-33	10	29	2	-21	5.3	8/2/2006
Aspalt Pad	C10	0	-33	20	91	3	-14	5.3	8/2/2006
Aspalt Pad	D1	0	-33	60	339	6	4	5.3	8/2/2006
Aspalt Pad	D2	0	-33	60	339	8	17	5.3	8/2/2006
Aspalt Pad	D3	0	-33	40	215	4	-8	5.3	8/2/2006
Aspalt Pad	D4	0	-33	20	91	3	-14	5.3	8/2/2006
Aspalt Pad	D5	0	-33	30	153	2	-21	5.3	8/2/2006
Aspalt Pad	D6	0	-33	20	91	2	-21	5.3	8/2/2006
Aspalt Pad	D7	0	-33	10	29	0	-33	5.3	8/2/2006
Aspalt Pad	D8	0	-33	10	29	0	-33	5.3	8/2/2006

Attachment F, Table F-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009F
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009F**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	D9	0	-33	60	339	5	-2	5.3	8/2/2006
Aspalt Pad	D10	0	-33	10	29	1	-27	5.3	8/2/2006
Aspalt Pad	E1	0	-33	60	339	5	-2	5.3	8/2/2006
Aspalt Pad	E2	0	-33	10	29	1	-27	5.3	8/2/2006
Aspalt Pad	E3	0	-33	80	463	7	10	5.3	8/2/2006
Aspalt Pad	E4	0	-33	40	215	5	-2	5.3	8/2/2006
Aspalt Pad	E5	0	-33	20	91	2	-21	5.3	8/2/2006
Aspalt Pad	E6	0	-33	20	91	3	-14	5.3	8/2/2006
Aspalt Pad	E7	0	-33	20	91	2	-21	5.3	8/2/2006
Aspalt Pad	E8	0	-33	40	215	4	-8	5.3	8/2/2006
Aspalt Pad	E9	0	-33	20	91	3	-14	5.3	8/2/2006
Aspalt Pad	E10	0	-33	30	153	4	-8	5.3	8/2/2006
Aspalt Pad	F1	0	-33	80	463	10	29	5.3	8/2/2006
Aspalt Pad	F2	0	-33	40	215	3	-14	5.3	8/2/2006
Aspalt Pad	F3	0	-33	40	215	4	-8	5.3	8/2/2006
Aspalt Pad	F4	0	-33	40	215	3	-14	5.3	8/2/2006
Aspalt Pad	F5	0	-33	20	91	2	-21	5.3	8/2/2006
Aspalt Pad	F6	0	-33	10	29	1	-27	5.3	8/2/2006
Aspalt Pad	F7	0	-33	20	91	2	-21	5.3	8/2/2006

Attachment F, Table F-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009F
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009F**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	F8	0	-33	40	215	4	-8	5.3	8/2/2006
Aspalt Pad	F9	0	-33	40	215	3	-14	5.3	8/2/2006
Aspalt Pad	F10	0	-33	20	91	3	-14	5.3	8/2/2006
Aspalt Pad	G1	0	-33	40	215	4	-8	5.3	8/2/2006
Aspalt Pad	G2	0	-33	40	215	5	-2	5.3	8/2/2006
Aspalt Pad	G3	0	-33	40	215	4	-8	5.3	8/2/2006
Aspalt Pad	G4	0	-33	40	215	3	-14	5.3	8/2/2006
Aspalt Pad	G5	0	-33	20	91	3	-14	5.3	8/2/2006
Aspalt Pad	G6	0	-33	40	215	3	-14	5.3	8/2/2006
Aspalt Pad	G7	0	-33	40	215	3	-14	5.3	8/2/2006
Aspalt Pad	G8	0	-33	40	215	3	-14	5.3	8/2/2006
Aspalt Pad	G9	0	-33	20	91	3	-14	5.3	8/2/2006
Aspalt Pad	G10	0	-33	40	215	4	-8	5.3	8/2/2006
Aspalt Pad	H1	0	-33	40	215	6	4	5.3	8/2/2006
Aspalt Pad	H2	0	-33	40	215	3	-14	5.3	8/2/2006
Aspalt Pad	H3	0	-33	20	91	2	-21	5.3	8/2/2006
Aspalt Pad	H4	0	-33	60	339	6	4	5.3	8/2/2006
Aspalt Pad	H5	0	-33	20	91	2	-21	5.3	8/2/2006
Aspalt Pad	H6	0	-33	20	91	3	-14	5.3	8/2/2006

Attachment F, Table F-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009F
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009F**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	H7	0	-33	10	29	2	-21	5.3	8/2/2006
Aspalt Pad	H8	0	-33	20	91	1	-27	5.3	8/2/2006
Aspalt Pad	H9	0	-33	30	153	5	-2	5.3	8/2/2006
Aspalt Pad	H10	0	-33	10	29	1	-27	5.3	8/2/2006
Aspalt Pad	I1	0	-33	60	339	6	4	5.3	8/2/2006
Aspalt Pad	I2	0	-33	60	339	5	-2	5.3	8/2/2006
Aspalt Pad	I3	0	-33	40	215	3	-14	5.3	8/2/2006
Aspalt Pad	I4	0	-33	60	339	5	-2	5.3	8/2/2006
Aspalt Pad	I5	0	-33	20	91	2	-21	5.3	8/2/2006
Aspalt Pad	I6	0	-33	20	91	3	-14	5.3	8/2/2006
Aspalt Pad	I7	0	-33	40	215	6	4	5.3	8/2/2006
Aspalt Pad	I8	0	-33	20	91	1	-27	5.3	8/2/2006
Aspalt Pad	I9	0	-33	20	91	1	-27	5.3	8/2/2006
Aspalt Pad	I10	0	-33	40	215	4	-8	5.3	8/2/2006
Aspalt Pad	J1	0	-33	60	339	6	4	5.3	8/2/2006
Aspalt Pad	J2	0	-33	60	339	6	4	5.3	8/2/2006
Aspalt Pad	J3	0	-33	40	215	4	-8	5.3	8/2/2006
Aspalt Pad	J4	0	-33	40	215	5	-2	5.3	8/2/2006
Aspalt Pad	J5	0	-33	20	91	1	-27	5.3	8/2/2006

Attachment F, Table F-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009F
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009F**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

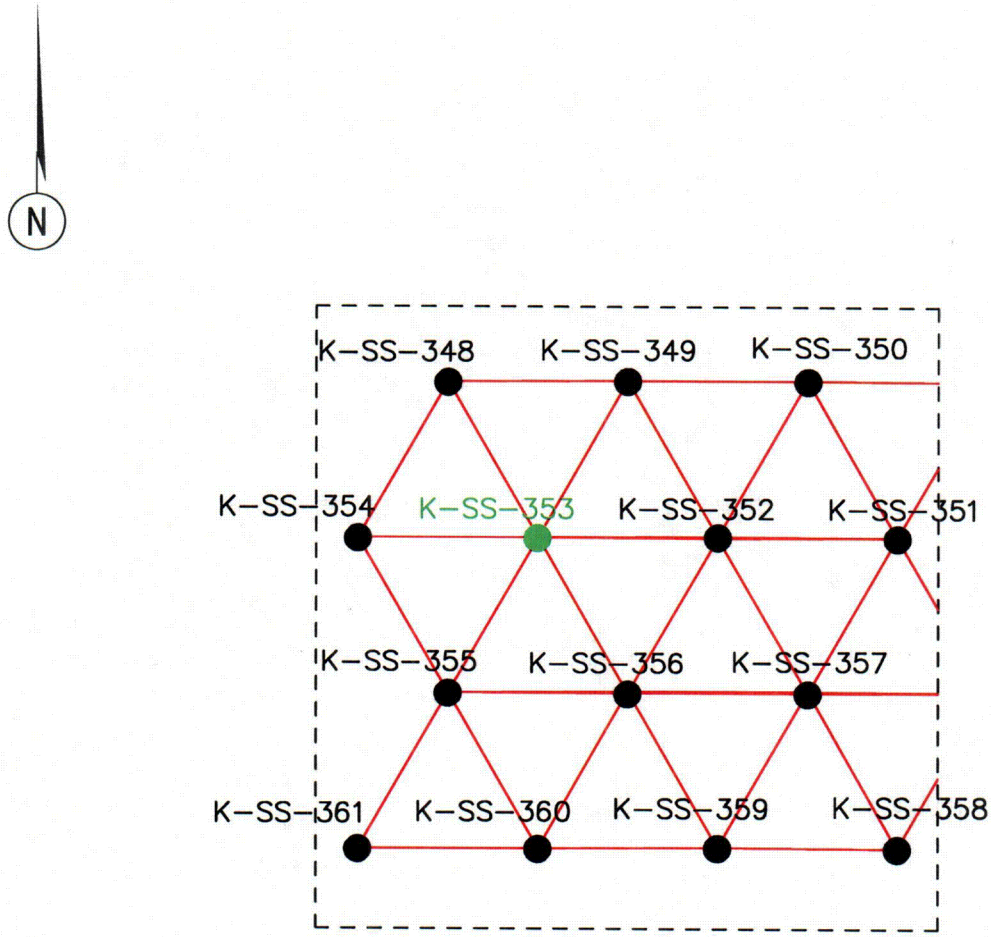
		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	J6	0	-33	10	29	0	-33	5.3	8/2/2006
Aspalt Pad	J7	0	-33	10	29	0	-33	5.3	8/2/2006
Aspalt Pad	J8	0	-33	10	29	1	-27	5.3	8/2/2006
Aspalt Pad	J9	0	-33	40	215	3	-14	5.3	8/2/2006
Aspalt Pad	J10	0	-33	60	339	4	-8	5.3	8/2/2006

Notes:

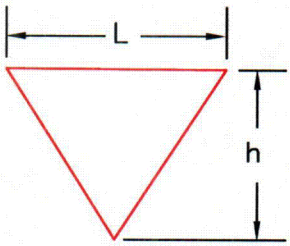
1. The weighted cpm is determined by the surveyor. Since alpha counts (clicks on audible) are infrequent, and 1 count may equal 10 cpm, the surveyor determines the "weighted average".
2. The acceptance criteria for Total Contamination is 944 dpm/100cm^2.
3. Scans are used to identify elevated area above the acceptance criteria.
4. Compliance is demonstrated by static counts and smear (sample) results.
5. Background is an average of fourteen (14) two minute readings taken at equally spaced distances across survey unit.

ATTACHMENT G
TABLE OF CONTENTS

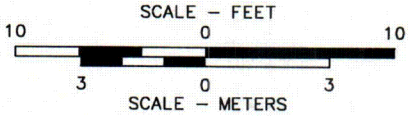
- **FIGURE G-1** Systematic Sampling Locations
- Alpha Scan MDC Calculation Form
- Total Alpha Contamination Survey Data Conversion Form
- **TABLE G-1** Gross Alpha Scan Results Summary



SUB-UNIT KAISER-FSSPOA-009 G



N = 14
L = 2.9m
h = 2.5m
AREA = 100m^2



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

● RANDOM START POINT

FIGURE G-1
SYSTEMATIC SAMPLING LOCATIONS
SURVEY UNIT KAISER-FSSPOA-009
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFD	08/31/06
CHECKED	RFD	08/31/06
DRAWN	DEB	08/01/06

DRAWING NUMBER
PA4072094G

Penn E&R
Environmental & Remediation, Inc.

C-24

Daily Alpha Scan MDC

KAISER-FSSPOA-009B through KAISER-FSSPOA-009H

Instrument Serial Number:	177171	Cal. Due:	7/24/2007
Detector Serial Number:	PR124946	Cal. Due:	7/24/2007
Radiation Detected:	Alpha		For < 3 count background

Probability of observing 2 or more counts:

$$P(n \geq 2) = 1 - \left(1 + \frac{(GE+B)d}{60v}\right)\left(e^{-\frac{(GE+B)d}{60v}}\right)$$

Probability of observing a single count:

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

	D Date	G Activity (dpm)	d Detector Width (cm)	E Instrument Efficiency (cpm)	v Scan Speed (cm/s)	B Background Countrate (cpm)	P Probability (-)
1	7/29/2006	540	16.0	0.1108	5.33	N/A	0.95
2	7/29/2006	1080	16.0	0.1108	10.7	N/A	0.95
3	7/31/2006	540	16.0	0.1108	5.33	N/A	0.95
4	7/31/2006	1080	16.0	0.1108	10.7	N/A	0.95
5	8/1/2006	540	16.0	0.1108	5.33	N/A	0.95
6	8/1/2006	1080	16.0	0.1108	10.7	N/A	0.95
7	8/2/2006	540	16.0	0.1108	5.33	N/A	0.95
8	8/2/2006	1080	16.0	0.1108	10.7	N/A	0.95
9	8/3/2006	540	16.0	0.1108	5.33	N/A	0.95
10	8/3/2006	1080	16.0	0.1108	10.7	N/A	0.95
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Comments: Survey Sub-Units Kaiser-FSSPOA-009B through Kaiser-FSSPOA-009H
Floor monitor scanning at 1/2 detector width per second or less.
Instrument Model and Detector Model/Type: Ludlum 2360 Alpha-Beta Scaler/Rate Meter with Model 43-37 582cm² Gas Proportional Alpha-Beta Detector

Prepared By:	David B. Weyant	Date:	8/18/06
Reviewed By:	Andrew J. Lombardo	Date:	8/18/06

Notes:
1.) Instrument Efficiency is the 4π instrument efficiency.

Total Alpha Contamination
Survey Unit Kaiser-FSSPOA-009G
Survey Data Conversion Form
Form ESC/HPM/M-3-2-2

Date of Survey:	8/8/2006	Type of Radiation:	Alpha
Instrument Serial #:	177171	Calibration Due Date:	7/24/2007
Detector Serial #:	PR12946	Calibration Due Date:	7/24/2007
E_s (Surface Efficiency):	0.25	E_i (Insturment Efficiency):	0.2216
BKG Counts:	81	BKG Count Time (min):	28
Active Area of Detector Probe (cm^2):	582	MDC ($dpm/100cm^2$):	17.4

FSS Swipe Number	Survey Location	Survey Point Count Time (min)	Gross Counts (cts)	Gross Count Rate (cpm)	Net Count Rate (cpm)	Total Contamination ($dpm/100cm^2$)	95% CL Uncertainty ($dpm/100cm^2$)
K-SS-348	MARSSIM-001	2	21	11	7.61	23.6	14.1
K-SS-349	MARSSIM-002	2	22	11	8.11	25.1	14.4
K-SS-350	MARSSIM-003	2	19	10	6.61	20.5	13.4
K-SS-351	MARSSIM-004	2	26	13	10.1	31.3	15.6
K-SS-352	MARSSIM-005	2	18	9	6.11	18.9	13.0
K-SS-353	MARSSIM-006	2	23	12	8.61	26.7	14.7
K-SS-354	MARSSIM-007	2	11	6	2.61	8.1	10.3
K-SS-355	MARSSIM-008	2	27	14	10.6	32.9	15.9
K-SS-356	MARSSIM-009	2	29	15	11.6	36.0	16.5
K-SS-357	MARSSIM-010	2	40	20	17.1	53.1	19.3
K-SS-358	MARSSIM-011	2	53	27	23.6	73.2	22.2
K-SS-359	MARSSIM-012	2	51	26	22.6	70.1	21.8
K-SS-360	MARSSIM-013	2	41	21	17.6	54.6	19.6
K-SS-361	MARSSIM-014	2	55	28	24.6	76.3	22.6

Comments: 14 consecutive 2-minute background counts used.
Instrument Model and Detector Model/Type: Ludlum 2360 Alpha-Beta Scaler/Rate Meter with Model 43-37 582cm² Gas Proportional Alpha-Beta Detector

Prepared By: David B. Weyant	Date: 8/8/2006
Reviewed By: Andrew J. Lombardo	Date: 8/10/2006

Attachment G, Table G-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009G
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009G**

asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	A1	0	-30	40	218	5	1	4.9	8/2/2006
Aspalt Pad	A2	0	-30	40	218	4	-5	4.9	8/2/2006
Aspalt Pad	A3	0	-30	40	218	3	-12	4.9	8/2/2006
Aspalt Pad	A4	0	-30	10	32	2	-18	4.9	8/2/2006
Aspalt Pad	A5	0	-30	20	94	2	-18	4.9	8/2/2006
Aspalt Pad	A6	0	-30	50	280	5	1	4.9	8/2/2006
Aspalt Pad	A7	0	-30	10	32	0	-30	4.9	8/2/2006
Aspalt Pad	A8	0	-30	10	32	1	-24	4.9	8/2/2006
Aspalt Pad	A9	0	-30	40	218	5	1	4.9	8/2/2006
Aspalt Pad	A10	0	-30	40	218	3	-12	4.9	8/2/2006
Aspalt Pad	B1	0	-30	60	342	6	7	4.9	8/2/2006
Aspalt Pad	B2	0	-30	50	280	3	-12	4.9	8/2/2006
Aspalt Pad	B3	0	-30	40	218	2	-18	4.9	8/2/2006
Aspalt Pad	B4	0	-30	20	94	2	-18	4.9	8/2/2006
Aspalt Pad	B5	0	-30	40	218	3	-12	4.9	8/2/2006
Aspalt Pad	B6	0	-30	10	32	0	-30	4.9	8/2/2006
Aspalt Pad	B7	0	-30	40	218	3	-12	4.9	8/2/2006
Aspalt Pad	B8	0	-30	10	32	0	-30	4.9	8/2/2006

Attachment G, Table G-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009G
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009G**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	B9	0	-30	10	32	0	-30	4.9	8/2/2006
Aspalt Pad	B10	0	-30	20	94	2	-18	4.9	8/2/2006
Aspalt Pad	C1	0	-30	10	32	1	-24	4.9	8/2/2006
Aspalt Pad	C2	0	-30	40	218	3	-12	4.9	8/2/2006
Aspalt Pad	C3	0	-30	40	218	3	-12	4.9	8/2/2006
Aspalt Pad	C4	0	-30	10	32	2	-18	4.9	8/2/2006
Aspalt Pad	C5	0	-30	20	94	2	-18	4.9	8/2/2006
Aspalt Pad	C6	0	-30	40	218	2	-18	4.9	8/2/2006
Aspalt Pad	C7	0	-30	20	94	1	-24	4.9	8/2/2006
Aspalt Pad	C8	0	-30	20	94	3	-12	4.9	8/2/2006
Aspalt Pad	C9	0	-30	20	94	3	-12	4.9	8/2/2006
Aspalt Pad	C10	0	-30	10	32	0	-30	4.9	8/2/2006
Aspalt Pad	D1	0	-30	20	94	2	-18	4.9	8/2/2006
Aspalt Pad	D2	0	-30	10	32	1	-24	4.9	8/2/2006
Aspalt Pad	D3	0	-30	20	94	3	-12	4.9	8/2/2006
Aspalt Pad	D4	0	-30	20	94	3	-12	4.9	8/2/2006
Aspalt Pad	D5	0	-30	20	94	3	-12	4.9	8/2/2006
Aspalt Pad	D6	0	-30	20	94	1	-24	4.9	8/2/2006

Attachment G, Table G-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009G
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009G**

asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	D7	0	-30	10	32	2	-18	4.9	8/2/2006
Aspalt Pad	D8	0	-30	10	32	0	-30	4.9	8/2/2006
Aspalt Pad	D9	0	-30	10	32	0	-30	4.9	8/2/2006
Aspalt Pad	D10	0	-30	10	32	0	-30	4.9	8/2/2006
Aspalt Pad	E1	0	-30	60	342	7	13	4.9	8/2/2006
Aspalt Pad	E2	0	-30	40	218	4	-5	4.9	8/2/2006
Aspalt Pad	E3	0	-30	60	342	6	7	4.9	8/2/2006
Aspalt Pad	E4	0	-30	40	218	4	-5	4.9	8/2/2006
Aspalt Pad	E5	0	-30	20	94	4	-5	4.9	8/2/2006
Aspalt Pad	E6	0	-30	10	32	0	-30	4.9	8/2/2006
Aspalt Pad	E7	0	-30	10	32	0	-30	4.9	8/2/2006
Aspalt Pad	E8	0	-30	40	218	3	-12	4.9	8/2/2006
Aspalt Pad	E9	0	-30	40	218	5	1	4.9	8/2/2006
Aspalt Pad	E10	0	-30	10	32	1	-24	4.9	8/2/2006
Aspalt Pad	F1	0	-30	10	32	1	-24	4.9	8/2/2006
Aspalt Pad	F2	0	-30	20	94	2	-18	4.9	8/2/2006
Aspalt Pad	F3	0	-30	40	218	4	-5	4.9	8/2/2006
Aspalt Pad	F4	0	-30	20	94	3	-12	4.9	8/2/2006

Attachment G, Table G-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009G
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number KAISER-FSSPOA-009G

asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	F5	0	-30	40	218	5	1	4.9	8/2/2006
Aspalt Pad	F6	0	-30	20	94	3	-12	4.9	8/2/2006
Aspalt Pad	F7	0	-30	20	94	3	-12	4.9	8/2/2006
Aspalt Pad	F8	0	-30	40	218	6	7	4.9	8/2/2006
Aspalt Pad	F9	0	-30	40	218	4	-5	4.9	8/2/2006
Aspalt Pad	F10	0	-30	40	218	2	-18	4.9	8/2/2006
Aspalt Pad	G1	0	-30	60	342	7	13	4.9	8/2/2006
Aspalt Pad	G2	0	-30	20	94	3	-12	4.9	8/2/2006
Aspalt Pad	G3	0	-30	40	218	3	-12	4.9	8/2/2006
Aspalt Pad	G4	0	-30	10	32	1	-24	4.9	8/2/2006
Aspalt Pad	G5	0	-30	20	94	1	-24	4.9	8/2/2006
Aspalt Pad	G6	0	-30	10	32	1	-24	4.9	8/2/2006
Aspalt Pad	G7	0	-30	10	32	1	-24	4.9	8/2/2006
Aspalt Pad	G8	0	-30	10	32	1	-24	4.9	8/2/2006
Aspalt Pad	G9	0	-30	40	218	3	-12	4.9	8/2/2006
Aspalt Pad	G10	0	-30	20	94	2	-18	4.9	8/2/2006
Aspalt Pad	H1	0	-30	40	218	5	1	4.9	8/2/2006
Aspalt Pad	H2	0	-30	80	466	10	32	4.9	8/2/2006

Attachment G, Table G-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009G
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009G**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	H3	0	-30	40	218	4	-5	4.9	8/2/2006
Aspalt Pad	H4	0	-30	40	218	5	1	4.9	8/2/2006
Aspalt Pad	H5	0	-30	40	218	3	-12	4.9	8/2/2006
Aspalt Pad	H6	0	-30	40	218	5	1	4.9	8/2/2006
Aspalt Pad	H7	0	-30	40	218	4	-5	4.9	8/2/2006
Aspalt Pad	H8	0	-30	40	218	2	-18	4.9	8/2/2006
Aspalt Pad	H9	0	-30	10	32	1	-24	4.9	8/2/2006
Aspalt Pad	H10	0	-30	20	94	3	-12	4.9	8/2/2006
Aspalt Pad	I1	0	-30	60	342	8	19	4.9	8/2/2006
Aspalt Pad	I2	0	-30	60	342	7	13	4.9	8/2/2006
Aspalt Pad	I3	0	-30	40	218	4	-5	4.9	8/2/2006
Aspalt Pad	I4	0	-30	60	342	6	7	4.9	8/2/2006
Aspalt Pad	I5	0	-30	40	218	3	-12	4.9	8/2/2006
Aspalt Pad	I6	0	-30	40	218	4	-5	4.9	8/2/2006
Aspalt Pad	I7	0	-30	20	94	1	-24	4.9	8/2/2006
Aspalt Pad	I8	0	-30	40	218	4	-5	4.9	8/2/2006
Aspalt Pad	I9	0	-30	20	94	2	-18	4.9	8/2/2006
Aspalt Pad	I10	0	-30	40	218	3	-12	4.9	8/2/2006

Attachment G, Table G-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009G
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number KAISER-FSSPOA-009G

asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

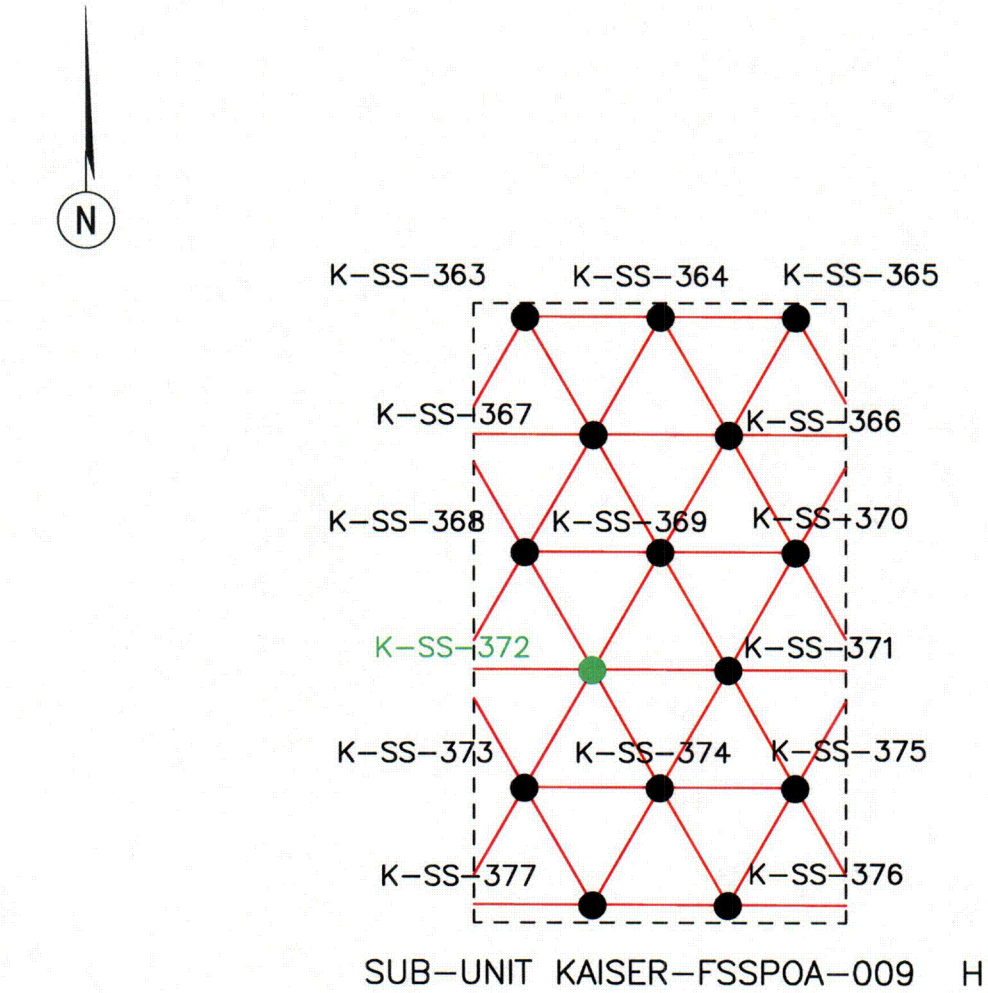
		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	J1	0	-30	60	342	6	7	4.9	8/2/2006
Aspalt Pad	J2	0	-30	60	342	5	1	4.9	8/2/2006
Aspalt Pad	J3	0	-30	20	94	3	-12	4.9	8/2/2006
Aspalt Pad	J4	0	-30	40	218	5	1	4.9	8/2/2006
Aspalt Pad	J5	0	-30	20	94	2	-18	4.9	8/2/2006
Aspalt Pad	J6	0	-30	20	94	3	-12	4.9	8/2/2006
Aspalt Pad	J7	0	-30	20	94	4	-5	4.9	8/2/2006
Aspalt Pad	J8	0	-30	20	94	3	-12	4.9	8/2/2006
Aspalt Pad	J9	0	-30	20	94	1	-24	4.9	8/2/2006
Aspalt Pad	J10	0	-30	40	218	3	-12	4.9	8/2/2006

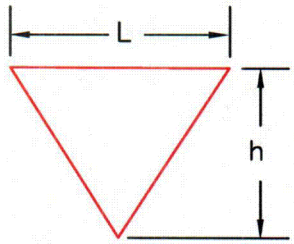
Notes:

1. The weighted cpm is determined by the surveyor. Since alpha counts (clicks on audible) are infrequent, and 1 count may equal 10 cpm, the surveyor determines the "weighted average".
2. The acceptance criteria for Total Contamination is 944 dpm/100cm².
3. Scans are used to identify elevated area above the acceptance criteria.
4. Compliance is demonstrated by static counts and smear (sample) results.
5. Background is an average of fourteen (14) two minute readings taken at equally spaced distances across survey unit.

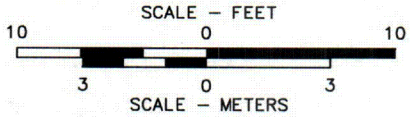
ATTACHMENT H
TABLE OF CONTENTS

- **FIGURE H-1** Systematic Sampling Locations
- Alpha Scan MDC Calculation Form
- Total Alpha Contamination Survey Data Conversion Form
- **TABLE H-1** Gross Alpha Scan Results Summary





N = 14 (15 COLLECTED)
L = 2.2m
h = 1.9m
AREA = 60m^2



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

● RANDOM START POINT

FIGURE H-1
SYSTEMATIC SAMPLING LOCATIONS
SURVEY UNIT KAISER-FSSPOA-009
FINAL STATUS SURVEY
THORIUM REMEDIATION PROJECT
TULSA, OKLAHOMA FACILITY

PREPARED FOR
KAISER ALUMINUM & CHEMICAL CORPORATION
TULSA, OKLAHOMA

APPROVED	RFD	08/31/06
CHECKED	RFD	08/31/06
DRAWN	DEB	08/02/06

DRAWING NUMBER
PA4072094A

Penn E&R
Environmental & Remediation, Inc.

C-25

Daily Alpha Scan MDC

KAISER-FSSPOA-009B through KAISER-FSSPOA-009H

Instrument Serial Number:	177171	Cal. Due:	7/24/2007
Detector Serial Number:	PR124946	Cal. Due:	7/24/2007
Radiation Detected:	Alpha		For < 3 count background

Probability of observing 2 or more counts:

$$P(n \geq 2) = 1 - \left(1 + \frac{(GE+B)d}{60v}\right)\left(e^{\frac{(GE+B)d}{60v}}\right)$$

Probability of observing a single count:

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

	D Date	G Activity (dpm)	d Detector Width (cm)	E Instrument Efficiency (cpm)	v Scan Speed (cm/s)	B Background Countrate (cpm)	P Probability (-)
1	7/29/2006	540	16.0	0.1108	5.33	N/A	0.95
2	7/29/2006	1080	16.0	0.1108	10.7	N/A	0.95
3	7/31/2006	540	16.0	0.1108	5.33	N/A	0.95
4	7/31/2006	1080	16.0	0.1108	10.7	N/A	0.95
5	8/1/2006	540	16.0	0.1108	5.33	N/A	0.95
6	8/1/2006	1080	16.0	0.1108	10.7	N/A	0.95
7	8/2/2006	540	16.0	0.1108	5.33	N/A	0.95
8	8/2/2006	1080	16.0	0.1108	10.7	N/A	0.95
9	8/3/2006	540	16.0	0.1108	5.33	N/A	0.95
10	8/3/2006	1080	16.0	0.1108	10.7	N/A	0.95
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Comments: Survey Sub-Units Kaiser-FSSPOA-009B through Kaiser-FSSPOA-009H
Floor monitor scanning at 1/2 detector width per second or less.
Instrument Model and Detector Model/Type: Ludlum 2360 Alpha-Beta Scaler/Rate Meter with Model 43-37 582cm² Gas Proportional Alpha-Beta Detector

Prepared By:	David B. Weyant	Date:	8/18/06
Reviewed By:	Andrew J. Lombardo	Date:	8/18/06

Notes:
1.) Instrument Efficiency is the 4π instrument efficiency.

Total Alpha Contamination
Survey Unit Kaiser-FSSPOA-009H
Survey Data Conversion Form
Form ESC/HPM/M-3-2-2

Date of Survey:	8/9/2006	Type of Radiation:	Alpha
Instrument Serial #:	177171	Calibration Due Date:	7/24/2007
Detector Serial #:	PR12946	Calibration Due Date:	7/24/2007
E_s (Surface Efficiency):	0.25	E_I (Insturment Efficiency):	0.2216
BKG Counts:	136	BKG Count Time (min):	30
Active Area of Detector Probe (cm^2):	582	MDC ($dpm/100cm^2$):	20.5

FSS Swipe Number	Survey Location	Survey Point Count Time (min)	Gross Counts (cts)	Gross Count Rate (cpm)	Net Count Rate (cpm)	Total Contamination ($dpm/100cm^2$)	95% CL Uncertainty ($dpm/100cm^2$)
K-SS-363	MARSSIM-001	2	24	12	7.47	23.2	15.1
K-SS-364	MARSSIM-002	2	23	12	6.97	21.6	14.8
K-SS-365	MARSSIM-003	2	16	8	3.47	10.8	12.4
K-SS-366	MARSSIM-004	2	28	14	9.47	29.4	16.3
K-SS-367	MARSSIM-005	2	17	9	3.97	12.3	12.8
K-SS-368	MARSSIM-006	2	26	13	8.47	26.3	15.7
K-SS-369	MARSSIM-007	2	32	16	11.5	35.6	17.4
K-SS-370	MARSSIM-008	2	21	11	5.97	18.5	14.1
K-SS-371	MARSSIM-009	2	57	29	24.0	74.3	23.1
K-SS-372	MARSSIM-010	2	49	25	20.0	61.9	21.4
K-SS-373	MARSSIM-011	2	42	21	16.5	51.1	19.8
K-SS-374	MARSSIM-012	2	35	18	13.0	40.2	18.1
K-SS-375	MARSSIM-013	2	72	36	31.5	97.6	25.9
K-SS-376	MARSSIM-014	2	53	27	22.0	68.1	22.3
K-SS-377	MARSSIM-015	2	48	24	19.5	60.4	21.2

Comments: 15 consecutive 2-minute background counts used.
Instrument Model and Detector Model/Type: Ludlum 2360 Alpha-Beta Scaler/Rate Meter with Model 43-37 582cm² Gas Proportional Alpha-Beta Detector

Prepared By: David B. Weyant	Date: 8/9/2006
Reviewed By: Andrew J. Lombardo	Date: 8/10/2006

Attachment H, Table H-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009H
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009H**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	A1	0	-26	60	346	5	5	4.2	8/3/2006
Aspalt Pad	A2	0	-26	40	222	3	-8	4.2	8/3/2006
Aspalt Pad	A3	0	-26	40	222	4	-1	4.2	8/3/2006
Aspalt Pad	A4	0	-26	20	98	2	-14	4.2	8/3/2006
Aspalt Pad	A5	0	-26	40	222	3	-8	4.2	8/3/2006
Aspalt Pad	A6	0	-26	20	98	2	-14	4.2	8/3/2006
Aspalt Pad	A7	0	-26	30	160	3	-8	4.2	8/3/2006
Aspalt Pad	A8	0	-26	20	98	3	-8	4.2	8/3/2006
Aspalt Pad	A9	0	-26	60	346	6	11	4.2	8/3/2006
Aspalt Pad	A10	0	-26	40	222	4	-1	4.2	8/3/2006
Aspalt Pad	B1	0	-26	70	408	8	23	4.2	8/3/2006
Aspalt Pad	B2	0	-26	40	222	4	-1	4.2	8/3/2006
Aspalt Pad	B3	0	-26	60	346	3	-8	4.2	8/3/2006
Aspalt Pad	B4	0	-26	40	222	4	-1	4.2	8/3/2006
Aspalt Pad	B5	0	-26	30	160	5	5	4.2	8/3/2006
Aspalt Pad	B6	0	-26	30	160	3	-8	4.2	8/3/2006
Aspalt Pad	B7	0	-26	40	222	5	5	4.2	8/3/2006
Aspalt Pad	B8	0	-26	30	160	4	-1	4.2	8/3/2006
Aspalt Pad	B9	0	-26	60	346	5	5	4.2	8/3/2006

Attachment H, Table H-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009H
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009H**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	B10	0	-26	40	222	3	-8	4.2	8/3/2006
Aspalt Pad	C1	0	-26	40	222	6	11	4.2	8/3/2006
Aspalt Pad	C2	0	-26	60	346	5	5	4.2	8/3/2006
Aspalt Pad	C3	0	-26	40	222	3	-8	4.2	8/3/2006
Aspalt Pad	C4	0	-26	40	222	2	-14	4.2	8/3/2006
Aspalt Pad	C5	0	-26	40	222	5	5	4.2	8/3/2006
Aspalt Pad	C6	0	-26	60	346	7	17	4.2	8/3/2006
Aspalt Pad	C7	0	-26	40	222	4	-1	4.2	8/3/2006
Aspalt Pad	C8	0	-26	40	222	4	-1	4.2	8/3/2006
Aspalt Pad	C9	0	-26	10	36	0	-26	4.2	8/3/2006
Aspalt Pad	C10	0	-26	20	98	3	-8	4.2	8/3/2006
Aspalt Pad	D1	0	-26	40	222	4	-1	4.2	8/3/2006
Aspalt Pad	D2	0	-26	60	346	4	-1	4.2	8/3/2006
Aspalt Pad	D3	0	-26	20	98	2	-14	4.2	8/3/2006
Aspalt Pad	D4	0	-26	40	222	4	-1	4.2	8/3/2006
Aspalt Pad	D5	0	-26	40	222	3	-8	4.2	8/3/2006
Aspalt Pad	D6	0	-26	30	160	3	-8	4.2	8/3/2006
Aspalt Pad	D7	0	-26	40	222	2	-14	4.2	8/3/2006
Aspalt Pad	D8	0	-26	70	408	7	17	4.2	8/3/2006

Attachment H, Table H-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009H
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSPOA-009H**
asphalt
Tech: DBW

Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector
s/n: 177171/PR124946

Cal Due: 7/24/2007
Alpha Eff: 11.08%

		Scan				weighted	weighted	Bgrd	
Location	Grid	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2min)	Date
Aspalt Pad	D9	0	-26	60	346	5	5	4.2	8/3/2006
Aspalt Pad	D10	0	-26	20	98	3	-8	4.2	8/3/2006
Aspalt Pad	E1	0	-26	60	346	7	17	4.2	8/3/2006
Aspalt Pad	E2	0	-26	60	346	3	-8	4.2	8/3/2006
Aspalt Pad	E3	0	-26	50	284	6	11	4.2	8/3/2006
Aspalt Pad	E4	0	-26	70	408	8	23	4.2	8/3/2006
Aspalt Pad	E5	0	-26	60	346	6	11	4.2	8/3/2006
Aspalt Pad	E6	0	-26	40	222	6	11	4.2	8/3/2006
Aspalt Pad	E7	0	-26	10	36	0	-26	4.2	8/3/2006
Aspalt Pad	E8	0	-26	40	222	5	5	4.2	8/3/2006
Aspalt Pad	E9	0	-26	50	284	5	5	4.2	8/3/2006
Aspalt Pad	E10	0	-26	40	222	5	5	4.2	8/3/2006
Aspalt Pad	F1	0	-26	40	222	4	-1	4.2	8/3/2006
Aspalt Pad	F2	0	-26	60	346	5	5	4.2	8/3/2006
Aspalt Pad	F3	0	-26	60	346	6	11	4.2	8/3/2006
Aspalt Pad	F4	0	-26	80	470	12	48	4.2	8/3/2006
Aspalt Pad	F5	0	-26	20	98	3	-8	4.2	8/3/2006
Aspalt Pad	F6	0	-26	40	222	4	-1	4.2	8/3/2006
Aspalt Pad	F7	0	-26	20	98	2	-14	4.2	8/3/2006

Attachment H, Table H-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-009H
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number	**KAISER-FSSPOA-009H**	Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-37 582cm² Gas Proportional Detector	Cal Due:	7/24/2007
	asphalt	s/n: 177171/PR124946	Alpha Eff:	11.08%
	Tech: DBW			

		Scan				*weighted*	*weighted*	*Bgrd*	
Location	***Grid***	*cpm* min	*dpm/100cm²* min	*cpm* max	*dpm/100cm²* max	*cpm* ave	*dpm/100cm²* ave	*cpm* (2min)	**Date**
Aspalt Pad	*F8*	*0*	*-26*	*20*	*98*	*3*	*-8*	*4.2*	8/3/2006
Aspalt Pad	*F9*	*0*	*-26*	*10*	*36*	*0*	*-26*	*4.2*	8/3/2006
Aspalt Pad	*F10*	*0*	*-26*	*20*	*98*	*3*	*-8*	*4.2*	8/3/2006

Notes:

1. The weighted cpm is determined by the surveyor. Since alpha counts (clicks on audible) are infrequent, and 1 count may equal 10 cpm, the surveyor determines the "weighted average".
2. The acceptance criteria for Total Contamination is 944 dpm/100cm^2.
3. Scans are used to identify elevated area above the acceptance criteria.
4. Compliance is demonstrated by static counts and smear (sample) results.
5. Background is an average of nine (9) two minute readings taken at equally spaced distances across survey unit.

ATTACHMENT I

Laboratory Analytical Results

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

Invoice # 12339
PO A - 009 A
KSS-378 → K-SS-392
K-SS-347 (QA)

August 15, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060693

Dear Mr. Weyant,

Please find enclosed the analytical report for your samples received in our laboratory on August 11, 2006 for the above captioned project. Sixteen swipes were received in good condition and analyzed for Gross Alpha/Beta with an expedited 2-work-day turn time. Results were faxed on 8/15/06.

All Quality Control for the requested analyses is reported on the analytical report. The method blank, laboratory control standard and matrix spikes and spike duplicates for all analyses were within method control limits with the exception of the Gross Beta method Blank. Results were not affected in any way.

Your samples will be returned as requested.

Thank you for choosing Outreach Laboratory and if you have any questions feel free to call.

Laboratory Director

ODEQ ID #9517
NRC ODEQ LIC. #27522-01

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID# OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060693
Date Reported:	8/15/06
Date Received:	8/11/06
Page Number:	1 of 5

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060693-01						
Client ID:	K-SS-347						
Date Sampled:	8/10/06 2:24:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	-0.229 +/- 0.443	dpm/100cm 2	0.542		8/11/06	RE
Gross Beta	EPA 900/9310	0.182 +/- 1.51	dpm/100cm 2	1.62		8/11/06	RE
Lab ID:	20060693-02						
Client ID:	K-SS-378						
Date Sampled:	8/10/06 2:19:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	5.10 +/- 1.48	dpm/100cm 2	1.07		8/11/06	RE
Gross Beta	EPA 900/9310	5.49 +/- 1.90	dpm/100cm 2	1.75		8/11/06	RE
Lab ID:	20060693-03						
Client ID:	K-SS-379						
Date Sampled:	8/10/06 10:40:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.520 +/- 0.554	dpm/100cm 2	0.466		8/11/06	RE
Gross Beta	EPA 900/9310	2.08 +/- 1.48	dpm/100cm 2	1.45		8/11/06	RE
Lab ID:	20060693-04						
Client ID:	K-SS-380						
Date Sampled:	8/10/06 10:41:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.416	dpm/100cm 2	0.453		8/11/06	RE
Gross Beta	EPA 900/9310	3.16 +/- 1.35	dpm/100cm 2	1.20		8/11/06	RE

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060693
Date Reported:	8/15/06
Date Received:	8/11/06
Page Number:	2 of 5

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060693-05						
Client ID:	K-SS-381						
Date Sampled:	8/10/06 10:42:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.039 +/- 0.526	dpm/100cm 2	0.560		8/11/06	RE
Gross Beta	EPA 900/9310	0.281 +/- 1.36	dpm/100cm 2	1.45		8/11/06	RE
Lab ID:	20060693-06						
Client ID:	K-SS-382						
Date Sampled:	8/10/06 10:43:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.071 +/- 0.546	dpm/100cm 2	0.574		8/11/06	RE
Gross Beta	EPA 900/9310	2.01 +/- 1.40	dpm/100cm 2	1.36		8/11/06	RE
Lab ID:	20060693-07						
Client ID:	K-SS-383						
Date Sampled:	8/10/06 10:44:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	1.03 +/- 0.550	dpm/100cm 2	0.269		8/11/06	RE
Gross Beta	EPA 900/9310	4.32 +/- 2.36	dpm/100cm 2	2.37		8/11/06	RE
Lab ID:	20060693-08						
Client ID:	K-SS-384						
Date Sampled:	8/10/06 10:45:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.071 +/- 0.355	dpm/100cm 2	0.359		8/11/06	RE
Gross Beta	EPA 900/9310	1.35 +/- 1.39	dpm/100cm 2	1.41		8/11/06	RE

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060693
Date Reported:	8/15/06
Date Received:	8/11/06
Page Number:	3 of 5

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060693-09						
Client ID:	K-SS-385						
Date Sampled:	8/10/06 10:46:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.808 +/- 0.663	dpm/100cm 2	0.542		8/11/06	RE
Gross Beta	EPA 900/9310	1.47 +/- 1.58	dpm/100cm 2	1.62		8/11/06	RE
Lab ID:	20060693-10						
Client ID:	K-SS-386						
Date Sampled:	8/10/06 10:47:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	1.26 +/- 1.13	dpm/100cm 2	1.07		8/11/06	RE
Gross Beta	EPA 900/9310	0.134 +/- 1.62	dpm/100cm 2	1.75		8/11/06	RE
Lab ID:	20060693-11						
Client ID:	K-SS-387						
Date Sampled:	8/10/06 10:48:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.422	dpm/100cm 2	0.466		8/11/06	RE
Gross Beta	EPA 900/9310	1.98 +/- 1.47	dpm/100cm 2	1.45		8/11/06	RE
Lab ID:	20060693-12						
Client ID:	K-SS-388						
Date Sampled:	8/10/06 10:49:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.664 +/- 0.575	dpm/100cm 2	0.453		8/11/06	RE
Gross Beta	EPA 900/9310	3.35 +/- 1.36	dpm/100cm 2	1.20		8/11/06	RE

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060693
Date Reported:	8/15/06
Date Received:	8/11/06
Page Number:	4 of 5

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060693-13						
Client ID:	K-SS-389						
Date Sampled:	8/10/06 10:50:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.832 +/- 0.680	dpm/100cm 2	0.560		8/11/06	RE
Gross Beta	EPA 900/9310	1.48 +/- 1.44	dpm/100cm 2	1.45		8/11/06	RE
Lab ID:	20060693-14						
Client ID:	K-SS-390						
Date Sampled:	8/10/06 10:51:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.193 +/- 0.571	dpm/100cm 2	0.574		8/11/06	RE
Gross Beta	EPA 900/9310	2.34 +/- 1.42	dpm/100cm 2	1.36		8/11/06	RE
Lab ID:	20060693-15						
Client ID:	K-SS-391						
Date Sampled:	8/10/06 10:52:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.193 +/- 0.394	dpm/100cm 2	0.359		8/11/06	RE
Gross Beta	EPA 900/9310	2.55 +/- 1.47	dpm/100cm 2	1.40		8/11/06	RE
Lab ID:	20060693-16						
Client ID:	K-SS-392						
Date Sampled:	8/10/06 10:53:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.459	dpm/100cm 2	0.542		8/11/06	RE
Gross Beta	EPA 900/9310	1.04 +/- 1.56	dpm/100cm 2	1.62		8/11/06	RE

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060693
Date Reported:	8/15/06
Date Received:	8/11/06
Page Number:	5 of 5

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Gross Alpha	0	84.0	100.0	17.6	NC				8/11/06
Gross Alpha	0	81.0	74.0	8.9	NC				8/10/06
Gross Beta	0.50	72.0	65.0	9.4	NC				8/11/06
Gross Beta	2.34	98.0	112.0	12.9	NC				8/10/06

Lab Approval:

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company: NASA Glenn & Chem, Inc.
Name: DAVID G. WEMAT
Address: 7311 E. 41st ST.
City: TULSA State: OK Zip: 74145
Phone: 724-934-3370 Fax: 918-384-3171
Local: 918-384-0506
Cell: 724-794-0071

Bill To:
Company: NASA / EPA
Name: Bill Vinzant / DAVE WEMAT
Address: 7311 E. 41st ST.
City: TULSA State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: NASSA-4072
PROJECT #: PA-4200-4072
PROJECT NAME: NASSA-Glenn, Remed.
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): Rush Due BY 8-15-06
SAMPLER: Signature

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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)	Gross α/β	Gross α Gross β	Gross α Gross β Radium 226	Radium 226 Radium 228	Radium 226 Radium 228 Gross Alpha				REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
15	K-SS-391	8-9-06	10:52	SWR	1	Cloth	None	X	X	X	X	X				Grab
16	K-SS-392	1	10:52	S	1	S	1	X	X	X	X	X				1

RELINQUISHED BY: DATE TIME RECEIVED BY: DATE TIME

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.

FOR LABORATORY USE ONLY: 2006CL0952

Sample Condition Upon Receipt: GOOD

Custody Seals Intact: Y N

Cooler Temperature: N/A

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company: Kaiser Alum & Chem Corp.
Name: David R. Weyant
Address: 7211 E. 41st St.
City: Tulsa State: OK Zip: 74145
Phone: 724-934-3330 Fax #: 918-384-2171

Cell: 918-384-0566 724-799-0071

Bill To:
Company: Kaiser Alum & Chem Corp
Name: Bill Vinzant / David Weyant
Address: 7211 E. 41st St.
City: Tulsa State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: Kaiser-4072
PROJECT #: OA-4000-4072
PROJECT NAME: Kaiser-Thos. Grants.
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): Results due By 8-15-01
SAMPLER: Signature: David Weyant

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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 (EPA-232)	Alpha + Beta Activity for Ra, Th, U	MDC < 0.5 pCi/g	Grad	MDC <1	Gamma Spec	Alpha Spec		REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
1	K-SS-377	8-10-01	14:14	Solid	1	Cloth	None		X		X	X	X	X		Grab
2	K-SS-378		14:19		1				X		X	X	X	X		
3	K-SS-379		10:46		1				X		X	X	X	X		
4	K-SS-380		10:41		1				X		X	X	X	X		
5	K-SS-381		10:42		1				X		X	X	X	X		
6	K-SS-382		10:47		1				X		X	X	X	X		
7	K-SS-383		10:44		1				X		X	X	X	X		
8	K-SS-384		10:45		1				X		X	X	X	X		
9	K-SS-385		10:46		1				X		X	X	X	X		
10	K-SS-386		10:47		1				X		X	X	X	X		
11	K-SS-387		10:48		1				X		X	X	X	X		
12	K-SS-388		10:49		1				X		X	X	X	X		
13	K-SS-389		10:50		1				X		X	X	X	X		
14	K-SS-390		10:51		1				X		X	X	X	X		

RELINQUISHED BY: David Weyant DATE: 8-13-01 TIME: RECEIVED BY: DATE: TIME:

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 RE[illegible] DISPOSAL: All non-hazardous samples shall be disposed of 30 days after issue of final report. All others will be [illegible] at client's expense.

FOR LABORATORY USE ONLY: 200600750

Sample Condition Upon Receipt: Good

Custody Seals Intact: Y N

Cooler Temperature: NA

SAMPLE LOGIN

Date Received: *8/11/06 10:24:03* Lab Number: 20060693 Due: 8/15/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060693-01 A Gross Alpha/Beta	K-SS-347	Swipe	08/10/06	Plastic	Sm Zip Bag	None	No	No
20060693-02 A Gross Alpha/Beta	K-SS-378	Swipe	08/10/06	Plastic	Sm Zip Bag	None	No	No
20060693-03 A Gross Alpha/Beta	K-SS-379	Swipe	08/10/06	Plastic	Sm Zip Bag	None	No	No
20060693-04 A Gross Alpha/Beta	K-SS-380	Swipe	08/10/06	Plastic	Sm Zip Bag	None	No	No
20060693-05 A Gross Alpha/Beta	K-SS-381	Swipe	08/10/06	Plastic	Sm Zip Bag	None	No	No
20060693-06 A Gross Alpha/Beta	K-SS-382	Swipe	08/10/06	Plastic	Sm Zip Bag	None	No	No
20060693-07 A Gross Alpha/Beta	K-SS-383	Swipe	08/10/06	Plastic	Sm Zip Bag	None	No	No
20060693-08 A Gross Alpha/Beta	K-SS-384	Swipe	08/10/06	Plastic	Sm Zip Bag	None	No	No
20060693-09 A Gross Alpha/Beta	K-SS-385	Swipe	08/10/06	Plastic	Sm Zip Bag	None	No	No
20060693-10 A Gross Alpha/Beta	K-SS-386	Swipe	08/10/06	Plastic	Sm Zip Bag	None	No	No
20060693-11 A Gross Alpha/Beta	K-SS-387	Swipe	08/10/06	Plastic	Sm Zip Bag	None	No	No
20060693-12 A	K-SS-388	Swipe	08/10/06	Plastic	Sm Zip Bag	None	No	No

Gross Alpha/Beta									
20060693-13 A Gross Alpha/Beta	K-SS-389	Swipe	08/10/06	Plastic	Sm Zip Bag	None	No	No
20060693-14 A Gross Alpha/Beta	K-SS-390	Swipe	08/10/06	Plastic	Sm Zip Bag	None	No	No
20060693-15 A Gross Alpha/Beta	K-SS-391	Swipe	08/10/06	Plastic	Sm Zip Bag	None	No	No
20060693-16 A Gross Alpha/Beta	K-SS-392	Swipe	08/10/06	Plastic	Sm Zip Bag	None	No	No

CONTAINER INSPECTION

 # Coolers 0 **Custody Seals Broken** -- **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ☑ **Labels in Tact** ✓ **Radiation Survey Complete** ☐

Anomalies

Inspected By: _____ **DATE** _____

QA or Designee Review: Raymond Thomas **DATE** 08/11/06

Sample Custodian Review: [illegible] **DATE** 8/11/06

'roject Notes:

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

Invoice # 12743
K-SS-273 → 286
K-SS-287 (QA).
POA-0096

August 15, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060663

Dear Mr. Weyant,

Please find enclosed the analytical report for your samples received in our laboratory on August 7, 2006 for the above captioned project. Fourteen swipes were received in good condition and analyzed for Gross Alpha/Beta with an expedited 5 work-day turn time. Results were faxed on 8/14/06.

All Quality Control for the requested analyses is reported on the analytical report. The method blank, laboratory control standard and matrix spikes and spike duplicates for all analyses were within method control limits with the exception of the Gross Beta method Blank. Results were not affected in any way.

Your samples will be returned as requested.

Thank you for choosing Outreach Laboratory and if you have any questions feel free to call.

Laboratory Director

ODEQ ID #9517
NRC ODEQ LIC. #27522-01

ACCREDITED IN ACCORDANCE WITH nelac

CERT. ID# OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060663
Date Reported:	8/15/06
Date Received:	8/7/06
Page Number:	1 of 5

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060663-01						
Client ID:	K-SS-273						
Date Sampled:	8/3/06 1:40:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.459	dpm/100cm 2	0.542		8/7/06	SD
Gross Beta	EPA 900/9310	0.421 +/- 1.52	dpm/100cm 2	1.62		8/7/06	SD
Lab ID:	20060663-02						
Client ID:	K-SS-274						
Date Sampled:	8/3/06 1:42:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.348	dpm/100cm 2	0.466		8/7/06	SD
Gross Beta	EPA 900/9310	0.881 +/- 1.40	dpm/100cm 2	1.45		8/7/06	SD
Lab ID:	20060663-03						
Client ID:	K-SS-275						
Date Sampled:	8/3/06 1:44:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.380	dpm/100cm 2	0.453		8/7/06	SD
Gross Beta	EPA 900/9310	0.666 +/- 1.16	dpm/100cm 2	1.20		8/7/06	SD
Lab ID:	20060663-04						
Client ID:	K-SS-276						
Date Sampled:	8/3/06 1:46:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.437	dpm/100cm 2	0.560		8/7/06	SD
Gross Beta	EPA 900/9310	1.14 +/- 1.42	dpm/100cm 2	1.45		8/7/06	SD

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060663
Date Reported:	8/15/06
Date Received:	8/7/06
Page Number:	2 of 5

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060663-05						
Client ID:	K-SS-277						
Date Sampled:	8/3/06 1:48:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.411	dpm/100cm 2	0.574		8/7/06	SD
Gross Beta	EPA 900/9310	0.191 +/- 1.27	dpm/100cm 2	1.36		8/7/06	SD
Lab ID:	20060663-06						
Client ID:	K-SS-278						
Date Sampled:	8/3/06 1:50:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.244	dpm/100cm 2	0.269		8/7/06	SD
Gross Beta	EPA 900/9310	1.16 +/- 2.24	dpm/100cm 2	2.37		8/7/06	SD
Lab ID:	20060663-07						
Client ID:	K-SS-279						
Date Sampled:	8/3/06 1:52:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.071 +/- 0.355	dpm/100cm 2	0.359		8/7/06	SD
Gross Beta	EPA 900/9310	0.873 +/- 1.36	dpm/100cm 2	1.40		8/7/06	SD
Lab ID:	20060663-08						
Client ID:	K-SS-280						
Date Sampled:	8/3/06 1:54:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.337 +/- 0.514	dpm/100cm 2	0.466		8/7/06	SD
Gross Beta	EPA 900/9310	1.26 +/- 1.43	dpm/100cm 2	1.45		8/7/06	SD

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060663
Date Reported:	8/15/06
Date Received:	8/7/06
Page Number:	3 of 5

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060663-09						
Client ID:	K-SS-281						
Date Sampled:	8/3/06 1:56:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.341	dpm/100cm 2	0.453		8/7/06	SD
Gross Beta	EPA 900/9310	1.24 +/- 1.21	dpm/100cm 2	1.20		8/7/06	SD
Lab ID:	20060663-10						
Client ID:	K-SS-282						
Date Sampled:	8/3/06 1:58:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.469	dpm/100cm 2	0.560		8/7/06	SD
Gross Beta	EPA 900/9310	1.33 +/- 1.43	dpm/100cm 2	1.45		8/7/06	SD
Lab ID:	20060663-11						
Client ID:	K-SS-283						
Date Sampled:	8/3/06 2:00:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.417 +/- 0.399	dpm/100cm 2	0.269		8/7/06	SD
Gross Beta	EPA 900/9310	2.12 +/- 2.27	dpm/100cm 2	2.37		8/7/06	SD
Lab ID:	20060663-12						
Client ID:	K-SS-284						
Date Sampled:	8/3/06 2:02:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.193 +/- 0.394	dpm/100cm 2	0.359		8/7/06	SD
Gross Beta	EPA 900/9310	1.45 +/- 1.40	dpm/100cm 2	1.40		8/7/06	SD

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060663
Date Reported:	8/15/06
Date Received:	8/7/06
Page Number:	4 of 5

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060663-13						
Client ID:	K-SS-285						
Date Sampled:	8/3/06 2:04:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.015 +/- 0.504	dpm/100cm 2	0.542		8/7/06	SD
Gross Beta	EPA 900/9310	0 +/- 1.49	dpm/100cm 2	1.62		8/7/06	SD
Lab ID:	20060663-14						
Client ID:	K-SS-286						
Date Sampled:	8/3/06 2:06:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.368	dpm/100cm 2	0.466		8/7/06	SD
Gross Beta	EPA 900/9310	1.02 +/- 1.41	dpm/100cm 2	1.45		8/7/06	SD
Lab ID:	20060663-15						
Client ID:	K-SS-287						
Date Sampled:	8/3/06 4:10:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.399	dpm/100cm 2	0.453		8/7/06	SD
Gross Beta	EPA 900/9310	0.953 +/- 1.19	dpm/100cm 2	1.20		8/7/06	SD

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060663
Date Reported:	8/15/06
Date Received:	8/7/06
Page Number:	5 of 5

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Gross Alpha	0.051	85.0	94.0	9.9	NC				8/7/06
Gross Beta	3.08	65.0	66.0	0.8	NC				8/7/06

Lab Approval:

BDL = Below Detection Limit

OUTREACH LABORATORY

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

Cell: 724-799-0071

CHAIN OF CUSTODY

Results To:
LOCAL: 918-394-0566
Company: KAISER Alum & Chem Tol.
Name: DAVID E. WEYANT
Address: 7311 E. 41st St.
City: TULSA State: OK Zip: 74145
Phone: 724-934-3530 Fax #: 918-394-3171

Bill To:
Company: KAISER / Pizzo & Co
Name: Bill Winfrost / Dave Weyant
Address: 7311 E. 41st St.
City: TULSA State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: KAISER - 4072
PROJECT #: PA - 4000 - 4072
PROJECT NAME: KAISER Alum/Chem, Pinola
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): 5 DAY TAT.
SAMPLER: Signature

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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)	Gross α	Gross β	Ra-226 DPM/liter	Radium-226 DPM/liter	Radium-228 DPM/liter				REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
1	K-SS-272	1340	5/2/06	Solid	1	Cloth	NONE	X	X	X	X	X				GRAB
2	K-SS-274	1342			1			X	X	X	X	X				
3	K-SS-275	1344			1			X	X	X	X	X				
4	K-SS-276	1346			1			X	X	X	X	X				
5	K-SS-277	1348			1			X	X	X	X	X				
6	K-SS-278	1350			1			X	X	X	X	X				
7	K-SS-279	1352			1			X	X	X	X	X				
8	K-SS-280	1354			1			X	X	X	X	X				
9	K-SS-281	1356			1			X	X	X	X	X				
10	K-SS-282	1358			1			X	X	X	X	X				
11	K-SS-283	1400			1			X	X	X	X	X				
12	K-SS-284	1402			1			X	X	X	X	X				
13	K-SS-285	1404			1			X	X	X	X	X				
14	K-SS-286	1610			1			X	X	X	X	X				

RELINQUISHED BY: [signature] DATE 5/2/06 TIME 1110 RECEIVED BY: [signature] DATE 5/2/06 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).

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: 20060605

Sample Condition Upon Receipt: Good

Custody Seals Intact Y N

Cooler Temperature: NA

SAMPLE LOGIN

Date Received: *8/7/06 1:40:57 P* **Lab Number:** 20060663 **Due:** 8/14/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060663-01 A Gross Alpha/Beta	K-SS-273	Swipe	08/03/06	Plastic	Sm Zip Bag	None	No	No
20060663-02 A Gross Alpha/Beta	K-SS-274	Swipe	08/03/06	Plastic	Sm Zip Bag	None	No	No
20060663-03 A Gross Alpha/Beta	K-SS-275	Swipe	08/03/06	Plastic	Sm Zip Bag	None	No	No
20060663-04 A Gross Alpha/Beta	K-SS-276	Swipe	08/03/06	Plastic	Sm Zip Bag	None	No	No
20060663-05 A Gross Alpha/Beta	K-SS-277	Swipe	08/03/06	Plastic	Sm Zip Bag	None	No	No
20060663-06 A Gross Alpha/Beta	K-SS-278	Swipe	08/03/06	Plastic	Sm Zip Bag	None	No	No
20060663-07 A Gross Alpha/Beta	K-SS-279	Swipe	08/03/06	Plastic	Sm Zip Bag	None	No	No
20060663-08 A Gross Alpha/Beta	K-SS-280	Swipe	08/03/06	Plastic	Sm Zip Bag	None	No	No
20060663-09 A Gross Alpha/Beta	K-SS-281	Swipe	08/03/06	Plastic	Sm Zip Bag	None	No	No
20060663-10 A Gross Alpha/Beta	K-SS-282	Swipe	08/03/06	Plastic	Sm Zip Bag	None	No	No
20060663-11 A Gross Alpha/Beta	K-SS-283	Swipe	08/03/06	Plastic	Sm Zip Bag	None	No	No
20060663-12 A	K-SS-284	Swipe	08/03/06	Plastic	Sm Zip Bag	None	No	No

Gross Alp... eta								
20060663-13 A Gross Alpha/Beta	K-SS-285	Swipe	08/03/06	Plastic	Sm Zip Bag	None	No	No
20060663-14 A Gross Alpha/Beta	K-SS-286	Swipe	08/03/06	Plastic	Sm Zip Bag	None	No	No
20060663-15 A Gross Alpha/Beta	K-SS-287	Swipe	08/03/06	Plastic	Sm Zip Bag	None	No	No

CONTAINER INSPECTION

 # Coolers 0 **Custody Seals Broken** **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ✓ **Labels in Tact** ✓ **Radiation Survey Complete** ✓

Anomalies

Inspected By: _____ **DATE** _____

QA or Designee Review: Raymond Hinman **DATE** 08/07/06

Sample Custodian Review: [illegible] **DATE** 8/7/06

Project Notes:

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

INVOICE # 12349
POA-009C
H-SS-288 → 301
Sw/P21

August 15, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060664

Dear Mr. Weyant,

Please find enclosed the analytical report for your samples received in our laboratory on August 7, 2006 for the above captioned project. Fourteen swipes were received in good condition and analyzed for Gross Alpha/Beta with an expedited 5-work-day turn time. Results were faxed on 8/14/06.

All Quality Control for the requested analyses is reported on the analytical report. The method blank, laboratory control standard and matrix spikes and spike duplicates for all analyses were within method control limits with the exception of the Gross Beta method Blank. Results were not affected in any way.

Your samples will be returned as requested.

Thank you for choosing Outreach Laboratory and if you have any questions feel free to call.

Laboratory Director

ODEQ ID #9517
NRC ODEQ LIC. #27522-01

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID# OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060664
Date Reported:	8/15/06
Date Received:	8/7/06
Page Number:	1 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060664-01						
Client ID:	K-SS-288						
Date Sampled:	8/4/06 9:45:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.498	dpm/100cm 2	0.560		8/7/06	SD
Gross Beta	EPA 900/9310	0.999 +/- 1.41	dpm/100cm 2	1.45		8/7/06	SD
Lab ID:	20060664-02						
Client ID:	K-SS-289						
Date Sampled:	8/4/06 9:46:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.461	dpm/100cm 2	0.574		8/7/06	SD
Gross Beta	EPA 900/9310	0.239 +/- 1.28	dpm/100cm 2	1.36		8/7/06	SD
Lab ID:	20060664-03						
Client ID:	K-SS-290						
Date Sampled:	8/4/06 9:47:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.417 +/- 0.399	dpm/100cm 2	0.269		8/8/06	SD
Gross Beta	EPA 900/9310	1.69 +/- 2.26	dpm/100cm 2	2.37		8/8/06	SD
Lab ID:	20060664-04						
Client ID:	K-SS-291						
Date Sampled:	8/4/06 9:48:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.071 +/- 0.355	dpm/100cm 2	0.359		8/8/06	SD
Gross Beta	EPA 900/9310	0 +/- 1.30	dpm/100cm 2	1.40		8/8/06	SD

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060664
Date Reported:	8/15/06
Date Received:	8/7/06
Page Number:	2 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060664-05						
Client ID:	K-SS-292						
Date Sampled:	8/4/06 9:49:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.475	dpm/100cm 2	0.542		8/8/06	SD
Gross Beta	EPA 900/9310	1.38 +/- 1.58	dpm/100cm 2	1.62		8/8/06	SD
Lab ID:	20060664-06						
Client ID:	K-SS-293						
Date Sampled:	8/4/06 9:50:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.215 +/- 0.485	dpm/100cm 2	0.466		8/8/06	SD
Gross Beta	EPA 900/9310	2.60 +/- 1.51	dpm/100cm 2	1.45		8/8/06	SD
Lab ID:	20060664-07						
Client ID:	K-SS-294						
Date Sampled:	8/4/06 9:51:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.176 +/- 0.465	dpm/100cm 2	0.453		8/8/06	SD
Gross Beta	EPA 900/9310	1.86 +/- 1.26	dpm/100cm 2	1.20		8/8/06	SD
Lab ID:	20060664-08						
Client ID:	K-SS-295						
Date Sampled:	8/4/06 9:52:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.512	dpm/100cm 2	0.560		8/8/06	SD
Gross Beta	EPA 900/9310	1.14 +/- 1.42	dpm/100cm 2	1.45		8/8/06	SD

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060664
Date Reported:	8/15/06
Date Received:	8/7/06
Page Number:	3 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060664-09						
Client ID:	K-SS-296						
Date Sampled:	8/4/06 9:53:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.445	dpm/100cm 2	0.574		8/8/06	SD
Gross Beta	EPA 900/9310	1.29 +/- 1.35	dpm/100cm 2	1.36		8/8/06	SD
Lab ID:	20060664-10						
Client ID:	K-SS-297						
Date Sampled:	8/4/06 9:54:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.356 +/- 0.381	dpm/100cm 2	0.269		8/8/06	SD
Gross Beta	EPA 900/9310	1.26 +/- 2.24	dpm/100cm 2	2.37		8/8/06	SD
Lab ID:	20060664-11						
Client ID:	K-SS-298						
Date Sampled:	8/4/06 9:55:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	1.05 +/- 0.596	dpm/100cm 2	0.359		8/8/06	SD
Gross Beta	EPA 900/9310	0.969 +/- 1.36	dpm/100cm 2	1.40		8/8/06	SD
Lab ID:	20060664-12						
Client ID:	K-SS-299						
Date Sampled:	8/4/06 9:56:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.489	dpm/100cm 2	0.542		8/8/06	SD
Gross Beta	EPA 900/9310	0.278 +/- 1.51	dpm/100cm 2	1.62		8/8/06	SD

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060664
Date Reported:	8/15/06
Date Received:	8/7/06
Page Number:	4 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060664-13						
Client ID:	K-SS-300						
Date Sampled:	8/4/06 9:57:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.032 +/- 0.439	dpm/100cm 2	0.466		8/8/06	SD
Gross Beta	EPA 900/9310	1.55 +/- 1.45	dpm/100cm 2	1.45		8/8/06	SD
Lab ID:	20060664-14						
Client ID:	K-SS-301						
Date Sampled:	8/4/06 9:58:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.416	dpm/100cm 2	0.453		8/8/06	SD
Gross Beta	EPA 900/9310	1.43 +/- 1.22	dpm/100cm 2	1.20		8/8/06	SD

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Gross Alpha	0.088	93.0	85.0	8.6	NC				8/8/06
Gross Alpha	0.051	85.0	94.0	9.9	NC				8/7/06
Gross Beta	0.52	79.0	64.0	21.6	NC				8/8/06
Gross Beta	3.08	65.0	66.0	0.8	NC				8/7/06

Lab Approval:

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company: Kaiser Alum & Chem Inc.
Name: David B. Weyant
Address: 7311 E. 41st St.
City: Tulsa State: OK Zip: 74145
Phone: 724-934-3530 Fax #: 918-384-3171

Local: 918-384-0546
Cell: 724-799-0071

Bill To:
Company: Kaiser/Penn E & R
Name: Bill Vinzant/Dave Weyant
Address: 7311 E. 41st St.
City: Tulsa State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: Kaiser-4072
PROJECT #: TA 4000-4072
PROJECT NAME: Kaiser Alum Thor. Remed
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): 5 day TAT
SAMPLER: Signature / Dan Duffey

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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)	Gross α/β	α MDC < 1 dpm/100 cm²	β MDC < 3 dpm/100 cm²	Results in Units dpm/100 cm²	Return to Client for Archive				REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
1	K-55-288	8-4-06	0945	Swipe	1	Poly	None	X	X	X	X	X				
2	K-55-289		0946													
3	K-55-290		0947													
4	K-55-291		0948													
5	K-55-292		0949													
6	K-55-293		0950													
7	K-55-294		0951													
8	K-55-295		0952													
9	K-55-296		0953													
10	K-55-297		0954													
11	K-55-298		0955													
12	K-55-299		0956													
13	K-55-300		0957													
14	K-55-301		0958													

RELINQUISHED BY: [signature] DATE 8/4/06 TIME 110 RECEIVED BY: [signature] DATE 8/4/06 TIME 110

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.

FOR LABORATORY USE ONLY: 0606064

Sample Condition Upon Receipt: Good

Custody Seals Intact: Y N

Cooler Temperature: NA

SAMPLE LOGIN

Date Received: *8/7/06 1:46:12 P* Lab Number: 20060664 Due: *8/14/06*

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060664-01 A Gross Alpha/Beta	K-SS-288	Swipe	08/04/06	Plastic	Sm Zip Bag	None	No	No
20060664-02 A Gross Alpha/Beta	K-SS-289	Swipe	08/04/06	Plastic	Sm Zip Bag	None	No	No
20060664-03 A Gross Alpha/Beta	K-SS-290	Swipe	08/04/06	Plastic	Sm Zip Bag	None	No	No
20060664-04 A Gross Alpha/Beta	K-SS-291	Swipe	08/04/06	Plastic	Sm Zip Bag	None	No	No
20060664-05 A Gross Alpha/Beta	K-SS-292	Swipe	08/04/06	Plastic	Sm Zip Bag	None	No	No
20060664-06 A Gross Alpha/Beta	K-SS-293	Swipe	08/04/06	Plastic	Sm Zip Bag	None	No	No
20060664-07 A Gross Alpha/Beta	K-SS-294	Swipe	08/04/06	Plastic	Sm Zip Bag	None	No	No
20060664-08 A Gross Alpha/Beta	K-SS-295	Swipe	08/04/06	Plastic	Sm Zip Bag	None	No	No
20060664-09 A Gross Alpha/Beta	K-SS-296	Swipe	08/04/06	Plastic	Sm Zip Bag	None	No	No
20060664-10 A Gross Alpha/Beta	K-SS-297	Swipe	08/04/06	Plastic	Sm Zip Bag	None	No	No
20060664-11 A Gross Alpha/Beta	K-SS-298	Swipe	08/04/06	Plastic	Sm Zip Bag	None	No	No
20060664-12	K-SS-299	Swipe	08/04/06	Plastic	Sm Zip Bag	None	No	No

Gross Alpha/Beta									
20060664-13 A Gross Alpha/Beta	K-SS-300	Swipe	08/04/06	Plastic	Sm Zip Bag	None	No	No
20060664-14 A Gross Alpha/Beta	K-SS-301	Swipe	08/04/06	Plastic	Sm Zip Bag	None	No	No

CONTAINER INSPECTION

 # Coolers 0 **Custody Seals Broken** **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ✓ **Labels in Tact** ☑ **Radiation Survey Complete** ✓

Anomalies

Inspected By: _____ **DATE** _____

QA or Designee Review: Raymond Thomas **DATE** 08/07/06

Sample Custodian Review: [illegible] **DATE** 8/7/06

Project Notes:

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

Invoice # 12345
PoA - 009D
K-SS 303 → 316 swipes

August 15, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060665

Dear Mr. Weyant,

Please find enclosed the analytical report for your samples received in our laboratory on August 7, 2006 for the above captioned project. Fourteen swipes were received in good condition and analyzed for Gross Alpha/Beta with an expedited 5-work-day turn time. Results were faxed on 8/14/06.

All Quality Control for the requested analyses is reported on the analytical report. The method blank, laboratory control standard and matrix spikes and spike 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 feel free to call.

Laboratory Director

ODEQ ID #9517
NRC ODEQ LIC. #27522-01

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID# OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060665
Date Reported:	8/15/06
Date Received:	8/7/06
Page Number:	1 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060665-01						
Client ID:	K-SS-303						
Date Sampled:	8/5/06 9:20:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.484	dpm/100cm 2	0.560		8/8/06	SD
Gross Beta	EPA 900/9310	0.952 +/- 1.40	dpm/100cm 2	1.45		8/8/06	SD
Lab ID:	20060665-02						
Client ID:	K-SS-304						
Date Sampled:	8/5/06 9:21:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.071 +/- 0.546	dpm/100cm 2	0.574		8/8/06	SD
Gross Beta	EPA 900/9310	1.15 +/- 1.34	dpm/100cm 2	1.36		8/8/06	SD
Lab ID:	20060665-03						
Client ID:	K-SS-305						
Date Sampled:	8/5/06 9:22:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.417 +/- 0.399	dpm/100cm 2	0.269		8/8/06	SD
Gross Beta	EPA 900/9310	0.590 +/- 2.21	dpm/100cm 2	2.37		8/8/06	SD
Lab ID:	20060665-04						
Client ID:	K-SS-306						
Date Sampled:	8/5/06 9:23:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.193 +/- 0.394	dpm/100cm 2	0.359		8/8/06	SD
Gross Beta	EPA 900/9310	0.969 +/- 1.36	dpm/100cm 2	1.40		8/8/06	SD

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060665
Date Reported:	8/15/06
Date Received:	8/7/06
Page Number:	2 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060665-05						
Client ID:	K-SS-307						
Date Sampled:	8/5/06 9:24:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.427	dpm/100cm 2	0.542		8/8/06	SD
Gross Beta	EPA 900/9310	0 +/- 1.47	dpm/100cm 2	1.62		8/8/06	SD
Lab ID:	20060665-06						
Client ID:	K-SS-308						
Date Sampled:	8/5/06 9:25:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.093 +/- 0.455	dpm/100cm 2	0.466		8/8/06	SD
Gross Beta	EPA 900/9310	0.929 +/- 1.41	dpm/100cm 2	1.45		8/8/06	SD
Lab ID:	20060665-07						
Client ID:	K-SS-309						
Date Sampled:	8/5/06 9:26:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.237 +/- 0.480	dpm/100cm 2	0.453		8/8/06	SD
Gross Beta	EPA 900/9310	1.91 +/- 1.26	dpm/100cm 2	1.20		8/8/06	SD
Lab ID:	20060665-08						
Client ID:	K-SS-310						
Date Sampled:	8/5/06 9:27:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.100 +/- 0.539	dpm/100cm 2	0.560		8/8/06	SD
Gross Beta	EPA 900/9310	1.72 +/- 1.45	dpm/100cm 2	1.45		8/8/06	SD

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060665
Date Reported:	8/15/06
Date Received:	8/7/06
Page Number:	3 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060665-09						
Client ID:	K-SS-311						
Date Sampled:	8/5/06 9:28:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.505	dpm/100cm 2	0.574		8/8/06	SD
Gross Beta	EPA 900/9310	0.862 +/- 1.32	dpm/100cm 2	1.36		8/8/06	SD
Lab ID:	20060665-10						
Client ID:	K-SS-312						
Date Sampled:	8/5/06 9:29:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.783 +/- 0.495	dpm/100cm 2	0.269		8/8/06	SD
Gross Beta	EPA 900/9310	1.93 +/- 2.27	dpm/100cm 2	2.37		8/8/06	SD
Lab ID:	20060665-11						
Client ID:	K-SS-313						
Date Sampled:	8/5/06 9:30:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.289	dpm/100cm 2	0.359		8/8/06	SD
Gross Beta	EPA 900/9310	1.16 +/- 1.38	dpm/100cm 2	1.40		8/8/06	SD
Lab ID:	20060665-12						
Client ID:	K-SS-314						
Date Sampled:	8/5/06 9:31:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.489	dpm/100cm 2	0.542		8/8/06	SD
Gross Beta	EPA 900/9310	0.134 +/- 1.50	dpm/100cm 2	1.62		8/8/06	SD

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060665
Date Reported:	8/15/06
Date Received:	8/7/06
Page Number:	4 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	**20060665-13**						
Client ID:	**K-SS-315**						
Date Sampled:	**8/5/06 9:32:00 AM**						
Matrix:	**Swipe**						
	Radiochemical Analyses						
Gross Alpha	EPA 900/9310	0.093 +/- 0.455	dpm/100cm 2	0.466		8/8/06	SD
Gross Beta	EPA 900/9310	1.41 +/- 1.44	dpm/100cm 2	1.45		8/8/06	SD
Lab ID:	**20060665-14**						
Client ID:	**K-SS-316**						
Date Sampled:	**8/5/06 9:33:00 AM**						
Matrix:	**Swipe**						
	Radiochemical Analyses						
Gross Alpha	EPA 900/9310	0.237 +/- 0.480	dpm/100cm 2	0.453		8/8/06	SD
Gross Beta	EPA 900/9310	1.82 +/- 1.25	dpm/100cm 2	1.20		8/8/06	SD

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Gross Alpha	0	82.0	74.0	9.3	NC				8/8/06
Gross Alpha	0.088	93.0	85.0	8.6	NC				8/8/06
Gross Beta	0.21	69.0	75.0	8.1	NC				8/8/06
Gross Beta	0.52	79.0	64.0	21.6	NC				8/8/06

Lab Approval:

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company: Kaiser Alum & Chem Inc
Name: David B. Weyant
Address: 7311 E. 41st St
City: Tulsa State: OK Zip: 74145
Phone: 724-934-3530 Fax #: 918-384-3171

Local: 918-384-0566
Cell: 724-799-0071

Bill To:
Company: Kaiser / Penn F & R
Name: Bill Vinzant / Dave Weyant
Address: 7311 E. 41st St.
City: Tulsa State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: Kaiser-4072
PROJECT #: PA-4000-4072
PROJECT NAME: Kaiser Alum Tulsa Removed
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): 5 day TAT
SAMPLER: Signature / Dan Turney

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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)	Gross α/β	α MDC < 1 cpm/100cm²	β MDC < 3 cpm/100cm²	Results Gamma cpm/100cm²	Results Gamma cpm/100cm² Fox Archive				REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
1	K-44-303	8-9-06	0920	SWIPE	1	CLOTH	NONE	X	X	X	X	X				
2	K-44-304	↓	0921	↓	↓	↓	↓	↓	↓	↓	↓	↓				
3	K-44-305	↓	0922	↓	↓	↓	↓	↓	↓	↓	↓	↓				
4	K-44-306	↓	0923	↓	↓	↓	↓	↓	↓	↓	↓	↓				
5	K-44-307	↓	0924	↓	↓	↓	↓	↓	↓	↓	↓	↓				
6	K-44-308	↓	0925	↓	↓	↓	↓	↓	↓	↓	↓	↓				
7	K-44-309	↓	0926	↓	↓	↓	↓	↓	↓	↓	↓	↓				
8	K-44-310	↓	0927	↓	↓	↓	↓	↓	↓	↓	↓	↓				
9	K-44-311	↓	0928	↓	↓	↓	↓	↓	↓	↓	↓	↓				
10	K-44-312	↓	0929	↓	↓	↓	↓	↓	↓	↓	↓	↓				
11	K-44-313	↓	0930	↓	↓	↓	↓	↓	↓	↓	↓	↓				
12	K-44-314	↓	0931	↓	↓	↓	↓	↓	↓	↓	↓	↓				
13	K-44-315	↓	0932	↓	↓	↓	↓	↓	↓	↓	↓	↓				
14	K-44-316	↓	0933	↓	↓	↓	↓	↓	↓	↓	↓	↓				

RELINQUISHED BY: Dan Turney DATE 8/9/06 TIME 110 RECEIVED BY: [illegible] DATE 8/9/06 TIME 110

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.

FOR LABORATORY USE ONLY:

Sample Condition Upon Receipt: Good

Custody Seals Intact: Y N

Cooler Temperature: NA

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company
Name
Address
City State Zip
Phone Fax #

Bill To:
Company
Name
Address
City State Zip

ANALYSIS REQUESTED

PO #
PROJECT #
PROJECT NAME
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY)
SAMPLER Signature

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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								REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															

RELINQUISHED BY: DATE TIME RECEIVED BY: DATE TIME

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 RETENTION/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 NA

Gross Alpha/Beta									
20060665-13 A Gross Alpha/Beta	K-SS-315	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No	
20060665-14 A Gross Alpha/Beta	K-SS-316	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No	

CONTAINER INSPECTION

 # Coolers 0 **Custody Seals Broken** ☐ **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ✓ **Labels in Tact** ✓ **Radiation Survey Complete** ✓

Anomalies

Inspected By: _____ **DATE** _____

QA or Designee Review: Raymond Thom **DATE** 08/07/06

Sample Custodian Review: [illegible] **DATE** 8/7/06

Project Notes:

SAMPLE LOGIN

Date Received: *8/7/06 1:48:23 P* **Lab Number:** 20060665 **Due:** 8/14/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060665-01 A Gross Alpha/Beta	K-SS-303	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060665-02 A Gross Alpha/Beta	K-SS-304	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060665-03 A Gross Alpha/Beta	K-SS-305	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060665-04 A Gross Alpha/Beta	K-SS-306	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060665-05 A Gross Alpha/Beta	K-SS-307	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060665-06 A Gross Alpha/Beta	K-SS-308	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060665-07 A Gross Alpha/Beta	K-SS-309	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060665-08 A Gross Alpha/Beta	K-SS-310	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060665-09 A Gross Alpha/Beta	K-SS-311	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060665-10 A Gross Alpha/Beta	K-SS-312	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060665-11 A Gross Alpha/Beta	K-SS-313	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060665-12 A	K-SS-314	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No

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

Invoice # 12346
PO A-0098
K-SS-318 → 331 Swipes

August 15, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060666

Dear Mr. Weyant,

Please find enclosed the analytical report for your samples received in our laboratory on August 7, 2006 for the above captioned project. Fourteen swipes were received in good condition and analyzed for Gross Alpha/Beta with an expedited 5-work-day turn time. Results were faxed on 8/14/06.

All Quality Control for the requested analyses is reported on the analytical report. The method blank, laboratory control standard and matrix spikes and spike 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 feel free to call.

Laboratory Director

ODEQ ID #9517
NRC ODEQ LIC. #27522-01

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID# OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060666
Date Reported:	8/15/06
Date Received:	8/7/06
Page Number:	1 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	**20060666-01**						
Client ID:	**K-SS-318**						
Date Sampled:	**8/5/06 10:30:00 AM**						
Matrix:	**Swipe**						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.512	dpm/100cm 2	0.560		8/8/06	SD
Gross Beta	EPA 900/9310	1.05 +/- 1.41	dpm/100cm 2	1.45		8/8/06	SD
Lab ID:	**20060666-02**						
Client ID:	**K-SS-319**						
Date Sampled:	**8/5/06 10:31:00 AM**						
Matrix:	**Swipe**						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.411	dpm/100cm 2	0.574		8/8/06	SD
Gross Beta	EPA 900/9310	1.72 +/- 1.38	dpm/100cm 2	1.36		8/8/06	SD
Lab ID:	**20060666-03**						
Client ID:	**K-SS-320**						
Date Sampled:	**8/5/06 10:32:00 AM**						
Matrix:	**Swipe**						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.539 +/- 0.434	dpm/100cm 2	0.269		8/8/06	SD
Gross Beta	EPA 900/9310	0.111 +/- 2.19	dpm/100cm 2	2.37		8/8/06	SD
Lab ID:	**20060666-04**						
Client ID:	**K-SS-321**						
Date Sampled:	**8/5/06 10:33:00 AM**						
Matrix:	**Swipe**						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.193 +/- 0.394	dpm/100cm 2	0.359		8/8/06	SD
Gross Beta	EPA 900/9310	0.825 +/- 1.36	dpm/100cm 2	1.40		8/8/06	SD

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060666
Date Reported:	8/15/06
Date Received:	8/7/06
Page Number:	2 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060666-05						
Client ID:	K-SS-322						
Date Sampled:	8/5/06 10:34:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.015 +/- 0.504	dpm/100cm 2	0.542		8/8/06	SD
Gross Beta	EPA 900/9310	0 +/- 1.50	dpm/100cm 2	1.62		8/8/06	SD
Lab ID:	20060666-06						
Client ID:	K-SS-323						
Date Sampled:	8/5/06 10:35:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.032 +/- 0.439	dpm/100cm 2	0.466		8/8/06	SD
Gross Beta	EPA 900/9310	2.56 +/- 1.51	dpm/100cm 2	1.45		8/8/06	SD
Lab ID:	20060666-07						
Client ID:	K-SS-324						
Date Sampled:	8/5/06 10:36:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.399	dpm/100cm 2	0.453		8/8/06	SD
Gross Beta	EPA 900/9310	2.39 +/- 1.29	dpm/100cm 2	1.20		8/8/06	SD
Lab ID:	20060666-08						
Client ID:	K-SS-325						
Date Sampled:	8/5/06 10:37:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.512	dpm/100cm 2	0.560		8/8/06	SD
Gross Beta	EPA 900/9310	0 +/- 1.32	dpm/100cm 2	1.45		8/8/06	SD

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060666
Date Reported:	8/15/06
Date Received:	8/7/06
Page Number:	3 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060666-09						
Client ID:	K-SS-326						
Date Sampled:	8/5/06 10:38:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.461	dpm/100cm 2	0.574		8/8/06	SD
Gross Beta	EPA 900/9310	0.766 +/- 1.31	dpm/100cm 2	1.36		8/8/06	SD
Lab ID:	20060666-10						
Client ID:	K-SS-327						
Date Sampled:	8/5/06 10:39:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.295 +/- 0.362	dpm/100cm 2	0.269		8/8/06	SD
Gross Beta	EPA 900/9310	1.50 +/- 2.25	dpm/100cm 2	2.37		8/8/06	SD
Lab ID:	20060666-11						
Client ID:	K-SS-328						
Date Sampled:	8/5/06 10:40:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.315 +/- 0.428	dpm/100cm 2	0.359		8/8/06	SD
Gross Beta	EPA 900/9310	1.21 +/- 1.38	dpm/100cm 2	1.40		8/8/06	SD
Lab ID:	20060666-12						
Client ID:	K-SS-329						
Date Sampled:	8/5/06 10:41:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.427	dpm/100cm 2	0.542		8/8/06	SD
Gross Beta	EPA 900/9310	1.43 +/- 1.58	dpm/100cm 2	1.62		8/8/06	SD

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060666
Date Reported:	8/15/06
Date Received:	8/7/06
Page Number:	4 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060666-13						
Client ID:	K-SS-330						
Date Sampled:	8/5/06 10:42:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.387	dpm/100cm 2	0.466		8/8/06	SD
Gross Beta	EPA 900/9310	2.32 +/- 1.49	dpm/100cm 2	1.45		8/8/06	SD
Lab ID:	20060666-14						
Client ID:	K-SS-331						
Date Sampled:	8/5/06 10:43:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.115 +/- 0.449	dpm/100cm 2	0.453		8/8/06	SD
Gross Beta	EPA 900/9310	2.29 +/- 1.29	dpm/100cm 2	1.20		8/8/06	SD

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Gross Alpha	0	82.0	74.0	9.3	NC				8/8/06
Gross Beta	0.21	69.0	75.0	8.1	NC				8/8/06

Lab Approval: _____

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company: KAISER ALUM & CHEM INC
LOAN: Name: DAVID B. WEYANT
918-384-0566 Address: 7311 41ST ST
CELL: City: TULSA State: OK Zip: 74145
724-779-0071 Phone: 724-934-3530 Fax #: 918-384-3171

Bill To:
Company: KAISER / FEWE & R
Name: BILL WEYANT / DAVE WEYANT
Address: 7311 E. 41ST ST
City: TULSA State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: KAISER - 4072
PROJECT #: TA - 4.000 - 0072
PROJECT NAME: KAISER ALUM THOR FEWED
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): 5 DAY TAT
SAMPLER: Signature: DAVID WEYANT

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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	CHROM X / P	X NDC 1	P NDC 2	TEMPS CHECK	REPORTS TO CLIENT FOR ACCEPT				REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
1	[illegible] - 18	8-5-02	1020	WIPE	1	CLEAN	NONE	X	X	X	X	X				
2	[illegible] 19		1021													
3	[illegible] 20		103_													
4	[illegible] 21		1029													
5	[illegible] 22		[illegible]													
6	[illegible]		11[illegible]													
7	[illegible] 24		1036													
8	[illegible] 25		1037													
9	[illegible] 26		1038													
10	[illegible] 27		[illegible]													
11	[illegible] 28		[illegible]													
12	[illegible] 29		[illegible]													
13	[illegible]		1042													
14	[illegible] 31	✓	1043	✓	✓	✓	✓	✓	✓	✓	✓	✓				

RELINQUISHED BY: [illegible] DATE 8/5/02 TIME 110 RECEIVED BY: [illegible] DATE 8/5/ TIME 110

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 R[illegible] DISPOSAL: All non-hazardous samples shall be disposed of 30 days after issue of final report. All others will be [illegible] at client's expense.

FOR LABORATORY USE ONLY: [illegible]

Sample Condition Upon Receipt: GOOD

Custody Seals Intact: Y N

Cooler Temperature: NA

SAMPLE LOGIN

Date Received: *8/7/06 1:50:30 P* Lab Number: 20060666 Due: 8/14/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060666-01 A Gross Alpha/Beta	K-SS-318	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060666-02 A Gross Alpha/Beta	K-SS-319	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060666-03 A Gross Alpha/Beta	K-SS-320	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060666-04 A Gross Alpha/Beta	K-SS-321	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060666-05 A Gross Alpha/Beta	K-SS-322	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060666-06 A Gross Alpha/Beta	K-SS-323	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060666-07 A Gross Alpha/Beta	K-SS-324	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060666-08 A Gross Alpha/Beta	K-SS-325	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060666-09 A Gross Alpha/Beta	K-SS-326	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060666-10 A Gross Alpha/Beta	K-SS-327	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060666-11 A Gross Alpha/Beta	K-SS-328	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060666-12 A	K-SS-329	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No

Gross Alpha/Beta								
:0060666-13 A Gross Alpha/Beta	K-SS-330	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No
20060666-14 A Gross Alpha/Beta	K-SS-331	Swipe	08/05/06	Plastic	Sm Zip Bag	None	No	No

CONTAINER INSPECTION

 # Coolers 0 **Custody Seals Broken** — **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ✓ **Labels in Tact** ✓ **Radiation Survey Complete** ✓

Anomalies

Inspected By: _____ **DATE** _____

QA or Designee Review: Raymond Thomas **DATE** 08/07/06

Sample Custodian Review: [illegible] **DATE** 8/7/06

Project Notes:

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

K-SS- 333 → 346
PA - 0094
INVOICE # 12342

August 15, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060674

Dear Mr. Weyant,

Please find enclosed the analytical report for your samples received in our laboratory on August 9, 2006 for the above captioned project. Fourteen swipes were received in good condition and analyzed for Gross Alpha/Beta with an expedited 4 work-day turn time. Results were faxed on 8/15/06.

All Quality Control for the requested analyses is reported on the analytical report. The method blank, laboratory control standard and matrix spikes and spike 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 feel free to call.

Laboratory Director

ODEQ ID #9517
NRC ODEQ LIC. #27522-01

ACCREDITED IN ACCORDANCE WITH nelac
ERT. ID# OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060674
Date Reported:	8/15/06
Date Received:	8/9/06
Page Number:	1 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060674-01						
Client ID:	K-SS-333						
Date Sampled:	8/7/06 1:40:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.234 +/- 0.341	dpm/100cm 2	0.269		8/10/06	RE
Gross Beta	EPA 900/9310	1.55 +/- 2.25	dpm/100cm 2	2.37		8/10/06	RE
Lab ID:	20060674-02						
Client ID:	K-SS-334						
Date Sampled:	8/7/06 1:41:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.071 +/- 0.355	dpm/100cm 2	0.359		8/10/06	RE
Gross Beta	EPA 900/9310	1.50 +/- 1.40	dpm/100cm 2	1.41		8/10/06	RE
Lab ID:	20060674-03						
Client ID:	K-SS-335						
Date Sampled:	8/7/06 1:42:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.459	dpm/100cm 2	0.542		8/10/06	RE
Gross Beta	EPA 900/9310	1.47 +/- 1.58	dpm/100cm 2	1.62		8/10/06	RE
Lab ID:	20060674-04						
Client ID:	K-SS-336						
Date Sampled:	8/7/06 1:43:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.913	dpm/100cm 2	1.07		8/10/06	RE
Gross Beta	EPA 900/9310	0 +/- 1.60	dpm/100cm 2	1.75		8/10/06	RE

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060674
Date Reported:	8/15/06
Date Received:	8/9/06
Page Number:	2 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060674-05						
Client ID:	K-SS-337						
Date Sampled:	8/7/06 1:44:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.422	dpm/100cm 2	0.466		8/10/06	RE
Gross Beta	EPA 900/9310	0.833 +/- 1.40	dpm/100cm 2	1.45		8/10/06	RE
Lab ID:	20060674-06						
Client ID:	K-SS-338						
Date Sampled:	8/7/06 1:45:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.416	dpm/100cm 2	0.453		8/10/06	RE
Gross Beta	EPA 900/9310	1.67 +/- 1.24	dpm/100cm 2	1.20		8/10/06	RE
Lab ID:	20060674-07						
Client ID:	K-SS-339						
Date Sampled:	8/7/06 1:46:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.403	dpm/100cm 2	0.560		8/10/06	RE
Gross Beta	EPA 900/9310	0.090 +/- 1.35	dpm/100cm 2	1.45		8/10/06	RE
Lab ID:	20060674-08						
Client ID:	K-SS-340						
Date Sampled:	8/7/06 1:47:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.445	dpm/100cm 2	0.574		8/10/06	RE
Gross Beta	EPA 900/9310	0.670 +/- 1.31	dpm/100cm 2	1.36		8/10/06	RE

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060674
Date Reported:	8/15/06
Date Received:	8/9/06
Page Number:	3 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060674-09						
Client ID:	K-SS-341						
Date Sampled:	8/7/06 1:48:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.295 +/- 0.362	dpm/100cm 2	0.269		8/10/06	RE
Gross Beta	EPA 900/9310	2.17 +/- 2.28	dpm/100cm 2	2.37		8/10/06	RE
Lab ID:	20060674-10						
Client ID:	K-SS-342						
Date Sampled:	8/7/06 1:49:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.132 +/- 0.375	dpm/100cm 2	0.359		8/10/06	RE
Gross Beta	EPA 900/9310	1.50 +/- 1.40	dpm/100cm 2	1.41		8/10/06	RE
Lab ID:	20060674-11						
Client ID:	K-SS-343						
Date Sampled:	8/7/06 1:50:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	3.55 +/- 1.04	dpm/100cm 2	0.542		8/10/06	RE
Gross Beta	EPA 900/9310	4.49 +/- 1.75	dpm/100cm 2	1.62		8/10/06	RE
Lab ID:	20060674-12						
Client ID:	K-SS-344						
Date Sampled:	8/7/06 1:51:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.102 +/- 1.00	dpm/100cm 2	1.07		8/10/06	RE
Gross Beta	EPA 900/9310	0 +/- 1.61	dpm/100cm 2	1.75		8/10/06	RE

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060674
Date Reported:	8/15/06
Date Received:	8/9/06
Page Number:	4 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060674-13						
Client ID:	K-SS-345						
Date Sampled:	8/7/06 1:52:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.093 +/- 0.455	dpm/100cm 2	0.466		8/10/06	RE
Gross Beta	EPA 900/9310	0.976 +/- 1.41	dpm/100cm 2	1.45		8/10/06	RE
Lab ID:	20060674-14						
Client ID:	K-SS-346						
Date Sampled:	8/7/06 1:53:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.115 +/- 0.449	dpm/100cm 2	0.453		8/10/06	RE
Gross Beta	EPA 900/9310	1.91 +/- 1.26	dpm/100cm 2	1.20		8/10/06	RE

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Gross Alpha	0	72.0	83.0	13.8	NC				8/10/06
Gross Beta	0	64.0	67.0	3.8	NC				8/10/06

Lab Approval: _____

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
LOAL: 918-384-0566
CELL: 724-744.0671
Company: KAISER ALUM & CHEM INC.
Name: DAVID B. WEYAND
Address: 7311 E. 41st ST.
City: TULSA State: OK Zip: 74145
Phone: 724-934-3530 Fax #: 918-384-3171

Bill To:
Company: KAISER/PRAD ECO
Name: BILL VINZANT/DAVID WEYAND
Address: 7311 E. 41st ST.
City: TULSA State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: KAISER-4072
PROJECT #: PA-4000-4072
PROJECT NAME: KAISER ALUM INC.
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): PLEASE.
SAMPLER: DAVID WEYAND (Signature) 8-14-06

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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)	Grab/Comp	TCLP Metals	TCLP Volatile Organics	TCLP Semi-Volatile Organics	Pesticides & Herbicides				REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
1	K-SI-333	8-7-06	1340	SOIL	1	CLTH	NONE	X	X	X	X	X				GRAB
2	K-SI-334		1341		1			X	X	X	X	X				
3	K-SI-335		1342		1			X	X	X	X	X				
4	K-SI-336		1343		1			X	X	X	X	X				
5	K-SI-337		1344		1			X	X	X	X	X				
6	K-SI-338		1345		1			X	X	X	X	X				
7	K-SI-339		1346		1			X	X	X	X	X				
8	K-SI-340		1347		1			X	X	X	X	X				
9	K-SI-341		1348		1			X	X	X	X	X				
10	K-SI-342		1349		1			X	X	X	X	X				
11	K-SI-343		[illegible]		1			X	X	X	X	X				
12	K-SI-344		1351		1			X	X	X	X	X				
13	K-SI-345		1352		1			X	X	X	X	X				
14	K-SI-346		1353		1			X	X	X	X	X				

RELINQUISHED BY: DAVID WEYAND DATE: 8/14/06 TIME: 1400 RECEIVED BY: [illegible] DATE: 8/14 TIME: 1400

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 [illegible]/DISPOSAL: All non-hazardous samples shall be disposed of 30 days after issue of final report. All others will b[illegible]d at client's expense.

FOR LABORATORY USE ONLY: [illegible]

Sample Condition Upon Receipt: GOOD

Custody Seals Intact: Y N

Cooler Temperature: NA

SAMPLE LOGIN

Date Received: *8/9/06 10:48:27 A* **Lab Number:** 20060674 **Due:** 8/14/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060674-01 A Gross Alpha/Beta	K-SS-333	Swipe	08/07/06	Plastic	Sm Zip Bag	None	No	No
20060674-02 A Gross Alpha/Beta	K-SS-334	Swipe	08/07/06	Plastic	Sm Zip Bag	None	No	No
20060674-03 A Gross Alpha/Beta	K-SS-335	Swipe	08/07/06	Plastic	Sm Zip Bag	None	No	No
20060674-04 A Gross Alpha/Beta	K-SS-336	Swipe	08/07/06	Plastic	Sm Zip Bag	None	No	No
20060674-05 A Gross Alpha/Beta	K-SS-337	Swipe	08/07/06	Plastic	Sm Zip Bag	None	No	No
20060674-06 A Gross Alpha/Beta	K-SS-338	Swipe	08/07/06	Plastic	Sm Zip Bag	None	No	No
20060674-07 A Gross Alpha/Beta	K-SS-339	Swipe	08/07/06	Plastic	Sm Zip Bag	None	No	No
20060674-08 A Gross Alpha/Beta	K-SS-340	Swipe	08/07/06	Plastic	Sm Zip Bag	None	No	No
20060674-09 A Gross Alpha/Beta	K-SS-341	Swipe	08/07/06	Plastic	Sm Zip Bag	None	No	No
20060674-10 A Gross Alpha/Beta	K-SS-342	Swipe	08/07/06	Plastic	Sm Zip Bag	None	No	No
20060674-11 A Gross Alpha/Beta	K-SS-343	Swipe	08/07/06	Plastic	Sm Zip Bag	None	No	No
20060674-12 A	K-SS-344	Swipe	08/07/06	Plastic	Sm Zip Bag	None	No	No

Gross Alpha/Beta									
20060674-13 A Gross Alpha/Beta	K-SS-345	Swipe	08/07/06	Plastic	Sm Zip Bag	None	No	No
20060674-14 A Gross Alpha/Beta	K-SS-346	Swipe	08/07/06	Plastic	Sm Zip Bag	None	No	No

CONTAINER INSPECTION

 # Coolers 0 **Custody Seals Broken** ☐ **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ☑ **Labels in Tact** ☑ **Radiation Survey Complete** ☑

Anomalies

Inspected By: _____ **DATE** _____

QA or Designee Review: Raymond Thomas **DATE** 08/09/06

Sample Custodian Review: _____ **DATE** 8/9/06

Project Notes:

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

K-SS- 348 → 361
POA - 009G
Invoice # 12344

August 15, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060675

Dear Mr. Weyant,

Please find enclosed the analytical report for your samples received in our laboratory on August 9, 2006 for the above captioned project. Fourteen swipes were received in good condition and analyzed for Gross Alpha/Beta with an expedited 4 work-day turn time. Results were faxed on 8/15/06.

All Quality Control for the requested analyses is reported on the analytical report. The method blank, laboratory control standard and matrix spikes and spike 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 feel free to call.

Laboratory Director

ODEQ ID #9517
NRC ODEQ LIC. #27522-01

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID# OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060675
Date Reported:	8/15/06
Date Received:	8/9/06
Page Number:	1 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060675-01						
Client ID:	K-SS-348						
Date Sampled:	8/8/06 2:15:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.498	dpm/100cm 2	0.560		8/10/06	RE
Gross Beta	EPA 900/9310	0.904 +/- 1.40	dpm/100cm 2	1.45		8/10/06	RE
Lab ID:	20060675-02						
Client ID:	K-SS-349						
Date Sampled:	8/8/06 2:16:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.132 +/- 0.559	dpm/100cm 2	0.574		8/10/06	RE
Gross Beta	EPA 900/9310	0.335 +/- 1.28	dpm/100cm 2	1.36		8/10/06	RE
Lab ID:	20060675-03						
Client ID:	K-SS-350						
Date Sampled:	8/8/06 2:17:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.295 +/- 0.362	dpm/100cm 2	0.269		8/10/06	RE
Gross Beta	EPA 900/9310	2.79 +/- 2.30	dpm/100cm 2	2.37		8/10/06	RE
Lab ID:	20060675-04						
Client ID:	K-SS-351						
Date Sampled:	8/8/06 2:18:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.376 +/- 0.445	dpm/100cm 2	0.359		8/10/06	RE
Gross Beta	EPA 900/9310	1.16 +/- 1.38	dpm/100cm 2	1.41		8/10/06	RE

BDL = Below Detection Limit

Outreach Laboratory
311 North Aspen
Broken Arrow, OK 74012
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Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060675
Date Reported:	8/15/06
Date Received:	8/9/06
Page Number:	2 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060675-05						
Client ID:	K-SS-352						
Date Sampled:	8/8/06 2:19:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.192	dpm/100cm 2	0.542		8/10/06	RE
Gross Beta	EPA 900/9310	0 +/- 0.671	dpm/100cm 2	1.62		8/10/06	RE
Lab ID:	20060675-06						
Client ID:	K-SS-353						
Date Sampled:	8/8/06 2:20:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.432	dpm/100cm 2	1.07		8/10/06	RE
Gross Beta	EPA 900/9310	0 +/- 0.726	dpm/100cm 2	1.75		8/10/06	RE
Lab ID:	20060675-07						
Client ID:	K-SS-354						
Date Sampled:	8/8/06 2:21:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.387	dpm/100cm 2	0.466		8/10/06	RE
Gross Beta	EPA 900/9310	1.46 +/- 1.44	dpm/100cm 2	1.45		8/10/06	RE
Lab ID:	20060675-08						
Client ID:	K-SS-355						
Date Sampled:	8/8/06 2:22:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.054 +/- 0.433	dpm/100cm 2	0.453		8/10/06	RE
Gross Beta	EPA 900/9310	1.62 +/- 1.24	dpm/100cm 2	1.20		8/10/06	RE

BDL = Below Detection Limit

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Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060675
Date Reported:	8/15/06
Date Received:	8/9/06
Page Number:	3 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060675-09						
Client ID:	K-SS-356						
Date Sampled:	8/8/06 2:23:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.100 +/- 0.539	dpm/100cm 2	0.560		8/10/06	RE
Gross Beta	EPA 900/9310	0.952 +/- 1.40	dpm/100cm 2	1.45		8/10/06	RE
Lab ID:	20060675-10						
Client ID:	K-SS-357						
Date Sampled:	8/8/06 2:24:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.519	dpm/100cm 2	0.574		8/10/06	RE
Gross Beta	EPA 900/9310	1.39 +/- 1.36	dpm/100cm 2	1.36		8/10/06	RE
Lab ID:	20060675-11						
Client ID:	K-SS-358						
Date Sampled:	8/8/06 2:25:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.478 +/- 0.417	dpm/100cm 2	0.269		8/10/06	RE
Gross Beta	EPA 900/9310	1.45 +/- 2.25	dpm/100cm 2	2.37		8/10/06	RE
Lab ID:	20060675-12						
Client ID:	K-SS-359						
Date Sampled:	8/8/06 2:26:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.315 +/- 0.428	dpm/100cm 2	0.359		8/10/06	RE
Gross Beta	EPA 900/9310	0.777 +/- 1.35	dpm/100cm 2	1.41		8/10/06	RE

BDL = Below Detection Limit

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Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060675
Date Reported:	8/15/06
Date Received:	8/9/06
Page Number:	4 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060675-13						
Client ID:	K-SS-360						
Date Sampled:	8/8/06 2:27:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.475	dpm/100cm 2	0.542		8/10/06	RE
Gross Beta	EPA 900/9310	0.469 +/- 1.52	dpm/100cm 2	1.62		8/10/06	RE
Lab ID:	20060675-14						
Client ID:	K-SS-361						
Date Sampled:	8/8/06 2:28:00 PM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.959	dpm/100cm 2	1.07		8/10/06	RE
Gross Beta	EPA 900/9310	0 +/- 1.57	dpm/100cm 2	1.75		8/10/06	RE

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Gross Alpha	0	81.0	92.0	12.0	NC				8/10/06
Gross Alpha	0	72.0	83.0	13.8	NC				8/10/06
Gross Beta	0	104.0	114.0	9.0	NC				8/10/06
Gross Beta	0	64.0	67.0	3.8	NC				8/10/06

Lab Approval:

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company: Kaiser Alum & Chem Inc.
Name: David C. Weyant
Address: 7311 E. 41st St.
City: Tulsa State: OK Zip: 74145
Phone: 724 934-3230 Fax #: 918 384-3171
Local: 918-384-0106
Cell: 724-799-0071

Bill To:
Company: Kaiser Alum & Chem
Name: Bill Vincent / David Weyant
Address: 7311 E 41st St.
City: Tulsa State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: Kaiser - 4072
PROJECT #: PA-4000 - 4072
PROJECT NAME: Kaiser Alum & Chem Inc. Remediation
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): Results Due By 8-14-06
SAMPLER: Dave Weyant (Signature)

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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)	Grab/Composite	Total Metals (Hg, Cd, Cr, Pb, Ni, Zn, Cu, Ag, Al, Ba, Be, Co, Mo, Se, Sb, Tl, V)	Total Metals (Ag, Al, Ba, Be, Co, Mo, Se, Sb, Tl, V)	Total Metals (Hg, Cd, Cr, Pb, Ni, Zn, Cu)	Total Metals (As, Cd, Cr, Pb, Ni, Zn, Cu, Ag, Al, Ba, Be, Co, Mo, Se, Sb, Tl, V)				REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
1	K-SS-348	8-8-06	1415	Swipe	1	cloth	none	X	X	X	X	X				Grab
2	K-SS-349		1416		1			X	X	X	X	X				
3	K-SS-350		1417		1			X	X	X	X	X				
4	K-SS-351		1418		1			X	X	X	X	X				
5	K-SS-352		1419		1			X	X	X	X	X				
6	K-SS-353		1420		1			X	X	X	X	X				
7	K-SS-354		1421		1			X	X	X	X	X				
8	K-SS-355		1422		1			X	X	X	X	X				
9	K-SS-356		1423		1			X	X	X	X	X				
10	K-SS-357		1424		1			X	X	X	X	X				
11	K-SS-358		1425		1			X	X	X	X	X				
12	K-SS-359		1426		1			X	X	X	X	X				
13	K-SS-360		1427		1			X	X	X	X	X				
14	K-SS-361		1428		1			X	X	X	X	X				

RELINQUISHED BY: Dave Weyant DATE: 8/8 TIME: 1430 RECEIVED BY: [illegible] DATE: 8/8 TIME: 1430

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

FOR LABORATORY USE ONLY: 060875

Sample Condition Upon Receipt: Good

Custody Seals Intact: Y N

Cooler Temperature: NA

SAMPLE LOGIN

Date Received: *8/9/06 10:52:50 A* **Lab Number:** 20060675 **Due:** 8/14/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060675-01 A Gross Alpha/Beta	K-SS-348	Swipe	08/08/06	Plastic	Sm Zip Bag	None	No	No
20060675-02 A Gross Alpha/Beta	K-SS-349	Swipe	08/08/06	Plastic	Sm Zip Bag	None	No	No
20060675-03 A Gross Alpha/Beta	K-SS-350	Swipe	08/08/06	Plastic	Sm Zip Bag	None	No	No
20060675-04 A Gross Alpha/Beta	K-SS-351	Swipe	08/08/06	Plastic	Sm Zip Bag	None	No	No
20060675-05 A Gross Alpha/Beta	K-SS-352	Swipe	08/08/06	Plastic	Sm Zip Bag	None	No	No
20060675-06 A Gross Alpha/Beta	K-SS-353	Swipe	08/08/06	Plastic	Sm Zip Bag	None	No	No
20060675-07 A Gross Alpha/Beta	K-SS-354	Swipe	08/08/06	Plastic	Sm Zip Bag	None	No	No
20060675-08 A Gross Alpha/Beta	K-SS-355	Swipe	08/08/06	Plastic	Sm Zip Bag	None	No	No
20060675-09 A Gross Alpha/Beta	K-SS-356	Swipe	08/08/06	Plastic	Sm Zip Bag	None	No	No
20060675-10 A Gross Alpha/Beta	K-SS-357	Swipe	08/08/06	Plastic	Sm Zip Bag	None	No	No
20060675-11 A Gross Alpha/Beta	K-SS-358	Swipe	08/08/06	Plastic	Sm Zip Bag	None	No	No
20060675-12 A	K-SS-359	Swipe	08/08/06	Plastic	Sm Zip Bag	None	No	No

Gross Alpha/Beta								
20060675-13 A Gross Alpha/Beta	K-SS-360	Swipe	08/08/06	Plastic	Sm Zip Bag	None	No	No
20060675-14 A Gross Alpha/Beta	K-SS-361	Swipe	08/08/06	Plastic	Sm Zip Bag	None	No	No

CONTAINER INSPECTION

 # Coolers 0 **Custody Seals Broken** – **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ✓ **Labels in Tact** ✓ **Radiation Survey Complete** ✓

Anomalies

Inspected By: _____ **DATE** _____

QA or Designee Review: Raymond Thomas **DATE** 08/09/06

Sample Custodian Review: _____ **DATE** 8/9/06

Project Notes:

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

K-SS- 313 → 377 POA - 00911
K-SS- 317 (QA)

INVOICE # 12338

August 15, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060681

Dear Mr. Weyant,

Please find enclosed the analytical report for your samples received in our laboratory on August 10, 2006 for the above captioned project. Sixteen swipes were received in good condition and analyzed for Gross Alpha/Beta with an expedited 3 work-day turn time. Results were faxed on 8/15/06.

All Quality Control for the requested analyses is reported on the analytical report. The method blank, laboratory control standard and matrix spikes and spike duplicates for all analyses were within method control limits with the exception of the Gross Beta method Blank. Results were not affected in any way.

Your samples will be returned as requested.

Thank you for choosing Outreach Laboratory and if you have any questions feel free to call.

Laboratory Director

ODEQ ID #9517
NRC ODEQ LIC. #27522-01

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID# OK001

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Broken Arrow, OK 74012
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Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060681
Date Reported:	8/15/06
Date Received:	8/10/06
Page Number:	1 of 5

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060681-01						
Client ID:	K-SS-363						
Date Sampled:	8/9/06 10:05:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.193 +/- 0.394	dpm/100cm 2	0.359		8/10/06	RE
Gross Beta	EPA 900/9310	1.11 +/- 1.37	dpm/100cm 2	1.41		8/10/06	RE
Lab ID:	20060681-02						
Client ID:	K-SS-364						
Date Sampled:	8/9/06 10:06:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.198 +/- 0.545	dpm/100cm 2	0.542		8/10/06	RE
Gross Beta	EPA 900/9310	2.05 +/- 1.62	dpm/100cm 2	1.62		8/10/06	RE
Lab ID:	20060681-03						
Client ID:	K-SS-365						
Date Sampled:	8/9/06 10:07:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.913	dpm/100cm 2	1.07		8/10/06	RE
Gross Beta	EPA 900/9310	0.182 +/- 1.63	dpm/100cm 2	1.75		8/10/06	RE
Lab ID:	20060681-04						
Client ID:	K-SS-366						
Date Sampled:	8/9/06 10:08:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.422	dpm/100cm 2	0.466		8/10/06	RE
Gross Beta	EPA 900/9310	1.12 +/- 1.42	dpm/100cm 2	1.45		8/10/06	RE

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060681
Date Reported:	8/15/06
Date Received:	8/10/06
Page Number:	2 of 5

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	**20060681-05**						
Client ID:	**K-SS-367**						
Date Sampled:	**8/9/06 10:09:00 AM**						
Matrix:	**Swipe**						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.416	dpm/100cm 2	0.453		8/10/06	RE
Gross Beta	EPA 900/9310	1.34 +/- 1.22	dpm/100cm 2	1.20		8/10/06	RE
Lab ID:	**20060681-06**						
Client ID:	**K-SS-368**						
Date Sampled:	**8/9/06 10:10:00 AM**						
Matrix:	**Swipe**						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.100 +/- 0.539	dpm/100cm 2	0.560		8/10/06	RE
Gross Beta	EPA 900/9310	0.952 +/- 1.40	dpm/100cm 2	1.45		8/10/06	RE
Lab ID:	**20060681-07**						
Client ID:	**K-SS-369**						
Date Sampled:	**8/9/06 10:11:00 AM**						
Matrix:	**Swipe**						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0 +/- 0.214	dpm/100cm 2	0.574		8/10/06	RE
Gross Beta	EPA 900/9310	0.647 +/- 0.612	dpm/100cm 2	1.36		8/10/06	RE
Lab ID:	**20060681-08**						
Client ID:	**K-SS-370**						
Date Sampled:	**8/9/06 10:12:00 AM**						
Matrix:	**Swipe**						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.325 +/- 0.216	dpm/100cm 2	0.269		8/11/06	RE
Gross Beta	EPA 900/9310	0.999 +/- 1.03	dpm/100cm 2	2.37		8/11/06	RE

BDL = Below Detection Limit

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Date Reported:	8/15/06
Date Received:	8/10/06
Page Number:	3 of 5

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060681-09						
Client ID:	K-SS-371						
Date Sampled:	8/9/06 10:13:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.197 +/- 0.207	dpm/100cm 2	0.359		8/11/06	RE
Gross Beta	EPA 900/9310	0.587 +/- 0.625	dpm/100cm 2	1.41		8/11/06	RE
Lab ID:	20060681-10						
Client ID:	K-SS-372						
Date Sampled:	8/9/06 10:14:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.015 +/- 0.504	dpm/100cm 2	0.542		8/11/06	RE
Gross Beta	EPA 900/9310	0.373 +/- 1.52	dpm/100cm 2	1.62		8/11/06	RE
Lab ID:	20060681-11						
Client ID:	K-SS-373						
Date Sampled:	8/9/06 10:15:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.712 +/- 1.07	dpm/100cm 2	1.07		8/11/06	RE
Gross Beta	EPA 900/9310	0.469 +/- 1.64	dpm/100cm 2	1.75		8/11/06	RE
Lab ID:	20060681-12						
Client ID:	K-SS-374						
Date Sampled:	8/9/06 10:16:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.398 +/- 0.528	dpm/100cm 2	0.466		8/14/06	RE
Gross Beta	EPA 900/9310	0.211 +/- 1.36	dpm/100cm 2	1.45		8/14/06	RE

BDL = Below Detection Limit

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Lab Number:	20060681
Date Reported:	8/15/06
Date Received:	8/10/06
Page Number:	4 of 5

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060681-13						
Client ID:	K-SS-375						
Date Sampled:	8/9/06 10:17:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.054 +/- 0.433	dpm/100cm 2	0.453		8/14/06	RE
Gross Beta	EPA 900/9310	2.15 +/- 1.28	dpm/100cm 2	1.20		8/14/06	RE
Lab ID:	20060681-14						
Client ID:	K-SS-376						
Date Sampled:	8/9/06 10:18:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.405 +/- 0.602	dpm/100cm 2	0.560		8/14/06	RE
Gross Beta	EPA 900/9310	0.186 +/- 1.35	dpm/100cm 2	1.45		8/14/06	RE
Lab ID:	20060681-15						
Client ID:	K-SS-377						
Date Sampled:	8/9/06 10:19:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	1.23 +/- 0.755	dpm/100cm 2	0.574		8/14/06	RE
Gross Beta	EPA 900/9310	1.63 +/- 1.37	dpm/100cm 2	1.36		8/14/06	RE
Lab ID:	20060681-16						
Client ID:	K-SS-317						
Date Sampled:	8/9/06 11:14:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	1.47 +/- 0.675	dpm/100cm 2	0.359		8/11/06	RE
Gross Beta	EPA 900/9310	1.93 +/- 1.43	dpm/100cm 2	1.41		8/11/06	RE

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060681
Date Reported:	8/15/06
Date Received:	8/10/06
Page Number:	5 of 5

QC Report

Parameter	Blank	LCS	LCSD		DUP	MS	MSD		Date
		%REC	%REC	RPD	RPD	%REC	%REC	RPD	
Gross Alpha	0	81.0	74.0	8.9	NC				8/10/06
Gross Alpha	0	81.0	92.0	12.0	NC				8/10/06
Gross Beta	2.34	98.0	112.0	12.9	NC				8/10/06
Gross Beta	0	104.0	114.0	9.0	NC				8/10/06

Lab Approval:

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company: Kaiser Alum & Chem Inc.
Name: David J. Weyant
Address: 7211 E. 41st St.
City: Tulsa State: OK Zip: 74145
Phone: 724-934-3530 Fax #: 918-384-3171
Local: 918-384-0506
Cell: 724-744-0071

Bill To:
Company: Kaiser / Penn Eng
Name: Bill Vinzant / David Weyant
Address: 7211 E. 41st St.
City: Tulsa State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: Kaiser - 4572
PROJECT #: PA - 4000 - 4572
PROJECT NAME: Kaiser - Knox, Ohio.
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): Per Sat Doc
SAMPLER: Signature: [illegible] 8-14-06

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
	K-SS-361	8-9-06	1100	Soil	1	Cloth	none	X	X	X	X	X				Grab
	K-SS-364		1006		1			X	X	X	X	X				
	[illegible]		1007		1			X	X	X	X	X				
	[illegible]		[illegible]		1			X	X	X	X	X				
	[illegible]		[illegible]		1			X	X	X	X	X				
	[illegible]		[illegible]		1			X	X	X	X	X				
	[illegible]		[illegible]		1			X	X	X	X	X				
	[illegible]		[illegible]		1			X	X	X	X	X				
	[illegible]		[illegible]		1			X	X	X	X	X				
	[illegible]		[illegible]		1			X	X	X	X	X				
	[illegible]		[illegible]		1			X	X	X	X	X				
	[illegible]		[illegible]		1			X	X	X	X	X				
	[illegible]		[illegible]		1			X	X	X	X	X				
	[illegible]		[illegible]		1			X	X	X	X	X				

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

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.

FOR LABORATORY USE ONLY: [illegible]

Sample Condition Upon Receipt: Good

Custody Seals Intact: Y N

Cooler Temperature: NA

OUTREACH LABORATORY

CHAIN OF CUSTODY

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

Results To:
Company: Kaiser Alum & Chem Inc.
Name: Dave G. Weyant
Address: 7311 E. 41st St.
City: Tulsa State: OK Zip: 74145
Phone: 724-934-3234 Fax #: 918-384-3171
Local: 918-384-0166
Cell: 724-794-0071

Bill To:
Company: Kaiser / Pine Ear
Name: Bill Vinzant / Dave Weyant
Address: 7311 E. 41st St.
City: Tulsa State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: Kaiser-4572
PROJECT #: PA-4000-4572
PROJECT NAME: Kaiser - Alum. Remed.
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): Results Due By 8-14-06
SAMPLER: Dave Weyant / Dave Weyant (Signature)

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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)	Total Metals	Total Cyanide	Total Phenols	Total Sulfide	Total Arsenic				REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
	K-SS-377	8-9-06	10:14	SWTR	1	Plastic	none	X	X	X	X	X				Grab
	K-SS-317	8-9-06	11:14	SWTR	1		1	X	X	X	X	X				

RELINQUISHED BY: Dave Weyant / Dave Weyant DATE: / TIME: / RECEIVED BY: DATE: / TIME:
RELINQUISHED BY: DATE: TIME: RECEIVED BY: DATE: TIME:

My signature on the 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 DISPOSAL: All non-hazardous samples shall be disposed of 30 days after issue of final report. All others will be d at client's expense.

FOR LABORATORY USE ONLY:
Sample Condition Upon Receipt
Custody Seals Intact Y N NA
Cooler Temperature

SAMPLE LO

Date Received: *8/10/06 9:38:10 A* **Lab Number:** 20060681 **Due:** 8/14/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060681-01 A Gross Alpha/Beta	K-SS-363	Swipe	08/09/06	Plastic	Sm Zip Bag	None	No	No
20060681-02 A Gross Alpha/Beta	K-SS-364	Swipe	08/09/06	Plastic	Sm Zip Bag	None	No	No
20060681-03 A Gross Alpha/Beta	K-SS-365	Swipe	08/09/06	Plastic	Sm Zip Bag	None	No	No
20060681-04 A Gross Alpha/Beta	K-SS-366	Swipe	08/09/06	Plastic	Sm Zip Bag	None	No	No
20060681-05 A Gross Alpha/Beta	K-SS-367	Swipe	08/09/06	Plastic	Sm Zip Bag	None	No	No
20060681-06 A Gross Alpha/Beta	K-SS-368	Swipe	08/09/06	Plastic	Sm Zip Bag	None	No	No
20060681-07 A Gross Alpha/Beta	K-SS-369	Swipe	08/09/06	Plastic	Sm Zip Bag	None	No	No
20060681-08 A Gross Alpha/Beta	K-SS-370	Swipe	08/09/06	Plastic	Sm Zip Bag	None	No	No
20060681-09 A Gross Alpha/Beta	K-SS-371	Swipe	08/09/06	Plastic	Sm Zip Bag	None	No	No
20060681-10 A Gross Alpha/Beta	K-SS-372	Swipe	08/09/06	Plastic	Sm Zip Bag	None	No	No
20060681-11 A Gross Alpha/Beta	K-SS-373	Swipe	08/09/06	Plastic	Sm Zip Bag	None	No	No
20060681-12 A	K-SS-374	Swipe	08/09/06	Plastic	Sm Zip Bag	None	No	No

Gross Alpha/Beta								
20060681-13 A Gross Alpha/Beta	K-SS-375	Swipe	08/09/06	Plastic	Sm Zip Bag	None	No	No
20060681-14 A Gross Alpha/Beta	K-SS-376	Swipe	08/09/06	Plastic	Sm Zip Bag	None	No	No
20060681-15 A Gross Alpha/Beta	K-SS-377	Swipe	08/09/06	Plastic	Sm Zip Bag	None	No	No
20060681-16 A Gross Alpha/Beta	K-SS-317	Swipe	08/09/06	Plastic	Sm Zip Bag	None	No	No

CONTAINER INSPECTION

 # Coolers 0 **Custody Seals Broken** **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA ***Chain of Custody Record*** ☑ **Labels in Tact** ✓ **Radiation Survey Complete** ☑

Anomalies

Inspected By: _____ **DATE** 8/10/06

QA or Designee Review: _____ **DATE** _____

Sample Custodian Review: _____ **DATE** 8/10/06

Project Notes:

SUB-REPORT

SURVEY UNIT KAISER-FSSPOA-010

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ATTACHMENTS

ATTACHMENT A: Figure A-1 Gross Gamma Background and Scanning Survey Results
Figure A-2 Random Sampling Locations

ATTACHMENT B: Soil Survey Unit Worksheet No. 1

ATTACHMENT C: Laboratory Analytical Results

ATTACHMENT D: Figure D-1 Random Sampling Locations
Alpha Scan MDC Calculation
Table D-1 Gross Alpha Scan Results Summary
Total Alpha Contamination Survey Data Conversion Form

Final Status Survey Report
Volume VI - Post Operational Areas
Sub-Report No. POA-010
Survey Unit Kaiser-FSSPOA-010
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation
September 12, 2006

1.0 BACKGROUND

This sub-report documents the results of post operational 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-FSSPOA-010, the southern side (south of the north metal rail) of the railroad track spur area constructed for the load-out of exempt radiological materials to be disposed at the U.S. Ecology, Grandview, Idaho facility.

Survey Unit Kaiser-FSSPOA-010 is considered a Class 3 survey unit with an approximate surface area of 309 m^2. It overlies Excavation Bottom Survey Unit Kaiser-FSS-007. It is bounded to the south by the Union Pacific Railroad right-of-way, to the east by Excavation Bottom Survey Unit Kaiser-FSS-030, to the north by Post Operational Survey Units Kaiser-FSSPOA-005 and Kaiser-FSSPOA-011, and to the west by Excavation Bottom Survey Unit Kaiser-FSS-007 **(Figure 3)**.

Survey Unit Kaiser-FSSPOA-010 consists of the railroad spur's structural surfaces (south side of the north metal rail, wooden ties, and south metal rail), ballast material, and soil surface located to the immediate south of the rail spur. The load-out of the radiological materials occurred at the asphalt loading pad located to the immediate north of the railroad track spur. The final status survey of the northern portion of the railroad track spur is addressed as Survey Unit Kaiser-FSSPOA-011.

2.0 SURVEY ACTIVITIES AND RESULTS

This section of the sub-report presents the final status survey data for the ballast material/surface soil and structural surfaces (railroad spur's southern side of the north rail, wooden ties, and the south rail) of Survey Unit Kaiser-FSSPOA-010.

2.1 Ballast Material/Surface Soil

The final status survey of the ballast material/surface soil consisted of a judgmental gross gamma scan of the exposed surfaces of the survey unit and random sampling.

2.1.1 Gross Gamma Scan

The exposed surface of the Class 3 survey unit was surveyed through a 100 percent coverage gamma scan to confirm acceptable radiological conditions and identify any elevated areas. During the scanning of the survey unit, the detector was held close to the ground surface (1 to 2 inches) and moved in a serpentine pattern. Background measurements were obtained at 1-meter above the ground surface at 13 approximately equal-distant locations in the survey unit. The statistics for the 13 background measurements are provided below in **Table 1**. Background measurements ranged from 5,483 counts per minute (cpm) to 12,534 cpm.

A total of 2,934 measurements of gross count rate were made at two second intervals across the survey unit's 309 m^2 surface area. The results ranged from 3,322 cpm to 14,942 cpm. A statistical summary of the 100 percent coverage gamma scan of the survey unit is also provided below in **Table 1**.

Table 1 – Gross Gamma Scan Results Summary

Survey Area:	309 m^2	
Number of Scan Measurements (2-Second Intervals):	2,934	
Detector Swing Rate: (Swinging the detector a width of 1-meter side to side)	0.05 m/s (MARSSIM recommends 0.5 m/s)	
Results Summary:	**Background (Gross cpm)**	**Scan (Gross cpm)**
Minimum	5,483	3,322
Maximum	12,534	14,942
Average	7,482	6,856
Standard Deviation	2,360	2,559
Median	6,295	5,848

Contour maps of the gross gamma background and final (as-left condition) scanning survey results are presented on **Figure A-1** contained in **Attachment A**. The 100 percent coverage gross gamma scan did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site).

2.1.2 Random Sampling – Ballast Material/Surface Soil

As required by MARSSIM for a Class 3 survey unit, random soil samples were taken as part of the final survey. The Minimum Number of Samples Required (N) based on the scan MDC was determined to be 9 as documented on Soil Survey Unit Worksheet No. 1 (**Attachment B**).

A layout of the random sampling locations is provided on **Figure A-2** contained in **Attachment A**. The random sample locations were demarcated in the field using a GPS unit. A total of 13 soil samples (identified as K-1868 through K-1876, K-1927, K-1928, K-1930, and K-1931) were collected at the surface (0-6-inch depth interval) level using a clean, decontaminated sampling auger or sharpshooter shovel. The samples were forwarded to Outreach for analysis of Th-232 activity concentration. Analytical results are provided below in **Table 2**. Analytical data reports are contained in **Attachment C**.

Table 2 – Random Sample Results

Soil Sample ID	Gross Th-232 (pCi/g)	Std. Error (pCi/g)	MDC (pCi/g)	Net Th-232 (pCi/g)	Net DCGL (pCi/g)
K-1868	1.57	0.242	0.380	0.47	3.0
K-1869	0.809	0.125	0.282	0	3.0
K-1870	2.28	0.314	0.348	1.18	3.0
K-1871	0.898	0.166	0.261	0	3.0
K-1872	0.217	0.162	0.287	0	3.0
K-1873	0.695	0.073	0.290	0	3.0
K-1874	2.24	0.277	0.295	1.14	3.0
K-1875	1.95	0.322	0.471	0.85	3.0
K-1876	0.991	0.107	0.243	0	3.0
K-1927	1.79	0.208	0.213	0.69	3.0
K-1928	1.65	0.236	0.434	0.55	3.0
K-1930	1.82	0.321	0.594	0.72	3.0
K-1931	1.08	0.228	0.436	0	3.0
Average	***1.38***				
Standard Dev.	***0.643***				
Minimum	***0.217***				
Maximum	***2.28***				
Median	***1.57***				

All 13 random sample results (gross and net) were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$). The maximum gross Th-232 activity concentration was 2.28 pCi/g, which fell above the background Th-232 activity of 1.1 pCi/g for the site. The average gross Th-232 activity concentration was 1.38 pCi/g. The standard deviation of the 13 random samples was 0.643, which fell above the estimated standard deviation of 0.42 (based on the adjacent land final status survey results) used to calculate the minimum number of samples required.

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 0.643 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 (0.42). The net Th-232 activity concentration of 3.0 pCi/g was used as the DCGL and Δ was equal to 3.0 - 1.5, or 1.5. Delta divided by the sigma of 0.42 resulted in a relative shift of 3.57 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 DCGL value of 3.0 pCi/g, a recalculation of N results in a delta of (3 – 1.5) of 1.5 and a relative shift of (1.5 / 0.643) of 2.33. The resulting N is 11 (MARSSIM Table 5.3).

2.1.3 Wilcoxon Rank Sum (WRS) Testing

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

If the difference (1.51 pCi/g) between the maximum survey unit sample activity concentration (2.28 pCi/g) and the minimum reference background area soil sample activity concentration (0.77 pCi/g) is less than $DCGL_W$ (3.0 pCi/g), then the survey unit meets the release criterion. **Table 3** presents a summary of the data used to complete the statistical evaluation of the survey unit.

Table 3 – 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	197	1.52	S1	K-1868	1.57
R2	114	0.82	S2	K-1869	0.809
R3	258	0.81	S3	K-1870	2.28
R4	205	1.05	S4	K-1871	0.898
R5	243	0.77	S5	K-1872	0.217
R6	297	0.85	S6	K-1873	0.695
R7	68	1.33	S7	K-1874	2.24
R8	33	0.92	S8	K-1875	1.95
R9	246	1.46	S9	K-1876	0.991
R10	224	1.59	S10	K-1927	1.79

Reference Group	Sample ID	Th-232 (pCi/g)	Survey Unit Group	Sample ID	Th-232 (pCi/g)
R11	34	1.12	S11	K-1928	1.65
R12	27	1.24	S12	K-1930	1.82
R13	251	1.32	S13	K-1931	1.08
	Average	***1.14***		***Average***	***1.38***
	Std. Dev.	***0.29***		***Std. Dev.***	***0.643***
	Minimum	***0.77***		***Minimum***	***0.217***
	Maximum	***1.59***		***Maximum***	***2.28***
	Median	***1.12***		***Median***	***1.57***

2.2 Structural Surfaces (Wooden Ties and South Metal Rail)

The final status survey consisted of a judgmental gross alpha scan of the structural surfaces and random measurements of total and removable alpha contamination. The supporting documentation for the final status survey of the structural surfaces is contained in **Attachment D** and includes the following:

- **Figure D-1,** Random Sampling Locations
- Alpha Scan MDC Calculation
- **Table D-1,** Gross Alpha Scan Results Summary
- Total Alpha Contamination Survey Data Conversion Form

2.2.1 Gross Alpha Scan of Structural Surface

The structural surfaces of the Class 3 survey unit were surveyed through a judgmental gross alpha scan. Minimum, maximum, and average scan rates for alpha activity in gross cpm were recorded for the scan areas. The results of the scanning activities are summarized in **Table D-1** contained in **Attachment D**.

2.2.2 Random Measurements of Total and Removable Alpha Contamination

The final status survey also consisted of random measurements of total and removable alpha contamination. Since the DCGL values for total and removable contamination contained in the DPA have been revised (and approved by the NRC), the minimum number of sample points for measurement of total and removable alpha contamination has been recalculated. Since scanning measures total alpha contamination, the minimum number of sample points required (N) is re-determined if the alpha scan minimum detectable concentration (MDC) is greater than the total contamination DCGL.

<u>Determination of the Minimum Number of Sample Points (N)</u>

Paramount to determining the minimum number of sample points is the determination of the relative shift, delta over sigma (Δ/σ). Delta is equal to the difference between the DCGL and 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. The estimate of sigma used in the determination 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 (total) alpha activity concentration of 944 dpm/100cm^2 is the revised 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.

Adjusting N Based on Scan Minimum Detectable Contamination (MDC)

The scan of structural surfaces is used to detect elevated areas. The total contamination DCGL value applicable to final status surveys of structures for the Tulsa site is the DCGL-GA (DCGL gross alpha) and the value is 944 dpm/100cm^2 of total alpha contamination. Since the background count rate for gross alpha is usually very low, e.g., 1 count per minute (cpm), MARSSIM provides guidance for determining the scanning MDC for gross alpha based on the probability of detecting very small increments in gross alpha count rate, i.e., one of two counts. 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:

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

where:

$P(n \geq 1)$	=	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).

Increase the value of G until the corresponding probability equals the desired confidence level, e.g., 95 percent, and the resulting dpm is the MDC. (The dpm value may be divided by the active area of the detector, e.g., 100 cm^2 to yield an MDC result in dpm/100cm^2.) This method of determining the alpha scan MDC is not background dependent (assuming the background alpha count rate is low). However, the calculated MDC is dependent on the scan speed. Using this formula and typical alpha efficiencies for gas proportional detectors, the calculated scan MDC ranges from 400 to 1,180 dpm/100cm^2 based on scan speeds of a third of a detector width to one detector width per second. *This range of MDC values is the same magnitude as the DCGL-GA and does not result in an increase in the minimum number of samples required.*

The Minimum Number of Samples Required (N) was determined to be 9. However, the number of sample points used for the survey unit was 14.

Total and Removable Alpha Contamination Measurement Results

A layout of the total and removable alpha contamination measurement locations is provided on **Figure D-1** contained in **Attachment D**. At each of the 14 locations, a measurement (static count with a gas proportional detector) of total alpha contamination (identified as MARSSIM-001 through MARSSIM-014) and a smear sample for determination of removable alpha contamination (identified as K-SS-259 through K-SS-272) were collected on the structural surfaces. The smear samples were forwarded to Outreach for analysis of alpha activity (per the 100 cm^2 surface area sampled). Total alpha contamination measurement results are provided below in **Table 4**.

Table 4 – Total Alpha Contamination Measurement Results

Sample ID	DCGL-GA ($dpm/100cm^2$)	Total Contamination ($dpm/100cm^2$)	Std. Error ($dpm/100cm^2$)	MDC ($dpm/100cm^2$)
MARSSIM-001	944	52.7	38.1	48.3
MARSSIM-002	944	4.58	21.5	48.3
MARSSIM-003	944	4.58	21.5	48.3
MARSSIM-004	944	42.0	35.1	48.3
MARSSIM-005	944	90.2	47.1	48.3
MARSSIM-006	944	68.8	42.2	48.3
MARSSIM-007	944	4.58	21.5	48.3
MARSSIM-008	944	218	69.7	48.3
MARSSIM-009	944	31.3	31.8	48.3
MARSSIM-010	944	122	53.7	48.3
MARSSIM-011	944	58.1	39.5	48.3
MARSSIM-012	944	90.2	47.1	48.3
MARSSIM-013	944	58.1	39.5	48.3
MARSSIM-014	944	79.5	44.7	48.3
Average		***66.1***		
Standard Dev.		***56.3***		
Minimum		***4.58***		
Maximum		***218***		
Median		***58.1***		

All 14 total alpha contamination measurements were below the DCGL-GA of 944 $dpm/100cm^2$. The maximum total alpha contamination was 218 $dpm/100cm^2$. The average total alpha contamination was 66.1 $dpm/100cm^2$.

The standard deviation of the 14 equal-distant samples was 56.3, greater than the estimated standard deviation of 45.9 (based on the Flux Building Survey Unit FB-001 final status survey results) used to calculate the minimum number of samples (N) required. Using the observed standard deviation of 56.3 and the same methodology to determine N as presented above, a relative shift of 8.4 results. The N from Table 5.3 (MARSSIM) corresponding to a relative shift of 8.4 is 9.

Analytical results of the smear samples are provided below in **Table 5**. The analytical data report is contained in **Attachment D**.

Table 5 – Removable Alpha Contamination Smear Sample Results

Sample ID	DCGL-GA (dpm/100cm^2)	Removable Contamination (dpm/100cm^2)	Std. Error (dpm/100cm^2)	MDC (dpm/100cm^2)
MARSSIM-001 (K-SS-259)	94.4	0.755	0.774	0.631
MARSSIM-002 (K-SS-260)	94.4	0.755	0.774	0.631
MARSSIM-003 (K-SS-261)	94.4	0.844	0.793	0.631
MARSSIM-004 (K-SS-262)	94.4	1.83	0.983	0.631
MARSSIM-005 (K-SS-263)	94.4	1.65	0.951	0.631
MARSSIM-006 (K-SS-264)	94.4	2.27	1.06	0.631
MARSSIM-007 (K-SS-265)	94.4	1.56	0.935	0.631
MARSSIM-008 (K-SS-266)	94.4	15.7	2.39	0.631
MARSSIM-009 (K-SS-267)	94.4	2.45	1.09	0.631
MARSSIM-010 (K-SS-268)	94.4	10.9	2.02	0.631
MARSSIM-011 (K-SS-269)	94.4	1.83	0.983	0.631
MARSSIM-012 (K-SS-270)	94.4	4.15	1.33	0.631
MARSSIM-013 (K-SS-271)	94.4	1.38	0.902	0.631
MARSSIM-014 (K-SS-272)	94.4	0.397	0.690	0.631
Average		***3.32***		
Standard Dev.		***4.43***		
Minimum		***0.397***		
Maximum		***15.7***		
Median		***1.74***		

All 14 smear sample results were below the removable contamination DCGL-GA of 94.4 dpm/100cm^2 (10% of the total contamination DCGL-GA value). The maximum removable alpha contamination result was 15.7 dpm/100cm^2. The average removable alpha contamination result was 3.32 dpm/100cm^2, less than 4 % of the DCGL-GA value.

2.2.3 Wilcoxon Rank Sum (WRS) Testing

The total alpha contamination results were evaluated using the procedure contained in **Appendix C, Volume VI** of this Final Status Survey Report (Wilcoxon Rank Sum Test). The evaluation showed that the survey unit total alpha contamination results meet the DP statistical criterion based on the first statistical test described below.

If the difference (221 dpm/100cm^2) between the maximum survey unit total alpha contamination result (218 dpm/100cm^2) and the minimum reference background area total alpha contamination result (-2.85 dpm/100cm^2) is less than DCGL-GA (944 dpm/100cm^2), then the survey unit meets the release criterion. **Table 6** presents a summary of the data used to complete the statistical evaluation of the survey unit.

Table 6 – Reference Area and Survey Unit Total Alpha Contamination Results

Reference Group	Sample ID	Total Alpha Contamination (dpm/100cm^2)	Survey Unit Group	Sample ID	Total Alpha Contamination (dpm/100cm^2)
R1	Metal Rail	34.2	S1	MARSSIM-001	52.7
R2	Metal Rail	20.3	S2	MARSSIM-002	4.58
R3	Metal Rail	55.0	S3	MARSSIM-003	4.58
R4	Metal Rail	16.8	S4	MARSSIM-004	42.0
R5	Metal Rail	37.7	S5	MARSSIM-005	90.2
R6	Metal Rail	45.8	S6	MARSSIM-006	68.8
R7	Metal Rail	50.4	S7	MARSSIM-007	4.58
R8	Wooden Tie	-2.85	S8	MARSSIM-008	218
R9	Wooden Tie	6.41	S9	MARSSIM-009	31.3
R10	Wooden Tie	8.73	S10	MARSSIM-010	122
R11	Wooden Tie	9.89	S11	MARSSIM-011	58.1
R12	Wooden Tie	7.57	S12	MARSSIM-012	90.2
R13	Wooden Tie	8.73	S13	MARSSIM-013	58.1
R14	Wooden Tie	5.25	S14	MARSSIM-014	79.5
	Average:	***21.7***		***Average:***	***66.1***
	Standard Dev.	***19.1***		***Standard Dev.***	***56.3***
	Minimum:	***-2.85***		***Minimum:***	***4.58***
	Maximum:	***55.0***		***Maximum:***	***218***
	Median:	***13.4***		***Median:***	***58.1***

3.0 SUMMARY OF FINDINGS

Survey Unit Kaiser-FSSPOA-010 consists of the southern portion (south of the north metal rail) of the railroad track spur area constructed for the load-out of exempt radiological materials to be disposed at the U.S. Ecology, Grandview, Idaho facility. The load-out of the radiological materials occurred at the asphalt loading pad located to the immediate north of the railroad track spur. The final status survey of the northern portion of the railroad track spur is addressed as Survey Unit Kaiser-FSSPOA-011.

Survey Unit Kaiser-FSSPOA-010 is considered a Class 3 survey unit with an approximate surface area of 309 m^2. It overlies Excavation Bottom Survey Unit Kaiser-FSS-007. It is bounded to the south by the Union Pacific Railroad right-of-way, to the east by Excavation Bottom Survey Unit Kaiser-FSS-030, to the north by Post Operational Survey Units Kaiser-FSSPOA-005 and Kaiser-FSSPOA-011, and to the west by Excavation Bottom Survey Unit Kaiser-FSS-007 (**Figure 3**).

3.1 Ballast Material/Surface Soil

The acceptance criterion for open land areas (surface soil) at the Tulsa facility is the $DCGL_W$ of 3.0 pCi/g net Th-232 activity concentration. Final status survey activities for Survey Unit Kaiser-FSSPOA-010 consisted of a judgmental gross gamma scan of the exposed surface of the ballast material/soil and random sampling. The results of the final status survey activities were as follows:

- The 100 percent coverage gamma scan (final as-left condition) did not indicate the presence of small areas of elevated activity (above the $DCGL_W$ for the site).
- All 13 random sample results (gross and net) were below the open land area surrogate value of 3.0 pCi/g net Th-232 activity concentration ($DCGL_W$).
- The analytical results met the DP statistical criterion based on the first statistical evaluation of the data (WRS Test procedure).

3.2 Structural Surfaces - Total and Removable Alpha Contamination

The acceptance criterion for structures remaining at the Tulsa facility is the DCGL-GA of 944 dpm/100cm^2 for total alpha contamination and 94.4 dpm/100cm^2 for removable alpha contamination. Final status survey activities for Survey Unit Kaiser-FSSPOA-010 consisted of a judgmental gross alpha scan of the exposed structural surfaces of the survey unit and random measurements of total and removable alpha contamination. The results of the final status survey activities were as follows:

- All 14 random measurements of total alpha contamination were below the DCGL-GA of 944 dpm/100cm^2.
- All 14 smear sample results were below the DCGL-GA of 94.4 dpm/100cm^2 for removable alpha contamination.

- The total alpha contamination results meet the DP statistical criterion based on the first statistical evaluation of the data (WRS Test procedure).

3.3 Sum of Fractions for Entire Survey Unit

To evaluate the status of Survey Unit Kaiser-FSSPOA-010 as a whole, the fraction of each survey element's average activity divided by the applicable acceptance criteria is calculated for inclusion in the Sum of Fractions for the entire survey unit. The Total Sum of Fractions for total alpha contamination, removable alpha contamination, and the ballast material/surface soil is presented below in **Table 7.**

Table 7 – Fraction of Applicable Acceptance Criteria per Survey Unit Element

Survey Unit Element	Units	Average Activity	Acceptance Criteria	Fraction
FSSPOA-010 Total Alpha Contamination	dpm/100cm^2	66.1	944	0.07
FSSPOA-010 Removable Alpha Contamination	dpm/100cm^2	3.32	94.4	0.04
Ballast Material/Surface Soil	pCi/g	0	3.0	0.00
TOTAL SUM OF FRACTIONS				***0.11***

The results of the Sum of Fractions assessment show that Survey Unit Kaiser-FSSPOA-010 meets the DP acceptance criteria.

ATTACHMENT A
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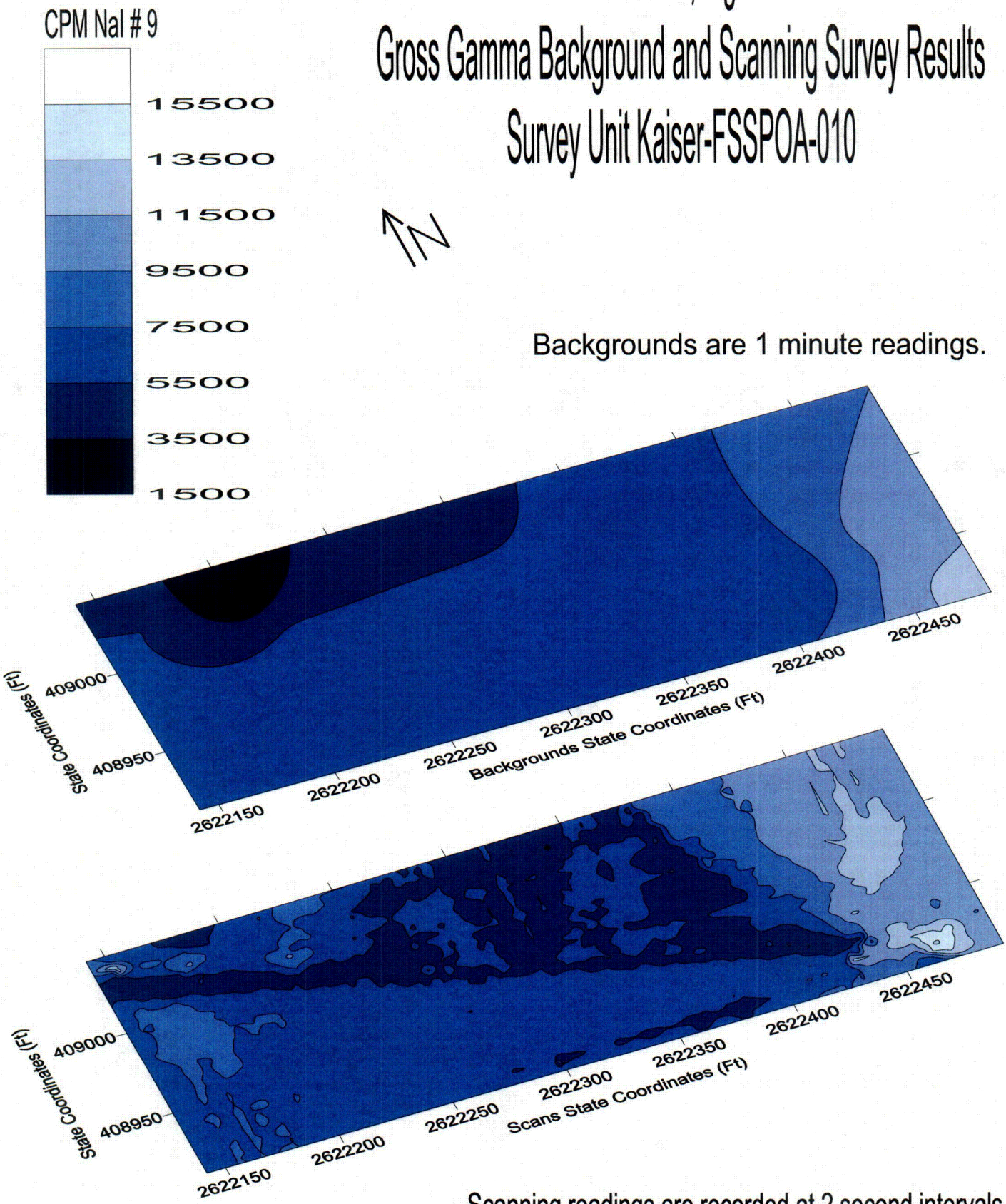
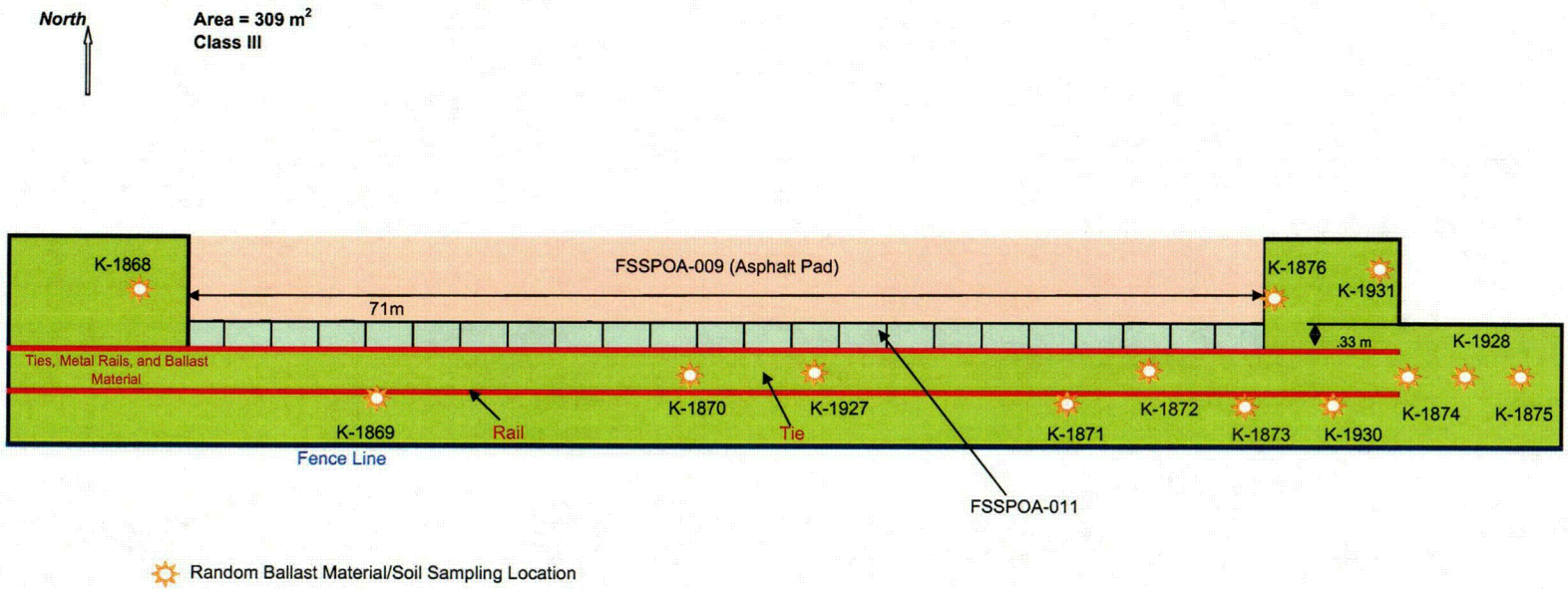
- **FIGURE A-1 Gross Gamma Background and Scanning Survey Results**
- **FIGURE A-2 Random Sampling Locations**

Attachment A, Figure A-1
Gross Gamma Background and Scanning Survey Results
Survey Unit Kaiser-FSSPOA-010



Scanning readings are recorded at 2 second intervals.

Figure A-2
Random Sampling Locations
Survey Unit Kaiser-FSSPOA- 010
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility



Q:\P4000\PA4072\FSS Reports\Volume VI\Survey Unit Kaiser-POA-010\Attachment A\POA-010 Figure A-2.xls

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ATTACHMENT B
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- **Soil Survey Unit Worksheet No. 1**

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-FSSPOA-010

2. Description: Southern Portion of Railroad Spur Area

3. Net Th-232 Acceptance Criteria (pCi/g): 3.0

4. Dimensions (m): Post Operational Area – approximately 87 meters x 3.6 meters; Area, A (m^2): 309

5. Estimated of Gross Gamma Scan Background Readings (cpm)
Average: 15,000 Minimum: 10,000 Maximum: 30,000

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) are:

- Gross Gamma Scan MDC (pCi/g): 3.1
- Minimum Number of Samples (N): 9

ATTACHMENT C

Laboratory Analytical Results

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

Invoice # 12700 8-7-06

K-1868 → 1876 PO# 010

August 7, 2006

ok ✓

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

David F. Weyant
DAVID F. WEYANT
PENN E&R

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060630

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples received in our laboratory on July 31, 2006 for the above captioned project. Nine soil samples were received in good condition and analyzed by Gamma Spectroscopy without drying and grinding and Percent Moisture with an expedited 5-work day turn. Results were faxed on 8/3/06.

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

ACCREDITED IN ACCORDANCE WITH nelac
CERT. ID #OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060630
Date Reported:	8/7/06
Date Received:	7/31/06
Page Number:	1 of 3

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	**20060630-01**						
Client ID:	**K-1868**						
Date Sampled:	**7/28/06 9:20:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	1.57 +/- 0.242	pCi/g	0.380		7/31/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	8.6	%		8/1/06	8/2/06	RS
Lab ID:	**20060630-02**						
Client ID:	**K-1869**						
Date Sampled:	**7/28/06 9:25:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.809 +/- 0.125	pCi/g	0.282		7/31/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	2.0	%		8/1/06	8/2/06	RS
Lab ID:	**20060630-03**						
Client ID:	**K-1870**						
Date Sampled:	**7/28/06 9:30:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	2.28 +/- 0.314	pCi/g	0.348		7/31/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	0.5	%		8/1/06	8/2/06	RS
Lab ID:	**20060630-04**						
Client ID:	**K-1871**						
Date Sampled:	**7/28/06 9:35:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					
Thorium 232	HASL 300	0.898 +/- 0.166	pCi/g	0.261		7/31/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	1.9	%		8/1/06	8/2/06	RS
Lab ID:	**20060630-05**						
Client ID:	**K-1872**						
Date Sampled:	**7/28/06 9:40:00 AM**						
Matrix:	**Soil**						
		Radiochemical Analyses					

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060630
Date Reported:	8/7/06
Date Received:	7/31/06
Page Number:	2 of 3

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Thorium 232	HASL 300	0.217 +/- 0.162	pCi/g	0.287		7/31/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	0.2	%		8/1/06	8/2/06	RS

Lab ID: 20060630-06
Client ID: K-1873
Date Sampled: 7/28/06 9:45:00 AM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.695 +/- 0.073	pCi/g	0.290		7/31/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	1.3	%		8/1/06	8/2/06	RS

Lab ID: 20060630-07
Client ID: K-1874
Date Sampled: 7/28/06 9:50:00 AM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	2.24 +/- 0.277	pCi/g	0.295		7/31/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	8.8	%		8/1/06	8/2/06	RS

Lab ID: 20060630-08
Client ID: K-1875
Date Sampled: 7/28/06 9:55:00 AM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	1.95 +/- 0.322	pCi/g	0.471		7/31/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	5.8	%		8/1/06	8/2/06	RS

Lab ID: 20060630-09
Client ID: K-1876
Date Sampled: 7/28/06 10:00:00 AM
Matrix: Soil

		Radiochemical Analyses					
Thorium 232	HASL 300	0.991 +/- 0.107	pCi/g	0.243		7/31/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	16.7	%		8/1/06	8/2/06	RS

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060630
Date Reported:	8/7/06
Date Received:	7/31/06
Page Number:	3 of 3

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Ac-228					12.0				7/31/06
Am-241		122.0	84.0	36.1					7/31/06
Co-60		97.0	99.0	2.1					7/31/06
Cs-137		94.0	94.0	0.7					7/31/06
Percent Moisture					5.7				8/2/06

Lab Approval:

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To: LOCAL: 918-394-0176 Cell: 714-799-0071

Company: KAISER - ALUM & CHEM INC.
Name: DAVID G. WEYAND
Address: 7211 E. 41st ST.
City: TULSA State: OK Zip: 74145
Phone: 714-934-3373 Fax #: 918-784-3171

Bill To:
Company: KAISER/FEDERAL
Name: BILL VINZANT / DAVE WEYAND
Address: 7211 E. 41st ST.
City: TULSA State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: KAISER - 4272
PROJECT #: PA - 4200 - 4272
PROJECT NAME: KAISER - THE ALUM PLANT
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): 5 DAY
SAMPLER: DAVE WEYAND Signature

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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)	GRAVIMETRIC (SW-846)	PETROLEUM HYDROCARBONS	VOC	ASTM 7216.42					REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
1	K-1868	7-28-06	0920	Soil	1	PLASTIC	NONE	X	X	X	X					GRAB
2	K-1869		0921	GRAVEL	1			X	X	X	X					
3	K-1870		0930	GRAVEL	1			X	X	X	X					
4	K-1871		0930	Soil	1			X	X	X	X					
5	K-1872		0940	GRAVEL	1			X	X	X	X					
6	K-1873		0940	GRAVEL	1			X	X	X	X					
7	K-1874		0950	Soil	1			X	X	X	X					
8	K-1875		0950	Soil	1			X	X	X	X					
9	K-1876		1000	Soil	1			X	X	X	X					

RELINQUISHED BY: DAVE WEYAND DATE 7/31/06 TIME 9:00 RECEIVED BY: [illegible] DATE 7/31/06 TIME 9:00

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.

FOR LABORATORY USE ONLY: [illegible]

Sample Condition Upon Receipt: [illegible]

Custody Seals Intact: (Y) N

Cooler Temperature: NA

SAMPLE LOGIN

Date Received: *7/31/06 10:30:14* **Lab Number:** 20060630 **Due:** 8/4/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060630-01 A	K-1868	Soil	07/28/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060630-02 A	K-1869	Soil	07/28/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060630-03 A	K-1870	Soil	07/28/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060630-04 A	K-1871	Soil	07/28/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060630-05 A	K-1872	Soil	07/28/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060630-06 A	K-1873	Soil	07/28/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060630-07 A	K-1874	Soil	07/28/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060630-08 A	K-1875	Soil	07/28/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060630-09 A	K-1876	Ballast	07/28/06	Plastic	16 oz	None	Yes	Yes
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								

CONTAINER INSPECTION

 # Coolers 1 **Custody Seals Broken** **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ✔ **Labels in Tact** ✔ **Radiation Survey Complete**

Anomalies

Inspected By: _____ **DATE** 7/31/06

QA or Designee Review: _____ **DATE** 07/31/06

Sample Custodian Review: _____ **DATE** 7/31/06

Project Notes:

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

RSSPOA-010
K-SS-259 → 272
Invoice # 12316
8-8-06

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060632
Date Reported:	8/8/06
Date Received:	7/31/06
Page Number:	1 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060632-01						
Client ID:	K-SS-259						
Date Sampled:	7/29/06 9:05:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.755 +/- 0.774	dpm/100cm 2	0.631		7/31/06	SD
Gross Beta	EPA 900/9310	0.981 +/- 0.245	dpm/100cm 2	2.57		7/31/06	SD
Lab ID:	20060632-02						
Client ID:	K-SS-260						
Date Sampled:	7/29/06 9:10:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.755 +/- 0.774	dpm/100cm 2	0.631		7/31/06	SD
Gross Beta	EPA 900/9310	0 +/- 2.25	dpm/100cm 2	2.57		7/31/06	SD
Lab ID:	20060632-03						
Client ID:	K-SS-261						
Date Sampled:	7/29/06 9:15:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.844 +/- 0.793	dpm/100cm 2	0.631		7/31/06	SD
Gross Beta	EPA 900/9310	0 +/- 2.33	dpm/100cm 2	2.57		7/31/06	SD
Lab ID:	20060632-04						
Client ID:	K-SS-262						
Date Sampled:	7/29/06 9:20:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	1.83 +/- 0.983	dpm/100cm 2	0.631		7/31/06	SD
Gross Beta	EPA 900/9310	2.15 +/- 2.54	dpm/100cm 2	2.57		7/31/06	SD

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060632
Date Reported:	8/8/06
Date Received:	7/31/06
Page Number:	2 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060632-05						
Client ID:	K-SS-263						
Date Sampled:	7/29/06 9:25:00 AM						
Matrix:	Swipé						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	1.65 +/- 0.951	dpm/100cm 2	0.631		7/31/06	SD
Gross Beta	EPA 900/9310	0.590 +/- 2.42	dpm/100cm 2	2.57		7/31/06	SD
Lab ID:	20060632-06						
Client ID:	K-SS-264						
Date Sampled:	7/29/06 9:30:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	2.27 +/- 1.06	dpm/100cm 2	0.631		7/31/06	SD
Gross Beta	EPA 900/9310	1.86 +/- 2.52	dpm/100cm 2	2.57		7/31/06	SD
Lab ID:	20060632-07						
Client ID:	K-SS-265						
Date Sampled:	7/29/06 9:35:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	1.56 +/- 0.935	dpm/100cm 2	0.631		7/31/06	SD
Gross Beta	EPA 900/9310	2.35 +/- 2.55	dpm/100cm 2	2.57		7/31/06	SD
Lab ID:	20060632-08						
Client ID:	K-SS-266						
Date Sampled:	7/29/06 9:40:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	15.7 +/- 2.39	dpm/100cm 2	6.31		7/31/06	SD
Gross Beta	EPA 900/9310	6.35 +/- 2.83	dpm/100cm 2	2.57		7/31/06	SD

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060632
Date Reported:	8/8/06
Date Received:	7/31/06
Page Number:	3 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060632-09						
Client ID:	K-SS-267						
Date Sampled:	7/29/06 9:45:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	2.45 +/- 1.09	dpm/100cm 2	6.31		8/1/06	SD
Gross Beta	EPA 900/9310	3.13 +/- 2.61	dpm/100cm 2	2.57		8/1/06	SD
Lab ID:	20060632-10						
Client ID:	K-SS-268						
Date Sampled:	7/29/06 9:50:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	10.9 +/- 2.02	dpm/100cm 2	0.631		8/1/06	SD
Gross Beta	EPA 900/9310	5.86 +/- 2.80	dpm/100cm 2	2.57		8/1/06	SD
Lab ID:	20060632-11						
Client ID:	K-SS-269						
Date Sampled:	7/29/06 9:55:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	1.83 +/- 0.983	dpm/100cm 2	0.631		8/1/06	SD
Gross Beta	EPA 900/9310	2.44 +/- 2.56	dpm/100cm 2	2.57		8/1/06	SD
Lab ID:	20060632-12						
Client ID:	K-SS-270						
Date Sampled:	7/29/06 10:00:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	4.15 +/- 1.33	dpm/100cm 2	0.631		8/1/06	SD
Gross Beta	EPA 900/9310	2.83 +/- 2.59	dpm/100cm 2	2.57		8/1/06	SD

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060632
Date Reported:	8/8/06
Date Received:	7/31/06
Page Number:	4 of 4

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060632-13						
Client ID:	K-SS-271						
Date Sampled:	7/29/06 10:05:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	1.38 +/- 0.902	dpm/100cm 2	0.631		8/1/06	SD
Gross Beta	EPA 900/9310	0.298 +/- 2.40	dpm/100cm 2	2.57		8/1/06	SD
Lab ID:	20060632-14						
Client ID:	K-SS-272						
Date Sampled:	7/29/06 10:10:00 AM						
Matrix:	Swipe						
		Radiochemical Analyses					
Gross Alpha	EPA 900/9310	0.397 +/- 0.690	dpm/100cm 2	0.631		8/1/06	SD
Gross Beta	EPA 900/9310	1.86 +/- 2.52	dpm/100cm 2	2.57		8/1/06	SD

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Gross Alpha	0	115.0	113.0	2.1	14.0				8/1/06
Gross Alpha	0.397	105.0	106.0	0.8	NC				7/31/06
Gross Beta	1.66	50.0	55.0	9.9	57.6				8/1/06
Gross Beta	0	57.0	53.0	7.8	NC				7/31/06

Lab Approval:

BDL = Below Detection Limit

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To: Company Kaiser Alum Rcha Inc.
Name DAVID R. WRYANT
Address 7211 E. 41st St.
City Tulsa State OK Zip 74145
Phone 774-994-3570 Fax # 918-294-2171

Bill To: Company Kaiser / Bro Eng
Name Bill Vuzal / Dave Wryant
Address 7211 E. 41st St.
City Tulsa State OK Zip 74145

ANALYSIS REQUESTED

PO # Kaiser - Hoyt
PROJECT # [illegible]
PROJECT NAME Kaiser - [illegible]
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY) 5 DAY
SAMPLER Signature

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
	K-SS 254	7-29-96	[illegible]	Water	1	Glass	[illegible]	X	X	X	X	X				Grab
	K-SS-260		[illegible]		1			X	X	X	X	X				
	K-SS-261		[illegible]		1			X	X	X	X	X				
	K-SS-262		[illegible]		1			X	X	X	X	X				
	K-SS-263		[illegible]		1			X	X	X	X	X				
	K-SS-264		[illegible]		1			X	X	X	X	X				
	K-SS-265		[illegible]		1			X	X	X	X	X				
	K-SS-266		[illegible]		1			X	X	X	X	X				
	K-SS-267		[illegible]		1			X	X	X	X	X				
	K-SS-268		[illegible]		1			X	X	X	X	X				
	K-SS-269		[illegible]		1			X	X	X	X	X				
	K-SS-270		[illegible]		1			X	X	X	X	X				
	K-SS-271		[illegible]		1			X	X	X	X	X				
	K-SS-272		[illegible]		1			X	X	X	X	X				

RELINQUISHED BY: [illegible] DATE [illegible] TIME [illegible] RECEIVED BY: [illegible] DATE [illegible] TIME [illegible]

RELINQUISHED BY: [illegible] DATE [illegible] TIME [illegible] RECEIVED BY: [illegible] DATE [illegible] TIME [illegible]

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 lia[illegible]le for any reasonable attorney and/or collection fees and all related costs necessary to remit the entire balance to O[illegible]each Technologies, Inc. (Outreach Laboratory).

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

FOR LABORATORY USE ONLY: [illegible]

Sample Condition Upon Receipt Good

Custody Seals Intact Y N N/A

Cooler Temperature [illegible]

SAMPLE LOGIN

Date Received: 7/31/06 10:35:43 **Lab Number:** 20060632 **Due:** 8/4/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060632-01 A Gross Alpha/Beta	K-SS-259	Swipe	07/29/06	Plastic	Sm Zip Bag	None	No	No
20060632-02 A Gross Alpha/Beta	K-SS-260	Swipe	07/29/06	Plastic	Sm Zip Bag	None	No	No
20060632-03 A Gross Alpha/Beta	K-SS-261	Swipe	07/29/06	Plastic	Sm Zip Bag	None	No	No
20060632-04 A Gross Alpha/Beta	K-SS-262	Swipe	07/29/06	Plastic	Sm Zip Bag	None	No	No
20060632-05 A Gross Alpha/Beta	K-SS-263	Swipe	07/29/06	Plastic	Sm Zip Bag	None	No	No
20060632-06 A Gross Alpha/Beta	K-SS-264	Swipe	07/29/06	Plastic	Sm Zip Bag	None	No	No
20060632-07 A Gross Alpha/Beta	K-SS-265	Swipe	07/29/06	Plastic	Sm Zip Bag	None	No	No
20060632-08 A Gross Alpha/Beta	K-SS-266	Swipe	07/29/06	Plastic	Sm Zip Bag	None	No	No
20060632-09 A Gross Alpha/Beta	K-SS-267	Swipe	07/29/06	Plastic	Sm Zip Bag	None	No	No
20060632-10 A Gross Alpha/Beta	K-SS-268	Swipe	07/29/06	Plastic	Sm Zip Bag	None	No	No
20060632-11 A Gross Alpha/Beta	K-SS-269	Swipe	07/29/06	Plastic	Sm Zip Bag	None	No	No
20060632-12 A	K-SS-270	Swipe	07/29/06	Plastic	Sm Zip Bag	None	No	No

Gross Alpha/Beta								
20060632-13 A Gross Alpha/Beta	K-SS-271	Swipe	07/29/06	Plastic	Sm Zip Bag	None	No	No
20060632-14 A Gross Alpha/Beta	K-SS-272	Swipe	07/29/06	Plastic	Sm Zip Bag	None	No	No

CONTAINER INSPECTION

 # Coolers 1 **Custody Seals Broken** **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ✓ **Labels in Tact** ✓ **Radiation Survey Complete**

Anomalies

Inspected By: _____ **DATE** 7/31/06

QA or Designee Review: _____ **DATE** 07/31/07

Sample Custodian Review: _____ **DATE** 7/31/06

Project Notes:

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

INVOICE # 12368
PoA- 010
K-1927 → | 1930 →
1928 | 1931

August 22, 2006

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

Project: Kaiser Thorium Remediation PA-4000-4072
OUTREACH LAB ID: 20060711

Dear Mr. Weyant:

Please find enclosed the analytical report for your samples received in our laboratory on August 18, 2006 for the above captioned project. Four soil samples were received in good condition and analyzed by Gamma Spectroscopy without drying and grinding and Percent Moisture with an expedited 2-work day. Results were faxed on time.

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

ACCREDITED IN ACCORDANCE WITH
CERT. ID #OK001

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060711
Date Reported:	8/22/06
Date Received:	8/18/06
Page Number:	1 of 2

Analytical Report

	Method	Result	Units	DL	Prep Date	Analysis Date	Analyst
Lab ID:	20060711-01						
Client ID:	K-1927						
Date Sampled:	7/27/06 3:35:00 PM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	1.79 +/- 0.208	pCi/g	0.213		8/18/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	1.3	%		8/21/06	8/22/06	RS
Lab ID:	20060711-02						
Client ID:	K-1928						
Date Sampled:	7/27/06 2:00:00 PM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	1.65 +/- 0.236	pCi/g	0.434		8/21/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	2.9	%		8/21/06	8/22/06	RS
Lab ID:	20060711-03						
Client ID:	K-1930						
Date Sampled:	7/26/06 2:10:00 PM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	1.82 +/- 0.321	pCi/g	0.594		8/21/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	6.2	%		8/21/06	8/22/06	RS
Lab ID:	20060711-04						
Client ID:	K-1931						
Date Sampled:	7/28/06 1:45:00 PM						
Matrix:	Soil						
		Radiochemical Analyses					
Thorium 232	HASL 300	1.08 +/- 0.228	pCi/g	0.436		8/18/06	SD
		Inorganics Analyses					
Percent Moisture	ASTM D2216-98	3.4	%		8/21/06	8/22/06	RS

BDL = Below Detection Limit

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

Client:	Kaiser Aluminum
Client Project:	Thorium Remediation
Lab Number:	20060711
Date Reported:	8/22/06
Date Received:	8/18/06
Page Number:	2 of 2

QC Report

Parameter	Blank	LCS %REC	LCSD %REC	LCSD RPD	DUP RPD	MS %REC	MSD %REC	MSD RPD	Date
Ac-228					8.4				
Am-241		100.0	113.0	11.7					8/17/06
Co-60		100.0	96.0	4.3					8/17/06
Cs-137		98.0	95.0	3.9					8/17/06
Percent Moisture					NC				8/22/06

Lab Approval:

BDL = Below Detection Limit

SAMPLE LOGIN

Date Received: *8/18/06 9:17:33 A* **Lab Number:** 20060711 **Due:** 8/22/06

Sample Number	Client Sample ID	Matrix	Date Sampled	Container Type	Container Size	Preservation	Custody Seal	Seal Intact
20060711-01 A	K-1927	Soil	07/27/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060711-02 A	K-1928	Soil	07/27/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060711-03 A	K-1930	Soil	07/26/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								
20060711-04 A	K-1931	Soil	07/28/06	Plastic	16 oz	None	No	No
Gamma Spec - Thorium 232								
Percent Moisture (LOD)								

CONTAINER INSPECTION

 # Coolers 0 **Custody Seals Broken** ☐ **Temperature:** C **Ice** **Radiation Survey:** <300 cpm

SAMPLE INSPECTION

Sample Seal Broken NA **Chain of Custody Record** ☑ **Labels in Tact** ☑ **Radiation Survey Complete** ☑

Anomalies

Inspected By: _____ **DATE** 8/18/06

QA or Designee Review: _____ **DATE** _____

Sample Custodian Review: _____ **DATE** 8/18/06

Project Notes:

OUTREACH LABORATORY

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

CHAIN OF CUSTODY

Results To:
Company: Kaiser Alum & Chem JV
Name: David G. Wyatt
Address: 7211 E. 41st St.
City: Tulsa State: OK Zip: 74145
Phone: 724-974-3171 Fax #: 918-384-3171
Local: 918-384-0506
Cell: 714-799-0071

Bill To:
Company: Kaiser / Ryan ERA
Name: Gil Vintan / David Wyatt
Address: 7211 E. 41st St.
City: Tulsa State: OK Zip: 74145

ANALYSIS REQUESTED

PO #: Kaiser - 4072
PROJECT #: PA 4000-4072
PROJECT NAME: Kaiser-Ther. Remsa.
REQUESTED TURNAROUND TIME (ADDITIONAL CHARGES MAY APPLY): Std. RA
SAMPLER: David G. Wyatt (Signature) 8-22-06
David G. Wyatt

LABORATORY ID	CLIENT SAMPLE ID	DATE SAMPLED	TIME SAMPLED	MATRIX	# CONTAINERS	CONTAINER 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	GRAMS (EPA-7471)	Ethanol (EPA-8015)	PCB (EPA-8082)	ASTM 7418 Aniline Content					REMARKS (I.E. FILTERED, UNFILTERED, GRAB, COMPOSITE)
	K-1927	7-27-06	1535	Soil	1	Mason	None	X	X	X	X					Grab
	K-1928	7-27-06	1400		1			X	X	X	X					
	K-1930	7-26-06	1410		1			X	X	X	X					
	K-1931	7-28-06	1345		1			X	X	X	X					

RELINQUISHED BY: David G. Wyatt DATE: 8/8/06 TIME: 830 RECEIVED BY: Ron Tidwell DATE: 8/8/06 TIME: 830

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 recall the entire balance to Outreach Technologies, Inc. (Outreach Laboratory)

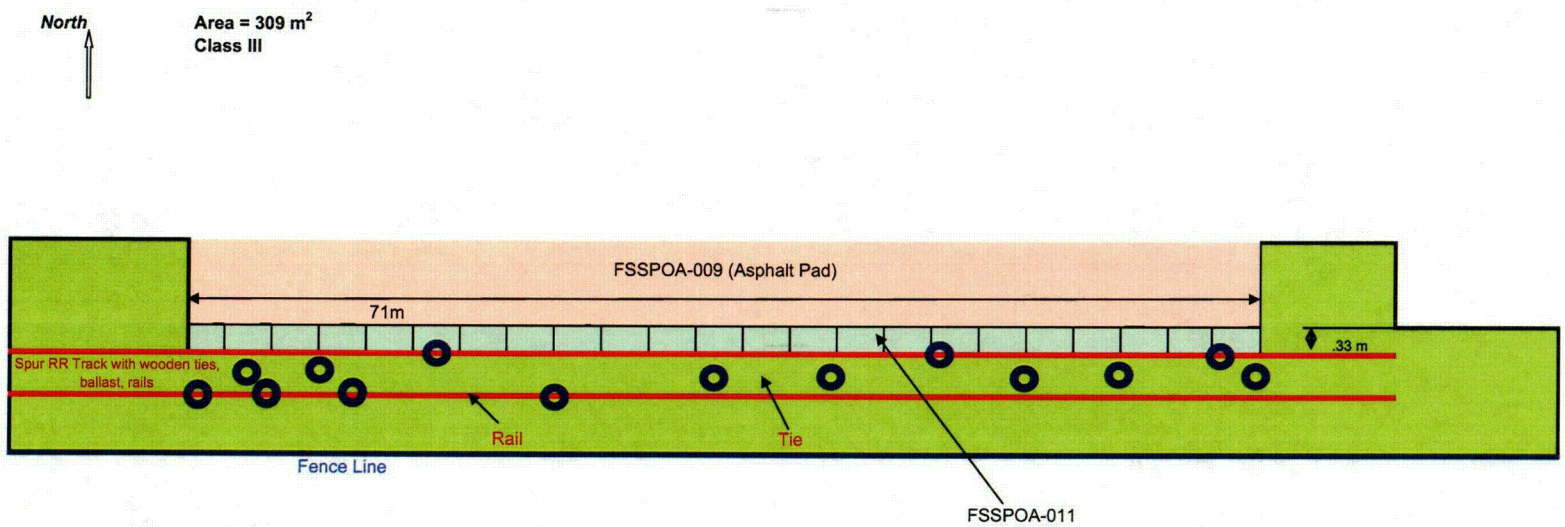
SAMPLE RETURN/DISPOSAL: All non-hazardous samples shall be disposed of 30 days after issue of final report. All others will be returned at client's expense.

FOR OUTREACH LABORATORY USE ONLY: 1426-077
Sample Condition Upon Receipt: Good
Custody Seals Intact: Y N
Cooler Temperature: _____

ATTACHMENT D
TABLE OF CONTENTS

- **FIGURE D-1 Random Sampling Locations**
- **Alpha Scan MDC Calculation Form**
- **TABLE D-1 Gross Alpha Scan Results Summary**
- **Total Alpha Contamination Survey Data Conversion Form**

Figure D-1
Random Sampling Locations
Survey Unit Kaiser-FSSPOA- 010
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility



Random Structural Surface Measurement/Sampling Location (Swipe Samples K-SS-259 through K-SS-272 from Right to Left).

C-28

Alpha Scan MDC Calculation
Survey Unit Kaiser-FSSPOA-010

Instrument Serial Number:	193686	Cal. Due:	3/2/2007
Detector Serial Number:	PR190485	Cal. Due:	3/2/2007
Radiation Detected:	Alpha		For < 3 count background

Probability of observing 2 or more counts:

$$P(n \geq 2) = 1 - \left(1 + \frac{(GE+B)d}{60v}\right)\left(e^{-\frac{(GE+B)d}{60v}}\right)$$

Probability of observing a single count:

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

	D Date	G Activity (dpm)	d Detector Width (cm)	E Instrument Efficiency (cpm)	v Scan Speed (cm/s)	B Background Countrate (cpm)	P Probability (-)
1	7/29/2006	400	11.7	0.1484	3.9	< 1	0.95
2	7/29/2006	800	11.7	0.1484	7.8	< 1	0.95
3	7/29/2006	1180	11.7	0.1484	11.7	< 1	0.95
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

Comments: Instrument Model and Detector Model/Type: Ludlum Model 2360 Alpha-Beta Scaler/Rate Meter with Model 43-68 100 cm² Gas Proportional Alpha-Beta Detector

Prepared By:	David B. Weyant	Date:	8/17/06
Reviewed By:	Andrew J. Lombardo	Date:	8/17/06

Notes:
1.) Instrument Efficiency is the 4π instrument efficiency.

Attachment D, Table D-1
Gross Alpha Scan Results Summary
Survey Unit Kaiser-FSSPOA-010
Final Status Survey
Thorium Remediation Project
Tulsa, Oklahoma Facility
Kaiser Aluminum & Chemical Corporation

Survey Number **KAISER-FSSFOA-010** Ludlum 2360 Alpha-Beta Scaler/Rate Meter with 43-68 100cm² Gas Proportional Detector s/n: 193686/PR190485 Cal Due: 3/2/2007

metal & wood Alpha Eff: 14.84%

Tech: DBW

		Scan				weighted	weighted	Bgrd	
Location	Swipe	cpm min	dpm/100cm² min	cpm max	dpm/100cm² max	cpm ave	dpm/100cm² ave	cpm (2 min)	Date
1 foot radius around static	K-SS-259	0	-34	5	73	0	-34	1.6	7/29/2006
1 foot radius around static	K-SS-260	0	-34	5	73	0	-34	1.6	7/29/2006
1 foot radius around static	K-SS-261	0	-34	5	73	0	-34	1.6	7/29/2006
1 foot radius around static	K-SS-262	0	-34	10	180	5	73	1.6	7/29/2006
1 foot radius around static	K-SS-263	0	-34	10	180	0	-34	1.6	7/29/2006
1 foot radius around static	K-SS-264	0	-34	5	73	0	-34	1.6	7/29/2006
1 foot radius around static	K-SS-265	0	-34	5	73	0	-34	1.6	7/29/2006
1 foot radius around static	K-SS-266	0	-34	100	2,106	60	1,250	1.6	7/29/2006
1 foot radius around static	K-SS-267	0	-34	5	73	0	-34	1.6	7/29/2006
1 foot radius around static	K-SS-268	0	-34	100	2,106	60	1,250	1.6	7/29/2006
1 foot radius around static	K-SS-269	0	-34	5	73	0	-34	1.6	7/29/2006
1 foot radius around static	K-SS-270	0	-34	5	73	0	-34	1.6	7/29/2006
1 foot radius around static	K-SS-271	0	-34	5	73	0	-34	1.6	7/29/2006
1 foot radius around static	K-SS-272	0	-34	5	73	0	-34	1.6	7/29/2006

Notes:

1. The weighted cpm is determined by the surveyor. Since alpha counts (clicks on audible) are infrequent, and 1 count may equal 10 cpm, the surveyor determines the "weighted average".
2. The acceptance criteria for Total Contamination is 944 dpm/100cm².
3. Scans are used to identify elevated area above the acceptance criteria.
4. Compliance is demonstrated by static counts and smear (sample) results.
5. Background is an average of fourteen (14) two minute readings taken at equally spaced distances across survey unit.

Total Alpha Contamination
Survey Unit Kaiser-FSSPOA-010
Survey Data Conversion Form
Form ESC/HPM/M-3-2-2

Date of Survey:	7/29/2006	Type of Radiation:	Alpha
Instrument Serial #:	193686	Calibration Due Date:	3/2/2007
Detector Serial #:	PR190485	Calibration Due Date:	3/2/2007
E_s (Surface Efficiency):	0.25	E_i (Insturment Efficiency):	0.2968
BKG Counts:	44	BKG Count Time (min):	28
Active Area of Detector Probe (cm^2):	126	MDC (dpm/100cm^2):	48.3

FSS Swipe Number	Survey Location	Survey Point Count Time (min)	Gross Counts (cts)	Gross Count Rate (cpm)	Net Count Rate (cpm)	Total Contamination (dpm/100cm^2)	95% CL Uncertainty (dpm/100cm^2)
K-SS-259	MARSSIM-001	2	13	6.50	4.93	52.7	38.1
K-SS-260	MARSSIM-002	2	4	2.00	0.43	4.58	21.5
K-SS-261	MARSSIM-003	2	4	2.00	0.43	4.58	21.5
K-SS-262	MARSSIM-004	2	11	5.50	3.93	42.0	35.1
K-SS-263	MARSSIM-005	2	20	10.0	8.43	90.2	47.1
K-SS-264	MARSSIM-006	2	16	8.00	6.43	68.8	42.2
K-SS-265	MARSSIM-007	2	4	2.00	0.43	4.58	21.5
K-SS-266	MARSSIM-008	2	44	22.0	20.4	219	69.7
K-SS-267	MARSSIM-009	2	9	4.50	2.93	31.3	31.8
K-SS-268	MARSSIM-010	2	26	13.0	11.4	122	53.7
K-SS-269	MARSSIM-011	2	14	7.00	5.43	58.1	39.5
K-SS-270	MARSSIM-012	2	20	10.0	8.43	90.2	47.1
K-SS-271	MARSSIM-013	2	14	7.00	5.43	58.1	39.5
K-SS-272	MARSSIM-014	2	18	9.00	7.43	79.5	44.7

Comments: 14 consecutive 2-minute Background counts used.
Instrument Model and Detector Model/Type: Ludlum Model 2360 Alpha-Beta Scaler/Rate Meter with Model 43 - 68 100cm² Gas Proportional Alpha-Beta Detector

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