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REV. 0

SUMMARY OF THE RADIOLOGICAL SURVEY FINDINGS FOR THE IOWA ARMY AMMUNITION PLANT EXPLOSIVE DISPOSAL AREA, INERT DISPOSAL AREA, DEMOLITION AREA / DEACTIVATION FURNACE, AND LINE 1 FORMER WASTE WATER IMPOUNDMENT AREA

MIDDLETOWN, IOWA

JUNE 6, 2006

U.S. Army Corps of Engineers
St. Louis District Office
Formerly Utilized Sites Remedial Action Program

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prepared by
U.S. Army Corps of Engineers, St. Louis District Office,
Formerly Utilized Sites Remedial Action Program

with technical assistance from
Science Applications International Corporation
under Contract No. FA4890-04-D-0004, Task Order DJ02

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ACRONYMS AND ABBREVIATIONS

σ	standard deviation
Ac	actinium
AEC	Atomic Energy Commission
agl	above ground level
Am	americium
AMS	Aerial Measurement System
ANL	Argonne National Laboratory
ANSI	American National Standards Institute
BG	burning ground
bgs	below ground surface
BN	Bechtel Nevada
CERCLA	Comprehensive Environmental Response Compensation Liability Act
Ci/g	Curies per gram
cm^2	centimeters squared
cpm	counts per minute
cps	counts per second
Cs	cesium
CWP	contaminated waste processor
DA/DF	Demolition Area/Deactivation Furnace
DCGL	derived concentration guideline level
dpm	disintegrations per minute
DOD	Department of Defense
DOE	Department of Energy
DQI	data quality indicator
DQO	Data Quality Objective
DU	depleted uranium
EDA	Explosive Disposal Area
EPA	United States Environmental Protection Agency
ft	feet
FUSRAP	Formerly Utilized Sites Remedial Action Program
GC	gross counts
GPS	Global Positioning System
HP	Health Physics
IAAAP	Iowa Army Ammunition Plant
IDA	Inert Disposal Area
IDNR	Iowa Department of Natural Resources
IDW	Investigation Derived Waste
IROD	Interim Record of Decision
IRP	Installation Restoration Program
K	potassium
keV	kilo-electron volts
L1FWWI	Line 1 Former Waste Water Impoundment
LAP	load, assemble, and pack
LCS	laboratory control sample
m	meter
µCi	microcuries
mph	miles per hour

ACRONYMS AND ABBREVIATIONS (CONT'D)

m/sec	meters per second
mrem/hr	millirem per hour
mrem/yr	millirem per year
MARSSIM	Multi Agency Radiation Survey and Site Investigation Manual
MDA	minimum detectable activity
MDC	minimum detectable concentration
MMGC	man-made gross counts
MS	matrix spike
μR/h	microrems per hour
NA	not analyzed
NAD	normalized absolute difference
NaI	sodium iodide
NC	not calculated
NRC	Nuclear Regulatory Commission
NV	Nevada
OU	operable unit
Pa	protactinium
PA	Preliminary Assessment
pCi/g	picoCuries per gram
PE	performance evaluation
PIPS	Passivated Implanted Planar Silicone
PPE	personal protective equipment
PRG	Preliminary Remediation Goal
QA	quality assurance
QC	quality control
QCSR	Quality Control Summary Report
Ra	radium
RCRA	Resource Conservation and Recovery Act
RDGPS	real-time differential global positioning system
REDAC	Radiation and Environmental Data Analyzer and Computer
REDAR V	Radiation and Environmental Data Acquisition and Recorder, Model V
RDX	cyclotrimethylene trinitramine
RI	Remedial Investigation
ROD	Record of Decision
RPD	relative percent difference
RSL	Remote Sensing Laboratory
SAIC	Science Applications International Corporation
SAG	Sampling and Analysis Guide
SDG	sample delivery group
Th	thorium
TNT	2,4,6-trinitrotoluene
U	uranium
USACE	United States Army Corps of Engineers
UXO	unexploded ordnance
ZnS	zinc sulfide

1.0 INTRODUCTION / PURPOSE

This report addresses a number of areas at the Iowa Army Ammunition Plant (IAAAP) in Middletown, Iowa which were identified and defined within the *Preliminary Assessment: Iowa Army Ammunition Plant, Middletown, Iowa* (USACE 2001a) as warranting further investigation for potential radioactive contamination under the Formerly Utilized Sites Remedial Action Program (FUSRAP). The areas warranting investigation were further defined in a letter from the United States Army Corps of Engineers (USACE) to the United States Environmental Protection Agency (EPA) Region VII, dated February 3, 2004 (USACE 2004b). These areas are identified as the Explosive Disposal Area (EDA), the Inert Disposal Area (IDA), the Demolition Area/Deactivation Furnace (DA/DF), and the Line 1 Former Waste Water Impoundment (L1FWWI). The locations of these areas are generally shown on Figure 1-1, as outlined in blue (Note: These sites are often referred to as the "Blue Sites").

The purpose of this document is to resolve whether or not these areas of IAAAP are impacted by anthropogenic radiological constituents based upon evaluation of data resulting from historical research, the flyover survey and recent radiological walkover surveys and sampling. If found to be impacted, the areas will require further investigation. If the areas were found not to be impacted, no further action will be necessary by FUSRAP and responsibility for these areas will remain with the Installation Restoration Program (IRP).

The activities conducted during the fieldwork are documented in this report. Section 2 presents the results of the historical research. Section 3 presents the aerial flyover data to address issues raised in the October 22, 2002 letter from FUSRAP to EPA (USACE 2002a). Section 4 presents screening survey analytical data generated for each of the selected areas. Section 5 presents conclusions reached after evaluating the data from each investigation, and overall conclusions are presented in Section 6. Ground-based fieldwork for the radiological screening survey was performed in August 2004 in accordance with the *Iowa Army Ammunition Plant Radiological Survey Plan* (USACE 2004a) which was developed using the guidance provided in NUREG 1575, *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) [Department of Defense (DOD) 2000].

Figure 1-1. Iowa Army Ammunition Plant

2.0 SITE DESCRIPTION AND HISTORY

The IAAAP is owned by the United States Army (Army) and operated by a private contractor, American Ordnance, LLC. The IAAAP is located in the southeastern part of Iowa, near Middletown, approximately ten miles west of the Mississippi River. It is a secured facility covering an area of approximately 7,730 hectares in a rural setting. Approximately 3,116 hectares are leased for agricultural use, 2,995 hectares are forested and the remaining land is used for administrative and industrial purposes (i.e., the plant areas). The topography of the IAAAP is roughly 60 % flat and 40 % rough and hilly. Little Flint Creek, Skunk River, Spring Creek, Long Creek, and Brush Creek have portions of their watersheds on the facility.

The history of the IAAAP, as presented in this report, was developed through a review of previous site-related documents. The historical documents that were reviewed were *Remedial Investigation/Risk Assessment (U.S. Army Environmental Center 1996), Preliminary Assessment, Iowa Army Ammunition Plant (USACE 2001a), Iowa Army Ammunition Plant Scoping Survey Plan for Firing Sites 6 and 12 (USACE, 2001b), IAAAP Aerial Radiological Survey (U.S. Army Joint Munitions Command 2003), and the Iowa Army Ammunition Plant Radiological Survey Plan (USACE 2004a).*

According to the *Remedial Investigation/Risk Assessment, Iowa Army Ammunition Plant, Middletown, Iowa* (U.S. Army Environmental Center 1996), IAAAP was initially developed in 1941 and has undergone modernization and expansion since that time. Production of ammunition and explosives for World War II began at the facility in September 1941 and ended in August 1945. Production was resumed in 1949 and has continued to the present.

The ammunition items that are loaded, assembled and packed at the IAAAP include projectiles, mortar rounds, warheads, demolition charges, anti-tank mines, anti-personnel mines, and the components of those munitions, including primers, detonators, fuses, and boosters. The load, assemble, and pack (LAP) operations use explosive material and lead-based initiating compounds. Only a few of the existing production lines are in operation (USACE 2001a).

Historical research revealed that portions of the IAAAP may contain radiological contamination from activities that supported the nation's early atomic energy program. The Atomic Energy Commission (AEC) conducted operations beginning in 1947, when a portion of Line 1, the EDA, Yards C, G, and L, and the Firing Site areas came under the control of the AEC and their contractor. The IAAAP was selected as the first production facility for manufacturing of high explosive components for weapons under the AEC. These areas occupied approximately 660 hectares within the IAAAP and became known as the Burlington Atomic Energy Commission Plant. In the late 1960's, it was determined that AEC operations would be phased out. The IDA and the DA/DF also warranted further investigation because they may have materials and wastes from the areas used by the AEC where radiological activities were in progress. In accordance with the *IAAAP Radiological Survey Plan* (USACE 2004a), the EDA, IDA, DA/DF, and the L1FWWI were addressed in this survey. These areas are described in the following sections.

2.1 EDA

2.1.1 EDA Description

The EDA is an irregularly shaped area that includes the North Burn Pads Landfill, the North Burn Pads, the East Burn Pads, and the West Burn Pads area, including the portion of the West Burn Pads area south of the road that leads to the East Burn Pads. The EDA is surrounded by predominantly forested land, which generally lies adjacent to the various drainages. Based on the observed topography of the area, surface-water flow from the EDA appears to drain toward and eventually into Spring Creek which flows north to south between the West Burn Pads area and the East Burn Pads. The general layout of the EDA is shown on Figure 4-2. The structures present at the time of the ground-based survey consisted of one two-story office building, four observation bunkers, and the Contaminated Waste Processor (CWP).

The northern portion includes the area generally bounded by the tree line north of the CWP, the north-south access road to the west, the east-west running tributary to Spring Creek to the south, and the wooded area to the east.

The eastern portion of the EDA includes the area enclosed by the fence in the East Burn Pads area, portions immediately outside the fence, and the area between the East Burn Pads and main Spring Creek, which separates the East Burn Pads area from the West Burn Pads area.

The western portion of the EDA includes the area of the West Burn Pads generally bounded by the east-west running tributary to Spring Creek that separates the North Burn Pads area from the West Burn Pads area. Spring Creek, which separates the East Burn Pads area from the West Burn Pads area; the east-west access road leading to the East Burn Pads and the north-south access road that leads towards the CWP.

The southern portion of the EDA is bounded by the east-west access road that leads to the East Burn Pads area, Spring Creek, the east-west road that provides access to Burning Ground-4 (BG-4) bunker, and the north-south access road leading towards the CWP.

The planned radiological screening was conducted in the above-described areas located in the northwest portion of the EDA. The CWP is still an active facility, and is being investigated under the installation's Compliance Clean Up Program.

At the time of the survey, the majority of the EDA areas were heavily covered with herbaceous vegetation. Spring Creek was lined with trees and other woody species.

2.1.2 EDA History

The EDA was referred to as the Burning Grounds in early histories and in 1941 was located on a portion of the East Burn Pads. The Burning Grounds was expanded sometime in the late 1940s to include the area currently known as the West Burn Pad area. The Burning Ground was designed for the decontamination of waste that was contaminated by explosive material generated at the plant. This material was initially placed in small shallow pits and ignited from a remote shelter (observation bunker) by a blasting machine.

The East Burn Pads at the EDA were comprised of eight raised earthen burning pads, each of which was bermed on three sides, and were enclosed within a 4.9-hectare fenced area. Historical records confirm that depleted uranium (DU) wastes were managed at the EDA East Burn Pads by AEC. This DU, in the form of explosive-contaminated DU hemispheres, was burned at the EDA East Burn Pads to remove the explosives contamination. The *Preliminary Assessment* reported that, following the burning operation, the residual ash material was screened to identify the presence of DU (excess alpha contamination). The DU-contaminated ash was then segregated and shipped offsite to the DOE Pantex facility in Amarillo, Texas for disposal (USACE 2001a).

In 1998, the Army performed cleanup activities at the East Burn Pads to address non-radiological soil contamination as specified in the Operable Unit (OU) 1 Interim Record of Decision (IROD) (U.S. Army Environmental Center 1997). The remediated soil was taken to the IDA and placed in Trench 6 and Trench 7 as part of the IRP (Department of the Army 2002). No radioactive materials were discovered during a gross radiological screening performed during this operation

(USACE 2001a). The monitoring wells located adjacent and down gradient of the East Burn Pads have not shown increased levels of uranium (U) in the groundwater.

The West Burn Pads area, included the West Burn Pads, West Burn Pads Landfill, Burn Cages, and Burn Cage Disposal area (consisting of two burn pads measuring approximately 15 meters (m) by 5 m, and a landfill measuring approximately 70 m by 91 m. The West Burn Pads were used by the AEC and the Army to rid metal parts of explosive contaminants. The metal parts were decontaminated by flashing the parts to burn away residual explosive contaminants. Ashes generated from these operations and from the East Burn Pads were placed in the West Burn Pads landfill.

The West Burn Pads area was remediated by the Army in 2001 as required by the OU1 IROD. Approximately 30,582 cubic meters (m^3) of contaminated soil and debris was excavated from the West Burn Pads area and disposed at the IDA. The cleanup included excavation of barium-contaminated soils which had not been previously identified in the Remedial Investigation (RI). Some of the soils removed from the West Burn Pads area required stabilization prior to final disposal in Trenches 6 and 7 at the IDA. No radioactive materials were discovered during a gross radiological screening performed during the remediation.

From 1968 to 1972, the approximately 0.3-hectare North Burn Pad Landfill received wastes, reported to include flash cans, containers, and ash from the North Burn Pads. The RI completed by the Army in 1996 found metals in the soil and groundwater. Pre-design characterization activities conducted in 1997 and 1998 found high levels of explosives in the soil and leachate. In accordance with the OU1 IROD, approximately 9,175 $m^3$of contaminated soil and debris was subsequently removed from the North Burn Pads Landfill in 1998, and was placed in trenches 6 and 7 at the IDA as part of the IRP.

Six structures were present at the EDA at the time of the survey: one two-story office building, four observation bunkers, and the CWP. The two-story office building is currently not in use, and historical records do not indicate that radiological material was ever stored in the building. However, to evaluate potential radiological contamination, the office building was included as part of the radiological survey. Historical records indicate that the observation bunkers were used during the burning of the explosive waste. The CWP was outside the area of interest, and historical records do not indicate that there is a potential for radioactive material to be present in or around this building.

2.2 IDA

2.2.1 IDA Description

The IDA covers approximately eight hectares. It is partially fenced, with access from the main road controlled by a locked gate. From 1941 to 1992, the IDA was used by the Army to manage plant waste materials, and included a trench-and-fill sanitary landfill, a burning ground, a metal salvage operation, a sludge lagoon, a waste-water sludge drying bed, and an earthen-bermed holding area formerly used to store sludge. The general layout of this area, in its current configuration, is shown in Figure 4-3. The physical extent along the north, east, and southeast is the IDA perimeter road and along the southwest is the forested area of the Firing Sites. The only structure present at the time of the survey was one administrative/maintenance support building that was constructed as part of the IRP/Comprehensive Environmental Response Compensation Liability Act (CERCLA) response actions.

As part of a CERCLA response action, in 1997, Trenches 1 through 5 of the former sanitary landfill were capped by the Army IRP. Trench 6 of the former sanitary landfill was partly filled during historic Army operations at the IDA. The unfilled portion of Trench 6 is used as a "Soil Repository" as described by the 1997 CERCLA response action. The Trench 6 Soil Repository has a lower geosythetic liner / drainage / leak detection system. It is approximately 200 m by 50 m and contains a storm-water sump area at the southern end. Contaminated soils from various IRP CERCLA response actions have been permanently disposed in Trench 6. Over 53,000 m^3 of contaminated soils have been disposed in Trench 6 during the Army's IRP cleanup. The depth of material placed in this trench appeared greater in the northern end than in the southern end. The southern portion of Trench 6 is used for the collection of storm water runoff and leachate, which is subsequently treated and released. Vegetation growth upon the contaminated soils within the trench was limited, but some areas of significant herbaceous vegetation were present.

Trench 7 is also a component of the 1997 CERCLA response action. Trench 7 has been designated as a Corrective Action Management Unit (CAMU) by EPA and serves as a temporary stockpile for contaminated soils that are being addressed in the OU1 IROD. Trench 7 is approximately 120 m by 75 m and also contains a storm-water sump area at the south end. Trench 7 is similar in construction to Trench 6, and includes a geosynthetic liner / drainage system. Over 7,000 m^3 of contaminated soils are currently stored in Trench 7, awaiting treatment under the Army IRP. Similar to Trench 6, the depth of material placed in this trench appeared greater in the northern end than in the southern end, and a runoff collection sump was present in the southern end. Vegetation growth upon the contaminated soils within this trench was very limited, with only a few areas of significant vegetation.

The final component of the IDA response action is the Cap Extension area, which is approximately 275 m by 60 m and is located in the southeast portion of the IDA, just inside the main entrance gate. Low-level contaminated soil from various Army response actions have been disposed in the Cap Extension area. This above-grade feature is characterized by relatively steep side slopes that are primarily covered with herbaceous vegetation. The top of the Cap Extension area is fairly flat and exhibits a variety of visible cover materials including bare soil, thick vegetation, and a thin plastic liner.

Current plans call for capping Trench 6 and the Cap Extension area when the Army's soil cleanup work at IAAP is complete. Wastes within Trench 7 will be treated and likely disposed within Trench 6, with Trench 7 ultimately dismantled and appropriately closed. However, alternative plans for Trench 7 may be developed.

2.2.2 IDA History

The IDA included a trench-and-fill sanitary landfill that operated from 1941 to 1992, a burning ground, a metal salvage operation, a sludge lagoon that was closed in 1984, a waste-water sludge drying bed, and an earthen holding area formerly used to store sludge.

The presence of radioactive material within the IDA resulting from Army operations from 1941-1992 has not been confirmed based on historical records. However, as part of the OU1 IROD, contaminated soils from various IAAP locations have been deposited/disposed in Trench 6, Trench 7, and the Cap Extension area at the IDA. Historical records indicate that radioactive materials may have been contained in these contaminated soils that were brought to the IDA from other IAAAP locations, including the EDA and the L1FWWI. Records associated with the various IRP soil cleanups that have been reviewed indicate that the CERCLA remediation wastes placed in the IDA were scanned prior to disposal, and that these remediation wastes did not contain measurable radioactive contamination.

The IDA, including Trench 6, Trench 7, and the Cap Extension area, is currently used as the repository for chemically contaminated soils from other sites on the IAAAP. Further investigation of the IDA for potential radioactive contamination was deemed warranted due to insufficient historical records regarding the instrumentation, methods, and detector limitations for the radiological screening performed on the soils disposed at the IDA that originated at the West Burn Pads area, East Burn Pads, North Burn Pads, North Burn Pad Landfill, L1FWWI.

Closure of the IDA landfill under the IRP began in 1996. During 1997, a low-permeability synthetic cap of approximately 7 hectares was placed over Trenches 1 through 5. This area was seeded in 1998. Trench 6, Trench 7, and the Cap Extension area remain open and uncovered, and are still in use as part of the IRP OU1 remedial action. Current plans call for capping Trench 6 and the Cap Extension area when the Army's soil cleanup work at IAAP is complete. Wastes within Trench 7 will be treated and likely disposed within Trench 6, with Trench 7 ultimately dismantled and appropriately closed. However, alternative plans for Trench 7 may be developed.

A single support building was present on the IDA at the time of the survey. This structure was constructed in 2003 in support of the CERCLA response action at the IDA, is outside the area of interest, and does not warrant evaluation for the presence of radioactive material.

2.3 DA/DF

2.3.1 DA/DF Description

The DA/DF area covers approximately four hectares in the southwestern portion of the IAAAP. The Demolition area was has been used and is still available for open detonation of ammunition items that required immediate disposal. The Deactivation Furnace included a feed area and retort system measuring 8 m by 30 m. An adjoining air pollution control system measures approximately 6 m by 8 m and includes a cyclone filter, a baghouse, fans, and an exhaust stack. The furnace was used to destroy small explosive-loaded components such as detonators, primers, and fuses. The general layout of this area, for the purposes of this report, is shown in Figure 4-4. The physical extent of this area is the open field to the east and the tree line along the north, south, and west. This area is relatively flat or gently sloping in the open areas with an eroded area at the extreme northwest corner of the area. The structures present at the time of the survey consisted of the Deactivation Furnace and support building and the three bunkers.

At the time of the survey, the Demolition area was densely covered with herbaceous vegetation while the drainage ditch that separates the Demolition area from the Deactivation Furnace was heavily wooded. The immediate area surrounding the Deactivation Furnace was also heavily vegetated to the tree lines located to the south and west.

2.3.2 DA/DF History

The Iowa Department of Natural Resources (IDNR) allows the open detonation of ammunition items that require immediate disposal due to safety considerations, such as ammunition rounds that become armed during assembly. Since the early 1940s, the Demolition area was used for open detonation of rejected ammunition. Currently, it is used only in emergencies. The Deactivation Furnace began use in 1971 and was closed under a Resource Conservation and Recovery Act (RCRA) closure in 1995. The furnace was used to demilitarize small explosive-loaded components such as detonators, primers, and fuses. The metal casings were recovered and sold as scrap; the ash from these operations was stored in drums as hazardous waste.

Historical records do not indicate that radiological material was ever used, stored, or managed at the Demolition area or the Deactivation Furnace, or that AEC activities ever occurred in these areas. However, interviews with former workers indicated that an AEC sign was present on the Deactivation Furnace building in the past.

Five structures were present on the DA/DF at the time of the survey: the Deactivation Furnace, the support building, and three bunkers. None of the buildings are currently in use. Since the DF was in operation during the time frame of AEC activities at the IAAAP, given the purpose of this area, and given the AEC security sign at the DF, the Preliminary Assessment (PA) concluded that this area warranted further field investigation for potential radioactive contamination.

2.4 L1FWWI

2.4.1 L1FWWI Description

The L1FWWI covered approximately three hectares and lies adjacent to the extreme southwest corner of the Line 1 area and includes the impoundment from the north dam to the south dam. This area is no longer used as a wastewater impoundment and was remediated in a CERCLA response action in 1997. The general layout of this area is shown on Figure 4-5. The area extends from approximately 91 m north of the north dam, runs along the Line 1 perimeter fence to the east, then runs along the perimeter road beyond the south dam to the south, and along the north-south access road on top of the west earthen berm to the west. The only structure present at the time of the survey consisted of one support building which houses a water treatment facility that was constructed as part of the 1997 CERCLA response action.

At the time of the survey, several feet (ft) of water were present in the impoundment basin. Soil at the edge of the water exhibited saturated characteristics. The portions of the study area upstream of the north berm and downstream of the south berm were densely covered by primarily herbaceous vegetation. The slope from the eastern portion of the impoundment basin to the Line 1 western perimeter fence was also heavily covered with herbaceous vegetation. Based on the topography of the area east of the impoundment basin, it appeared that the surface-water from a portion of the Line 1 area drained toward and eventually into the waste-water impoundment basin.

2.4.2 L1FWWI History

From 1948 to 1975, the AEC operated Line 1, which was the first production facility for manufacturing of high explosives components for weapons under the AEC. The Line also reportedly generated the largest volume of waste-water at the IAAAP during that period. The waste-water was contaminated by waste from the manufacture of explosives-containing components [primarily 2, 4, 6-trinitrotoluene (TNT) and cyclotrimethylene trinitramine (RDX)], condensate from a coal fired power plant, and coal pile runoff norm. The waste-water was collected in clarifiers, and the effluent was discharged through a system of ditches into an impoundment. Fly ash was added periodically to the impoundment to absorb explosives. This impoundment was formed in 1948 by damming an upper reach of Brush Creek, and was named the Line 1 Waste Water Impoundment. The impoundment was used as a settling pond where excess particulate matter could settle prior to discharge during periods of heavy rain. The nominal size of the impoundment was approximately 1.5-hectares and extended approximately 396 m upstream from the dam. During periods of high flow the impoundment may have enlarged to about 3-hectares and extended as much as 732 m upstream of the dam. The dam was operational until it was breached in 1957.

Historical records indicate that DU and tritium were used at Line 1 in AEC activities. There are historical references that indicate environmental releases of DU and tritium may have occurred during Line 1 AEC operations. DU components were machined at Line 1, and recent building surveys have shown the presence of DU inside of several Line 1 buildings. Records also indicate that the explosive contaminated effluent from Line 1 was sent to clarifiers for settling of the heavy particulates prior to discharge to the L1FWWI. If DU contamination was released in a manner similar to the explosives, it is possible that the DU would have settled out in the clarifiers prior to reaching the L1FWWI. A CERCLA Interim Response Action was completed in 1997, when approximately 6,000 m^3 of explosives-contaminated soils were excavated from the L1FWWI and disposed at the IDA. No historical records or references have been found that indicate whether a radiological screening was performed as part of the L1FWWI cleanup work. Following the soil cleanup, the L1FWWI was converted into a wetlands aimed at phytoremediating the surface water, ground water, sediment, and shallow soils contaminated by residual explosives.

Radiological screening has confirmed the presence DU in buildings at Line 1. No evidence of other radioactive material was identified in reviewing historical site documents. Historical records do indicate that 0.006 curies of elemental tritium gas was released per year to the atmosphere/environment at Line 1; however, elemental tritium in a gaseous form would not be persistent in the environment, as tritium gas rapidly disperses, and the half life of tritium is relatively short. Since DU was known to have been processed at Line 1 and the presence of DU was not evaluated as part of the CERCLA cleanup of the L1FWWI, additional investigation was warranted to evaluate potential radiological releases to the impoundment. The CERCLA remediation of the impoundment would have removed the majority of any accumulated DU sedimentation from the effluent or storm-water runoff.

The only structure present at the time of the survey consisted of one support building which houses a water treatment facility that was constructed as part of the 1997 CERCLA response action and does not warrant evaluation for potential radioactive contamination.

3.0 AERIAL RADIOLOGICAL SURVEY

3.1 SURVEY IMPLEMENTATION

An aerial radiological survey of the entire IAAAP and selected off-post areas was conducted in October 2002 to assess, within the limits of the detector system, the nature and extent of gamma-emitting radioisotopes, both man-made and natural. The survey objective was to identify areas that had been affected by a release of man-made radioactive isotopes and to help determine areas that had not been impacted.

The Remote Sensing Laboratory (RSL), operated by Bechtel Nevada (BN) for the U.S. Department of Energy Nevada Operations (DOE/NV), with support from Argonne National Laboratory (ANL) conducted the aerial survey of IAAAP. The RSL determined background radiation levels at IAAAP and radiation levels over the entire plant by using the Aerial Measurement System (AMS) in a DOE helicopter.

The aerial survey was designed to identify areas that may have been impacted by the release of man-made radioisotopes and to determine if any areas exist that constitute an immediate danger to human health or the environment. A secondary objective of the survey was to produce data that can be used in conjunction with other site information to guide future restoration efforts. The data collected during the aerial survey is being used in conjunction with the historical site information and land-based radiological survey data to determine the radiological status of the EDA, the IDA, the DA/DF, and the L1FWWI. Only information pertinent to the decision for the above mentioned sites is presented in the following text. A full detailed report of the aerial flyover can be found in *"IAAAP Aerial Radiological Survey"* (U.S. Army Joint Munitions Command 2003).

3.1.1 Instrumentation

The IAAAP survey was conducted with an array of twelve 2×4×16 inch sodium iodide (NaI) detectors mounted beneath a twin-engine Bell 412 helicopter. The AMS data acquisition system Radiation and Environmental Data Acquisition and Recorder, Model V (REDAR V) collects complete spectral information in 256 separate channels, spanning the energy range from 0 to 4,000 kilo-electron volts (keV).

Examples of the strength (minimum detectable activity [MDA]) of both point and distributed surface contaminants of concern are shown in Table 3-1.

All of the sensitivities cited above are for concentrations in excess of the natural background. That is, the soil activity is the sum of the concentration detected in the aerial survey plus the average concentration in the survey area. This sum is performed for each radionuclide. The average abundance is estimated from the set of judiciously selected ground-based, corroborative measurements. The actual MDA during the survey for DU was approximately 22 micro Curies (μCi), which is comparable to the calculated value of 20 μCi cited in Table 3-1.

Helicopter flight positions during the surveys were continuously determined with a radar altimeter and a real-time differential global positioning system (RDGPS). The RDGPS provides latitude and longitude position with accuracy of better than ±5 m (16 ft). With this RDGPS, Global Positioning System (GPS) data from a network of precisely measured locations surrounding the United States is transmitted to a control center, where range, timing, and ephemeris errors from the 24 GPS satellites are evaluated. Corrections for each satellite are then up-linked to a geo-stationary satellite, broadcast back to earth, and utilized by the helicopter RDGPS. For altitudes up to 300 m (984 ft), the accuracy of this system is ±0.6 m, or ±2%, whichever is greater.

Table 3-1. Estimated Aerial Survey Sensitivity[1,10]

Nuclide	Point Source MDA[2]		Uniform Soil[3]	Surface Deposition	CERCLA Risk Range Concentrations[9]	
	No offset	midway			1×10^{-6}	1×10^{-4}
	(μCi)*	(μCi)	(pCi/g)	(μCi/m²)	(pCi/g)	(pCi/g)
Depleted Uranium [4,8]	20 (60kg)**	45 (140kg)**	40	6.5	1.8	180
Cs-137	0.10	0.2	0.3	0.04	0.11	11
Ra-226[5]	0.70	1.8	1.4	0.30	0.026	2.6
Pu-239[6]	X[7]	X[7]	3.1	0.13	14	1400

1. Twelve 16"x4"x2" NaI(Tl) detectors, altitude of 100 feet (ft) above ground level (AGL), 200 ft spacing between flight lines, velocity of 60 knots [1 knot = 1.15 mile per hour (mph)]
2. Can be total of fragments within detector's field-of-view, whose radius is approximately the altitude above ground level
3. Other depth profiles generally have greater sensitivity, but overburden will hamper sensitivity.
4. No self-attenuation (negligible, if pieces < 0.5centimeter diameter.)
5. Assuming concentration of surrogate (Bi-214) is in secular equilibrium
6. Surrogate for Pu-239 is Am-241. Ratio of Pu:Am expected to be less than 10:1.
7. Not published in public documents (classified sensitivity).
8. Concentrations of DU less than the specified MDA fall within the CERCLA risk range with daughter products
9. Preliminary Remediation Goal (PRG) for outdoor worker
10. Table taken from *IAAAP Aerial Radiological Survey* Draft Final, July 10, 2003 and nuclides included in the table are based on historical documents.

* microcuries (μCi) (in orginal document was published as mircocuries (mCi))

** These correspond to the mass equivalents of 20 μCi and 45 μCi respectively of DU.

In aerial surveys, altitude, flight line spacing, and speed of the aircraft are chosen to optimize the detector sensitivity to radioisotopes and spatial resolution while maintaining a safe and efficient flight configuration. For the IAAAP survey, the position information was directed to an aircraft steering indicator used to guide the aircraft along predetermined, parallel flight lines. The position information from the RDGPS system and the radar altimeter data were simultaneously recorded, along with the spectral information from the NaI detectors, at 1-second intervals for post-flight analysis.

A computer-based system, the Radiation and Environmental Data Analyzer and Computer (REDAC) system, was used to evaluate the acquired data immediately following each survey flight. The REDAC system consists primarily of two computers, a printer, software, and a large-bed plotter.

3.1.2 Data Collection Methods

3.1.2.1 Aerial Data

Data were collected from a Bell 412 helicopter. The helicopter was flown at a constant speed of 60 knots (69 miles per hour (mph)) and an altitude of 100 ft over the survey area in a series of parallel flight lines spaced 200 ft apart. This procedure continued until all of the desired area was surveyed.

The data set, collected at the rate of one measurement per second during the flight, consisted of position and altitude data, atmospheric information, and gamma-ray energy spectra. The direction of the flight lines was chosen to minimize the amount of time consumed turning around, and thus minimize the time necessary to cover the area. Each flight included a pass over the test line, passes over the lines in the survey area designated for that flight, and then a repeat of the test line before landing. Flights over the test line were used to determine the contribution of cosmic and atmospheric radiation to the measurements. The test line was located just east of the survey area and was a 6,000-ft long path. The test line was predominantly over agricultural fields, with very few homes nearby.

3.1.2.2 Calibration and Quality Data

Fluctuations in atmospheric radon and cosmic radiation were measured during the survey. These data were then analyzed to determine the gamma ray contribution from atmospheric and cosmic sources. In the subsequent calculations, appropriate algorithms were applied to the aerial survey data to remove the count rates from radon, equipment and cosmic radiation.

For the surveyed area, a perimeter was flown over identifiable ground objects, such as roads and railway lines. Data from these perimeter flights were used as a quality check for the GPS data by visually matching the flight path flown with specific locations on a detailed map of the site.

An altitude profile (also referred to as an altitude spiral) was flown early in the survey period. The altitude profile consisted of several traversals of a specific path (the test line for this survey) conducted at five or six different altitudes. For the IAAAP survey, a maximum altitude of 500 ft was used. The altitude spiral was performed in order to determine an appropriate attenuation coefficient for gamma rays with increasing altitude and an initial background concentration. These values were then used to adjust the aerial measurements for minor fluctuations in altitude during subsequent flights.

3.1.2.3 Ground-Truth Measurements

As a quality control check on the aerial data, measurements were also made on the ground (ground-truth measurements) at selected locations and compared with aerial data from the same locations. The ground-truth measurements were made with a Reuter-Stokes ion chamber instrument (Reuter-Stokes Model RSS-112, GE Reuter-Stokes, Twinsburg, Ohio). The system measured the total exposure rate at a height of 1 m. This measurement provided an independent means of confirming the conversion from airborne counts to exposure rates.

3.1.3 System and Detection Sensitivity

The AMS can detect small changes in radiation over the detector footprint. The footprint of the detector extends out to a boundary defined as the location at which the count rate falls to one-half its original value. For aerial flights, the radius of the footprint is approximately equal to the altitude of the helicopter.

On November 12, 2002, a test flight was conducted with the helicopter system in a desert area near the RSL in Nevada over a set of DU sources. Eleven 9-kilogram (kg) sheets (each measuring 7 inch x 9½ inch x ½ inch) of DU were placed under the flight path of the helicopter. The helicopter flew a small survey pattern over the sources at four altitudes: 15 m, 30 m, 45 m, and 90 m (50, 100, 150, and 300 ft). The flight line spacing for these surveys was set equal to the altitude of the aircraft. The helicopter speed was 60 knots, the same velocity as that used during the IAAAP survey.

The sources were visible in the study data only on the lower two altitudes (50 ft and 100 ft). At a 15 m (50 ft) altitude, the low-energy gamma rays from DU are detected above the four standard deviation (4σ level). The high-energy gamma rays from DU are detected above the 3σ level. At a 30 m (100 ft) altitude, the low-energy gamma rays are not observed. The high-energy gamma rays are detected at about the 2σ level. That is, in about 95 out of 100 measurements, the high-energy gamma rays would be detected.

If the MDA for detecting DU during the IAAAP survey (conducted at a 100-ft altitude) is defined as the activity needed to reach a confidence level of 3σ (99.7%) of measurements would detect the high-energy gamma rays) the high-energy gamma rays can be used in the analysis, and the MDA will be about 22 µCi, which is comparable to the calculated value of 20 µCi cited in Table 3-1.

3.1.4 Data Analysis Algorithms

3.1.4.1 Gross-Count Method

The system records all gamma rays (anthropogenic and naturally occurring) with energies up to 4,000 keV; however, there are very few gamma rays that have energies greater than 3,000 keV. Because Gross-Count contours are meant only to depict terrestrial radiation levels, counts from cosmic radiation and airborne radon must be subtracted. The background count rate from cosmic radiation, atmospheric radon, and helicopter materials was determined by flying the aircraft over a body of water, which shielded the AMS instruments from terrestrial sources of radiation.

The Gross-Count contours generated from this data reflect the exposure rate at a height of 1 m from terrestrial sources (the background exposure rate has been subtracted). A typical, and highly variable, contribution from radon (approximately 0.2 microrem per hour (µR/h)) was ignored.

Gross-count data include contributions from natural sources of radiation. Consequently, these data reflect variations in terrestrial background radiation levels. Contours resulting from these variations in natural radiation often match specific surface features, such as tree lines, boundaries of cultivated land, and bodies of water, because of the different attenuation characteristics of the different materials. Exposure rate contours offer a sensitive means of identifying anomalous, potentially anthropogenic changes in the radiation environment, in addition to detailing variations in the natural background radiation emissions.

3.1.4.2 Man-Made Gross-Count Method

The man-made (anthropogenic) gross-count (MMGC) method is used to differentiate between anthropogenic radiation and naturally occurring radiation in a survey. The MMGC method, also referred to here as the "MMGC filter," relies on the fact that most gamma ray emissions from long-lived, anthropogenic sources of radioactivity occur in the energy region below about 1,400 keV. In areas in which only natural sources of gamma radiation are present, the ratio of the counts appearing below 1,400 keV to those appearing above 1,400 keV remains relatively constant. This relationship is true even if natural background radiation levels vary by a factor of 10 across the survey area. If this ratio changes spatially, it is most likely because of a contribution from anthropogenic gamma radiation.

The MMGC algorithm provides a means of identifying regions in the survey area where the shape of the energy spectrum deviates significantly from the shape of the background, or reference, spectrum. The MMGC algorithm is very insensitive to small changes in the abundance of anthropogenic isotopes, while being very sensitive to large changes in the abundance of natural isotopes.

The MMGC algorithm allows the data to be analyzed such that variations in the count rate due to changes in natural background levels are filtered out. In regions with only natural background radiation, the MMGC algorithm will yield count rates that fluctuate statistically around zero. Variations in count rate due to anthropogenic or industrially enhanced radioisotopes then appear as isolated contours with higher concentrations.

The increase in sensitivity obtained with the MMGC analysis over that of the gross-count method is significant. However, the MMGC filter is also sensitive to changes in the relative composition of natural background radiation. For example, areas where U (a naturally occurring radioisotope) is naturally high relative to the other natural radioisotopes can appear as anomalies when this algorithm is used.

3.2 SURVEY RESULTS

DU was the prevalent isotope found during the aerial survey. The aerial survey did not find any residual concentrations of radium (Ra)-226, americium (Am)-241, or cesium (Cs)-137 above naturally occurring radioisotope levels. The radiological contaminant of concern for this report was DU. Although DU was identified at locations within the IAAAP, the aerial flyover did not identify the presence of any above-background isotopes at the EDA, IDA, L1FWWI, or the DA/DF.

Results of the AMS aerial survey performed for the IAAAP are presented in two different forms: gross counts (GC), and MMGC. GC represent the total quantity of radiation present from terrestrial sources, both man-made and naturally occurring background. The gross-count data are presented in terms of counts per second (cps). Higher counts represent greater amounts of radioactivity. Because DU was the prevalent isotope found during the aerial survey, its distribution and concentration are represented by the MMGC results.

MMGC data are also presented in cps and represent areas at the IAAAP where the ratio of gamma radiation from all man-made radioisotopes to the remaining gamma spectrum is above normal (at the 3σ level). MMGC thus represent data in which variations in the count rate produced by changes in the natural background levels have been filtered out. MMGC data can also highlight locations that have large variations in background gamma emissions because of different geologic materials or rapidly changing readings caused by elevation variations in the detection system during measurement.

The gross-counts results for the AMS aerial survey for the entire IAAAP facility and off-post areas are shown on Figure 3-1. Gamma rays ranged from approximately 1,700 to 68,000 cps for a total of 50,333 data points in the survey. The mean gross-count rate was about 9,200 cps, and the statistical standard deviation of the counts was approximately 1,500 cps. Large portions of the facility had gross counts in the range of 9,000 to 12,000 cps. Nearly 100% (99.79%) of the data measurement points had count rates that were less than 12,000 cps; 50% of the measurement points had gross-count rates of less than about 9,500 cps.

Low count rates (3,000 to 5,000 cps) coincide with areas of surface water (e.g., the Skunk River along the southern boundary of the facility, Brush Creek, Spring Creek, Long Creek, and Mathes Lake. The highest count rates (greater than 26,000 cps) occurred in the east central portion of the facility (Yard E).

The man-made gross count results for the IAAAP survey are shown on Figure 3-2. The minimum MMGC was about -1,778 cps, the maximum MMGC was about 32,260 cps, and the mean value was about 26 cps. A total of 50,333 data points were recorded. The standard deviation for the MMGC was about 555 cps. A non-zero mean count (26 cps) indicates anomalies are present in the data. Three regions with anomalously high results are apparent in Figure 3-2. These regions correspond with Firing Site 12, the coal pile, and Yard E.

3.2.1 EDA

The aerial flyover of the EDA included eight passovers and did not indicate the presence of elevated gamma radiation as represented by anomalously high results. The GC of the area ranged roughly from 6,000 cps through 12,000 cps and was consistent with the count range across the site where 99.7% of the data points were less than 12,000 cps and 50% were less than 9,500 cps.

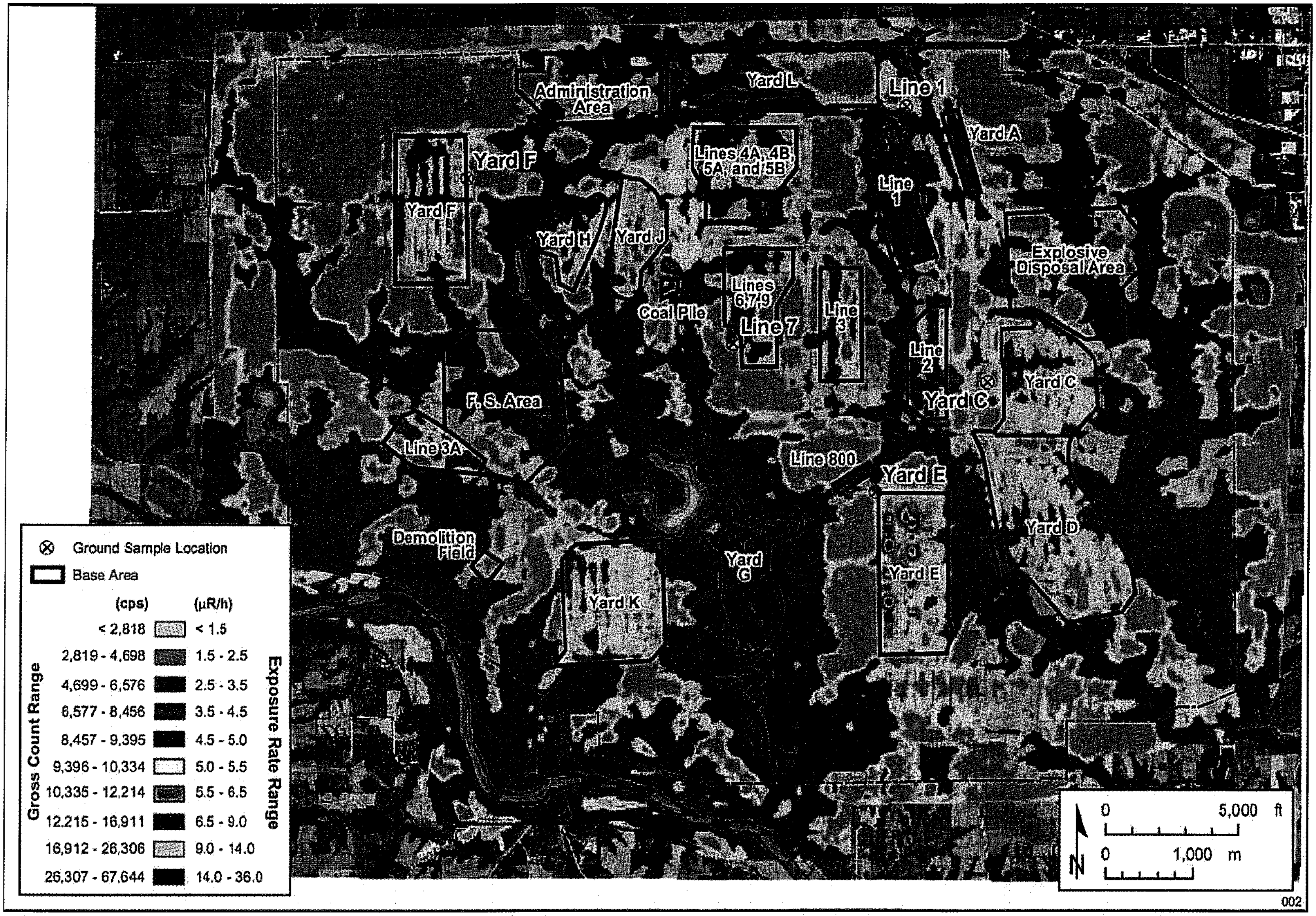


Figure 3-1. Gross Count Results for the IAAAP

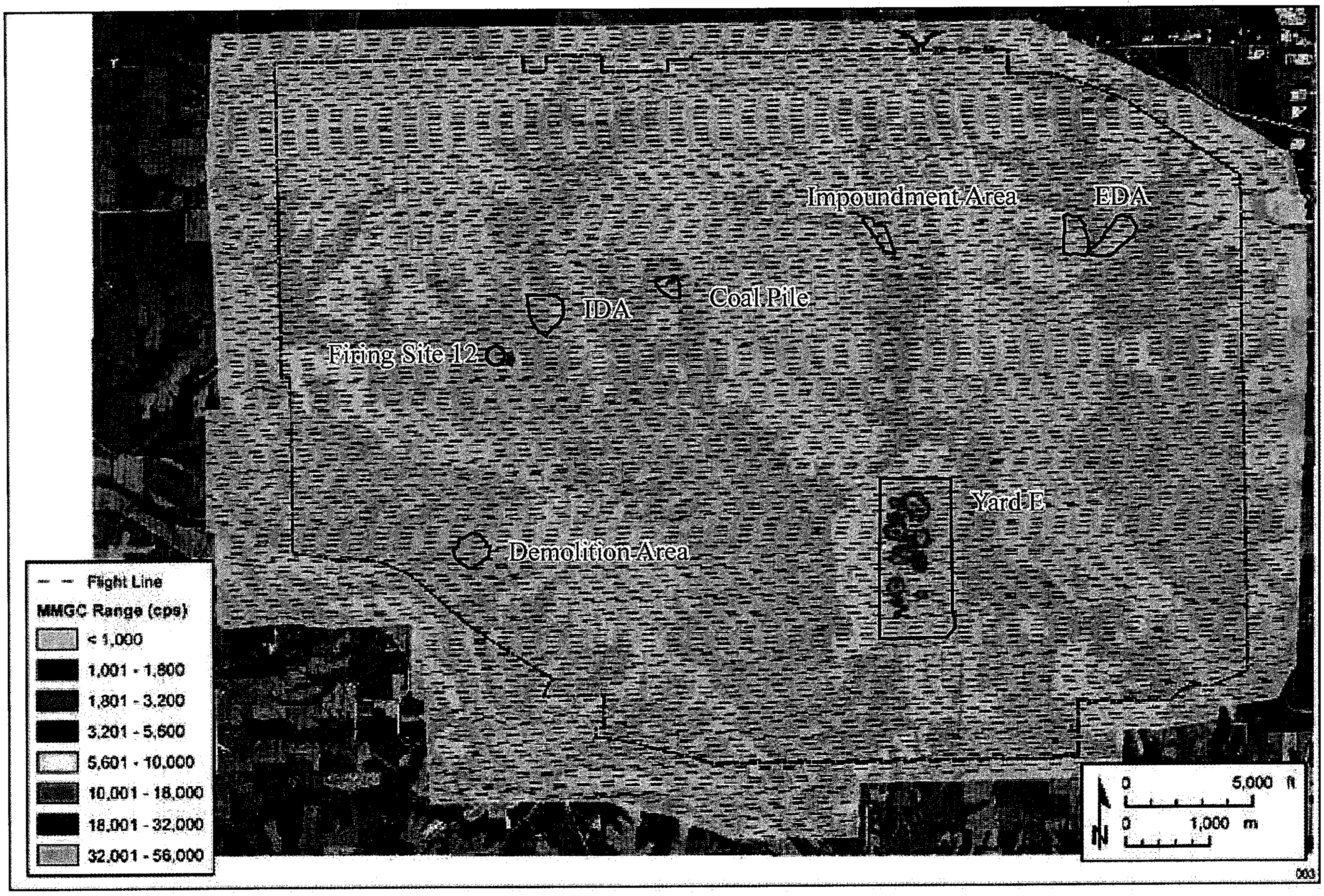


Figure 3-2 Man Made Gross Counts

The gross count rates in the area of the EDA (Figure 3-1) in general tend to follow the vegetation pattern. The lower count rate areas appear to correspond to areas covered with dense vegetation or trees while the areas of higher count rates appear to correspond to the cleared or grass covered areas.

3.2.2 IDA

The aerial flyover of the IDA included eight passovers and did not indicate the presence of elevated gamma radiation as represented by anomalously high results. The GC of the area ranged roughly from 10,000 cps through 12,000 cps and were consistent with the count range across the site where 99.7% of the data points were less than 12,000 cps and 50% were less than 9,500 cps. The gross counts appear higher than some other areas of the IAAAP because of the lack of vegetative growth.

The man-made gross count rates observed within the IDA (Figure 3-2) clearly show that all areas of the IDA are less than 1,000 cps. Thus, after filtering natural background fluctuations (caused in part due to changes in vegetation) there are no apparent anomalies present in the IDA. The presence of radiological gamma emitting isotopes appears to be consistent throughout the IDA and in general are not present.

3.2.3 DA/DF

The aerial flyover of the DA/DF included seven passovers and did not indicate the presence of elevated gamma radiation as represented by anomalously high results. The GC of the area ranged roughly from 10,000 cps through 12,000 cps and was consistent with the count range across the site where 99.7% of the data points were less than 12,000 cps and 50% were less than 9,500 cps. The gross counts over much of the DA/DF appear higher than some other areas of the IAAAP because of the lack of vegetative growth.

The man-made gross count rates observed within the DA/DF clearly show that all areas of the DA/DF are less than 1,000 cps. Thus after filtering natural background fluctuations (caused in part due to changes in vegetation) there are no apparent anomalies present in the DA/DF. The presence of radiological gamma emitting isotopes appears to be consistent throughout the DA/DF and in general are not present.

3.2.4 LIFWWI

The aerial flyover of the Line 1 Former Wastewater Impoundment included seven passovers and did not indicate the presence of elevated gamma radiation as represented by anomalously high results. The GC of the area ranged roughly from 6,000 cps through 12,000 cps and was consistent with the count range across the site where 99.7% of the data points were less than 12,000 cps and 50% were less than 9,500 cps.

The man-made gross count rates observed within the L1FWWI clearly show that all areas of the Line 1 Former Wastewater Impoundment are less than 1,000 cps. Thus after filtering natural background fluctuations (caused in part due to changes in vegetation) there are no apparent anomalies present in the area of L1FWWI. The presence of radiological gamma emitting isotopes appears to be consistent throughout the L1FWWI and in general are not present.

4.0 RADIOLOGICAL SCREENING SURVEY

In August 2004, a ground-based radiological screening survey was conducted by USACE at the EDA, IDA, L1FWWI and the DA/DF. The object of this survey was to generate specific data from these sites that, when used in conjunction with the historical information and the flyover survey data, will resolve whether or not these areas are impacted by radiological contamination.

4.1 SURVEY IMPLEMENTATION

The activities performed during the radiological screening survey included gamma walkover surveys, soil sampling, and investigation of structures located in the EDA, IDA, L1FWWI, and the DA/DF. Survey activities were conducted in accordance with the *Iowa Army Ammunition Plant Radiological Survey Plan* (USACE 2004a).

The specific data quality objectives (DQOs) established for this survey and DQO attainment are presented in Table 4-1. A more detailed discussion regarding the data quality is presented in the Quality Control Summary Report (QCSR) in Attachment A.

Table 4-1. DQOs

DQOs	DQO Attainment
Quality Assurance/Quality Control (QA/QC) split and duplicate soil samples will be collected at a frequency of at least 1 in 20.	QA/QC split and duplicate soil samples were collected at a frequency of 1 in 18 (4 of 70).
Precision will be determined by comparison of split and duplicate sample values with an objective relative percent difference (RPD) of 30% or less at 50% of the criterion value when reported activities are >5 times their MDAs; if samples are less than5 times their respective MDA, the normalized absolute difference (NAD) will be used with an objective NAD less than1.96.	RPD and/or NAD values for all analytes were within the ±30% window of acceptance for the verification samples.
Soil sampling data generated by the analytical laboratory will undergo data verification and validation with a project goal of 95% data usability.	The soil data achieved greater than the project goal of 95% data usability. 100% of the data is usable.
Target MDA for gamma spectroscopy will be less than1(pCi/g) potassium (K)-40, less than5 pCi/g U-238, and 0.5 pCi/g U-235.	The target MDA for gamma spectroscopy was met for K-40 with 0.6702 and U-238 with 1.227. Six U-235 sample analyses exceeded the target MDA of 0.5 pCi/g, the highest having a value of 1.408 pCi/g. These exceedances have no significant impact on the overall data usability for the following reasons: • Samples were also analyzed by alpha spectroscopy (a generally more sensitive analytical method). Target MDAs for samples analyzed by alpha spectroscopy were met for each sample as discussed below. • Data generated using alpha spectroscopy is used in the data tables in Section 5. • Analysis of samples by gamma spectroscopy was primarily used to provide data for the non-DU radionuclides. The associated DU radionuclides (i.e., U-234 and U-238) confirm that all samples yield results well below the 56 pCi/g screening level.
Target MDA for alpha spectroscopy will be 1.0 pCi/g for U-238, U-235, U-234.	The target MDA for alpha spectroscopy was met for U-238, U-235, and U-234 with the highest values being 0.438, 0.5749, and 0.5177, respectively.
A minimum of 12 random samples will be collected in each designated area.	Twelve random samples were collected in each designated area, with the exception of the EDA, where 24 samples were collected.
All radiological survey equipment will be operated and maintained by qualified personnel, in accordance with Science Applications International Corporation (SAIC) Health Physics Program procedures.	All radiological survey equipment was operated and maintained in accordance with Health Physics (HP)-30 Radiological Instrumentation of SAIC Health Physics Program procedures.

Table 4-1. DQOs (Cont'd)

DQOs	DQO Attainment
Gamma walkover data will be electronically recorded and visually displayed in color-coordinated maps.	Color-coded maps were produced for this document from electronically stored gamma walkover survey data.
Beta scan data will be recorded on standard survey forms in accordance with SAIC Health Physics Program procedures.	Beta scans were recorded on Attachment 1 per HP-11 Radiological Monitoring in accordance with SAIC Health Physics Program procedures.
Beta fixed point minimum detectable concentration (MDCs) will be 3000 disintegrations per minute (dpm)/100 centimeters squared (cm^2) or less than 50% of the screening level.	Actual Beta fixed point MDCs were 537 dpm/100cm^2 or less, which is less than 50% of the screening level.
Alpha fixed point MDCs will be 300 dpm/100cm^2 or less than 50 % of the screen level.	Actual Alpha fixed point MDCs were 291 dpm/100cm^2 or less, which is less than 50% of the screening level.
Beta scan MDCs will be 4000dpm/100cm^2 or less than 80% of the screening level.	Actual Beta scan MDCs were 966 dpm/100cm^2 or less, which is less than 80% of the screening level.
Ludlum 2929 alpha contamination MDA will be 60 dpm/100cm^2 or less than 10% of the screening level.	Actual Ludlum 2929 alpha contamination MDA was 14.89 dpm /100cm^2, which is less than 10% of the screening level.

4.1.1 Gamma Walkover Surveys

Gamma radiation walkover surveys were performed using a Ludlum Model 44-10 2" x 2" NaI gamma scintillation detector coupled with Trimble® GPS units. Surveyors advanced on-foot at a maximum speed of approximately 0.5 m per second while passing the detector approximately 10 to 15 (cm) over the ground surface in a serpentine pattern. Scanning results were electronically recorded once per second in counts per minute (cpm). Audible response of the meters was monitored during scanning.

In general, the gamma walkover surveys concentrated on low points or areas expected to have the highest likelihood of radiological contamination while those areas that were remote or less likely to be contaminated received a less intense survey. This approach, in accordance with standard practice, concentrated the greatest effort in the areas of highest risk potential while still providing coverage of other portions of the subject areas with lower risk potential. Additional area-specific discussion of gamma walkover survey findings and results are included in Section 5.

Radiological survey readings can be affected by several localized phenomena including, but not limited to, precipitation, barometric pressure, topography, ground surface geometry, and small differences between the multiple meters used during such surveys. Readings can also be affected when equipment cables become entwined with dense vegetation or when meter probes strike stalks, roots or rocks. Therefore, locations where initial walkover data indicated the potential presence of elevated radiological activity were further investigated to determine if the initial readings were reproducible and sustained. This further evaluation consisted of concentrated gamma walkover surveys in the immediate area of the initial anomaly and was conducted either at the time of the original survey or subsequent to the original survey. After such re-evaluation, locations that exhibited reproducible and sustained readings were sampled if the location was not represented by previously obtained samples taken from that or a similar area.

4.1.2 Soil Sampling

Soil sampling associated with this survey was conducted at IAAAP in August 2004 in accordance with the *Iowa Army Ammunition Plant Radiological Survey Plan* (USACE 2004a). Samples were obtained from the soil surface in the EDA and the DF/DA. To address the potential of both surface and subsurface contamination, some locations in areas of the L1FWWI and the IDA were sampled to a maximum depth of approximately 0.6 m below ground surface (bgs).

At the L1FWWI, remediation of the impoundment basin occurred in 1997. Therefore, six of the 12 randomly-located soil samples were obtained from the 15-cm to 30-cm bgs interval in order to target sediment that would most likely contain historical radioactive contamination while avoiding surface sediment that has accumulated since remediation was conducted.

At the IDA, 12 randomly placed soil samples were obtained from Trench 6 and Trench 7. The depth of the soil sampled at each location was also randomly determined from each discrete 15-cm interval from the surface to approximately 60-cm bgs such that each interval was sampled at least once. In accordance with the *Iowa Army Ammunition Plant Radiological Survey Plan* (USACE 2004a), this random depth approach was designed to increase the probability of detecting radiological contamination that may have been deposited in the trenches.

Surface soil samples were obtained using pre-cleaned stainless steel trowels and bowls. Pre-cleaned hand augers were used to obtain subsurface soil samples. Soil samples were homogenized in stainless steel bowls and field-screened for radioactivity using a Ludlum 2221/44-9. Soil samples were then placed into 1-quart steel sample cans.

The following excerpt from the *Iowa Army Ammunition Plant Radiological Survey Plan* (USACE 2004a) explains the derivation of the DU screening level:

> "*NUREG 1507, Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions* [Nuclear Regulatory Commission (NRC), 1998] lists the MDC for scanning with a 2" x 2" NaI detector for soil contaminated with DU at 56 pCi/g. It has been determined that this level of contamination will be detected at least 95% of the time by the average survey technician walking at a rate of 0.5 meters per second (m/sec). This scan MDC value is based on the assumption that instrument background is at or near 10,000 cpm. Site-specific background for instruments used during the walkover survey should be within ± 20% of this value to validate the use of the stated scan MDC. If instrument backgrounds fall outside this value, a site-specific scan MDC should be calculated.
>
> Conservative risk and dose assessment calculations were performed using the residual radiation code (RESRAD) Version 6.0 to model a residential scenario with DU soil contamination at 56 pCi/g. The resulting risk and dose to the maximum exposed individual from this evaluation is 5 E-5 and 8 millirem per year (mrem/yr), respectively, as described in Appendix A, *IAAAP Survey Screening Level Derived Concentration Guideline Level (DCGL) Risk/Dose Assessment.*
>
> The use of 56 pCi/g as a screening level for DU is applicable to IAAAP since it is expected that the soil at these sites is potentially contaminated with micron-size DU particles. In this situation, it is expected that the activity per gram of soil is much less than the known specific activity of solid DU [i.e., 3.637 E-7 Curies per gram (Ci/g)]. For solid DU (i.e., visible DU fragments), the specific activity is known and the appropriate parameter to define the minimum detectable quantity is the size of the fragment, not its activity.
>
> The presence of DU in excess of 56 pCi/g in any sample from a specific area will require additional investigation for that area or the affected parts of that area. If no samples from a specific area contain DU in excess of 56 pCi/g, no further action will be required in that area."

Soil sample results were compared to the established DU screening level of 56 pCi/g. Further discussion of the soil sampling findings and results is presented in Section 5.

4.1.3 Analysis of Soil Samples

Collected soil samples were sent to the USACE-validated FUSRAP Radioanalytical Laboratory located in Berkeley, Missouri and analyzed in accordance with the *FUSRAP St. Louis, Laboratory Quality Assurance Plan and Laboratory Procedures Manual* (SAIC 1999a).

The samples were processed for alpha spectroscopy analysis to determine isotopic concentrations of the three uranium isotopes present in DU (U-238, U-235 and U-234). Prepared samples were chemically processed using the Claude Sills method of chemical separation and were counted on a Canberra alpha spectroscopy system equipped with Passivated Implanted Planar Silicone (PIPS) detectors. Samples were counted in an attempt to achieve a detection sensitivity of 0.1 pCi/g for each isotope. The split samples collected were analyzed by alpha and gamma spectroscopy by Severn Trent Laboratories.

In addition, samples were dried, homogenized, and analyzed for gamma emitting isotopes using Marinelli beaker geometry and a Canberra gamma spectroscopy system. Sample results were reported for the standard FUSRAP library of contaminants [actinium(Ac)-227, Am-241, Cs-137, potassium (K)-40, Ra-226, Ra-228, thorium (Th)-228, Th-230, Th-232, U-235, U-238] and other peaks if identified during the analysis. Samples were counted in an attempt to achieve an MDA for K-40 of 1 pCi/g resulting in typical detection sensitivities for U-238 and U-235 of approximately 3 pCi/g and 0.2 pCi/g, respectively.

Validated sample data with qualifiers for both alpha and gamma spectroscopy analysis are presented in Attachment B.

4.1.4 Building Surveys

Building and structure surveys were limited to those structures that could be accessed safely. Three different types of measurements were taken from the same sample locations in each of the structures. Beta scans, total alpha-beta surface activity (fixed-point) measurements, and removable surface activity smears were performed in each structure. The measurements were taken at locations considered the most likely to be contaminated, such as entranceways, drains, and high traffic areas. Beta scans were performed at approximately 1 to 2 inches per second at approximately one quarter inch from the surface using Ludlum Model 2360 coupled with a Ludlum 43-89 zinc sulfide (ZnS) scintillator. Fixed point measurements were made with 60 second static counts using a 43-89 ZnS plastic scintillator. Removable activity was determined by smearing an area of approximately 100 cm^2 and then measuring the alpha and beta activity on the smear.

The established structures screening levels for total gross alpha and beta activity were selected from Table 1, *Surface and Volume Radioactivity Standards for Clearance* [American National Standards Institute (ANSI) 1999]. The screening levels for gross alpha and beta removable activity have been set at 10% of the limit total for total alpha and beta activity, respectively. The screening levels used for this screening survey are listed in Table 4-2.

Table 4-2. Screening Levels

Type of Radiation	Total Contamination (dpm/100cm^2)	Removable Contamination (dpm/100cm^2)	Investigation Level for Scanning (cpm)
Gross Alpha	600	60	Not applicable
Gross Beta	6000	600	4,800

4.2 SAMPLE AND WASTE DISPOSITION

Samples were surveyed, tracked by a chain of custody, packaged and sealed in strong tight containers and ground shipped from IAAAP to the USACE-validated FUSRAP Radioanalytical Laboratory located in Berkeley, Missouri. All sample containers were verified free of loose contamination and the dose rate on the outside of the shipping container was verified as being less than 0.5 millirem per hour (mrem/hr). The QC split samples were transported by courier from the FUSRAP Radioanalytical Laboratory by Severn Trent Laboratories for analysis in their Earth City, Missouri laboratory.

There was a limited amount of waste generated as a result of this survey. The waste generated consisted of personal protective equipment (PPE) (surgical and cotton gloves) and swipes. The PPE was surveyed for unrestricted release and placed in "clean" trash for disposal. Sampling activities at the Cap Extension area in the IDA resulted in the generation of Cs-137 contaminated investigation derived waste (IDW). This IDW was transferred to the DOD Executive Agent for Low Level Radioactive Waste at the Rock Island Arsenal and recycled for reuse by DOD.

4.3 SURVEY RESULTS/ANALYTICAL DATA

4.3.1 Reference Area

As described in the *Iowa Army Ammunition Plant Scoping Survey Plan for Firing Sites 6 and 12* (USACE 2001b), the reference area was used to determine background soil U levels at the site. The reference area was located northeast of the IAAAP Gate 4 in the field behind and southwest of Casey's General Store, as shown on Figure 4-1. Soil samples were taken from seven locations within the reference area. In addition, one duplicate sample and one split sample were taken from location IAAP25028. The soil sample locations were randomly generated and distributed across the reference area. The reference soil sample alpha spectroscopy analysis results for the uranium isotopes are shown in Table 4-3.

Table 4-3. Reference Area Soil Sample Analytical Results

Reference Area Data Summary			
Parameters	**U-234 (pCi/g)**	**U-235 (pCi/g)**	**U-238 (pCi/g)**
Mean	1.19	0.13	1.50
Median	1.35	0.13	1.56
Standard Deviation	0.29	0.03	0.27
Maximum	1.50	0.18	1.89
No. Samples	9	9	9
Reference Area Data			
Sample ID	**U-234 (pCi/g)**	**U-235 (pCi/g)**	**U-238 (pCi/g)**
IAAP25025	0.96	0.18	1.62
IAAP25026	1.40	0.16	1.73
IAAP25027	1.35	0.13	1.89
IAAP25028	1.35	0.11	1.48
IAAP25028-1[a]	1.15	0.13	1.49
IAAP25028-2[b]	0.69	0.06	1.06
IAAP25029	0.84	0.11	1.11
IAAP25030	1.46	0.12	1.56
IAAP25031	1.50	0.14	1.58

a) Field duplicate
b) Field split

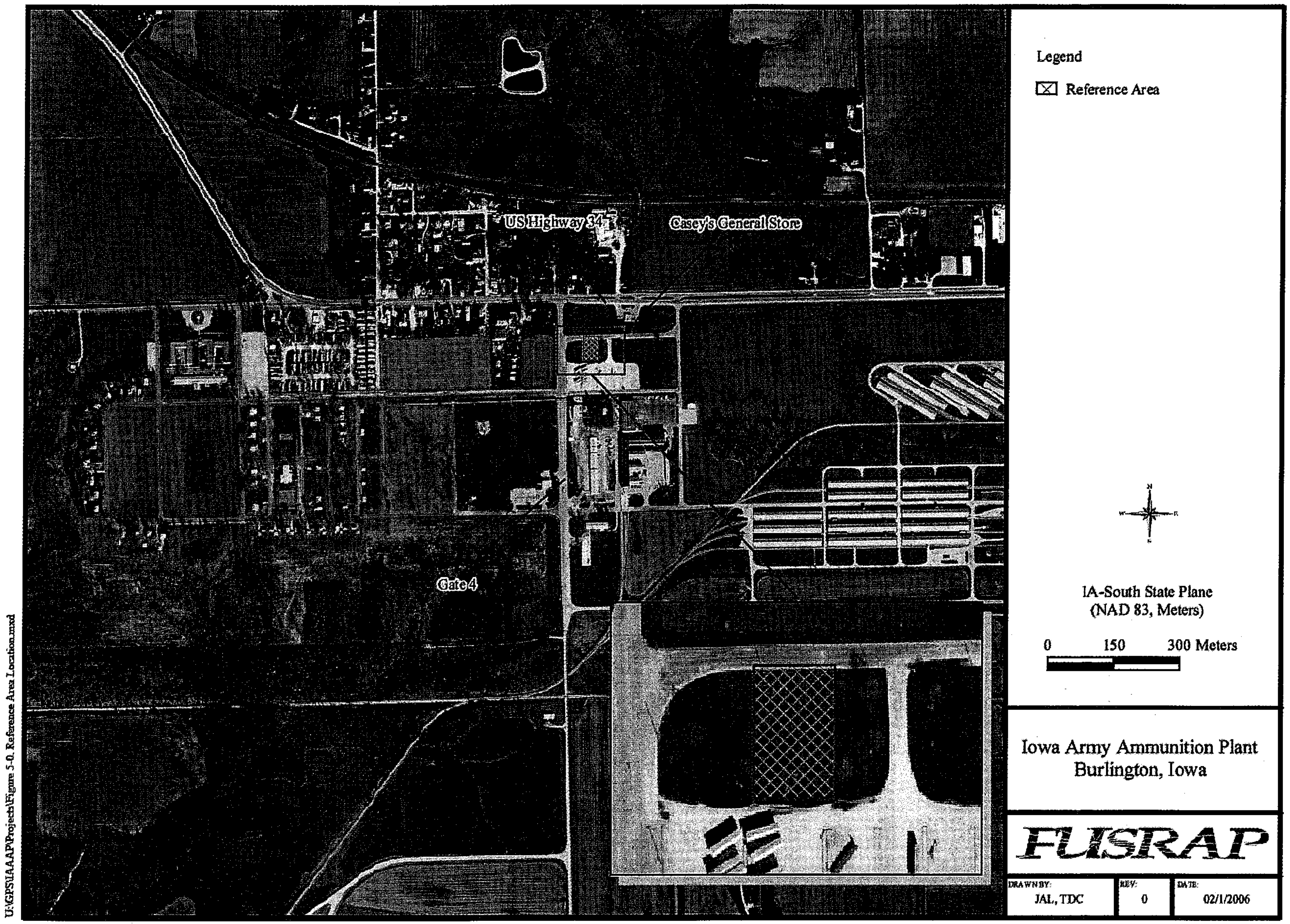


Figure 4-1. Reference Area Location

4.3.2 EDA

The EDA was defined for this study as the North Burn Pads Landfill, the North Burn Pads, the East Burn Pads, the West Burn Pads area, including the area of the West Burn Pads Area south of the road that leads to the East Burn Pads. Most of the area was densely vegetated during the time of the walkover and sampling. Field efforts included gamma walkovers, soil sampling, and structure surveys for this area.

4.3.2.1 Gamma Walkover Survey

The majority of the gamma walkover surveys of the EDA were performed on August 17 and 18, 2004. While portions of the entire area received some coverage in accordance with the *Iowa Army Ammunition Plant Radiological Survey Plan* (USACE 2004a), the focus of the walkovers was on the following areas:

- The corridor of Spring Creek
- Drainages to Spring Creek
- The perimeter of the former East Burn Pads
- Area between the south road and the south perimeter fence of the East Burn Pads
- West Burn Pads area
- North Burn Pads
- North Burn Pads Landfill

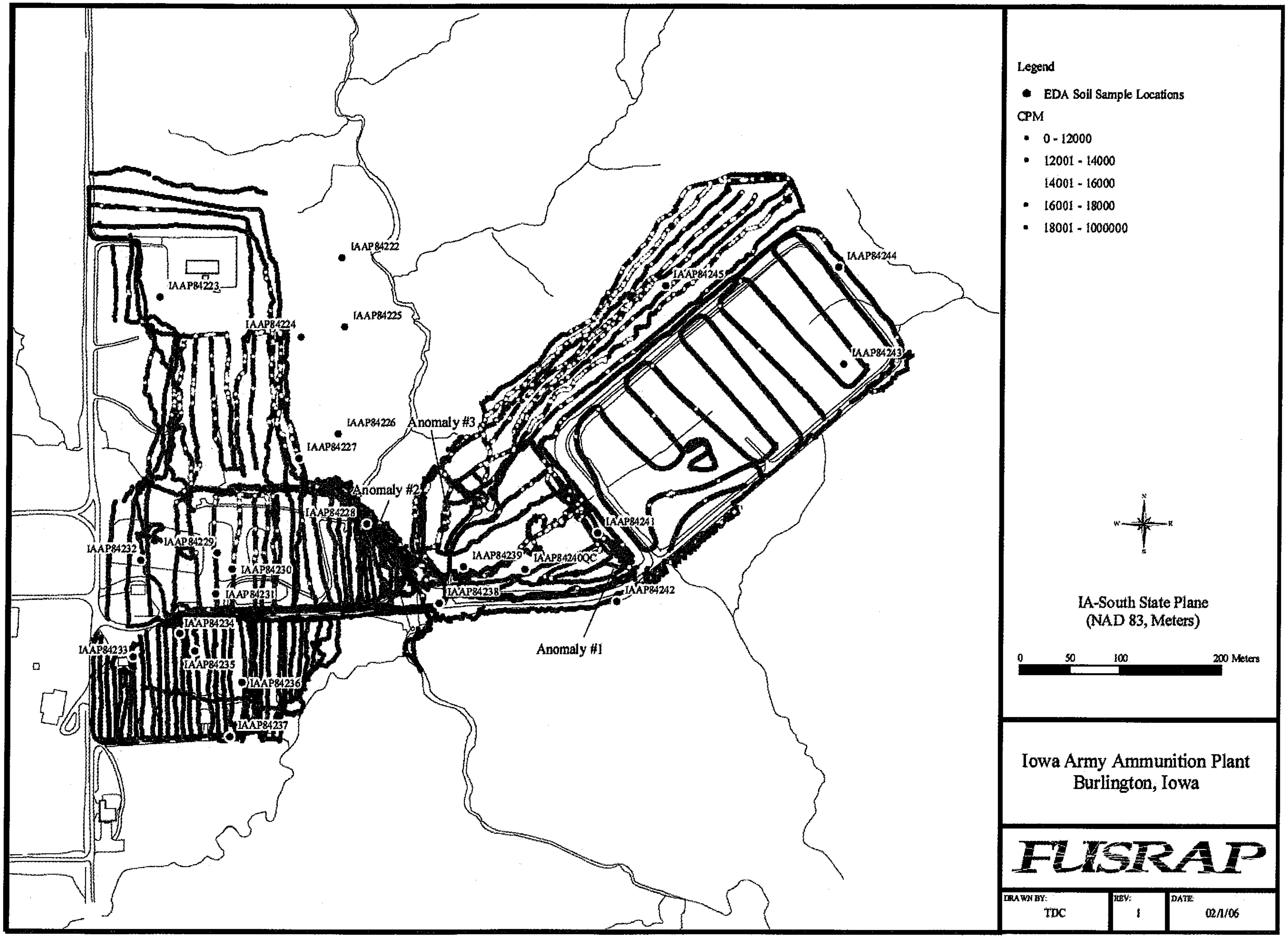
The East Burn Pads included a 5-hectare lot enclosed by a fence as well as areas to the north and southwest. The enclosed area and area north of the fence were relatively flat and covered with dense vegetation. The southwest portion of the East Burn Pads slopes to the southwest, towards the creek that bisects the EDA. Background gamma radiation levels in the East Burn Pad area generally ranged from approximately 13,000 cpm to 15,000 cpm.

The West Burn Pads area was heavily vegetated but included two areas devoid of vegetation. This area sloped to the north towards the drainage feature that divides the West Burn Pads area from the North Burn Pads Landfill, and to the east towards the main creek. Background radiation levels were generally between 12,000 cpm and 14,000 cpm.

The North Burn Pads and North Burn Pads Landfill sloped southward towards the drainage feature and were also heavily covered with herbaceous vegetation interspersed with trees. Gamma walkover surveys were conducted in this area with the exception of the immediate area of the CWP. Background radiation levels across the North Burn Pads and North Burn Pads Landfill, including areas immediately adjacent to the CWP, generally ranged between approximately 12,000 cpm to 14,000 cpm.

Because of concerns with unexploded ordnance (UXO), the walkover for the area south of the West Burn Pads area was delayed until August 24, 2004 when a UXO expert from the USACE-Rock Island District was present to clear the area for walkovers and sampling. This area was heavily vegetated and sloped primarily to the east towards the main EDA drainage feature. Included in the gamma walkover survey of this portion were the areas around the bunkers along the south access road. Background radiation levels generally ranged between 10,000 cpm and 12,000 cpm.

Gamma walkover results for the EDA are presented in Figure 4-2. As described in Section 4.1.1, areas appearing to exhibit gamma radiation counts at rates significantly greater than background levels were investigated further to determine if the increase in count rate at the location was reproducible. Three initial anomalies were detected within the EDA and are also shown on Figure 4-2. All anomalies were further investigated by performing additional gamma walkover



U:\GPS\IAAAP\Projects\Figure5-1 EDA Gamma Walkover and Sample Locations.mxd

Figure 4-2. EDA Gamma Walkover Survey Data and Soil Sample Locations surveys at the prescribed coordinates and in the general vicinity. The original count rate for Anomaly #1, located just southwest of the East Burn Pads, could not be reproduced unless the probe was lowered into a shallow depression. Erosion had created the small depression with steep sides that was approximately 31 cm in depth. The increased count rate was determined to be due to geometry change and therefore a biased sample was not obtained. The original count rate for Anomaly #2, located near a ditch leading to Spring Creek, could not be recreated in its entirety. However, a small increase was observed on a small area of soil void of vegetation. The slight increase noted did not exceed the investigation level. It was determined that the original count rate was due to change in vegetation cover and did not require a biased sample. No increase in count rate was observed at or in the general vicinity of Anomaly #3. The original count rate that was investigated was a single data point, which did not correlate to surrounding data points. The original count rate was determined to be due to meter fluctuations or operator error (surveyor kicking the probe, loose cable or other) and no sample was obtained.

4.3.2.2 Soil Sampling

Twenty-four soil samples were collected from the surface interval (0 cm to 15 cm) from predetermined random locations as indicated in the survey plan (USACE 2004a). The majority of the soil samples were collected on August 17, 18, and 24, 2004. No biased samples were collected in the EDA because no areas of reproducible elevated gamma radioactivity were identified.

Split and duplicate samples were collected at location IAAP84240. The soil throughout the EDA was primarily a brown silty clay/topsoil. Sample locations are presented on Figure 4-2.

Sample analytical results are shown in Table 4-4. Soil samples from the EDA exhibited uranium levels approximately equal to background levels. No sample had DU in excess of 56 pCi/g.

Table 4-4. EDA Soil Sample Analytical Results

Sample ID	Sample Type	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)
IAAP84222	Random	0.97	0.00	1.06
IAAP84223	Random	0.73	0.13	1.00
IAAP84224	Random	1.71	0.00	0.98
IAAP84225	Random	1.63	0.14	1.80
IAAP84226	Random	1.01	0.12	0.86
IAAP84227	Random	2.03	1.02	1.54
IAAP84228	Random	1.04	0.00	0.46
IAAP84229	Random	0.96	0.08	0.71
IAAP84230	Random	1.07	0.00	1.01
IAAP84231	Random	0.83	0.20	0.79
IAAP84232	Random	1.86	0.00	0.88
IAAP84233	Random	0.75	0.00	0.57
IAAP84234	Random	1.01	0.05	1.56
IAAP84235	Random	1.37	0.08	1.22
IAAP84236	Random	1.22	0.00	1.12
IAAP84237	Random	0.60	0.07	0.78
IAAP84238	Random	0.44	0.00	0.81
IAAP84239	Random	0.55	0.00	0.86
IAAP84240	Random	0.79	0.00	0.64
IAAP84241	Random	0.95	0.00	0.78
IAAP84242	Random	0.57	0.03	0.48
IAAP84243	Random	0.99	0.06	1.05
IAAP84244	Random	1.12	0.00	0.61
IAAP84245	Random	1.33	0.00	1.27

4.3.2.3 Building Surveys

Building surveys were performed on bunkers BG-2, BG-3, BG-4, and BG-5 and building BG-1 on August 24, 2004. Surveys focused on areas that would likely be contaminated. Each building surveyed had a minimum of three locations scanned, alpha-beta fixed point measurements taken, and smears collected. Survey results are presented in Table 4-5.

According to the *Iowa Army Ammunition Plant Radiological Survey Plan* (USACE 2004a), since the beta scan MDA (721 dpm/100 cm^2) was well below the structure screening level (6,000 dpm/100 cm^2), a minimum of two fixed-point alpha/beta and loose surface contamination measurements is appropriate in each building regardless of the results of the scan for quantitative purposes. The number of points measured was consistent with the size of the buildings. Three fixed point measurements and smears were collected in each bunker. In BG-1, a two story brick building, ten fixed point measurement locations and smears were collected. The other buildings were bunkers. BG-3 was larger than other bunkers in the EDA. All scan results were less than the investigation level. All alpha and beta fixed point readings were less than the screening levels. Survey results are presented in Attachment C. One fixed point location in BG-5 identified radioactivity at above-background levels. Additional scanning was conducted near this point and throughout the bunker. A total of three fixed point measurements were taken. All additional surveys conducted were at or near background values, well below the screening values.

Table 4-5. EDA Building Survey Results

Sample ID	Sample Location	Removable Alpha (dpm/100cm^2)	Removable Beta (dpm/100cm^2)	Total Alpha (dpm/100cm^2)	Total Beta (dpm/100cm^2)
1	BG-1	<60	<600	163	<515
2	BG-1	<60	<600	122	<515
3	BG-1	<60	<600	<113	1310
4	BG-1	<60	<600	<113	821
5	BG-1	<60	<600	163	<515
6	BG-1	<60	<600	<274	960
7	BG-1	<60	<600	<274	<539
8	BG-1	<60	<600	<274	<539
9	BG-1	<60	<600	<274	<539
10	BG-1	<60	<600	<274	585
1	EDA Bunker (BG-2)	<60	<600	<113	434
2	EDA Bunker (BG-2)	<60	<600	<113	<418
3	EDA Bunker (BG-2)	<60	<600	163	<418
1	BG-3	<60	<600	<141	490
2	BG-3	<60	<600	<141	<449
3	BG-3	<60	<600	<141	<449
1	BG-4	<60	<600	<170	<415
2	BG-4	<60	<600	<170	<415
3	BG-4	<60	<600	<170	<415
1	BG-5	<60	<600	533	739
2	BG-5	<60	<600	<291	<469
3	BG-5	<60	<600	<291	<469

< - less than

4.3.3 IDA

The IDA covers approximately eight hectares. It is partially fenced, with access from the main road controlled by a locked gate. From 1941 to 1992, the IDA was used by the Army to manage plant waste materials, and included a trench-and-fill landfill sanitary landfill, a burning ground, a metal salvage operation, a sludge lagoon, a waste-water sludge drying bed, and an earthen-bermed holding area formerly used to store sludge. Trench 6, Trench 7, and the Cap Extension area (random fill) were the areas surveyed and sampled as a part of this survey effort.

4.3.3.1 Gamma Walkover Survey

Gamma walkover surveys were performed on Trenches 6 and 7 of the IDA on August 23, 2004. The Cap Extension area was surveyed on August 26, 2004. The gamma walkover survey of Trench 7 and the Cap Extension area revealed areas of apparent elevated radioactivity that were further investigated and subsequently sampled as described below. Gamma walkover results are shown in Figure 4-3.

Gamma walkover surveys at the IDA began at Trench 7, located in the northwest corner of the IDA. Visible within the trench were fill materials including soil, rubble, and metal debris. Liner material was exposed at the surface across much of the trench area, particularly in the southern and western portions. The depth of the fill materials appeared greater in the north end of the trench than the south end where more of the trench side slopes were visible. Some vegetation was present across the soil-covered portions. The southern portion of the trench served as a storm-water collection sump. Background radiation levels were in the 12,000 cpm to 14,000 cpm range within the trench. Higher levels were observed on the western slope of the trench. This slope consisted primarily of exposed liner material. It is likely that these increased levels can be attributed to the substantial change in geometry in that portion of the survey area (Anomaly #1).

Biased sample IAAP84249 was obtained from this slope on the day following the initial survey to investigate the increased levels (Anomaly #1). Additional gamma levels were obtained using a NaI 2"X2" to identify the area of higher sustained counts of gamma radiation. The area of highest gamma levels on the day of the sampling was sampled and is considered representative of the larger area of elevated counts. No other significant anomalies were identified in Trench 7. Soil sample analytical results are presented in Section 4.3.3.2.

Gamma walkover surveys continued in Trench 6, located just southeast of Trench 7. The floor of this trench was primarily soil, debris, and waste materials. Conditions similar to Trench 7 were observed; the depth of the deposited material within the trench was greater in the north end than the south end. The southern portion of the trench served as a storm-water collection sump. The eastern slope was covered with exposed liner material. The materials within Trench 6 exhibited gamma radiation background levels of 9,000 cpm to 11,000 cpm with no significant anomalies.

On August 26, 2004, a gamma walkover survey was performed on the Cap Extension area portion of the IDA. The Cap Extension area is an above-grade feature (stockpile) located in the eastern portion of the IDA, just inside the main entrance gate. The surface of the Cap Extension area was varied and included bare soil, areas of thick vegetation, and some rubble. The gamma walkover survey of the Cap Extension area showed that gamma radiation levels generally ranged between 12,000 cpm to 14,000 cpm. One area (Anomaly #2) indicating gamma radiation of approximately 100,000 cpm (significantly greater than the screening level of 2,000 cpm) was identified on top of the pile, approximately 80 m south of the northern limits of the cap. A biased soil sample, IAAP84252, was obtained from that location to investigate the elevated activity. Additional discussion on soil sampling and the associated analytical results is presented in Section 4.3.3.2.

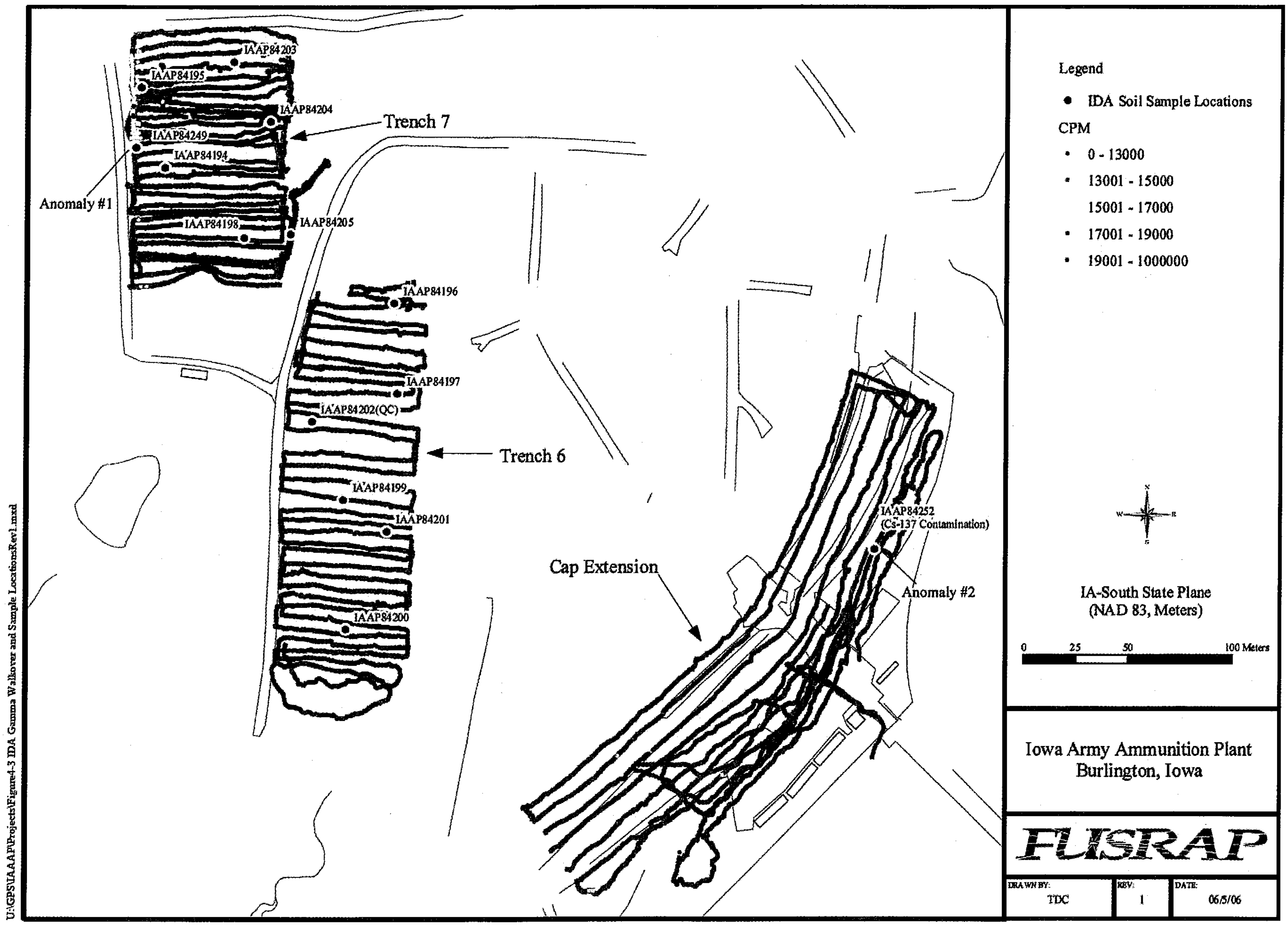


Figure 4-3. IDA Gamma Walkover Survey Data and Soil Sample Locations

4.3.3.2 Soil Sampling

Twelve randomly-located and two biased soil samples were collected at the IDA. Many sample locations, as presented in the survey plan (USACE 2004a), did not fall within Trench 6 and Trench 7 as originally intended. It was therefore necessary for the sampling locations to be randomly redistributed within the trenches as shown on Figure 4-3. Sample depth for each randomly-located location was randomly established from each discrete 15-cm interval within the first 60 cm of the soil profile. The analytical results of the soil samples collected from the IDA are shown in Table 4-6.

Table 4-6. IDA Soil Sample Analytical Results

Sample ID	Sample Type	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)
IAAP84194	Random	1.05	0.14	1.16
IAAP84195	Random	1.53	0.00	1.38
IAAP84196	Random	1.34	0.26	1.33
IAAP84197	Random	0.98	0.00	0.97
IAAP84198	Random	1.16	0.00	1.33
IAAP84199	Random	1.39	0.22	1.33
IAAP84200	Random	2.08	0.00	3.06
IAAP84201	Random	0.72	0.00	0.56
IAAP84202	Random	1.24	0.00	1.28
IAAP84203	Random	0.97	0.00	1.45
IAAP84204	Random	0.76	0.06	0.75
IAAP84205	Random	0.65	0.00	0.9
IAAP84249	Biased	1.14	0.09	1.58
IAAP84252	Biased	0.56	0.12	0.84

In Trench 7, three samples were collected from the surface interval of 0 cm to 15 cm bgs, and one each at the 15 cm to 30 cm, 30 cm to 46 cm, and 46 cm to 60 cm intervals. The soil was described as very dark and grey/brown sandy clay. The same process was applied to samples collected in Trench 6. The soil was described as brown with sand, silt, and clay. Split and duplicate samples were also collected at location IAAP84202.

The first of the two biased samples collected in the IDA, IAAP84249, was a surface sample collected from the western berm of Trench 7 to investigate generally elevated gamma walkover readings along this berm. Uranium in this sample was at background levels.

The second biased sample, IAAP84252, was collected as the result of the gamma walkover survey on the Cap Extension area where a metallic object was located at approximately 20 cm bgs and removed. Neither the object nor its origin could be positively identified at the time of the survey. The metallic object measured approximately 3.8 cm by 3.8 cm and exhibited a beta/gamma field screen reading of approximately 33,000 cpm on a Ludlum 44-9. The soil sample (IAAP84252) was taken from the 0 to 20 cm bgs interval after the metallic object was removed. Subsequent gamma spectroscopy analysis revealed that the soil in sample IAAP84252 contained 226 pCi/g Cs-137, while the metallic object exhibited approximately 100,000 pCi/g Cs-137. Uranium in the soil sample was at background level. No uranium was detected in the metallic object. Locations of samples taken from the IDA areas are shown on Figure 4-3. The highest U-238 concentration was 3.06 pCi/g, from random sample IAAP84200, which is well below the 56 pCi/g soil screening level concentration for DU.

Due to batch processing with IAAP85252 and the potential for cross-contamination, the reported Cs-137 result for IAAP84201 is from the initial gamma analysis, as noted in Attachment B.

4.3.4 DA/DF

The DA/DF area covers approximately four hectares in the southwestern portion of the IAAAP, which was used for open detonation of ammunition items that required immediate disposal. The Deactivation Furnace includes a feed area and retort system, an adjoining air pollution control system, and an exhaust stack. The physical boundaries for this survey were limited to the open field to the east and the tree line on the other three sides. The structures present at the time of the survey consisted of the Deactivation Furnace and support building and the three bunkers. Field efforts included a gamma walkover survey, soil sampling, and structure surveys for this area.

4.3.4.1 Gamma Walkover Survey

Gamma walkover surveys were conducted in the DA/DF portion of the IAAAP on August 24, 25, and 26, 2004. There were three areas that received additional evaluation during the survey. These three areas are discussed below and are indicated on Figure 4-4.

Initial gamma walkover surveys focused on the area immediately surrounding the Deactivation Furnace. Soil in this vicinity was heavily vegetated at the time of the survey except for those portions immediately south and west of the Deactivation Furnace where gravel drives and former parking areas exist. Soil in this vicinity exhibited gamma radiation background levels of approximately 9,000 cpm to 11,000 cpm with no anomalies.

Gamma walkover surveys were also conducted in the open areas on both the east and west side of the Deactivation Furnace entrance road. The area west of the entrance road was heavily covered with herbaceous vegetation with some pockets of small trees. The area generally sloped westward, toward the wooded drainage that separates this area from the Demolition Area. The area east of the access road was also heavily covered with herbaceous vegetation and generally sloped eastward towards an adjacent drainage. A single data point in this area (Anomaly #1) showed levels of approximately 18,500 cpm. This point was unique, not sustained, and was recorded by a meter that had consistently read approximately 1000 to 1500 cpm higher than the other meters used that day. No biased sample was obtained from this location. Soil in this vicinity generally exhibited gamma radiation background levels of approximately 12,000 cpm to 14,000 cpm.

Gamma walkover surveys were also conducted in and along the surface-water drainage that separates the Demolition Area from the Deactivation Furnace area. This drainage was heavily wooded and contained significant understory vegetation. The substrate ranged from loose topsoil to rocky outcroppings. Depth of the drainage, as compared to the surrounding topography, increased towards the southwest. Substrate in this drainage exhibited gamma radiation background levels of approximately 12,000 cpm to 14,000 cpm with no anomalies.

The area between the main surface-water drainage way and the entrance road to the Demolition Area received a gamma walkover survey. This area was heavily covered with herbaceous vegetation with occasional groups of trees. This area generally sloped to the southeast, towards the main surface-water drainage. Soil in this vicinity exhibited gamma radiation background levels of approximately 13,000 cpm to 15,000 cpm with no anomalies.

Gamma walkover surveys were conducted in the area to the north of the Demolition Area entrance road near bunker 900-189-1. This portion of the Demolition Area is relatively flat and contains some areas of thick vegetation, while other areas, particularly near the demolition pad, contain much less vegetation. Surveys in this area were focused primarily on the demolition pad area and the bunkers in the eastern portion. Soil in this vicinity exhibited gamma radiation background levels of approximately 12,000 cpm to 14,000 cpm. An area that appeared to exhibit gamma radiation levels that were slightly above the surrounding area was identified just north of

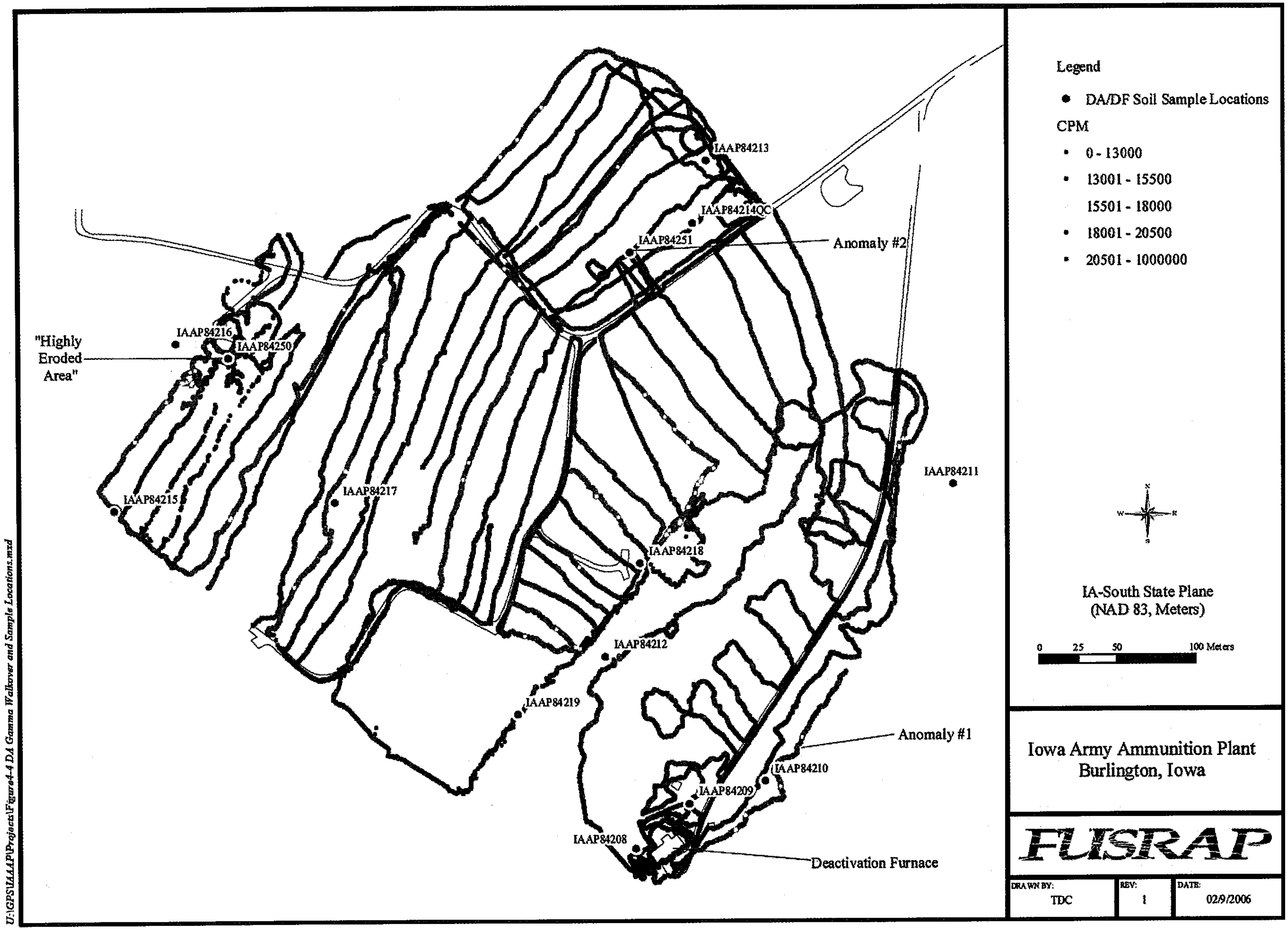


Figure 4-4. DA/DF Gamma Walkover Survey Data and Soil Sample Locations

the main demolition pad (Anomaly #2). Biased sample IAAP84251 was taken at that location to investigate. Soil sample analytical results are discussed in Section 4.3.4.2. No anomalies were identified in other portions of this area.

A gamma walkover was also conducted over the large area of land located west of the "Y" in the Demolition Area entrance road. This area was heavily covered with herbaceous vegetation and contained pockets of medium sized trees. In the northwestern portion of this area there is a highly eroded area that appears to drain surface-water from this watershed. Because this area is an obvious topographical low point, and therefore a possible area for deposition of potentially radioactive demolition materials, gamma walkover surveys focused on this portion of the area and a biased soil sample was also taken (IAAP84250). Soil across the flat portion of this area as well as the eroded section exhibited gamma radiation background levels of approximately 12,000 cpm to 14,000 cpm with no anomalies.

4.3.4.2 Soil Sampling

In accordance with the *Iowa Army Ammunition Plant Radiological Survey Plan* (USACE 2004a), 12 randomly-located samples were collected in the DA/DF area, from the surface interval (0 cm to 15 cm). The planned locations of three sampling points (IAAP84211, IAAP84215, and IAAP84216) fell in areas of heavy tree and brush cover just outside the DA/DF study area. Therefore, these locations were moved, no more than 18 m, in order to be located back into the study area. The soil was generally dark brown topsoil with some samples containing silt and clay. The analytical results of the soil samples collected from the DA/DF are shown in Table 4-7.

Table 4-7. DA/DF Soil Sample Analytical Results

Sample ID	Sample Type	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)
IAAP84208	Random	0.97	0.14	1.10
IAAP84209	Random	0.85	0.29	1.29
IAAP84210	Random	0.93	0.00	1.18
IAAP84211	Random	1.57	0.19	1.23
IAAP84212	Random	1.20	0.11	1.30
IAAP84213	Random	1.27	0.07	1.16
IAAP84214	Random	1.08	0.13	1.14
IAAP84215	Random	0.68	0.05	0.87
IAAP84216	Random	0.96	0.00	0.74
IAAP84217	Random	0.72	0.07	1.15
IAAP84218	Random	0.77	0.00	0.59
IAAP84219	Random	1.19	0.06	1.37
IAAP84250	Biased	0.84	0.04	0.48
IAAP84251	Biased	0.78	0.18	0.86

The potential presence of subsurface UXO was a concern in this area. Therefore, sampling locations were investigated for subsurface objects by an UXO specialist prior to intrusive sampling. The UXO expert arrived on the site on August 24, 2004.

Two biased samples were collected from the DA/DF area. One biased sample, IAAP84250, was collected from the surface interval at the bottom of the eroded zone in the northwestern portion of the Demolition Area. This area is an obvious low point within the surrounding topography and therefore has the potential to be an accumulation point for sediments from that portion of the site. The other biased sample, IAAP84251, was collected from a burn pad near the bunkers in the northern portion of the area. Initial gamma walkover surveys indicated a slight increase in radioactivity at the location of this soil sample. Sample locations are shown on Figure 4-4. Soil sample analytical results for the DA/DF from both biased and random sampling locations were well below the 56 pCi/g soil screening level concentration for DU.

4.3.4.3 Building Surveys

Building surveys were performed on Bunker 900-189-1 in the Demolition Area and a building and two concrete pads in the Deactivation Furnace area on August 25, 2004. Surveys focused on areas that would likely be contaminated. Survey results are presented in Attachment C.

Three alpha-beta fixed point measurements were collected on the interior of Bunker 900-189-1. The entrances and walkway between the two entrances were surveyed. At each fixed point measurement location a smear was also taken to assess removable contamination. Bunker 900-189-1 results were below the screening levels. Two bunkers near Bunker 900-189-1 were not surveyed, due to either safety concerns or the fact that they were full of materials and therefore not accessible. Based on historical uses and the findings of the survey of Bunker 900-189-1, as well the findings of bunker surveys at the EDA, additional surveys of DA/DF bunkers are not necessary.

The Deactivation Furnace consisted of several structures located on two concrete pads. The Deactivation Furnace buildings are not in use; however, one is used for storage. Some structures were not accessed due to safety concerns. Areas that were accessible for surveying included the concrete pads and a room where explosives were loaded into the furnace.

Twenty alpha-beta fixed point measurements were taken at the deactivation furnace and smears were collected to assess removable contamination. The results of the surveys are presented in Table 4-8. The concrete pads at this facility exhibited alpha results over the 600 dpm/100cm^2 screening level. Due to the noted increase in alpha counts, alpha scanning was used during the investigation of the concrete pads at the Deactivation Furnace. According to the *IAAAP radiological survey plan* (USACE 2004a) only two points are needed per structure, however, more readings were taken to determine the extent of the elevated alpha activity on the concrete pads. The area having the highest alpha reading was located on the small concrete pad. Survey personnel covered this small area with plastic sheeting for 24 hours after which another reading was made to rule out radon as a possible cause for the elevated readings. The reading before the plastic was put in place was 2935 dpm/cm^2 and 24 hours later when the plastic was removed it was 2038 dpm/cm^2. Survey personnel noted the presence of dark-colored stains intermittently distributed on the small concrete pad. Based on similar situations at other sites, as well as professional judgment, it is believed that the elevated counts on the pad are due to naturally occurring radioactive material contained within the concrete.

The Iowa Department of Health performed a subsequent evaluation of this concrete pad in September 2005 using radiological spectrum-yielding field instrumentation. The radiological spectrum that was obtained was slightly higher than background and consistent with that generated by naturally occurring radioisotopes and their progeny. The Iowa Department of Health conclusion is that the original survey discovered something, possibly a piece of aggregate, in the concrete pad.

Table 4-8. DA/DF Building Survey Results

Sample ID	Sample Location	Removable Alpha (dpm/100cm^2)	Removable Beta (dpm/100cm^2)	Total Alpha (dpm/100cm^2)	Total Beta (dpm/100cm^2)
1	Deactivation Furnace	<60	<600	224	531
2	Deactivation Furnace	<60	<600	1427	1624
3	Deactivation Furnace	<60	<600	1182	1246
4	Deactivation Furnace	<60	<600	1060	1086

Table 4-8. DA/DF Building Survey Results (Cont'd)

Sample ID	Sample Location	Removable Alpha (dpm/100cm²)	Removable Beta (dpm/100cm²)	Total Alpha (dpm/100cm²)	Total Beta (dpm/100cm²)
5	Deactivation Furnace	<60	<600	1936	1352
6	Deactivation Furnace	<60	<600	2935	2208
7	Deactivation Furnace	<60	<600	1957	1476
8	Deactivation Furnace	<60	<600	387	768
9	Deactivation Furnace	<60	<600	265	892
10	Deactivation Furnace	<60	<600	795	886
11	Deactivation Furnace	<60	<600	<61	<406
12	Deactivation Furnace	<60	<600	<61	490
13	Deactivation Furnace	<60	<600	<61	<406
14	Deactivation Furnace	<60	<600	224	496
15	Deactivation Furnace	<60	<600	734	744
16	Deactivation Furnace	<60	<600	326	472
17	Deactivation Furnace	<60	<600	122	531
18	Deactivation Furnace	<60	<600	387	638
19	Deactivation Furnace	<60	<600	571	496
20	Deactivation Furnace	<60	<600	632	880
1	DEMO 900-189-1	<60	<600	<MDC	<MDC
2	DEMO 900-189-1	<60	<600	<MDC	<MDC
3	DEMO 900-189-1	<60	<600	<MDC	<MDC

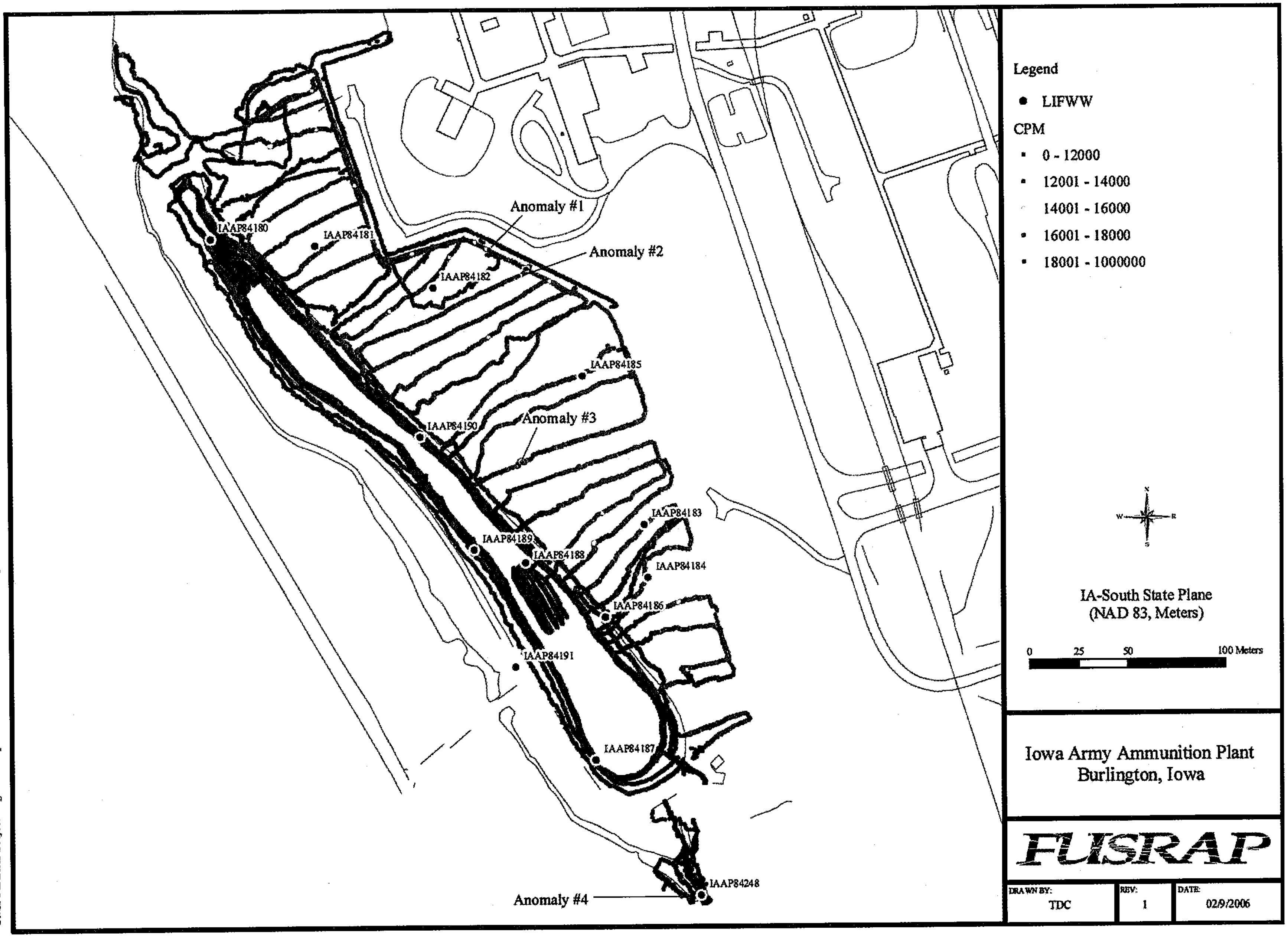
4.3.5 L1WWI

For purposes of this survey, the L1FWWI includes the impoundment from dam to dam and covers approximately 3 hectares. The survey area also included the area extending approximately 100 m north of the north dam, to the Line 1 perimeter fence to the east, and south to the perimeter road located south of the south dam. The survey boundary area extends west to the perimeter road that runs north and south on top of the berm. It was noted that the Line 1 impoundment was located downhill from Line 1 and the two areas are separated by a chain-link fence. Based on the topography of the area east of the impoundment basin, it appeared that the surface-water from a portion of the Line 1 area drained toward and eventually into the waste-water impoundment basin. The impoundment floor was under water at the time of the visit and the visible surrounding soil was covered with grass.

4.3.5.1 Gamma Walkover Survey

Gamma walkover surveys of the L1FWWI occurred on August 16 and 17, 2004. The focus of the surveys was along the circumference of the impoundment basin, an island surrounded by water, the drainage ways exiting from the west side of Line 1 leading to the impoundment, and the areas north of the north dam and south of the south dam. The heavily vegetated sloped area northeast of the impoundment and the grassy strip adjacent to the Line 1 fence received a less dense coverage. Gamma walkover results are shown in Figure 4-5.

Because of the relatively low water levels and forecasted rain, initial gamma walkover survey efforts focused on the area in the immediate vicinity of the impoundment. Most of the area immediately adjacent to the impounded water was steep-sloped and heavily covered with vegetation. An "island" measuring approximately 40 m by 20 m was accessible in the impoundment bottom and was surveyed. Soil immediately adjacent to the impounded water and soil on the exposed "island" exhibited background radiation levels between approximately 9,000 cpm and 11,000 cpm and showed no anomalies.



U:\GPS\IAAAP\Projects\Figure4-5 Impoundment Gamma Walkover and Sample LocationsRev1.mxd

Figure 4-5. L1FWWI Gamma Walkover Survey Data and Soil Sample Locations

Gamma walkover surveys continued in the area between the impoundment basin and the west perimeter fence of Line 1. This area was heavily vegetated and sloped from Line 1 towards the impoundment basin. Several areas near the Line 1 perimeter fence exhibited gamma count rates at above-background levels, however these results were not sustained and were not reproduced upon further investigation. In addition, increased counts in some areas can be attributed to significant changes in ground surface geometry, i.e., holes into which the survey meter was placed. Specifically, Anomaly #1 could not be reproduced upon additional investigation. The original count rate was a single data point located along the driving path along the west side of the Line 1 perimeter fence. This single data point was determined to be due to meter fluctuations or operator error (surveyor kicking the probe, loose cable or other) and no sample was obtained. Anomaly #2 was an area of a small depression (swale) on (and just west of) the driving path that is present along the western Line 1 perimeter fence. Upon re-investigation, only a very slight count rate increase could be detected in this area. The original cause of the elevated activity was determined to be due to the localized topography change (swale) and no biased sample was taken from this location. Anomaly #3 was located in a hole that was part of an obvious storm water drainage swale. Such an increase in count rate is typically seen when the soil geometry around the probe changes dramatically, such as being lowered into a hole. The anomaly could not be reproduced unless the probe was lowered into the hole. It was determined that the increase in count rate was indeed due to the dramatic change in soil geometry and therefore no sample was obtained. In general, soil on the sloped area between the impoundment basin and the west perimeter fence generally exhibited background gamma radiation levels between approximately 11,000 cpm and 13,000 cpm.

Gamma walkover surveys were conducted along the drainage channel north of the north dam of the impoundment. The area adjacent to the stream channel extending approximately 100 m north of the dam was low-lying and heavily covered with herbaceous vegetation. Background gamma radiation levels in this area generally ranged between approximately 9,000 cpm to 11,000 cpm with no anomalies.

Gamma walkover surveys were also conducted along the drainage channel south of the south dam of the impoundment. These surveys covered areas along the drainage channel from the south dam road to near the culvert that delivers water beneath the main road. The area along this drainage channel was rocky and overgrown with herbaceous vegetation and some trees. One sustained, reproducible area of elevated radioactivity (Anomaly #4) was identified in this drainage immediately adjacent to a larger boulder. This small area exhibited a sustained gamma activity of approximately 15,000 cpm in an area with a background level of approximately 11,000 cpm. A biased soil sample, IAAP84248 was obtained from this location. Additional discussion and soil sample analytical results are presented in Section 4.3.5.2.

4.3.5.2 Soil Sampling

Twelve random and one biased sample were collected from the L1FWWI area on August 19, 2004. Because of water present in the impoundment, four random sample locations (IAAP84180, IAAP84187, IAAP84188, and IAAP84189) were moved approximately three meters from the location prescribed by the survey plan to the locations indicated on Figure 4-5. Six of the random samples were collected from 0 cm to 15 cm bgs while the other six were from the 15 cm to 30 cm bgs interval. The six random samples that were collected from the 15 cm to 30 cm interval were primarily collected in or near the basin. The collection of subsurface samples was performed in an effort to identify any potential contamination that may have been covered by the deposition of silt in the basin. At sample location IAAP84184, one split sample and one duplicate sample were also collected. The soil in the area of the impoundment was predominately brown and gray silty clay.

One biased soil sample (IAAP84248) was collected from the isolated area of elevated radioactivity identified south of the south dam. Soil sample analytical results from the L1FWWI area are presented in Table 4-9. Analytical results from soil samples obtained within the L1FWWI survey area show that DU concentrations are less than the established screening level of 56 pCi/g. The concentrations of uranium isotopes in samples from the impoundment area are similar to those of the reference area samples.

Table 4-9. L1FWWI Soil Sample Analytical Results

Sample ID	Sample Type	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)
IAAP84180	Random	0.65	0.06	0.84
IAAP84181	Random	1.03	0.00	0.65
IAAP84182	Random	1.23	0.08	1.43
IAAP84183	Random	1.27	0.07	1.14
IAAP84184	Random	1.04	0.04	0.69
IAAP84185	Random	0.84	0.07	0.74
IAAP84186	Random	1.39	0.00	0.61
IAAP84187	Random	0.85	0.14	1.28
IAAP84188	Random	0.52	0.05	0.77
IAAP84189	Random	0.47	0.00	0.57
IAAP84190	Random	0.59	0.00	0.76
IAAP84191	Random	1.19	0.07	1.14
IAAP84248	Biased	0.97	0.07	1.14

4.4 ADDITIONAL SOIL DATA

In addition to the target analyte (depleted uranium), the collected soil samples from four investigation areas (i.e., EDA, IDA, DA/DF, and L1FWWI) were analyzed by gamma spectroscopy for Ac-227, Cs-137, K-40, protactinium (Pa)-231, Ra-226, Ra-228, Th-228, Th-230, and Th-232. Available reference area values are presented in Table 4-10.

Of the 60 soil samples collected from the four investigation areas, only one sample exhibited results above background or the detection limit for any of the radionuclides analyzed. This soil sample, IAAP84252, was associated with the Cs-137-containing metal object discussed in Section 4.3.3.2 and indicated a Cs-137 concentration of 226 pCi/g. The mean reference area value for Cs-137 is 0.47 pCi/g. Summary statistics for the additional nuclides are presented below in Tables 4-11 through 4-14. Individual values for these radionuclides are presented in Appendix B.

Table 4-10. Reference Area Soil Sample Analytical Results for Additional Nuclides

Reference Area Data Summary					
Parameter	**Cs-137**	**K-40**	**Ra-228**	**Th-228**	**Th-232**
Mean (pCi/g)	0.47	13.24	0.96	0.96	0.96
Median (pCi/g)	0.44	14.03	1.02	1.02	1.02
Standard Deviation	0.11	2.13	0.20	0.20	0.20
Range (pCi/g)	0.32	6.86	0.55	0.55	0.55
Maximum (pCi/g)	0.69	15.70	1.14	1.14	1.14
Number (n)	8	8	8	8	8
IAAP25025 (pCi/g)	0.43	14.52	0.95	0.95	0.95
IAAP25026 (pCi/g)	0.38	13.99	1.13	1.13	1.13
IAAP25027 (pCi/g)	0.37	14.03	1.09	1.09	1.09
IAAP25028 (pCi/g)	0.53	12.01	0.81	0.81	0.81
IAAP25028-1 (pCi/g)	0.53	12.5	0.83	0.83	0.83
IAAP25029 (pCi/g)	0.69	8.84	0.59	0.59	0.59
IAAP25030 (pCi/g)	0.42	14.39	1.12	1.12	1.12
IAAP25031 (pCi/g)	0.44	15.70	1.14	1.14	1.14

Table 4-11. Additional Soil Data from the EDA

	Ac-227	Cs-137	Pa-231	K-40	Ra-226	Ra-228	Th-228	Th-230	Th-232
Mean (pCi/g)	0.02	0.32	0.15	13.16	1.09	0.84	0.84	1.39	0.84
Median (pCi/g)	0.00	0.34	0.17	13.38	1.06	0.90	0.90	0.76	0.90
Standard Deviation	0.03	0.20	0.14	3.33	0.19	0.23	0.23	1.84	0.23
Range (pCi/g)	0.13	0.62	0.44	13.00	0.81	0.93	0.93	7.50	0.93
Maximum (pCi/g)	0.13	0.64	0.44	18.56	1.53	1.21	1.21	7.50	1.21
Number (n)	24	24	24	24	24	24	24	24	24

Table 4-12. Additional Soil Data from the IDA

	Ac-227	Cs-137	Pa-231	K-40	Ra-226	Ra-228	Th-228	Th-230	Th-232
Mean (pCi/g)	0.02	16.27	0.14	12.31	1.12	0.84	0.84	0.58	0.84
Median (pCi/g)	0.00	0.10	0.12	12.39	1.12	0.86	0.86	0.00	0.86
Standard Deviation	0.05	60.42	0.15	2.47	0.19	0.21	0.21	0.95	0.21
Range (pCi/g)	0.18	226.20	0.46	8.21	0.56	0.78	0.78	3.14	0.78
Maximum (pCi/g)	0.18	226.20	0.46	16.43	1.46	1.31	1.31	3.14	1.31
Number (n)	14	14	14	14	14	14	14	14	14

Table 4-13. Additional Soil Data from the DA/DF

	Ac-227	Cs-137	Pa-231	K-40	Ra-226	Ra-228	Th-228	Th-230	Th-232
Mean (pCi/g)	0.05	0.21	0.13	15.16	1.18	0.98	0.98	1.29	0.98
Median (pCi/g)	0.03	0.15	0.04	15.75	1.22	0.97	0.97	0.82	0.97
Standard Deviation	0.06	0.20	0.15	2.06	0.12	0.10	0.10	1.58	0.10
Range (pCi/g)	0.18	0.54	0.38	7.67	0.41	0.37	0.37	4.28	0.37
Maximum (pCi/g)	0.18	0.53	0.38	17.75	1.37	1.11	1.11	4.28	1.11
Number (n)	14	14	14	14	14	14	14	14	14

Table 4-14. Additional Soil Data from L1FWWI

	Ac-227	Cs-137	Pa-231	K-40	Ra-226	Ra-228	Th-228	Th-230	Th-232
Mean (pCi/g)	0.01	0.14	0.18	12.87	0.95	0.86	0.86	0.85	0.86
Median (pCi/g)	0.00	0.07	0.17	12.34	1.02	0.85	0.85	0.60	0.85
Standard Deviation	0.01	0.17	0.20	2.33	0.27	0.18	0.18	1.08	0.18
Range (pCi/g)	0.04	0.54	0.71	7.47	0.88	0.65	0.65	3.93	0.65
Maximum (pCi/g)	0.04	0.54	0.71	17.33	1.47	1.25	1.25	3.93	1.25
Number (n)	13	13	13	13	13	13	13	13	13

5.0 INVESTIGATION CONCLUSIONS

5.1 EDA

5.1.1 Historical

Historical records confirm the presence of DU in at least a portion of the waste burned or disposed in the EDA by AEC. Historical records indicate that a measurable amount of radiation was noted when performing a radiological screening of the residual ash from the various burn areas during the disposal operations. The standard practice at the time was to segregate any ash residue containing excessive alpha contamination after burning, then bag the residue, and ship it to the Pantex, Texas site for disposal. Ash not containing excessive alpha contamination was ultimately disposed of in three landfill cells at the IDA (USACE 2001a). The active areas within the EDA were all remediated for chemical contaminants with confirmation chemical sampling performed in the excavation prior to 2002. No radiological screening or survey result summaries reviewed from the remediation phase of this area reported elevated levels of radioactive material.

5.1.2 Aerial Flyover

The aerial flyover conducted in 2002 (after the remediation of the EDA) did not identify the presence of any elevated gamma emitting radioisotopes. The gross count flyover did indicate a slight difference in count rate between the cleared areas and the areas containing trees and dense vegetation. This count rate variation is consistent with normal background fluctuations due to vegetation shielding. The MMGC method, established after "filtering" of the terrestrial contours, indicates a consistent count rate across the entire EDA with no variations of note. The aerial flyover indicates that there are no large areas that have been affected by the release of anthropogenic radioisotopes, no areas of the EDA that pose an immediate danger to human health or the environment, and that the gamma emitting radioisotope concentrations present on the EDA are consistent with background levels.

5.1.3 Screening Survey

The radiological screening survey conducted in 2004 (after the aerial flyover and remediation of the burning grounds) did not identify the presence of DU in excess of the screening level. The gamma walkover effort was biased in areas of logical deposition and collection of radioactive material runoff from erosion. In addition, areas of dense vegetation, adjacent to buildings, and other small areas that may have not obtained good resolution during the aerial flyover were targeted for gamma walkover. No unexplained elevated gamma readings were obtained during the gamma walkover. In addition, 24 soil samples were obtained across the EDA in random locations. All samples had results near or below the reference area sample results with little deviation in concentration observed. All direct and removable contamination measurements taken within the structures of the EDA were well below the established screening level for alpha and beta contamination. The screening survey did not identify the presence of radioactive material in excess of screening levels during the gamma walkover, soil sampling, or radiological contamination survey of the structures.

5.1.4 Radiological Status of the EDA

From historical evidence it is clear that radioactive material was managed and handled at this site; however, based on the investigations performed to date (flyover, walkover, and soil sampling), the site is not impacted with radioactive materials from AEC operations. There were no observable releases of DU at the EDA that pose a threat, and the DU detected was present at levels consistent with those in the reference area.

5.2 IDA

5.2.1 Historical

Historical presence of radioactive material within the IDA has not been confirmed from historical records. However, residual ash and remediated soil from the West Burn Pads area, East Burn Pads, North Burn Pads, North Burn Pads Landfill, L1FWWI, and the Fire Training Pit were placed in Trench 6, Trench 7, and the Cap Extension area. Wastes contaminated with chemical residues were placed in the IDA for storage and treatment. Due to the lack of detailed information concerning the radiological scanning, it was not possible to determine the detection sensitivity utilized during the scan, thus a screening level survey at the IDA was determined to be appropriate to address this data gap.

5.2.2 Aerial Flyover

The aerial flyover conducted in 2002 did not identify the presence of any elevated gamma emitting radioisotopes. The variation in count rate is consistent with normal background fluctuations due to vegetation shielding. The MMGC method, established after "filtering" of the terrestrial contours, indicates a consistent count rate across the entire IDA with no variations of note. The aerial flyover indicates that there are no large areas that have been affected by the release of anthropogenic radioisotopes, no areas of the IDA that pose an immediate danger to human health or the environment, and that the gamma emitting radioisotope concentrations present on the IDA are consistent with background levels.

5.2.3 Screening Survey

The radiological screening survey conducted in 2004 did not identify the presence of DU in excess of the screening level. The gamma walkover survey effort was focused on Trench 6, Trench 7, and the Cap Extension area. Two areas of elevated gamma readings were identified during the gamma walkover survey. In the first area, on the western berm of Trench 7, a sample was collected and showed uranium to be at background levels. The second biased sample was collected as a result of a small localized area of gamma activity identified during the gamma walkover survey on the Cap Extension area. At this location a metallic object was located at approximately 20 cm bgs. The metallic object was subsequently removed and transferred to the DOD Executive Agent for Low Level Radioactive Waste at the Rock Island Arsenal and recycled for reuse by DOD. Based on the location of the object at the IDA, it is likely that it originated at the EDA, possibly the West Burn Pads, and was subsequently moved to the IDA as part of the Army's IRP cleanup efforts at that area. Laboratory analysis confirmed Cs-137 contamination of the biased soil sample IAAP84252 below the metallic object. The soil below the object (IAAP84252) is believed to contain the highest levels of Cs-137 in the soil (226 pCi/g). Although contamination associated with this object has not been fully delineated, it can be assumed that the soil contamination would only decrease with distance from the object's former location. Uranium in the soil sample was present at levels consistent with the reference area.

Neither the object nor its origin could be positively identified, however it exhibited the characteristics of a melted radioactive source or otherwise controlled item. The radiological concentration and physical nature of the object are consistent with controlled items. Due to the high probability that the Cs-137 object is a controlled item and the rigid inventory controls associated with such items, it is unlikely that similar objects are present elsewhere within the IDA, the EDA, or on the IAAAP site. Any residual Cs-137 soil contamination present in the immediate area of the object's former location at the Cap Extension Area will be addressed by the IRP. The area of Cs soil contamination is currently covered with approximately 20 cm of soil and access to the IDA is restricted.

Twelve additional soil samples were obtained across the IDA in random locations. All samples had results near or below the reference area sample results with little deviation in concentration observed. Except as noted above, the screening survey did not identify the presence of radioactive material in excess of the reference area during the gamma walkover survey and soil sampling.

5.2.4 Radiological Status of the IDA

The historical investigation, aerial flyover and subsequent screening survey all show that the IDA is not impacted with DU. There were no observable releases of DU at the IDA that pose a threat, and the DU detected was present at levels consistent with those in the reference area. A Cs-137 containing object was found in the Cap Extension Area which exhibits the characteristics of a melted source or other controlled item, although the specific origin of the object could not be identified. Due to the high probability that the Cs-137 object is a controlled item and the rigid inventory controls associated with such items there is no reason to believe that similar objects are present elsewhere within the IDA or on the IAAAP site. The Cs-137 object was transferred to the DOD Executive Agent for Low Level Radioactive Waste at the Rock Island Arsenal and any residual contamination resulting from the object is the responsibility of the IRP.

5.3 DA/DF

5.3.1 Historical

Historical records do not indicate that radiological material was ever stored in the structures on the DA/DF area, that these structures were controlled at any time, or that AEC activities occurred in these areas. However, interviews with former workers indicated that an AEC sign was present on the Deactivation Furnace building in the past. Historical presence of radioactive material within the DA/DF has not been confirmed from historical records.

5.3.2 Aerial Flyover

The aerial flyover conducted in 2002 did not identify the presence of any elevated gamma emitting radioisotopes. The gross count flyover did indicate a slight difference in count rate between the cleared areas and the areas containing trees and dense vegetation. This count rate variation is consistent with normal background fluctuations due to vegetation shielding. The MMGC method, established after "filtering" of the terrestrial contours, indicates a consistent count rate across the entire DA/DF with no variations of note. The aerial flyover indicates that there are no large areas that have been affected by the release of anthropogenic radioisotopes, no areas of the DA/DF that pose an immediate danger to human health or the environment and that the gamma emitting radioisotope concentrations present on the DA/DF are consistent with background levels.

5.3.3 Screening Survey

The radiological screening survey conducted in 2004 did not identify the presence of DU in excess of the screening level. The gamma walkover effort was aimed at the area around the furnace, open areas around the entrance road to the furnace, the surface water drainage dividing the area, open, flat areas of the Demolition Area and the highly eroded section in the northwestern portion of the DA/DF area. With the exception of one area with slightly elevated gamma readings (which sampling showed did not include uranium above background) there were no sustainable or reproducible anomalies in this area. In accordance with the survey plan (USACE 2004a), 12 randomly-located samples were collected in the DA/DF area, from the surface interval (0 cm to 15 cm). Two biased samples, one in a low point and the other near the burn pads in the northern part of the area, were also collected. Soil sample analytical results for the DA/DF from both biased and random sampling locations were well below the 56 pCi/g soil screening level concentration for DU and were near or below the results of samples obtained from the reference area.

During the building survey of the DA/DF area, the area having the highest alpha reading was located on a small concrete pad. Additional survey was conducted in this area. Based on similar situations at other sites, professional judgment, and evaluation by Iowa Department of Health personnel, it is believed that the elevated counts on the pad are due to naturally occurring radioactive material contained within the concrete.

5.3.4 Radiological Status of the DA/DF

The historical investigation, aerial flyover and subsequent screening survey show that the DA/DF area is not impacted with radioactive materials from AEC operations. There were no observable releases of DU at the DA/DF that pose a threat, and the DU detected was present at levels consistent with those in the reference area.

5.4 L1FWWI

5.4.1 Historical

Historical records indicate that there was a potential for DU releases to the environment from Line 1 AEC activities. Radiological screening or survey result summaries have confirmed the presence of depleted uranium in a portion of the buildings at Line 1. The records indicate that the explosive contaminated effluent from Line 1 was sent to clarifiers for settling of the heavy particulates. The diluted effluent was then discharged to the Line 1 Impoundment. An Interim Response Action was completed in 1997 when explosives-contaminated soils were excavated from the impoundment and transported to the IDA. No historical records or references have been found that indicate a radiological screening was performed during this Interim Response Action or that a radiological release occurred to the impoundment.

5.4.2 Aerial Flyover

The aerial flyover conducted in 2002 did not identify the presence of any elevated gamma emitting radioisotopes. The gross count flyover did indicate a slight difference in count rate between the cleared areas and the areas containing trees and dense vegetation. This count rate variation is consistent with normal background fluctuations due to vegetation shielding. The MMGC method, established after "filtering" of the terrestrial contours, indicates a consistent count rate across the entire L1FWWI with no variations of note. The aerial flyover indicates that there are no large areas that have been affected by the release of anthropogenic radioisotopes, no areas of the L1FWWI that pose an immediate danger to human health or the environment and that the gamma emitting radioisotope concentrations present on the L1FWWI are consistent with background levels.

5.4.3 Screening Survey

The radiological screening survey conducted in 2004 did not identify the presence of DU in excess of the screening level. Gamma walkover surveys of the L1FWWI occurred on August 16 and 17, 2004. The focus of the surveys was along the circumference of the impoundment basin, an island surrounded by water, the drainage ways exiting from the west side of Line 1 leading to the impoundment and the areas north of the north dam and south of the south dam. The heavily vegetated sloped area northeast of the impoundment and the grassy strip adjacent to the Line 1 fence received survey coverage. Twelve random samples and one biased sample were collected from the L1FWWI area. The biased sample was taken from an area south of the dam with slightly elevated gamma readings. The concentrations of uranium isotopes in all samples from the L1FWWI area are well below the 56 pCi/g DU screening level.

The screening survey confirmed that no radioactive material were present in areas of highest potential for contamination to accumulate. The screening survey confirmed the aerial flyover conclusion that the concentrations of gamma emitting radioisotopes within the L1FWWI area were consistent with those found in samples from the reference area.

5.4.4 Radiological Status of L1FWWI Area

The recent flyover data and screening walkover surveys and sampling confirm a lack of radiological contamination. Consequently, it is the conclusion of this document that L1FWWI area is not impacted with radiological material from AEC. There were no observable releases of DU at the L1FWWI that pose a threat, and the DU detected was present at levels consistent with those in the reference area.

6.0 CONCLUSION

The areas identified as the EDA, IDA, DA/DF, and the L1FWWI were found to be un-impacted by FUSRAP potential contaminants of concern. Therefore, no further action at these areas is necessary by FUSRAP, with the exception of the West Burn Pads Area South of the Road, which will be addressed for potential chemical contamination in the IAAAP Remedial Investigation Work Plan. Responsibility for the EDA (excluding the West Burn Pads Area South of the Road), DA/DF, L1FWWI, and IDA including any residual Cs-137 contamination remains with the IRP.

7.0 REFERENCES

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ATTACHMENT A

QUALITY CONTROL SUMMARY REPORT

IOWA ARMY AMMUNITION PLANT
QUALITY CONTROL SUMMARY REPORT

A-1 INTRODUCTION

A-1.1 Project Description

This project is the initial assessment of selected individual areas at the Iowa Army Ammunitions Plant (IAAAP) that are potentially affected by various modes of radiological contamination. These areas have been identified by USACE. The initial assessment of these areas was accomplished by conducting building surveys, gamma walkovers and soil sampling. Sampling was conducted in general accordance with protocols from the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) (DOD 2000) and the project-developed *Iowa Army Ammunition Plant Radiological Survey Plan* (USACE 2004a).

A-1.2 Project Objectives

The objective of this radiological screening survey is the resolution of whether or not the soil and man-made materials (i.e., pavements, floors in and around structures) present at the surface of areas identified by the preliminary assessment (PA) (USACE, 2001a) as having low probability for radioactive contamination are radioactively contaminated.

A-1.3 Project Implementation

The proposal for this project was submitted to the United States Army Corps of Engineers (USACE) in January 2004 and subsequently authorized in August 2004. The sampling was conducted in August of 2004. Radiological analyses were conducted by the Formerly Utilized Sites Remedial Action Program (FUSRAP) St. Louis Radiological laboratory, with quality assurance (QA) split samples analyzed by a contract laboratory, Severn-Trent Laboratories.

A-1.4 Purpose of this Report

The primary intent of this assessment is to illustrate that data generated from this sampling can withstand scientific scrutiny, are appropriate for their intended purpose, are technically defensible, and are of known and acceptable sensitivity, precision, and accuracy.

A-2 QUALITY ASSURANCE PROGRAM

A quality assurance project plan (QAPP) was prepared for this project and is based upon the Sampling and Analysis Guide (SAG) (USACE 2000) developed for the St. Louis FUSRAP Sites. The QAPP established requirements for both field and laboratory quality control (QC) procedures. In general, analytical laboratory QC duplicates, matrix spikes, laboratory control samples, and method blanks were required for every 20 field samples or less of each matrix and analyte types.

One of the primary goals of the QA program is to ensure that the quality of results for environmental measurements is appropriate for the intended use of the data. To this end, a QAPP and standardized field procedures were compiled to guide the investigation. Through the process of readiness review, training, equipment calibration, QC implementation, and detailed documentation, the project has successfully accomplished the goals set by the QA Program.

EPA "definitive" data have been reported including the following basic information:

a. laboratory case narratives
b. sample results
c. laboratory method blank results
d. laboratory control standard results
e. laboratory sample matrix spike recoveries
f. laboratory duplicate results
g. surrogate recoveries (Volatile Organic Compounds (VOCs), Semi-Volatile Organic Compounds (SVOCs), Pesticide/Polychlorinated Biphenyls (PCBs))
h. sample extraction dates
i. sample analysis dates

This information from the laboratory, along with field information, provides the basis for subsequent data evaluation relative to sensitivity, precision, accuracy, representativeness and completeness. These parameters are presented in Section A-4.

A-3 DATA VALIDATION

This project implemented the use of data validation checklists to facilitate laboratory data validation. These checklists were completed by the project designated validation staff and were reviewed by the project laboratory coordinator. Data validation checklists for each laboratory sample delivery group (SDG) are retained with laboratory data deliverables by SAIC.

A-3.1 Laboratory Data Validation

Analytical data generated for this project have been subjected to a process of data verification, validation, and review. Several criteria were established against which the data are compared and from which a judgment is rendered regarding the acceptance and qualification of the data. Because it is beyond the scope of this report to cite those criteria, the reader is directed to the following documents for specific detail:

- *USACE Kansas City and St. Louis Districts Radionuclide Data Quality Evaluation Guidance for Alpha and Gamma Spectroscopy, December 17, 2002*. (USACE 2002b).
- SAIC, Technical Support Contractor, QA Technical Procedure (TP-DM-300-7) *Data Validation*. (SAIC 1999b).

Upon receipt of field and analytical data, the verification staff performed a systematic examination of the reports, following standardized data package checklists, to verify the content, presentation, and administrative validity of the data. In conjunction with the data package verification, laboratory electronic data diskettes were available. These diskette deliverables were subjected to review and verification against the hardcopy deliverable. Both a structural and technical assessment of the laboratory-delivered electronic reports were performed. The structural evaluation verified that the required data had been reported and that contract specified requirements were met (i.e., analytical holding times, contractual turnaround times, etc.).

During the validation phase of the review and evaluation process, data were subjected to a systematic technical review by examining the field and analytical QC results and laboratory documentation. The systematic technical review followed appropriate guidelines for laboratory data validation. These data validation guidelines define the technical review criteria, methods for evaluation of the criteria, and actions to be taken resulting from the review of these criteria. The primary objective of this phase was to assess and summarize the quality and reliability of the data for the intended use and to document factors that may affect the usability of the data. Data verification/validation included, but was not necessarily limited to, the following parameters:

Method Requirements

Requirements for all methods:
- Holding time information and methods requested
- Discussion of laboratory analysis, including any laboratory problems

Radiochemical Analysis
- Sample results
- Initial calibration
- Efficiency check
- Background determinations
- Spike recovery results
- Internal standard results (tracers or carriers)
- Duplicate results
- Self-absorption factor (α,β)
- Cross-talk factor (α,β)
- Laboratory control samples (LCS)
- Run log

As an end result of this phase of the review, the data were qualified based on the technical assessment of the validation criteria. Qualifiers were applied to each field and analytical result to indicate the usability of the data for its intended purpose. The majority of estimated values were assigned to analyte concentrations observed between the reporting level and method detection levels. The data has been appropriately identified and qualified.

A-3.2 Definition of Data Qualifiers (Flags)

During the data validation process, the laboratory data were assigned appropriate data validation flags and reason codes. Validation flags are defined as follows:

"=" Positive Result.

"U" When the material was analyzed for but not detected above the level of the associated value.

"J" When the associated value is an estimated quantity. Indicating there is cause to question accuracy or precision of the reported value.

"UJ" When the analyte was analyzed for but not detected above the associated value; however, the reported value is an estimate and demonstrates a decreased knowledge of its accuracy or precision.

"R" When the analyte value reported is unusable. The integrity of the analyte's identification, accuracy, precision, or sensitivity have raised significant question as to the reality of the information presented.

SAIC validation flagging codes and copies of validation checklists and qualified data forms are on-file with the analytical laboratory deliverable.

A-4 DATA EVALUATION

A-4.1 Accuracy

Accuracy provides a gauge or measure of the agreement between an observed result and the true value for an analysis. Analytical accuracy is evaluated by measuring the agreement between an analytical result and its known or true value. This is generally determined through use of laboratory control samples (LCSs), matrix spike (MS) analysis, and performance evaluation (PE) samples. Accuracy, as measured through the use of LCSs, determines the method's implementation of accuracy independent of sample matrix, as well as document laboratory analytical process control. Accuracy determined by the MS is a function of both matrix and analytical process.

A-4.1.1 Radiological Parameters

Individual sample chemical yields and LCS recoveries were within the ± 25 percent criteria for the verification samples, and therefore, the data can be used for its intended purpose.

A-4.1.2 Inter-Laboratory Accuracy

As a measure of analytical accuracy, relative percent differences (RPD) for split sample pairs for the two radiological analytical groups (i.e., alpha spectroscopy and gamma spectroscopy) were evaluated by using an independent contract laboratory. Sample homogeneity, analytical method performance, and the quantity of analyte being measured contribute to this measure of sample analytical accuracy.

As the RPD approaches zero, complete agreement between the split sample pairs is achieved. When one or both sample values were between the quantitation level and less than five times the analyte reporting level, the normalized absolute difference (NAD) was evaluated. If both samples were not detected for a given analyte, then the precision was considered acceptable.

The analytical accuracy (i.e., split precision) between the FUSRAP laboratory and the contract laboratory met the SAG goal of ensuring that 90 percent of the IAAAP samples were within either the ±30 percent criteria for RPD data quality indicator (DQI) or less than 1.96 for the NAD DQI (Tables A-4-1 and A-4-2). All samples were within the control limits for either RPD or NAD.

Table A-4-1. Split Precision Among Alpha Spectroscopy Analyses

	Uranium-234		Uranium-235		Uranium-238	
SampleName	RPD	NAD	RPD	NAD	RPD	NAD
IAAP84184/IAAP84184-2	14.6%	NA	NC	NC	NA	0.74
IAAP84202/IAAP84202-2	NA	1.02	NC	NC	NA	0.65
IAAP84214/IAAP84214-2	13.4%	NA	NC	NC	20.9%	NA
IAAP84240/IAAP84240-2	1.3%	NA	NC	NC	5.2%	NA

NC – Value not calculated due to one or both of the results were non-detected.
NA – Not applicable.

Table A-4-2. Split Precision Among Gamma Spectroscopy Analyses

	Actinium-227		Am-241		Cesium-137		Potassium-40		Protactinium-231		Radium-226		Radium-228		Thorium-228		Thorium-230		Thorium-232	
SampleName	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD
IAAP84184/IAAP84184-2	NC	NC	NC	NC	21.6%	NA	12.7%	NA	NC	NC	24.2%	NA	5.7%	NA	NC	NC	NC	NC	5.7%	NA
IAAP84202/IAAP84202-2	NC	NC	NC	NC	NC	NC	0.2%	NA	NC	NC	10.0%	NA	3.0%	NA	NC	NC	NC	NC	3.0%	NA
IAAP84214/IAAP84214-2	NC	NC	NC	NC	NC	NC	7.0%	NA	NC	NC	24.5%	NA	6.1%	NA	NC	NC	NC	NC	6.1%	NA
IAAP84240/IAAP84240-2	NC	NC	NC	NC	19.2%	NA	11.9%	NA	NC	NC	22.7%	NA	15.2%	NA	NC	NC	NC	NC	15.2%	NA

NC – Value not calculated due to one or both of the results were non-detected.
NA – Not applicable.

A-4.2 Precision

A-4.2.1 Laboratory Precision

To evaluate precision within the on-site laboratory, lab duplicate samples were employed at a frequency of one duplicate per sample batch (no more than one duplicate per thirteen samples). As a measure of analytical precision, the RPD for laboratory duplicate sample pairs for the two radiological analytical groups (i.e., alpha spectroscopy and gamma spectroscopy) were employed at the time of verification and validation.

RPD and/or NAD values for the analytes were within the ±30% window of acceptance for the verification samples. Results are presented in Table A-4-3 and A-4-4.

A-4.2.2 Field Precision

Field duplicate samples were collected to ascertain the contribution to variability (i.e., precision) due to the combination of environmental media, sampling consistency, and analytical precision. Each field duplicate was collected from the same spatial and temporal conditions as the associated primary environmental sample. Soil samples were collected using the same sampling device and after homogenization for all analytes.

For the four field duplicate samples collected for the verification activities, the NAD and RPD values indicated good precision for the data. The sample pairs had RPDs or NADs that were within the control limits.

A-4.3 Sensitivity

Determination of minimum detectable values allows the investigation to assess the relative confidence which can be placed in a value in comparison to the magnitude or level of analyte concentration observed. The closer a measured value is to the minimum detectable concentration, the less confidence and more variation the measurement will have. Project sensitivity goals were expressed as quantitation level goals in the *Iowa Army Ammunition Plant Radiological Survey Plan* (USACE 2004a). These levels were achieved or exceeded throughout the analytical process.

Table A-4-3. Field Duplicate Precision Among Alpha Spectroscopy Analyses

	Uranium-234		Uranium-235		Uranium-238	
SampleName	RPD	NAD	RPD	NAD	RPD	NAD
IAAP84184/IAAP84184-1	11.1%	NA	NC	NC	24.6%	NA
IAAP84202/IAAP84202-1	29.1%	NA	NC	NC	5.3%	NA
IAAP84214/IAAP84214-1	NA	0.76	NC	NC	10.1%	NA
IAAP84240/IAAP84240-1	28.8%	NA	NC	NC	19.5%	NA

NC – Value not calculated due to one or both of the results were non-detected.
NA – Not applicable.

Table A-4-4. Field Duplicate Precision Among Gamma Spectroscopy Analyses

	Actinium-227		Am-241		Cesium-137		Potassium-40		Protactinium-231		Radium-226		Radium-228		Thorium-228		Thorium-230		Thorium-232	
SampleName	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD	RPD	NAD
IAAP84184/IAAP84184-1	NC	NC	NC	NC	4.5%	NA	0.6%	NA	NC	NC	4.6%	NA	1.7%	NA	1.7%	NA	NC	NC	1.7%	NA
IAAP84202/IAAP84202-1	NC	NC	NC	NC	14.8%	NA	0.2%	NA	NC	NC	5.3%	NA	4.8%	NA	4.8%	NA	NC	NC	4.8%	NA
IAAP84214/IAAP84214-1	NC	NC	NC	NC	8.4%	NA	1.7%	NA	NC	NC	7.4%	NA	5.1%	NA	5.1%	NA	NC	NC	5.1%	NA
IAAP84240/IAAP84240-1	NC	NC	NC	NC	11.2%	NA	4.1%	NA	NC	NC	22.3%	NA	8.2%	NA	8.2%	NA	NC	NC	8.2%	NA

NC – Value not calculated due to one or both of the results were non-detected.
NA – Not applicable.

A-4.4 Representativeness and Comparability

Representativeness expresses the degree to which data accurately reflect the analyte or parameter of interest for an environmental site and is the qualitative term most concerned with the proper design of a sampling program. Factors that affect the representativeness of analytical data include proper preservation, holding times, use of standard sampling and analytical methods, and determination of matrix or analyte interferences. Sample preservation, analytical methodologies, and soil sampling methodologies were documented to be adequate and consistently applied.

Comparability, like representativeness, is a qualitative term relative to a project data set as an individual. These investigations employed appropriate sampling methodologies, site surveillance, use of standard sampling devices, uniform training, documentation of sampling, standard analytical protocols/procedures, QC checks with standard control limits, and universally accepted data reporting units to ensure comparability to other data sets. Through the proper implementation and documentation of these standard practices, the project has established the confidence that the data will be comparable to other project and programmatic information.

A-4.5 Completeness

Usable data are defined as those data, which pass individual scrutiny during the verification and validation process and are accepted for unrestricted use. The data quality objective of achieving 90 percent completeness, as defined in the *Iowa Army Ammunition Plant Radiological Survey Plan* (USACE 2004a) was satisfied with the project producing valid results for 100 percent of the sample analyses performed and successfully collected.

A total of 60 random verification and five biased soil samples were collected with approximately 940 discrete analyses (i.e., analytes) being obtained, reviewed, and integrated into the assessment. The project produced acceptable results for 100.0 percent of the sample analyses performed.

A-5 DATA QUALITY ASSESSMENT SUMMARY

The overall quality of the IAAAP information meets or exceeds the established project objectives. Through proper implementation of the project data verification, validation, and assessment process, project information has been determined to be acceptable for use.

Data, as presented, have been qualified as usable, but estimated when necessary. Data that have been estimated have concentrations/activities that are below the quantitation limit or are indicative of accuracy, precision, or sensitivity being less than desired but adequate for interpretation.

Data produced for this survey demonstrates that it can withstand scientific scrutiny, is appropriate for its intended purpose, is technically defensible, and is of known and acceptable sensitivity, precision, and accuracy. Data integrity has been documented through proper implementation of QA and QC measures. The environmental information presented has an established confidence, which allows utilization for the project objectives and provides data for future needs.

ATTACHMENT B

ANALYTICAL DATA WITH QUALIFIERS

			Ac-227			Am-241			Cs-137			Pa-231			K-40			Ra-226			Ra-228			Th-230			Th-230			Th-232			U-234			U-235			U-238		
Station	Sample	Units	VQ	Result	MDC	VQ	Result	MDC	VQ	Result	MDC	VQ	Result	MDC	VQ	Result	MDC	VQ	Result	MDC	VQ	Result	MDC	VQ	Result	MDC	VQ	Result	MDC	VQ	Result	MDC	VQ	Result	MDC	VQ	Result	MDC	VQ	Result	MDC
IAAP84180	IAAP84180	pCi/g	UJ	-0.043	0.116	UJ	0.005	0.041	=	0.081	0.017	UJ	0.047	0.428	=	11.900	0.093	J	0.885	0.040	J	0.790	0.036	J	0.790	0.036	UJ	0.599	3.904	J	0.790	0.036	J	0.653	0.290	UJ	0.060	0.162	J	0.842	0.289
IAAP84181	IAAP84181	pCi/g	UJ	-0.032	0.153	UJ	0.006	0.055	=	0.110	0.018	UJ	0.172	0.592	=	14.180	0.163	=	1.240	0.057	=	0.993	0.056	=	0.993	0.056	UJ	1.068	5.058	UJ	0.993	0.056	J	1.025	0.163	U	0.000	0.202	J	0.645	0.302
IAAP84181	IAAP84182	pCi/g	UJ	-0.269	0.436	UJ	-0.032	0.155	=	0.543	0.077	UJ	0.707	1.942	=	17.330	0.661	=	1.469	0.180	=	1.245	0.196	=	1.245	0.196	UJ	-1.426	14.170	UJ	1.245	0.196	J	1.231	0.185	UJ	0.084	0.229	J	1.430	0.185
IAAP84183	IAAP84183	pCi/g	UJ	-0.077	0.138	UJ	0.018	0.046	=	0.214	0.022	UJ	0.220	0.589	=	14.980	0.174	=	1.048	0.052	J	1.012	0.051	J	1.012	0.051	UJ	-0.706	4.252	J	1.012	0.051	=	1.267	0.389	UJ	0.065	0.177	=	1.143	0.265
IAAP84184	IAAP84184	pCi/g	UJ	-0.025	0.150	UJ	0.010	0.049	=	0.323	0.026	UJ	-0.150	0.596	=	15.410	0.162	=	1.123	0.055	J	1.030	0.055	J	1.030	0.055	UJ	0.467	4.610	J	1.030	0.055	J	1.042	0.296	UJ	0.036	0.434	J	0.687	0.294
IAAP84184	IAAP84184-1	pCi/g	UJ	0.039	0.147	UJ	0.017	0.048	=	0.309	0.023	UJ	0.368	0.644	=	15.500	0.203	=	1.073	0.056	J	1.013	0.054	J	1.013	0.054	UJ	-1.959	4.513	J	1.013	0.054	=	1.165	0.247	UJ	0.061	0.164	J	0.879	0.132
IAAP84184	IAAP84184-2	pCi/g	U	0.130	0.500	U	0.009	0.210	=	0.260	0.120	U	-1.200	2.100	=	17.500	1.200	=	0.880	0.570	=	1.090	0.390	-	-	-	-	-	-	=	1.090	0.390	=	0.900	0.100	U	0.031	0.930	U	1.200	2.200
IAAP84185	IAAP84185	pCi/g	UJ	-0.087	0.144	UJ	0.003	0.048	=	0.308	0.020	UJ	0.404	0.640	=	14.790	0.184	=	1.021	0.052	J	0.887	0.054	J	0.887	0.054	UJ	1.453	4.549	J	0.887	0.054	J	0.836	0.267	UJ	0.066	0.178	J	0.740	0.143
IAAP84186	IAAP84186	pCi/g	UJ	-0.004	0.108	UJ	0.014	0.038	=	0.036	0.018	UJ	0.241	0.493	=	11.090	0.154	=	0.825	0.040	J	0.758	0.039	J	0.758	0.039	UJ	1.081	3.534	J	0.758	0.039	=	1.386	0.314	UJ	-0.016	0.325	J	0.612	0.262
IAAP84187	IAAP84187	pCi/g	UJ	-0.054	0.117	UJ	0.015	0.043	U	0.013	0.017	UJ	0.147	0.474	=	10.810	0.098	J	0.692	0.046	J	0.846	0.044	J	0.846	0.044	UJ	1.088	4.143	J	0.846	0.044	J	0.848	0.416	UJ	0.140	0.189	=	1.281	0.284
IAAP84188	IAAP84188	pCi/g	UJ	-0.004	0.101	UJ	0.005	0.034	U	0.014	0.015	UJ	0.212	0.438	=	10.800	0.148	=	0.593	0.038	J	0.600	0.039	J	0.600	0.039	UJ	1.340	3.287	J	0.600	0.039	J	0.525	0.118	UJ	0.054	0.146	J	0.772	0.219
IAAP84189	IAAP84189	pCi/g	UJ	0.041	0.113	UJ	0.011	0.039	UJ	0.001	0.015	UJ	-0.069	0.402	J	10.340	0.121	J	0.669	0.038	J	0.676	0.039	J	0.676	0.039	UJ	-0.254	3.657	J	0.676	0.039	J	0.468	0.269	UJ	-0.033	0.396	J	0.573	0.268
IAAP84190	IAAP84190	pCi/g	UJ	0.003	0.101	UJ	-0.013	0.034	UJ	0.005	0.013	UJ	-0.092	0.377	=	9.861	0.079	J	0.613	0.032	J	0.670	0.034	J	0.670	0.034	UJ	-0.360	3.317	J	0.670	0.034	J	0.586	0.275	U	0.000	0.182	J	0.760	0.147
IAAP84191	IAAP84191	pCi/g	UJ	-0.056	0.153	UJ	-0.040	0.048	=	0.073	0.020	UJ	0.050	0.593	=	13.460	0.171	=	1.046	0.051	J	0.858	0.047	J	0.858	0.047	UJ	-1.817	4.686	J	0.858	0.047	=	1.192	0.289	UJ	0.071	0.192	J	1.144	0.155
IAAP84194	IAAP84194	pCi/g	UJ	-0.024	0.123	UJ	0.033	0.050	=	0.118	0.017	UJ	-0.093	0.524	=	13.520	0.139	=	1.196	0.048	J	0.857	0.048	J	0.857	0.048	UJ	2.009	4.595	J	0.857	0.048	J	1.048	0.158	UJ	0.144	0.195	J	1.160	0.157
IAAP84195	IAAP84195	pCi/g	UJ	0.000	0.136	UJ	0.018	0.052	=	0.042	0.019	UJ	0.175	0.610	=	14.990	0.173	=	1.411	0.050	J	0.959	0.055	J	0.959	0.055	UJ	-1.188	4.952	J	0.959	0.055	=	1.526	0.188	U	0.000	0.232	J	1.382	0.187
IAAP84196	IAAP84196	pCi/g	UJ	-0.071	0.127	UJ	0.011	0.048	=	0.078	0.016	UJ	0.128	0.521	=	12.550	0.141	=	1.192	0.047	J	0.855	0.045	J	0.855	0.045	UJ	0.158	4.628	J	0.855	0.045	=	1.338	0.145	J	0.264	0.179	=	1.332	0.144
IAAP84197	IAAP84197	pCi/g	UJ	-0.031	0.126	UJ	0.009	0.044	=	0.076	0.017	UJ	-0.066	0.540	=	12.170	0.143	=	1.056	0.047	J	0.804	0.045	J	0.804	0.045	UJ	-0.657	4.308	J	0.804	0.045	=	0.977	0.132	UJ	-0.030	0.362	=	0.973	0.132
IAAP84198	IAAP84198	pCi/g	UJ	0.086	0.131	UJ	0.029	0.052	=	0.121	0.018	UJ	0.352	0.568	=	14.160	0.150	=	1.211	0.048	J	0.936	0.045	J	0.936	0.045	UJ	-0.988	4.669	J	0.936	0.045	=	1.163	0.282	U	0.000	0.188	=	1.326	0.281
IAAP84199	IAAP84199	pCi/g	UJ	-0.035	0.106	UJ	-0.001	0.034	=	0.073	0.019	UJ	0.300	0.478	=	9.016	0.127	J	0.914	0.042	J	0.536	0.039	J	0.536	0.039	UJ	0.864	3.493	J	0.536	0.039	=	1.392	0.164	J	0.224	0.202	=	1.326	0.163
IAAP84200	IAAP84200	pCi/g	UJ	0.011	0.123	UJ	-0.023	0.037	=	0.498	0.016	UJ	0.102	0.512	=	8.216	0.132	=	1.040	0.040	J	0.528	0.044	J	0.528	0.044	U	3.137	4.014	J	0.528	0.044	=	2.083	0.171	UJ	-0.020	0.392	=	3.064	0.317
IAAP84201	IAAP84201	pCi/g	UJ	-0.123	0.152	UJ	0.014	0.040	J	0.02*	0.020	UJ	-0.077	0.708	=	10.330	0.162	J	0.896	0.062	J	0.722	0.056	=	0.722	0.056	UJ	0.884	3.908	=	0.722	0.056	J	1.223	0.174	UJ	0.079	0.215	J	0.577	0.174
IAAP84202	IAAP84202	pCi/g	UJ	-0.059	0.111	UJ	0.025	0.041	=	0.037	0.017	UJ	0.206	0.504	=	12.220	0.124	=	1.039	0.043	J	0.773	0.043	J	0.773	0.043	UJ	-2.248	3.748	J	0.773	0.043	=	1.237	0.140	U	0.000	0.172	=	1.283	0.139
IAAP84202	IAAP84202-1	pCi/g	UJ	-0.055	0.136	UJ	-0.016	0.047	J	0.032	0.021	UJ	0.226	0.592	=	12.190	0.120	=	1.095	0.049	J	0.737	0.049	J	0.737	0.049	UJ	-2.965	4.542	J	0.737	0.049	J	0.922	0.132	U	0.000	0.162	=	1.353	0.131
IAAP84202	IAAP84202-2	pCi/g	U	0.420	0.550	U	0.029	0.170	U	0.048	0.140	U	0.100	2.200	=	12.200	1.100	=	0.940	0.520	=	0.750	0.650	-	-	-	-	-	-	=	0.750	0.650	=	0.650	0.120	U	0.270	1.200	U	0.900	1.800
IAAP84203	IAAP84203	pCi/g	UJ	-0.025	0.128	UJ	0.008	0.048	=	0.163	0.019	UJ	0.211	0.533	=	14.170	0.159	=	1.310	0.044	J	0.984	0.045	J	0.984	0.045	UJ	1.026	4.849	J	0.984	0.045	=	0.971	0.132	U	0.000	0.162	=	1.451	0.131
IAAP84204	IAAP84204	pCi/g	UJ	-0.091	0.098	UJ	-0.016	0.034	=	0.142	0.014	UJ	-0.070	0.455	=	8.720	0.089	J	0.920	0.039	J	0.597	0.037	J	0.597	0.037	UJ	-2.313	3.310	J	0.597	0.037	J	0.760	0.129	UJ	0.059	0.159	J	0.745	0.238
IAAP84205	IAAP84205	pCi/g	UJ	0.002	0.124	UJ	-0.003	0.049	J	0.024	0.018	U	0.464	0.549	=	13.720	0.132	=	1.191	0.051	J	1.019	0.048	J	1.019	0.048	UJ	-0.830	4.837	J	1.019	0.048	J	0.655	0.111	U	0.000	0.137	=	0.897	0.110
IAAP84208	IAAP84208	pCi/g	UJ	0.046	0.149	UJ	0.002	0.046	=	0.097	0.024	UJ	0.217	0.607	=	14.970	0.187	J	1.074	0.052	J	0.943	0.057	=	0.943	0.057	UJ	0.764	4.422	=	0.943	0.057	J	0.970	0.292	UJ	0.143	0.194	J	1.095	0.156
IAAP84209	IAAP84209	pCi/g	UJ	0.004	0.166	UJ	0.018	0.051	=	0.397	0.026	UJ	-0.204	0.650	=	16.530	0.189	=	1.222	0.060	J	0.921	0.057	J	0.921	0.057	UJ	-1.653	4.726	J	0.921	0.057	J	0.851	0.312	UJ	0.286	0.384	=	1.294	0.167
IAAP84210	IAAP84210	pCi/g	UJ	0.096	0.162	UJ	-0.012	0.050	=	0.465	0.026	UJ	0.043	0.681	=	17.750	0.217	=	1.130	0.062	J	0.970	0.060	J	0.970	0.060	UJ	0.866	4.682	J	0.970	0.060	J	0.928	0.249	UJ	-0.015	0.307	=	1.183	0.134
IAAP84211	IAAP84211	pCi/g	UJ	-0.080	0.179	UJ	-0.001	0.057	=	0.395	0.026	UJ	0.044	0.755	=	16.020	0.245	=	1.247	0.066	J	1.075	0.066	J	1.075	0.066	U	3.701	5.234	J	1.075	0.066	=	1.571	0.285	UJ	0.192	0.352	=	1.226	0.284
IAAP84212	IAAP84212	pCi/g	UJ	-0.076	0.163	UJ	0.027	0.052	=	0.436	0.023	UJ	-0.070	0.637	=	15.470	0.204	=	1.231	0.061	=	1.096	0.065	=	1.096	0.065	UJ	1.220	4.915	=	1.096	0.065	=	1.198	0.141	UJ	0.113	0.324	=	1.297	0.141
IAAP84213	IAAP84213	pCi/g	U	0.176	0.184	UJ	0.014	0.053	=	0.529	0.023	UJ	0.251	0.702	=	14.580	0.232	=	1.111	0.062	J	0.897	0.069	J	0.897	0.069	UJ	0.306	4.907	J	0.897	0.069	=	1.270	0.143	UJ	0.065	0.177	=	1.159	0.143
IAAP84214	IAAP84214	pCi/g	UJ	-0.015	0.168	UJ	-0.012	0.050	=	0.175	0.022	UJ	0.320	0.648	=	16.300	0.194	=	1.215	0.054	J	0.970	0.057	J	0.970	0.057	UJ	4.233	4.629	J	0.970	0.057	=	1.075	0.314	UJ	0.129	0.175	=	1.135	0.263
IAAP84214	IAAP84214-1	pCi/g	UJ	0.040	0.179	UJ	0.026	0.052	=	0.191	0.026	UJ	0.170	0.668	=	16.020	0.194	=	1.308	0.054	J	1.020	0.064	J	1.020	0.064	UJ	-1.298	4.957	J	1.020	0.064	=	1.778	0.155	U	0.000	0.192	=	1.256	0.155
IAAP84214	IAAP84214-2	pCi/g	U	0.280	0.490	U	0.110	0.210	U	0.107	0.180	U	-1.600	2.000	=	15.200	0.800	=	0.950	0.600	=	1.030	0.800	-	-	-	-	-	-	=	1.030	0.800	=	0.940	0.080	U	0.017	0.920	U	1.700	2.100
IAAP84215	IAAP84215	pCi/g	UJ	0.051	0.160	UJ	0.021	0.049	=	0.127	0.023	UJ	-0.315	0.615	=	16.940	0.221	=	1.364	0.058	J	0.929	0.058	J	0.929	0.058	UJ	-0.013	4.588	J	0.929	0.058	J	0.679	0.263	UJ	0.054	0.147	=	0.873	0.118
IAAP84216	IAAP84216	pCi/g	UJ	0.070	0.178	UJ	-0.001	0.052	UJ	-0.009	0.026	UJ	0.376	0.703	=	16.890	0.214	=	1.231	0.065	J	1.078	0.062	J	1.078	0.062	UJ	0.340	5.016	J	1.078	0.062	J	0.964	0.373	UJ	-0.019	0.386	J	0.743	0.168
IAAP84217	IAAP84217	pCi/g	UJ	0.020	0.172	UJ	-0.006	0.052	=	0.109	0.027	UJ	-0.073	0.680	=	16.180	0.220	=	1.368	0.058	=	1.107	0.061	=	1.107	0.061	U	4.281	4.964	=	1.107	0.061	J	0.722	0.150	UJ	0.069	0.186	=	1.147	0.278
IAAP84218	IAAP84218	pCi/g	UJ	0.139	0.142	UJ	0.015	0.049	UJ	-0.006	0.017	UJ	-0.111	0.513	=	10.080	0.106	J	0.970	0.048	J	0.954	0.049	J	0.954	0.049	UJ	-0.148	4.677	J	0.954	0.049	J	0.766	0.148	U	0.000	0.183	J	0.586	0.274
IAAP84219	IAAP84219	pCi/g	UJ	-0.026	0.127	UJ	0.006	0.046	UJ	0.005	0.017	UJ	0.197	0.485	=	14.200	0.126	=	1.162	0.042	=	1.062	0.044	=	1.062	0.044	UJ	1.099	4.443	=	1.062	0.044	J	1.190	0.170	UJ	0.058	0.389	=	1.372	0.169
IAAP84222	IAAP84222	pCi/g	UJ	-0.099	0.139	UJ	0.000	0.047	J	0.057	0.021	U	0.438	0.625	=	13.840	0.170	=	1.073	0.093	J	0.931	0.055	J	0.931	0.055	U	3.512	4.405	J	0.931	0.055	J	0.971	0.146	U	0.000	0.180	J	1.061	0.271
IAAP84223	IAAP84223	pCi/g	UJ	-0.110	0.142	UJ	0.018	0.048	=	0.301	0.021	UJ	-0.022	0.635	=	14.720	0.187	=	1.053	0.057	J	0.922	0.054	J	0.922	0.054	UJ	1.786	4.478	J	0.922	0.054	J	0.728	0.267	UJ	0.131	0.177	J	1.002	0.143
IAAP84224	IAAP84224	pCi/g	UJ	0.049	0.483	UJ	-0.024	0.160	=	0.573	0.077	UJ	-1.323	2.242	=	17.800	0.670	=	1.322	0.209	J	1.212	0.217	J	1.212	0.217	UJ	-3.661	15.060	J	1.212	0.217	=	1.705	0.178	U	0.000	0.219	J	0.980	0.329
IAAP84225	IAAP84225	pCi/g	UJ	-0.445	0.464	UJ	0.080	0.168	=	0.531	0.082	UJ	0.441	2.241	=	18.560	0.519	=	1.529	0.195	J	1.148	0.206	J	1.148	0.206	UJ	-2.549	14.280	J	1.148	0.206	=	1.625	0.285	UJ	0.139	0.189	=	1.800	0.153
IAAP84226	IAAP84226	pCi/g	UJ	-0.061	0.149	UJ	0.020	0.049	=	0.407	0.023	UJ	0.333	0.690	=	15.780	0.174	=	1.164	0.062	J	0.866	0.060	J	0.866	0.060	UJ	0.803	4.754	J	0.866	0.060	J	1.006	0.151	UJ	0.121	0.347	J	0.862	0.334
IAAP84227	IAAP84227	pCi/g	U	0.135	0.143	UJ	0.007	0.047	=	0.312	0.025	UJ	0.250	0.637	=	12.030	0.162	=	1.045	0.056	J	0.804	0.055	J	0.804	0.055	J	7.499	4.189	J	0.804	0.055	J	2.030	0.518	J	1.015	0.344	J	1.535	0.277
IAAP84228	IAAP84228	pCi/g	UJ	-0.168	0.136	UJ	0.005	0.048	J	0.020	0.016	UJ	0.082	0.509	=	15.490	0.107	J	0.985	0.047	J	0.922	0.043	J	0.922	0.043	U	1.551	4.583	J	0.922	0.043	=	1.041	0.128	U	0.000	0.158	J	0.459	0.237
IAAP84229	IAAP84229	pCi/g	U	-0.038	0.124	U	0.007	0.046	J	0.121	0.017	U	0.177	0.518	=	13.130	0.142	J	0.845	0.046	J	0.827	0.051	J	0.827	0.051	UJ	3.836	4.198	J	0.827	0.051	J	0.956	0.327	UJ	0.080	0.217	J	0.710	0.175
IAAP84230	IAAP84230	pCi/g	UJ	-0.049	0.125	UJ	0.000	0.044	=	0.046	0.016	UJ	0.162	0.485	=	12.880	0.127	J	0.965	0.043	J	0.809	0.045	J	0.809	0.045	UJ	0.480	4.279	=	0.809	0.045	=	1.072	0.126	U	0.000	0.156	=	1.010	0.234
IAAP84231	IAAP84231	pCi/g	UJ	0.060	0.123	UJ	-0.006	0.042	=	0.070	0.017	UJ	-0.010	0.481	=	12.400	0.138	J	0.766	0.044	J	0.753	0.042	J	0.753	0.042	UJ	1.002	4.044	=	0.753	0.042	J	0.835	0.267	J	0.196	0.177	J	0.791	0.143
IAAP84232	IAAP84232	pCi/g	UJ	0.078	0.142	UJ	0.005	0.049	=	0.099	0.024	UJ	0.217	0.621	=	12.750	0.181	=	1.202	0.058	J	0.831	0.053	J	0.831	0.053	UJ	1.333	4.560	J	0.831	0.053	=	1.859	0.343	U	0.000	0.191	J	0.883	0.342
IAAP84233	IAAP84233	pCi/g	UJ	0.030	0.116	U	0.0419	0.046	=	0.063	0.015	UJ	0.2583	0.528	=	9.415	0.139	=	1.0527	0.042	J	0.4964	0.046	J	0.4964	0.046	UJ	-1.497	3.957	J	0.4964	0.046	J	0.746	0.144	UJ	-0.016	0.331	J	0.570	0.267
IAAP84234	IAAP84234	pCi/g	UJ	0.026	0.141	UJ	0.019	0.048	=	0.603	0.021	UJ	0.269	0.639	=	10.000	0.169	=	1.298	0.058	J	0.587	0.057	J	0.587	0.057	UJ	0.749	4.519	J	0.587	0.057	J	1.005	0.160	UJ	0.055	0.367	=	1.560	0.353
IAAP84235	IAAP84235	pCi/g	UJ	-0.001	0.164	UJ	0.004	0.052	=	0.424	0.023	UJ	0.028	0.651	=	14.470	0.188	=	1.294	0.060	J	0.915	0.061	J	0.915	0.061	UJ	-2.269	4.714	J	0.915	0.061	=	1.373	0.177	UJ	0.081	0.219	J	1.220	0.328
IAAP84236	IAAP84236	pCi/g	UJ	-0.112	0.154	UJ	0.029	0.050	=	0.387	0.024	UJ	0.260	0.664	=	12.180	0.218	=	1.134	0.060	J	0.888	0.061	J	0.888	0.061	UJ	0.706	4.667	J	0.888	0.061	=	1.223	0.297	UJ	-0.018	0.575	J	1.115	0.432
IAAP84237	IAAP84237	pCi/g	UJ	-0.013	0.102	UJ	0.014	0.032	=	0.497	0.017	UJ	0.191	0.481	=	5.557	0.147	J	0.887	0.039	J	0.283	0.039	J	0.283	0.039	UJ	-0.565	3.017	J	0.283	0.039	J	0.598	0.280	UJ	0.069	0.186	J	0.776	0.150
IAAP84238	IAAP84238	pCi/g	UJ	-0.016	0.083	UJ	0.001	0.031	=	0.182	0.011	UJ	0.179	0.365	=	5.573	0.088	J	0.716	0.030	J	0.284	0.032	J	0.284	0.032	UJ	-0.127	2.845	=	0.284	0.032	J	0.442	0.120	UJ	-0.014	0.274	J	0.814	0.264
IAAP84239	IAAP84239	pCi/g	UJ	0.013	0.130	UJ	0.020	0.047	=	0.442	0.020	UJ	0.006	0.487	=	9.696	0.102	J	0.885	0.050	J	0.910	0.043	J	0.910	0.043	UJ	0.761	4.404	J	0.910	0.043	J	0.550	0.217	U	0.000	0.144	=	0.860	0.117
IAAP84240	IAAP84240	pCi/g	UJ	-0.174	0.360	UJ	0.008	0.124	=	0.643	0.058	UJ	0.108	1.492	=	13.970	0.484	J	1.168	0.159	J	1.060	0.130	J	1.060	0.130	UJ	0.161	10.750	J	1.060	0.130	J	0.790	0.224	U	0.000	0.149	J	0.643	0.266
IAAP84240	IAAP84240-1	pCi/g	UJ	0.008	0.367	UJ	0.032	0.139	=	0.574	0.061	U	1.181	1.794	=	14.560	0.406	=	1.461	0.143	J	0.977	0.150	J	0.977	0.150	UJ	-4.397	11.400	J	0.977	0.150	J	1.056	0.325	UJ	0.067	0.181	J	0.782	0.323
IAAP84240	IAAP84240-2	pCi/g	U	-0.050	0.490	U	-0.006	0.210	=	0.530	0.130	U	-1.100	2.500	=	12.400	0.300	=	0.930	0.610	=	0.910	0.370	-	-	-	-	-	-	=	0.910	0.370	=	0.780	0.110	U	0.280	1.300	U	1.000	2.300
IAAP84241	IAAP84241	pCi/g	UJ	-0.038	0.143	UJ	0.014	0.050	=	0.370	0.020	UJ	-0.073	0.594	=	13.620	0.144	=	1.008	0.053	J	0.931	0.051	J	0.931	0.051	UJ	1.020	4.812	J	0.931	0.051	J	0.951	0.143	U	0.000	0.177	J	0.776	0.265
IAAP84242	IAAP84242	pCi/g	UJ	0.067	0.143	UJ	0.005	0.046	=	0.474	0.021	UJ	0.003	0.541	=	12.600	0.165	J	0.950	0.044	J	0.737	0.046	J	0.737	0.046	UJ	-0.860	4.430	J	0.737	0.046	J	0.570	0.244	UJ	0.030	0.359	J	0.483	0.131
IAAP84243	IAAP84243	pCi/g	UJ	0.032	0.168	UJ	-0.001	0.056	=	0.314	0.024	UJ	0.210	0.649	=	16.560	0.168	=	1.272	0.055	J	1.030	0.057	J	1.030	0.057	U	4.361	5.121	J	1.030	0.057	J	0.992	0.253	UJ	0.062	0.168	=	1.050	0.136
IAAP84244	IAAP84244	pCi/g	UJ	-0.022	0.139	UJ	0.001	0.051	=	0.195	0.018	UJ	-0.019	0.503	=	16.300	0.157	=	1.237	0.047	J	0.949	0.047	J	0.949	0.047	U	0.654	4.728	J	0.949	0.047	=	1.115	0.258	U	0.000	0.171	J	0.613	0.138
IAAP84245	IAAP84245	pCi/g	UJ	0.043	0.149	U	0.037	0.053	=	0.453	0.022	UJ	-0.199	0.594	=	16.400	0.150	=	1.210	0.048	J	0.979	0.049	J	0.979	0.049	U	3.136	4.822	J	0.979	0.049	J	1.328	0.409	UJ	-0.021	0.423	J	1.272	0.342
IAAP84248	IAAP84248	pCi/g	UJ	-0.023	0.145	UJ	0.006	0.050	=	0.036	0.023	UJ	0.205	0.559	=	12.340	0.155	=	1.135	0.051	J	0.799	0.048	J	0.799	0.048	U	3.930	4.845	J	0.799	0.048	J	0.966	0.464	UJ	0.072	0.480	J	1.135	0.388
IAAP84249	IAAP84249	pCi/g	UJ	-0.085	0.334	UJ	-0.043	0.115	UJ	-0.007	0.057	UJ	-0.788	1.543	=	16.430	0.458	=	1.455	0.150	=	1.309	0.125	=	1.309	0.125	U	-3.041	11.030	=	1.309	0.125	J	1.410	0.434	UJ	0.089	0.242	=	1.584	0.195
IAAP84250	IAAP84250	pCi/g	UJ	-0.023	0.234	UJ	-0.036	0.066	UJ	-0.013	0.032	UJ	-0.152	0.857	=	14.170	0.253	J	0.960	0.076	J	1.009	0.091	J	1.009	0.091	UJ	1.313	6.788	J	1.009	0.091	J	0.841	0.120	UJ	0.041	0.275	=	0.485	0.119
IAAP84251	IAAP84251	pCi/g	UJ	0.069	0.157	UJ	-0.003	0.050	=	0.191	0.023	UJ	0.319	0.681	=	12.160	0.181	=	1.242	0.063	J	0.734	0.055	J	0.734	0.055	UJ	-0.077	4.723	J	0.734	0.055	J	0.778	0.141	UJ	0.176	0.322	J	0.865	0.260
IAAP84252	IAAP84252	pCi/g	UJ	0.183	0.770	UJ	0.027	0.164	=	226.200	0.094	UJ	-0.605	4.201	=	12.130	0.208	J	0.908	0.119	=	0.919	0.092	J	0.919	0.092	UJ	-0.920	14.750	J	0.919	0.092	J	0.426	0.245	UJ	-0.015	0.302	=	0.969	0.131

ATTACHMENT C

BUILDING SURVEY DATA

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP DEMO DEACTIVATION FURNACE**		HSWP: S-04.001.0	Page 1 of 6
Purpose Of Survey: Scoping Survey	Survey Number:	Date: 8/24/04	Time: 1422

Instrument Type(s): (√ if used)	Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector		Lab Bkgd: (CPM)❶ Alpha (α)	Lab Bkgd: (CPM)❶ Beta (βγ)	Lab Efficiency (0.00)❷ Alpha (α)	Lab Efficiency (0.00)❷ Beta (βγ)
☐ Ludlum 2360/43-89 (Q)	125	156373	167715	06/15/05	06/15/05	Before→	0.6	254	15.7	27.1
☐ Other ______	______					After→	0.7	179	15.7	27.1

Instrument Letter (A-H): F (*for this survey*)

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ 1m² Averaging ☐ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIC 0007		Field Bkgd (cpm) Alpha (α)❸ Initial		Field Bkgd (cpm) Alpha (α)❸ Final (*if needed*)		Field Bkgd (cpm) Beta (βγ)❹ Initial		Field Bkgd (cpm) Beta (βγ)❹ Final (*if needed*)		Contamination Limits (dpm/100cm²)	
Eff. Count (cpm)	439 / 476										
Decayed dpm	3163	Count 1	0	Count 4		Count 1	202	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SAIC 0006		Count 2	0	Count 5		Count 2	203	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4683 / 4316	Count 3	0	Count 6		Count 3	194	Count 6		Beta (βγ) Limit	6000
Decayed dpm	15909	Average	0	6 Ave		Average	200	6 Ave		Beta (βγ) Inv. Level	4800

***a priori* Action Levels: (CPM)**	Alpha (α) Limit	Alpha (α) Inv. Level	Beta (βγ) Limit	Beta (βγ) Inv. Level
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	29	24	708	607

REMARKS:

❶ 10 minute BKGD counts, or ____ min. Efficiency determined at calibration.
❷ 1 min source count, or ____ min.
❸ 1 minute BKGD counts, or ____ min.
❹ 1 minute BKGD counts, or ____ min.

TECHNICIAN(S) SIGNATURE/DATE: 8/24/04 /

REVIEWER SIGNATURE/DATE: 11/3/04

SAIC RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: **IAAAP DEMO DEACTIVATION FURNACE** | HSWP: S-04.001.0 |

PURPOSE OF SURVEY: Scoping Survey | DATE: 8/24/04 | TIME: 1422

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector	Background (CPM): Alpha (α)	Background (CPM): Beta (βγ)	Efficiency (%): Alpha (α)	Efficiency (%): Beta (βγ)
☒ Ludlum 2221/43-10-1	N/A	180850	194700	04/27/05	04/27/05	0.2	43	34.1	38.0
☒ Ludlum 2360/43-89 Q	125	156373	167715	06/15/05	06/15/05	0	200	15.7	27.1
☐ Ludlum 2360/43-89	125								
☐ Micro-R	N/A								

Contamination Limits: (dpm/100cm²) Removable α 60; Removable βγ 600; Total α 600; Total βγ 6000

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm² βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm² βγ Total	mR/hr or μR/hr
1	Back Stairs	0	0	<60	44	1	<600	11	11	224	290	90	531	NA
2	On concrete in front of side building	1	1	<60	50	7	<600	70	70	1427	475	275	1624	NA
3	On concrete in front of side building	0	0	<60	45	2	<600	58	58	1182	411	211	1246	NA
4	concrete	0	0	<60	42	0	<600	52	52	1060	384	184	1086	NA
5	Concrete pad	0	0	<60	41	0	<600	95	95	1936	429	229	1352	NA
6	Concrete in front of stairs	0	0	<60	41	0	<600	144	144	2935	574	374	2208	NA
7	To the right of stairs on concrete	0	0	<60	37	0	<600	96	96	1957	450	250	1476	NA
8	concrete	0	0	<60	34	0	<600	19	19	387	330	130	768	NA
9	concrete	0	0	<60	49	6	<600	13	13	265	351	151	892	NA
10	Concrete pad	1	1	<60	28	0	<600	39	39	795	350	150	886	NA

REMARKS: All beta scan results were less than the investigation level. However, fixed point alpha measurements were greater than expected. Therefore additional fixed point investigation surveys were performed. Several areas exceeded the fixed alpha contamination limits. An attempt to determine if radon was the cause of the increased counts was conducted by placing plastic over a sampling point and resurveying that location 24 hours later. The final result (sample 21) was 30% less than the original value, but still over the fixed alpha limit. Although radon may have added to the activity, it can not be determined that radon accounts for all of the activity.

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04   /

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC RADIOLOGICAL SURVEY REPORT (Supplement)

SURVEY LOCATION: **IAAAP DEMO DEACTIVATION FURNACE** | Page 3 of 6

Contamination Limits: (dpm/100cm²) Removable α 60 | Removable βγ 600 | Total α 600 | Total βγ 6000

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm² βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm² βγ Total	mR/hr or μR/hr
11	Inside building on control box	0	0	<60	35	0	<600	1	1	<MDC	163	0	<MDC	NA
12	Inside building on back wall	0	0	<60	35	0	<600	0	0	<MDC	283	83	490	NA
13	Inside building on floor near side door	0	0	<60	35	0	<600	0	0	<MDC	219	19	<MDC	NA
14	Concrete pad near deactivation furnace	0	0	<60	44	1	<600	11	11	224	284	84	496	NA
15	Edge of concrete pad near furnace	1	1	<60	43	0	<600	36	36	734	326	126	744	NA
16	On concrete pad near furnace	0	0	<60	46	3	<600	16	16	326	280	80	472	NA
17	Bottom of concrete pad under furnace	0	0	<60	33	0	<600	6	6	122	290	90	531	NA
18	Concrete pad near stairs by furnace	0	0	<60	53	10	<600	19	19	387	308	108	638	NA
19	Concrete pad	1	1	<60	37	0	<600	28	28	571	284	84	496	NA
20	Concrete pad in front of furnace	0	0	<60	43	0	<600	31	31	632	349	149	880	NA
21	Recheck of #6 after 24 hours	NA	NA	NA	NA	NA	NA	100	100	2038	500	300	1771	NA

REMARKS: 43-10-1 MDA for alpha is 13dpm and for beta 67 dpm.
21.This spot was covered in plastic and left in place for 24 hours then the plastic was removed and a fixed point was retaken.
43-89 MDA for alpha is 61 dpm/100cm² and for beta is 406 dpm/100cm².

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 /

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

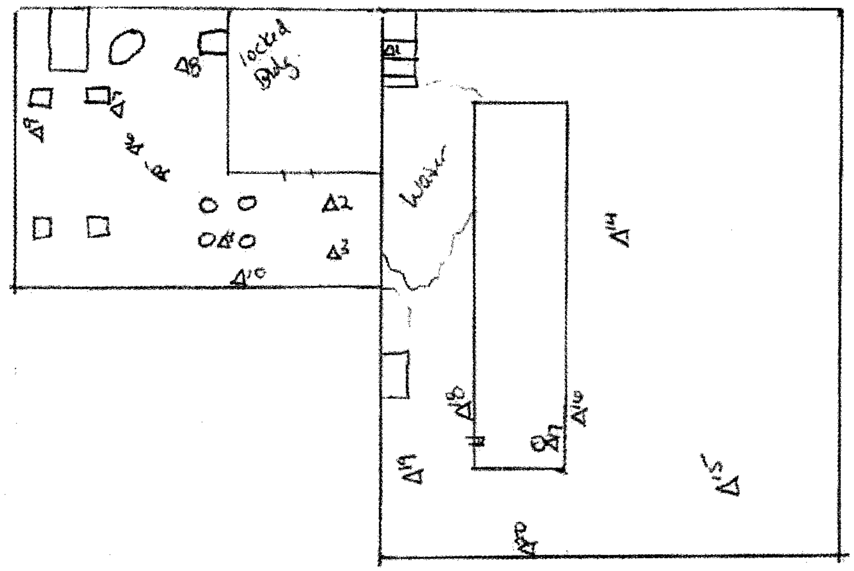
SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [3]

Survey Number: Deactivation furnace | Page 4 of 6

Legend: (Fill in blank) ______ = Smear Location ______ = G/A Dose Rate ☐ mR/hr ☐ µR/hr

Show numbering of all survey surfaces on the map.

outside concrete pads w/misc. structures.



REMARKS: Biased beta scan surveys were performed in areas w/the highest potential for contamination in accordance w/section 4.3 2 2 of the survey plan.
Scan Range: 150 - 600cpm (Beta)

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04

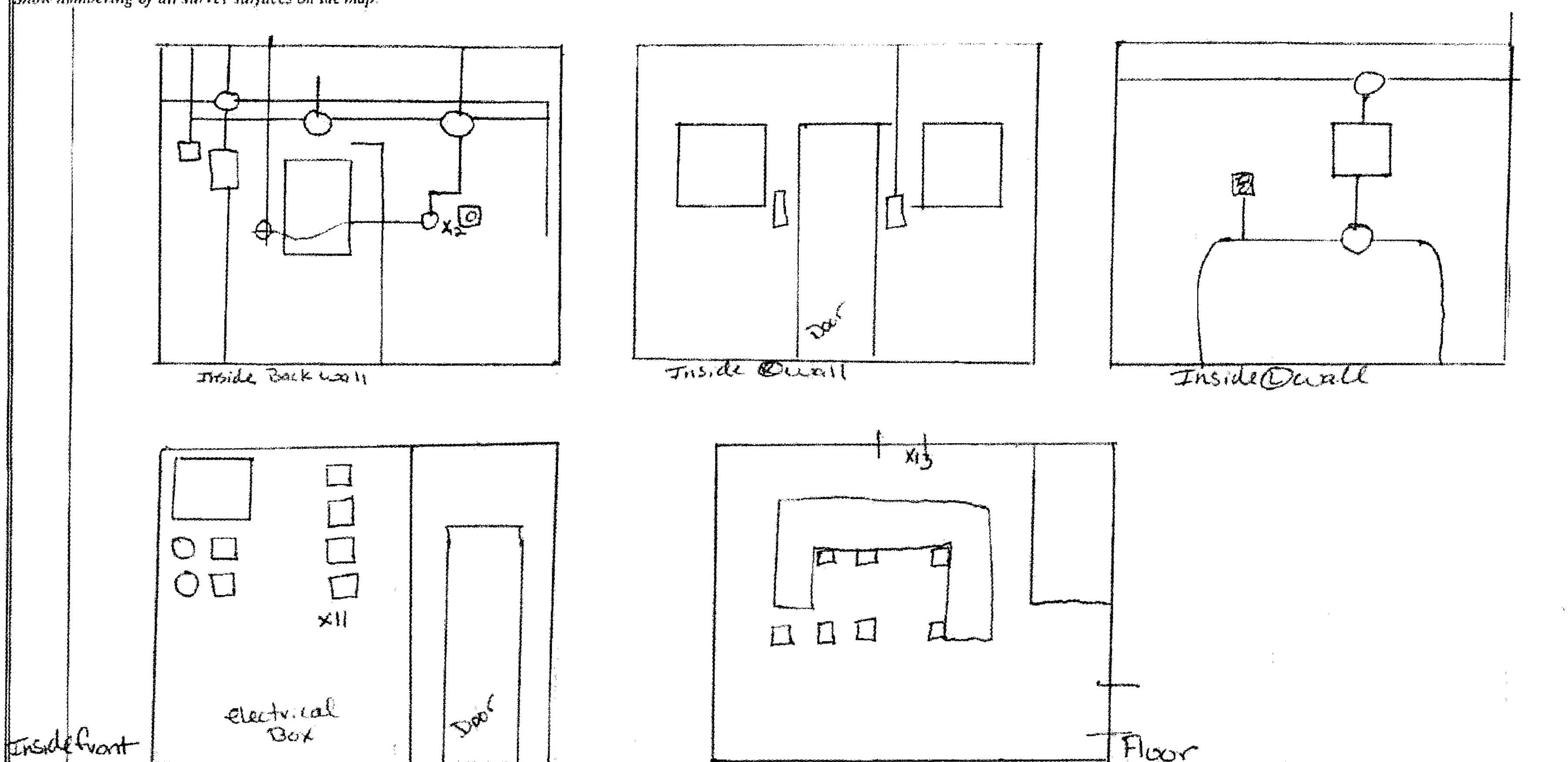
REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [3]

Survey Number: Deactivation furnace inside of Building | Page 5 of 6

Legend: (Fill in blank) ______ = Smear Location ______ = G/A Dose Rate ☐ mR/hr ☐ µR/hr

Show numbering of all survey surfaces on the map.



REMARKS: Based beta scan Surveys were Performed in areas w/the highest Potential for contamination in accordance to section 3.2.2 of the Survey Plan
Scan Range 150 – 300cpm (Beta)

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 /

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

Version 1.3 9/25/2003

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

Leole

Survey Number:	Date: 8/18/2004	Inst. Letter: F

Alpha				Beta		
$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **61.1** (dpm/100cm²)			$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **406** (dpm/100cm²)	
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.98** (should be ≥ 0.85)			$i = \frac{w}{s}$ $MDCR = d'\sqrt{b \cdot \left(\frac{i}{60}\right)} \cdot \left(\frac{60}{i}\right)$ $MDC = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	i = 3.0 *MDCR* = 87 Beta Scan *MDC* = **724** (dpm/100cm²)	
Alpha Information				**Beta Information**		
Background count rate (R_b)	0	(cpm)		Background count rate (R_b) or (b)	200	(cpm)
Background count time (t_b)	1	(minutes)		Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)		Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.157	(cpm/dpm)		Instrument efficiency (e_i)	0.271	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)		Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm²)		Probe area (PA)	125	(cm²)
Width of the probe face (d) or (w)	7.6	(cm)		Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)		Scan speed (s) or (v)	2.5	(cm/sec)
-----	-----	-----		Index of detectability (d')	1.38	-----
-----	-----	-----		Surveyor efficiency (p)	0.5	-----
Investigation level (G)	480	(dpm/100cm²)		-----	-----	-----

1 in/sec = 2.5 cm/sec   2 in/sec = 5.1 cm/sec   3 in/sec = 7.6 cm/sec   :   The width of the probe face for a Ludlum 43-89 is 7.6 cm

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP EDA BG-1**		HSWP: S-04.001.0	
Purpose Of Survey: Scoping Survey	Survey Number:	Date: 8/24/04	Time: 1138

Instrument Type(s): (√ if used)	Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector		Lab Bkgd: (CPM)❶ Alpha (α)	Lab Bkgd: (CPM)❶ Beta (βγ)	Lab Efficiency (0.00)❷ Alpha (α)	Lab Efficiency (0.00)❷ Beta (βγ)
☐ Ludlum 2360/43-89 (Q)	125	156373	167715	06/15/05	06/15/05	Before→	0.6	254	15.7	27.1
☐ Other ______	______					After→	0.7	179	15.7	27.1

Instrument Letter (A-H): ___B____ (for this survey)

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ 1m² Averaging ☒ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIC 00017		**Field Bkgd (cpm) Alpha (α)❸** Initial		Final (if needed)		**Field Bkgd (cpm) Beta (βγ)❹** Initial		Final (if needed)		**Contamination Limits (dpm/100cm²)**	
Eff. Count (cpm)	~~477~~ 439 / ~~4??~~ 476										
Decayed dpm	3130	Count 1	0	Count 4		Count 1	310	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SAIC00020		Count 2	1	Count 5		Count 2	332	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4083 / 4316	Count 3	0	Count 6		Count 3	343	Count 6		Beta (βγ) Limit	6000
Decayed dpm	15909	Average	.3	6 Ave		Average	328	6 Ave		Beta (βγ) Inv. Level	4800

a priori Action Levels: (CPM)	Alpha (α) Limit	Alpha (α) Inv. Level	Beta (βγ) Limit	Beta (βγ) Inv. Level
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	30	24	836	735

REMARKS:

❶ 10 minute BKGD counts, or _____min.
❷ 1 min source count, or _____min.
❸ 1 minute BKGD counts, or _____min.
❹ 1 minute BKGD counts, or _____min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 [signature] / 8-24-04

REVIEWER SIGNATURE/DATE: [signature] / 11/5/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP EDA BG-1**		HSWP: S-04.001.0	Page 2 of 7
Purpose Of Survey: Scoping Survey	Survey Number:	Date: 8/24/04	Time: 1138

Instrument Type(s): (√ if used)	Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector		Lab Bkgd: (CPM)❶ Alpha (α)	Lab Bkgd: (CPM)❶ Beta (βγ)	Lab Efficiency (0.00)❷ Alpha (α)	Lab Efficiency (0.00)❷ Beta (βγ)
☐ Ludlum 2360/43-89	125	145477	164816	06/15/05	06/15/05	Before→	0.4	222	14.4	26.0
☐ Other						After→	1.2	205	14.4	26.0

Instrument Letter (A-H): D *(for this survey)*

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ 1m² Averaging ☒ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIC 0007		Field Bkgd (cpm) Alpha (α)❸ Initial		Final *(if needed)*		Field Bkgd (cpm) Beta (βγ)❹ Initial		Final *(if needed)*		Contamination Limits (dpm/100cm²)	
Eff. Count (cpm)	472 / 446										
Decayed dpm	3103	Count 1	1	Count 4		Count 1	333	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SAIC 0006		Count 2	7	Count 5		Count 2	332	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4177 / 3948	Count 3	4	Count 6		Count 3	326	Count 6		Beta (βγ) Limit	6000
Decayed dpm	15909	Average	4*	6 Ave		Average	330	6 Ave		Beta (βγ) Inv. Level	4800

a priori Action Levels: (CPM)	Alpha (α) Limit	Alpha (α) Inv. Level	Beta (βγ) Limit	Beta (βγ) Inv. Level
$CPM : \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	31	26	818	720

REMARKS: *Field background alpha counts were higher than expected. This is likely due to increased radon.

❶ 10 minute BKGD counts, or ____ min.
❷ 1 min source count, or ____ min.
❸ 1 minute BKGD counts, or ____ min.
❹ 1 minute BKGD counts, or ____ min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] 8/24/04 /

REVIEWER SIGNATURE/DATE: [signature] 11/16/04

SAIC RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: **IAAAP EDA BG-1**	HSWP: S-04.001.0	Page 3 of 7
PURPOSE OF SURVEY: Scoping Survey	DATE: 8/24/04	TIME: 1138

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector	Background (CPM): Alpha (α)	Background (CPM): Beta (βγ)	Efficiency (%): Alpha (α)	Efficiency (%): Beta (βγ)
☒ Ludlum 2929/43-10-1	N/A	180850	194700	04/27/05	04/27/05	0.2	43	34.1	38.0
☒ Ludlum 2360/43-89 Q	125	156373	167715	06/15/05	06/15/05	0.3	328	15.7	27.1
☒ Ludlum 2360/43-89	125	145477	164816	06/15/05	06/15/05	4 (0.4)*	330	14.4	26.0
☐ Micro-R	N/A								

Contamination Limits: (dpm/100cm²) Removable α 60 Removable βγ 600 Total α 600 Total βγ 6000

Sample No	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm² βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm² βγ Total	mR/hr or µR/hr
1	Drain in back room of basement	0	0	<60	46	3	<600	8	8	163	396	68	<MDC	NA
2	Drain in main room of basement	1	1	<60	47	4	<600	6	6	122	397	69	<MDC	NA
3	Sink	0	0	<60	49	6	<600	4	4	<MDC	550	222	1310	NA
4	Wall in backroom near door	0	0	<60	45	2	<600	1	1	<MDC	467	139	821	NA
5	Bottom of stairs	0	0	<60	43	0	<600	8	8	163	400	72	<MDC	NA
6	Brick wall in SE corner Upstairs	0	0	<60	43	0	<600	10	10*	<MDC	486	156	960	NA
7	Doorway between rooms upstairs	0	0	<60	49	6	<600	6	6*	<MDC	398	68	<MDC	NA
8	Floor drain back room upstairs	0	0	<60	56	13	<600	4	4*	<MDC	381	51	<MDC	NA
9	Back room front of door upstairs	0	0	<60	53	10	<600	2	2*	<MDC	365	35	<MDC	NA
10	Main room drain upstairs	0	0	<60	59	16	<600	2	2*	<MDC	425	95	585	NA

REMARKS: Sample nos. 1 thru 5 are from instrument Q for the direct readings and Sample nos. 6 thru 10 are from the other 43-89 listed for the direct readings. *Since alpha field background for samples 6 thru 10 may have been skewed high due to radon, the initial daily alpha background check-in value (0.4) was used to conservatively calculate total alpha activity. 43-10-1 MDA: 13dpm for alpha, 67 dpm for beta. 43-89 Q MDA for alpha is 113 dpm/100cm2 and for beta is 515dpm/100cm². The other 43-89 MDA for alpha is 274 dpm/100cm² and for beta is 539dpm/100cm².

TECHNICIAN(S) SIGNATURE/DATE: [signature] 8/24/04

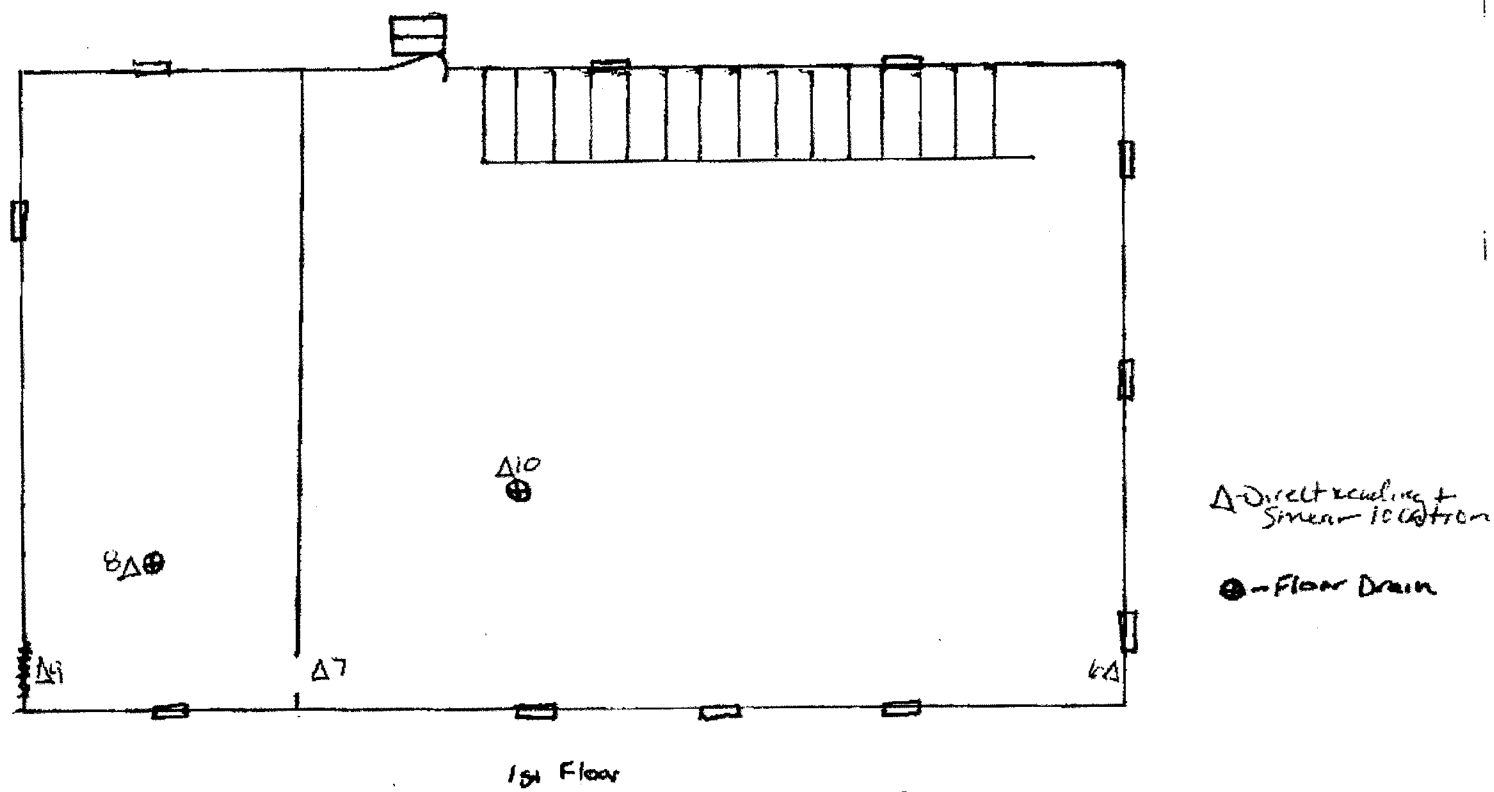
REVIEWER SIGNATURE/DATE: [signature] 11/16/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [3]

Survey Number: IAAAP GDA BG-1 1st Floor

Legend: (Fill in blank) Δ = Smear Location ______ = G/A Dose Rate mR/hr μR/hr

Show numbering of all survey surfaces on the map.



REMARKS: Based beta scan surveys were performed in areas with the highest potential for contamination in accordance with Section 4.3.2.2 of the Scoping Survey Plan.
Concrete Scans: 250-450 cpm (Beta)
Brick Scans: 350-600 cpm (Beta)

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 [signature] / 8-24-04

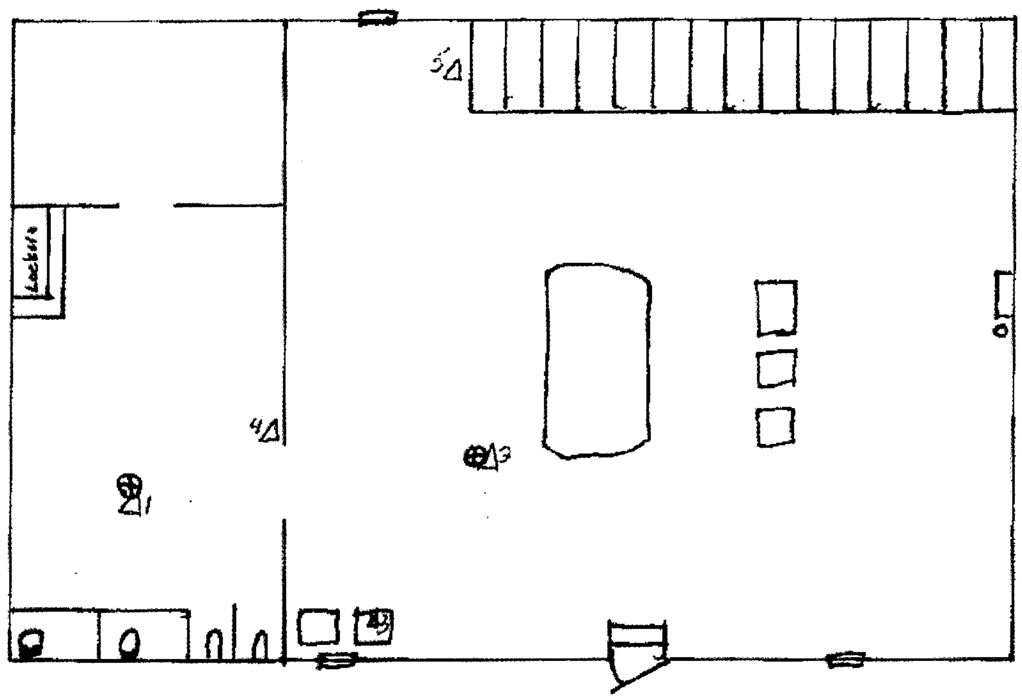
REVIEWER SIGNATURE/DATE: [signature] / 11/5/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [3]

Survey Number: IAAAP EDA BG-1 ~~up stairs~~ basement

Legend: (Fill in blank) Δ = Smear Location ______ = G/A Dose Rate mR/hr μR/hr

Show numbering of all survey surfaces on the map.



REMARKS: Biased Beta Scan Surveys were performed in areas with the highest Potential for contamination in accordance with Section 4.3.2.2 of the Scoping Survey Plan.
Concrete Scans: 250-450 cpm (Beta)
Brick Scans 350-600 cpm (Beta)

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 [signature] / 8-24-04

REVIEWER SIGNATURE/DATE: [signature] / 11/5/04

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

6 of 7

Survey Number:	Date: 8/18/2004	Inst. Letter: B

Alpha				Beta			
$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **113.1** (dpm/100cm²)			$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **515** (dpm/100cm²)		
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.98** (should be ≥ 0.85)			$i = \frac{w}{s}$ $MDCR = d'\sqrt{b*\left(\frac{i}{60}\right)}*\left(\frac{60}{i}\right)$ $MDC = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	i = 3.0 $MDCR$ = 111 Beta Scan *MDC* = **927** (dpm/100cm²)		
Alpha Information				**Beta Information**			
Background count rate (R_b)	0.3	(cpm)		Background count rate (R_b) or (b)	328	(cpm)	
Background count time (t_b)	1	(minutes)		Background count time (t_b)	1	(minutes)	
Sample count time (t_g)	1	(minutes)		Sample count time (t_g)	1	(minutes)	
Instrument efficiency (e_i)	0.157	(cpm/dpm)		Instrument efficiency (e_i)	0.271	(cpm/dpm)	
Surface efficiency (e_s)	0.25	(decimal)		Surface efficiency (e_s)	0.5	(decimal)	
Probe area (PA)	125	(cm²)		Probe area (PA)	125	(cm²)	
Width of the probe face (d) or (w)	7.6	(cm)		Width of the probe face (w) or (d)	7.6	(cm)	
Scan speed (v) or (s)	2.5	(cm/sec)		Scan speed (s) or (v)	2.5	(cm/sec)	
-----	-----	-----		Index of detectability (d')	1.38	-----	
-----	-----	-----		Surveyor efficiency (p)	0.5	-----	
Investigation level (G)	480	(dpm/100cm²)		-----	-----	-----	

1 in/sec = 2.5 cm/sec 2 in/sec = 5.1 cm/sec 3 in/sec = 7.6 cm/sec : The width of the probe face for a Ludlum 43-89 is 7.6 cm

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

7 of 7

Survey Number:	Date: 8/18/2004	Inst. Letter: D

Alpha			Beta		
$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **273.5** (dpm/100cm²)		$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **539** (dpm/100cm²)	
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.97** (should be ≥ 0.85)		$i = \frac{w}{s}$ $MDCR = d'\sqrt{b*\left(\frac{i}{60}\right)}*\left(\frac{60}{i}\right)$ $MDC = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	i = 3.0 MDCR = 111 Beta Scan *MDC* = **969** (dpm/100cm²)	
Alpha Information			**Beta Information**		
Background count rate (R_b)	4	(cpm)	Background count rate (R_b) or (b)	330	(cpm)
Background count time (t_b)	1	(minutes)	Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)	Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.144	(cpm/dpm)	Instrument efficiency (e_i)	0.26	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)	Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm²)	Probe area (PA)	125	(cm²)
Width of the probe face (d) or (w)	7.6	(cm)	Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)	Scan speed (s) or (v)	2.5	(cm/sec)
-----	-----	-----	Index of detectability (d')	1.38	-----
-----	-----	-----	Surveyor efficiency (p)	0.5	-----
Investigation level (G)	480	(dpm/100cm²)	-----	-----	-----

1 in/sec = 2.5 cm/sec 2 in/sec = 5.1 cm/sec 3 in/sec = 7.6 cm/sec : The width of the probe face for a Ludlum 43-89 is 7.6 cm

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP EDA BUNKER**	HSWP: S-04.001.0	Page 1 of 4
Purpose Of Survey: Scoping Survey	Survey Number:	Date: 8/18/04 / Time: 1302

Instrument Type(s): (√ if used)	Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector		Lab Bkgd: (CPM)❶ Alpha (α)	Lab Bkgd: (CPM)❶ Beta (βγ)	Lab Efficiency (0.00)❷ Alpha (α)	Lab Efficiency (0.00)❷ Beta (βγ)
☐ Ludlum 2360/43-89 (Q)	125	156373	167715	06/15/05	06/15/05	Before→	0.5	185	15.7	27.1
☐ Other ______	______					After→	0.5	247	15.7	27.1

Instrument Letter (A-H): A (*for this survey*)

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ 1m² Averaging ☒ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIL 0007		**Field Bkgd (cpm) Alpha (α)❸** Initial		Final (*if needed*)		**Field Bkgd (cpm) Beta (βγ)❹** Initial		Final (*if needed*)		**Contamination Limits (dpm/100cm²)**	
Eff. Count (cpm)	484 / 524										
Decayed dpm	3103	Count 1	0	Count 4		Count 1	213	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SAIL 0006		Count 2	1	Count 5		Count 2	211	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4564 / 4513	Count 3	0	Count 6		Count 3	211	Count 6		Beta (βγ) Limit	6000
Decayed dpm	15909	Average	.3	6 Ave		Average	212	6 Ave		Beta (βγ) Inv. Level	4800

a priori Action Levels: (CPM)	Alpha (α) Limit	Alpha (α) Inv. Level	Beta (βγ) Limit	Beta (βγ) Inv. Level
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	24	19	720	619

REMARKS:
❶ 10 minute BKGD counts, or _____min. Efficiency determined at calibration.
❷ 1 min source count, or _____min.
❸ 1 minute BKGD counts, or _____min.
❹ 1 minute BKGD counts, or _____min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] 8/18/04

REVIEWER SIGNATURE/DATE: [signature] 11/3/04

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

4 of 4

Survey Number:	Date: 8/18/2004	Inst. Letter: F

Alpha				Beta		
$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_s)\left(1+\frac{t_s}{t_b}\right)}}{(t_s)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **113.1** (dpm/100cm²)			$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_s)\left(1+\frac{t_s}{t_b}\right)}}{(t_s)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **418** (dpm/100cm²)	
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.98** (should be ≥ 0.85)			$i = \frac{w}{s}$ $MDCR = d'\sqrt{b \cdot \left(\frac{i}{60}\right)} \cdot \left(\frac{60}{i}\right)$ $MDC = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	i = 3.0 $MDCR$ = 89 Beta Scan *MDC* = **745** (dpm/100cm²)	
Alpha Information				**Beta Information**		
Background count rate (R_b)	0.3	(cpm)		Background count rate (R_b) or (b)	212	(cpm)
Background count time (t_b)	1	(minutes)		Background count time (t_b)	1	(minutes)
Sample count time (t_s)	1	(minutes)		Sample count time (t_s)	1	(minutes)
Instrument efficiency (e_i)	0.157	(cpm/dpm)		Instrument efficiency (e_i)	0.271	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)		Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm²)		Probe area (PA)	125	(cm²)
Width of the probe face (d) or (w)	7.6	(cm)		Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)		Scan speed (s) or (v)	2.5	(cm/sec)
-----	-----	-----		Index of detectability (d')	1.38	-----
-----	-----	-----		Surveyor efficiency (p)	0.5	-----
Investigation level (G)	480	(dpm/100cm²)		-----	-----	-----

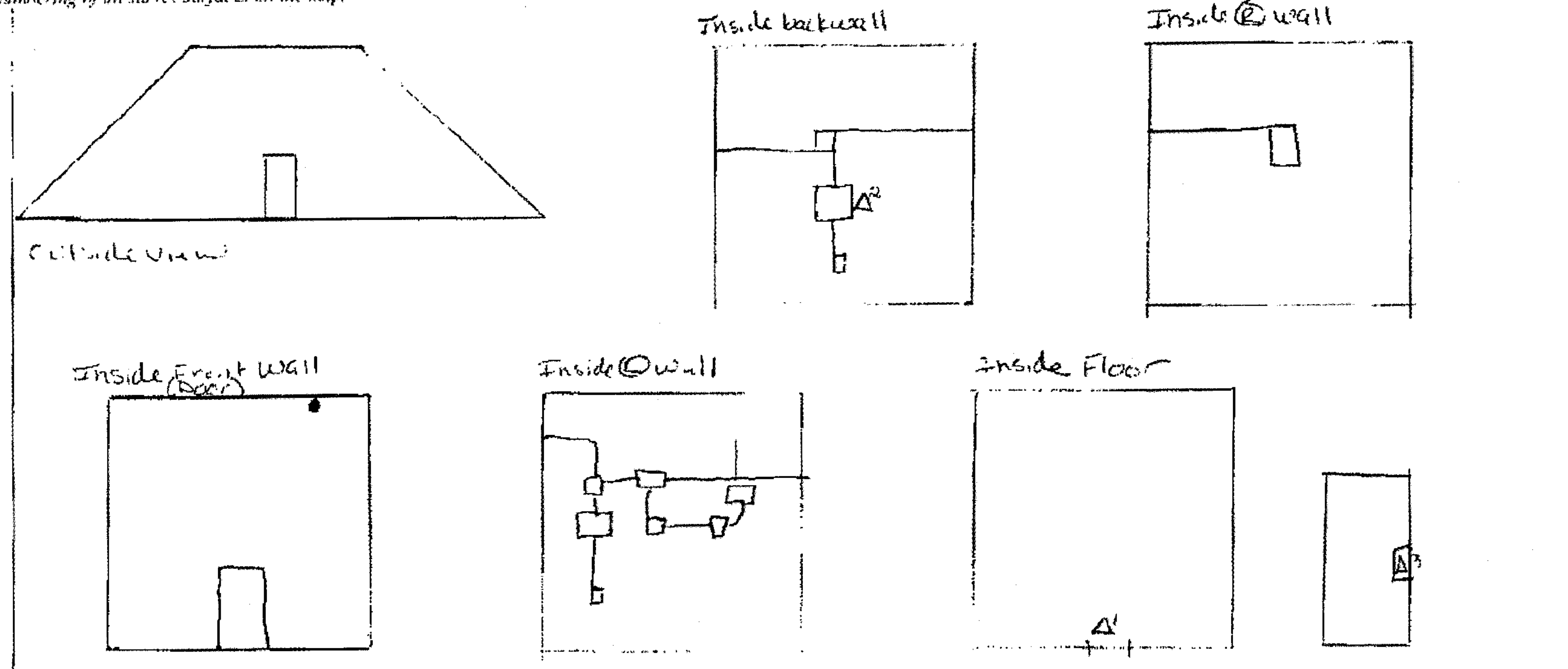
1 in/sec = 2.5 cm/sec   2 in/sec = 5.1 cm/sec   3 in/sec = 7.6 cm/sec   :   The width of the probe face for a Ludlum 43-89 is 7.6 cm

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [3]

Survey Number: IAAAP EDA Bunker

Legend: (Fill in blank) ____ = Smear Location ____ = G/A Dose Rate ☐ mR/hr ☐ μR/hr

Show numbering of all survey surfaces on the map.



REMARKS: Biased beta Scan Surveys were performed in areas with the highest potential for contamination in accordance w/section 4.3.2.2 of the Survey Plan.
Scan Range: 100 - 400cpm (Beta)

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/18/04

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: **IAAAP EDA BUNKER**	HSWP: S-04.001.0	Page 2 of 4
PURPOSE OF SURVEY: Scoping Survey	DATE: 8/18/04	TIME: 1302

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector	Background (CPM): Alpha (α)	Background (CPM): Beta (βγ)	Efficiency (%): Alpha (α)	Efficiency (%): Beta (βγ)
☒ Ludlum 2221/43-10-1	N/A	180850	194700	04/27/05	04/27/05	0.2	43	34.1	38.0
☒ Ludlum 2360/43-89 Q	125	156373	167715	06/15/05	06/15/05	0.3	212	15.7	27.1
☐ Ludlum 2221/44-9	15.5								
☐ Micro-R	N/A								

Contamination Limits: (dpm/100cm²) Removable α 60 Removable βγ 600 Total α 600 Total βγ 6000

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm² βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm² βγ Total	mR/hr or μR/hr
1	Floor	0	0	<60	42	0	<600	2	2	<MDC	286	74	434	NA
2	Inside wall	0	0	<60	42	0	<600	1	1	<MDC	238	26	<MDC	NA
3	Inside Door Push Plate	0	0	<60	44	1	<600	8	8	163	188	0	<MDC	NA

REMARKS: 43-10-1 MDA for alpha is 13 dpm and for beta is 67 dpm. 43-89 MDA for alpha is 113 dpm/100cm² and for beta is 418 dpm/100cm².

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/18/04 /

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP DEMO 900-189-1**		HSWP: S-04.001.0	Page 1 of 6
Purpose Of Survey: Scoping Survey	Survey Number:	Date: 8/25/04	Time: 1030

Instrument Type(s): (√ if used)	Detector Area (cm²)	Serial Number:		Cal. Due Date:			Lab Bkgd: (CPM) ❶		Lab Efficiency (0.00) ❷	
		meter	detector	meter	detector		Alpha (α)	Beta (βγ)	Alpha (α)	Beta (βγ)
☑ Ludlum 2360/43-89 (Q)	125	156373	167715	06/15/05	06/15/05	Before→	0.5	211	15.7	27.1
☐ Other ______	______					After→	0.5	214	15.7	27.1

Instrument Letter (A-H): H *(for this survey)*

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ 1m² Averaging ☒ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIC 0007		Field Bkgd (cpm) Alpha (α) ❸				Field Bkgd (cpm) Beta (βγ) ❹				Contamination Limits (dpm/100cm²)	
Eff. Count (cpm)	516 / 453	Initial		Final *(if needed)*		Initial		Final *(if needed)*			
Decayed dpm	3163	Count 1	0	Count 4		Count 1	278	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SAIC 9006		Count 2	0	Count 5		Count 2	262	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4459 / 4490	Count 3	1	Count 6		Count 3	237	Count 6		Beta (βγ) Limit	6000
Decayed dpm	15909	Average	3	6 Ave		Average	259	6 Ave		Beta (βγ) Inv. Level	4800

***a priori* Action Levels: (CPM)**	Alpha (α) Limit	Alpha (α) Inv. Level	Beta (βγ) Limit	Beta (βγ) Inv. Level
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	30	24	767	666

REMARKS:

❶ 10 minute BKGD counts, or ______min. Efficiency determined at calibration.

❷ 1 min source count, or ______min.

❸ 1 minute BKGD counts, or ______min.

❹ 1 minute BKGD counts, or ______min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/25/04 [signature] / 8-25-04

REVIEWER SIGNATURE/DATE: [signature] / 11/3/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP DEMO 900-189-1**		HSWP: S-04.001.0	Page 2 of 6
Purpose Of Survey: Scoping Survey	Survey Number:	Date: 8/25/04	Time: 1030

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector		Lab Bkgd: (CPM) ❶ Alpha (α)	Lab Bkgd: (CPM) ❶ Beta (βγ)	Lab Efficiency (0.00) ❷ Alpha (α)	Lab Efficiency (0.00) ❷ Beta (βγ)
☐ Ludlum 2360/43-89	125	145477	1648116	06/15/05	06/15/05	Before→	0.7	208	14.4	26.0
☐ Other ___	___					After→	1.0	206	14.4	26.0

Instrument Letter (A-H): ___I___ *(for this survey)*

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ $1m^2$ Averaging ☐ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIC 90007		**Field Bkgd (cpm) Alpha (α) ❸** Initial		Final *(if needed)*		**Field Bkgd (cpm) Beta (βγ) ❹** Initial		Final *(if needed)*		**Contamination Limits ($dpm/100cm^2$)**	
Eff. Count (cpm)	500 / 449										
Decayed dpm	3163	Count 1	1	Count 4		Count 1	260	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SAIC 90016		Count 2	0	Count 5		Count 2	242	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4444 / 4470	Count 3	1	Count 6		Count 3	255	Count 6		Beta (βγ) Limit	6000
Decayed dpm	1509	Average	.7	6 Ave		Average	252	6 Ave		Beta (βγ) Inv. Level	4800

***a priori* Action Levels: (CPM)**	**Alpha (α) Limit**	**Alpha (α) Inv. Level**	**Beta (βγ) Limit**	**Beta (βγ) Inv. Level**
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	28	22	740	642

REMARKS:

❶ 10 minute BKGD counts, or _____min. Efficiency determined at calibration. This instrument was used for QC purposes.
❷ 1 min source count, or _____min.
❸ 1 minute BKGD counts, or ___ min.
❹ 1 minute BKGD counts, or _____min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] 8/25/04 [signature] / 8-25-04

REVIEWER SIGNATURE/DATE: [signature] / 11/3/04

SAIC RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: **IAAAP DEMO 900-189-1** | HSWP: S-04.001.0 | Page 3 of 6

PURPOSE OF SURVEY: Scoping Survey | DATE: 8/25/04 | TIME: 1030

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector	Background (CPM): Alpha (α)	Background (CPM): Beta (βγ)	Efficiency (%): Alpha (α)	Efficiency (%): Beta (βγ)
☒ Ludlum 2221/43 10-1	N/A	180850	194700	04/27/05	04/27/05	0.2	43	34.1	38.0
☒ Ludlum 2360/43-89 Q	125	156373	167715	06/15/05	06/15/05	0.3	259	15.7	27.1
☒ Ludlum 2360/43-89	125	145477	164816	06/15/05	06/15/05	0.7	252	14.4	26.0
☐ Micro-R	N/A								

Contamination Limits: (dpm/100cm²) Removable α 60; Removable βγ 600; Total α 600; Total βγ 6000

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm² βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm² βγ Total	mR/hr or µR/hr
1	Floor concrete by door	1	1	<60	47	4	<600	1	1	<MDC	260	1	<MDC	NA
2	Floor concrete by door with phone	2	2	<60	54	11	<600	0	0	<MDC	242	0	<MDC	NA
3	Wall by phone	0	0	<60	63	20	<600	1	1	<MDC	255	0	<MDC	NA
4	QC of Floor concrete by door	0	0	<60	50	7	<600	4	4	<MDC	358	106	652	NA
5	QC of Floor concrete by door with phone	0	0	<60	52	9	<600	6	6	<MDC	351	99	609	NA

REMARKS: 43-10-1 MDA for alpha is 13 dpm and for beta is 67 dpm. QC instrument is the 43-89 without a letter assigned to it. 43-89Q MDA for alpha is 113 dpm/100cm² and for beta is 460 dpm/100cm². 43-89 MDA for alpha is 141 dpm/100cm² and for beta is 454 dpm/100cm². QC samples meet the data quality objectives.

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/25/04

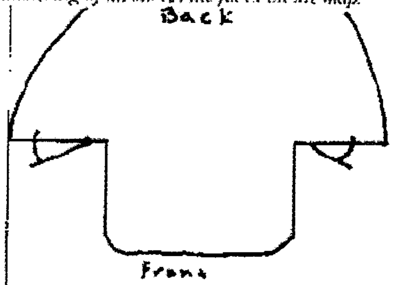
REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

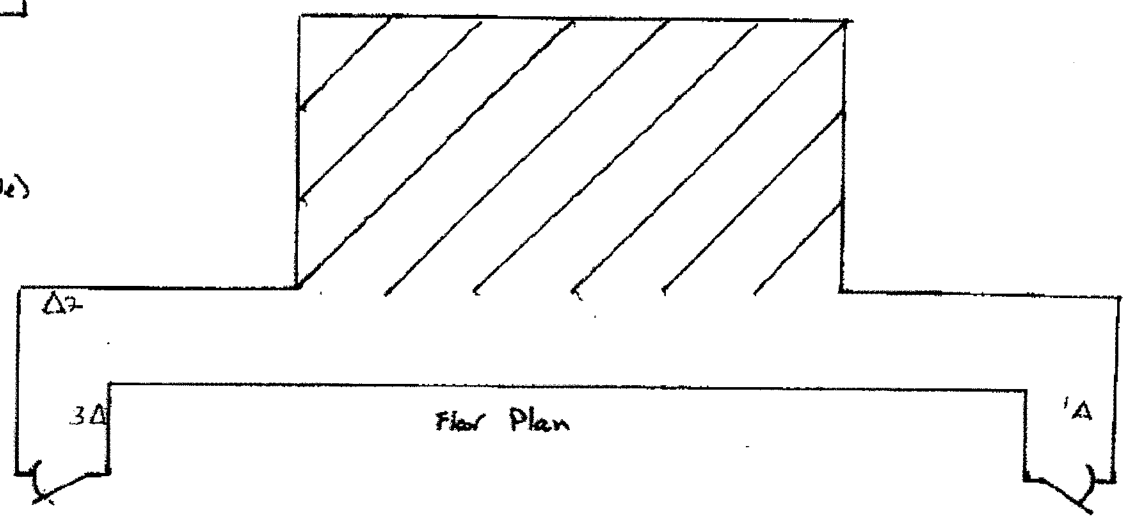
SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [3]

Survey Number: IAAAP Demolition area 900-189-1

Legend: (Fill in blank) Δ = Smear Location ______ = G/A Dose Rate ☐ mR/hr ☐ μR/hr

Show numbering of all survey surfaces on the map.





Raining during survey of the bunker, concrete was damp.

Δ-Direct reading and smear location

REMARKS: ☒ Area not surveyed Biased beta scan surveys were performed in areas w/ the highest potential for contamination in accordance w/ section 4.3.2.2 of the survey plan.
Scan Range: 200-350 cpm (Beta)

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/25/04 [signature] / 8-25-04

REVIEWER SIGNATURE/DATE: [signature] / 11/3/04

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

59.6

Survey Number:	Date:	8/18/2004	Inst. Letter:	H

Alpha		Beta	
$Static\ MDC = \dfrac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **113.1** (dpm/100cm²)	$Static\ MDC = \dfrac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **460** (dpm/100cm²)
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.98** (should be ≥ 0.85)	$i = \frac{w}{s}$ $MDCR = d'\sqrt{b*\left(\frac{i}{60}\right)}*\left(\frac{60}{i}\right)$ $MDC = \dfrac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	i = 3.0 $MDCR$ = 99 Beta Scan *MDC* = **824** (dpm/100cm²)

Alpha Information			Beta Information		
Background count rate (R_b)	0.3	(cpm)	Background count rate (R_b) or (b)	259	(cpm)
Background count time (t_b)	1	(minutes)	Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)	Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.157	(cpm/dpm)	Instrument efficiency (e_i)	0.271	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)	Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm²)	Probe area (PA)	125	(cm²)
Width of the probe face (d) or (w)	7.6	(cm)	Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)	Scan speed (s) or (v)	2.5	(cm/sec)
-----	-----	-----	Index of detectability (d')	1.38	-----
-----	-----	-----	Surveyor efficiency (p)	0.5	-----
Investigation level (G)	480	(dpm/100cm²)	-----	-----	-----

1 in/sec = 2.5 cm/sec 2 in/sec = 5.1 cm/sec 3 in/sec – 7.6 cm/sec : The width of the probe face for a Ludlum 43-89 is 7.6 cm

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

lefile

Survey Number:	Date: 8/18/2004	Inst. Letter: 1

Alpha		Beta	
$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **140.5** (dpm/100cm²)	$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **454** (dpm/100cm²)
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.98** (should be ≥ 0.85)	$i = \frac{w}{s}$ $MDCR = d'\sqrt{b*\left(\frac{i}{60}\right)}*\left(\frac{60}{i}\right)$ $MDC = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	i – 3.0 $MDCR$ – 97 Beta Scan *MDC* = **813** (dpm/100cm²)

Alpha Information			Beta Information		
Background count rate (R_b)	0.7	(cpm)	Background count rate (R_b) or (b)	252	(cpm)
Background count time (t_b)	1	(minutes)	Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)	Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.157	(cpm/dpm)	Instrument efficiency (e_i)	0.271	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)	Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm²)	Probe area (PA)	125	(cm²)
Width of the probe face (d) or (w)	7.6	(cm)	Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)	Scan speed (s) or (v)	2.5	(cm/sec)
-----	-----	-----	Index of detectability (d')	1.38	-----
-----	-----	-----	Surveyor efficiency (p)	0.5	-----
Investigation level (G)	480	(dpm/100cm²)	-----	-----	-----

1 in/sec = 2.5 cm/sec 2 in/sec = 5.1 cm/sec 3 in/sec = 7.6 cm/sec : The width of the probe face for a Ludlum 43-89 is 7.6 cm

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP EDA BG-5**		HSWP: S-04.001.0	
Purpose Of Survey: Scoping Survey	Survey Number:	Date: 8/24/04	Time: 1040

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector		Lab Bkgd: (CPM)❶ Alpha (α)	Lab Bkgd: (CPM)❶ Beta (βγ)	Lab Efficiency (0.00)❷ Alpha (α)	Lab Efficiency (0.00)❷ Beta (βγ)
☐ Ludlum 2360/43-89	125	145477	164816	06/15/05	06/15/05	Before→	0.4	222	14.4	26.0
☐ Other ______						After→	1.2	205	14.4	26.0

Instrument Letter (A-H): E (for this survey)

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ $1m^2$ Averaging ☐ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIL0007		Field Bkgd (cpm) Alpha (α)❸ Initial		Final (if needed)		Field Bkgd (cpm) Beta (βγ)❹ Initial		Final (if needed)		Contamination Limits (dpm/100cm^2)	
Eff. Count (cpm)	472 / 446	Count 1	5	Count 4		Count 1	220	Count 4		Alpha (α) Limit	600
Decayed dpm	3163	Count 2	2	Count 5		Count 2	277	Count 5		Alpha (α) Inv. Level	480
Beta (βγ) Source S/N: SAIL00016		Count 3	7	Count 6		Count 3	248	Count 6		Beta (βγ) Limit	6000
Eff. Count (cpm)	4122 / 3946	Average	4.7	6 Ave		Average	248	6 Ave		Beta (βγ) Inv. Level	4800
Decayed dpm	15309										

a priori Action Levels: (CPM)	Alpha (α) Limit	Alpha (α) Inv. Level	Beta (βγ) Limit	Beta (βγ) Inv. Level
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	32	26	736	638

REMARKS: Field background alpha counts were higher than expected. This is likely due to increased radon.

❶ 10 minute BKGD counts, or ____min. Efficiency determined at calibration.

❷ 1 min source count, or ____ min.

❸ 1 minute BKGD counts, or ____min.

❹ 1 minute BKGD counts, or ____min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] 8/24/04 /

REVIEWER SIGNATURE/DATE: [signature] 11/16/04

SAIC RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: **IAAAP EDA BG-5**	HSWP: S-04.001.0	Page 2 of 4
PURPOSE OF SURVEY: Scoping Survey	DATE: 8/24/04	TIME: 1040

Instrument Type(s): (√ if used)	Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency (%) Alpha (α)	Efficiency (%) Beta (βγ)
☒ Ludlum 2221/43-10-1	N/A	180850	194700	04/27/05	04/27/05	0.2	43	34.1	38.0
☒ Ludlum 2360/43-89	125	145477	164816	06/15/05	06/15/05	4.7(0.4)*	248	14.4	26.0
☐ Ludlum 2221/44-9	15.5								
☐ Micro-R	N/A								

Contamination Limits: (dpm/100cm²) Removable α 60 Removable βγ 600 Total α 600 Total βγ 6000

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm² βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm² βγ Total	mR/hr or μR/hr
1	Floor of Door Threshold	0	0	<60	51	8	<600	24	24*	533	368	120	739	NA
2	Floor	0	0	<60	39	0	<600	1	1*	<MDC	305	57	<MDC	NA
3	Inside back wall	0	0	<60	41	0	<600	8	8*	<MDC	315	67	<MDC	NA

REMARKS:
Floor was covered with dirt. *Since alpha field background may have been higher due to radon, the initial daily alpha background checkin value (0.4) was used to conservatively calculate total alpha activity. 43-10-1 MDA for alpha is 13dpm and for beta is 67 dpm. 43-89 MDA for alpha is 291 dpm/100cm² and for beta 469 dpm/100cm².

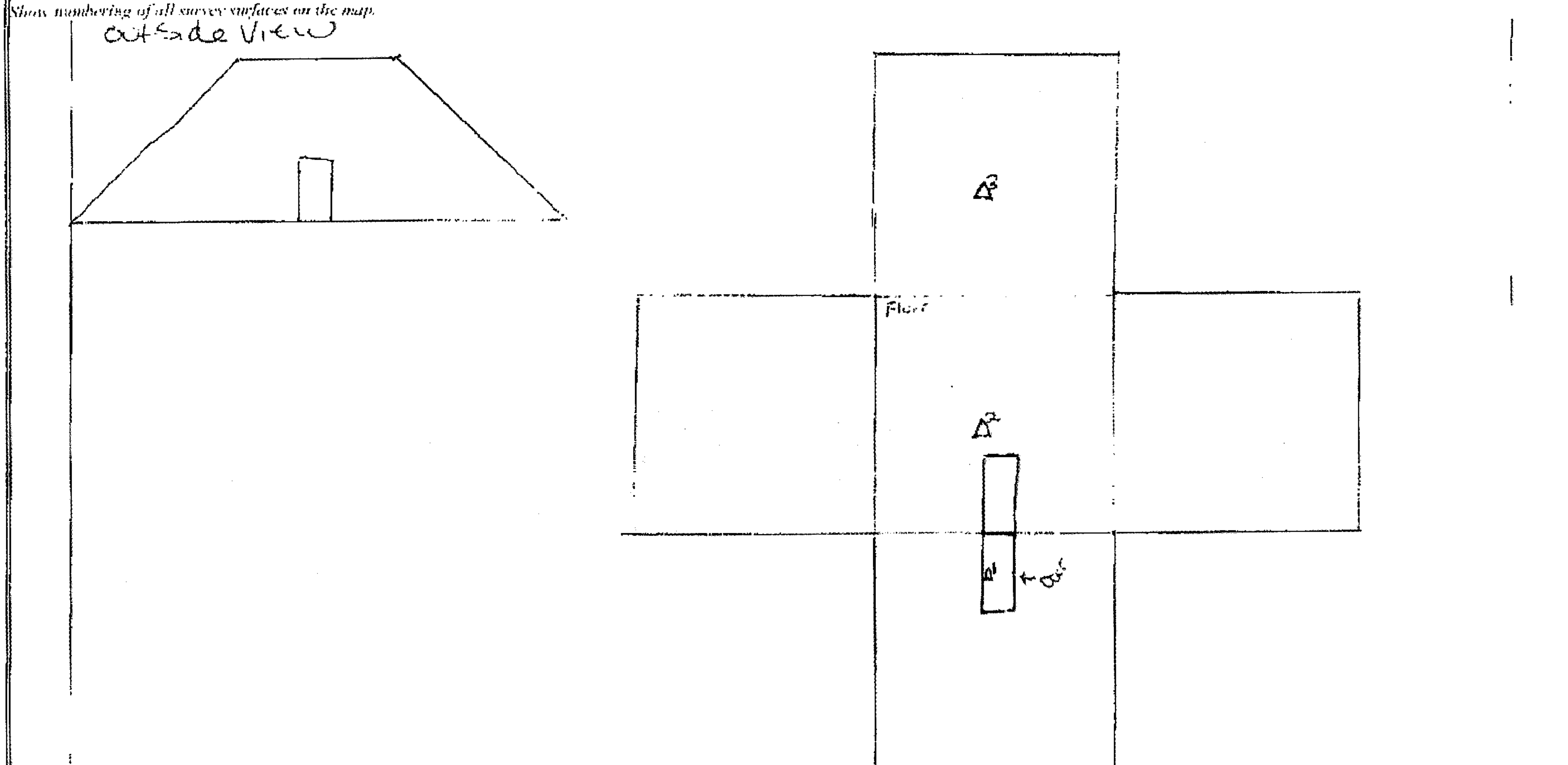
TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 /

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [3]

Survey Number: B6-5	Page 3 of 4
Legend: (Fill in blank) ____ = Smear Location ____ = G/A Dose Rate ☐ mR/hr ☐ µR/hr	

Show numbering of all survey surfaces on the map.



REMARKS: Biased beta scan surveys were performed in areas with the highest potential for contamination in accordance w/ Section 4.3.2.2 of the SEP... Survey Plan.
Scan Ranges: 150-400cpm (Beta)

TECHNICIAN(S) SIGNATURE/DATE: [signature]	8/24/04
REVIEWER SIGNATURE/DATE: [signature]	11/16/04

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

Survey Number:	Date:	8/18/2004	Inst. Letter:	E

Alpha		Beta	
$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **290.8** (dpm/100cm²)	$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **469** (dpm/100cm²)
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.97** (should be ≥ 0.85)	$i = \frac{w}{s}$ $MDCR = d'\sqrt{b*\left(\frac{i}{60}\right)}*\left(\frac{60}{i}\right)$ $MDC = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	i = 3.0 $MDCR$ = 97 Beta Scan *MDC* = **840** (dpm/100cm²)

Alpha Information			Beta Information		
Background count rate (R_b)	4.7	(cpm)	Background count rate (R_b) or (b)	248	(cpm)
Background count time (t_b)	1	(minutes)	Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)	Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.144	(cpm/dpm)	Instrument efficiency (e_i)	0.26	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)	Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm²)	Probe area (PA)	125	(cm²)
Width of the probe face (d) or (w)	7.6	(cm)	Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)	Scan speed (s) or (v)	2.5	(cm/sec)
-----	-----	-----	Index of detectability (d')	1.38	-----
-----	-----	-----	Surveyor efficiency (p)	0.5	-----
Investigation level (G)	480	(dpm/100cm²)	-----	-----	-----

1 in/sec = 2.5 cm/sec 2 in/sec = 5.1 cm/sec 3 in/sec = 7.6 cm/sec : The width of the probe face for a Ludlum 43-89 is 7.6 cm

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP EDA BG-4**		HSWP: S-04.001.0	Page 1 of 6
Purpose Of Survey: Scoping Survey	Survey Number:	Date: 8/24/04	Time: 1100

Instrument Type(s): (√ if used)	Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector		Lab Bkgd: (CPM)❶ Alpha (α)	Lab Bkgd: (CPM)❶ Beta (βγ)	Lab Efficiency (0.00)❷ Alpha (α)	Lab Efficiency (0.00)❷ Beta (βγ)
☐ Ludlum 2360/43-89 (Q)	125	156373	167715	06/15/05	06/15/05	Before→	0.6	254	15.7	27.1
☐ Other ______	______					After→	0.7	179	15.7	27.1

Instrument Letter (A-H): G *(for this survey)*

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ 1m² Averaging ☒ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIC 0007		**Field Bkgd (cpm) Alpha (α)❸** Initial		Final *(if needed)*		**Field Bkgd (cpm) Beta (βγ)❹** Initial		Final *(if needed)*		**Contamination Limits (dpm/100cm²)**	
Eff. Count (cpm)	472 / 446										
Decayed dpm	3103	Count 1	0	Count 4		Count 1	229	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SAIC 0006		Count 2	0	Count 5		Count 2	206	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4122 / 3948	Count 3	1	Count 6		Count 3	190	Count 6		Beta (βγ) Limit	6000
Decayed dpm	15909	Average	.3	6 Ave		Average	208	6 Ave		Beta (βγ) Inv. Level	4800

***a priori* Action Levels: (CPM)**	Alpha (α) Limit	Alpha (α) Inv. Level	Beta (βγ) Limit	Beta (βγ) Inv. Level
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	30	24	716	615

REMARKS:
❶ 10 minute BKGD counts, or _____ min. Efficiency determined at calibration.
❷ 1 min source count, or _____ min.
❸ 1 minute BKGD counts, or _____ min.
❹ 1 minute BKGD counts, or _____ min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] [illegible] /

REVIEWER SIGNATURE/DATE: [signature] 11/16/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP EDA BG-4**		HSWP: S-04.001.0	
Purpose Of Survey: Scoping Survey	Survey Number:	Date: 8/24/04	Time: 1100

Instrument Type(s): (√ if used)	Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector		Lab Bkgd: (CPM)❶ Alpha (α)	Lab Bkgd: (CPM)❶ Beta (βγ)	Lab Efficiency (0.00)❷ Alpha (α)	Lab Efficiency (0.00)❷ Beta (βγ)
☐ Ludlum 2360/43-89	125	145477	164816	06/15/05	06/15/05	Before→	0.4	222	14.4	26.0
☐ Other ________	________					After→	1.2	205	14.4	26.0

Instrument Letter (A-H): J
(for this survey)

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ 1m² Averaging ☒ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIC 00007		**Field Bkgd (cpm) Alpha (α)❸** Initial		Final *(if needed)*		**Field Bkgd (cpm) Beta (βγ)❹** Initial		Final *(if needed)*		**Contamination Limits (dpm/100cm²)**	
Eff. Count (cpm)	472 / 446										
Decayed dpm	3103	Count 1	1	Count 4		Count 1	179	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SAIC 00006		Count 2	0	Count 5		Count 2	181	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4127 / 3946	Count 3	2	Count 6		Count 3	217	Count 6		Beta (βγ) Limit	6000
Decayed dpm	15909	Average	1	6 Avc		Average	192	6 Avc		Beta (βγ) Inv. Level	4800

***a priori* Action Levels: (CPM)**	Alpha (α) Limit	Alpha (α) Inv. Level	Beta (βγ) Limit	Beta (βγ) Inv. Level
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100} \right) + fieldBKGD \right)$	28	23	680	582

REMARKS:
❶ 10 minute BKGD counts, or _____min. Efficiency determined at calibration. This meter was used for QC purposes.
❷ 1 min source count, or _____min.
❸ 1 minute BKGD counts, or _____min.
❹ 1 minute BKGD counts, or _____ min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] / [illegible] ________ /

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: **IAAAP EDA BG-4**	HSWP: S-04.001.0	Page 3 of 6
PURPOSE OF SURVEY: Scoping Survey	DATE: 8/24/04	TIME: 1100

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector	Background (CPM): Alpha (α)	Background (CPM): Beta (βγ)	Efficiency (%): Alpha (α)	Efficiency (%): Beta (βγ)
☒ Ludlum 2221/43-10-1	N/A	180850	194700	04/27/05	04/27/05	0.2	43	34.1	38.0
☒ Ludlum 2360/43-89 Q	125	156373	167715	06/15/05	06/15/05	0.6	208	15.7	27.1
☒ Ludlum 2360/43-89	125	145477	164816	06/15/05	6/15/05	1	192	14.4	26.0
☐ Micro-R	N/A								

Contamination Limits: (dpm/100cm²) Removable α 60 Removable βγ 600 Total α 600 Total βγ 6000

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm² βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm² βγ Total	mR/hr or µR/hr
1	Inside Left Wall	1	1	<60	39	0	<600	3	3	<MDC	249	41	<MDC	NA
2	Inside Right wall	0	0	<60	35	0	<600	2	2	<MDC	224	16	<MDC	NA
3	Inside Door	0	0	<60	43	0	<600	2	2	<MDC	179	0	<MDC	NA
4	QC of inside Left Wall	0	0	<60	43	0	<600	0	0	<MDC	235	43	<MDC	NA

REMARKS: 43-10-1 MDA for alpha is 13dpm and for beta is 67 dpm.
Scan range of the building was 150 to 300 on the concrete surfaces and 150 to 250 on the door. QC was taken with other the 43-89 not assigned a letter. MDA for 43-89 Q for alpha is 113dpm/100cm² and for beta is 414 dpm/100cm².
MDA for 43-89 for alpha is 170 dpm/100cm² and for beta is 415 dpm/100cm².

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 /

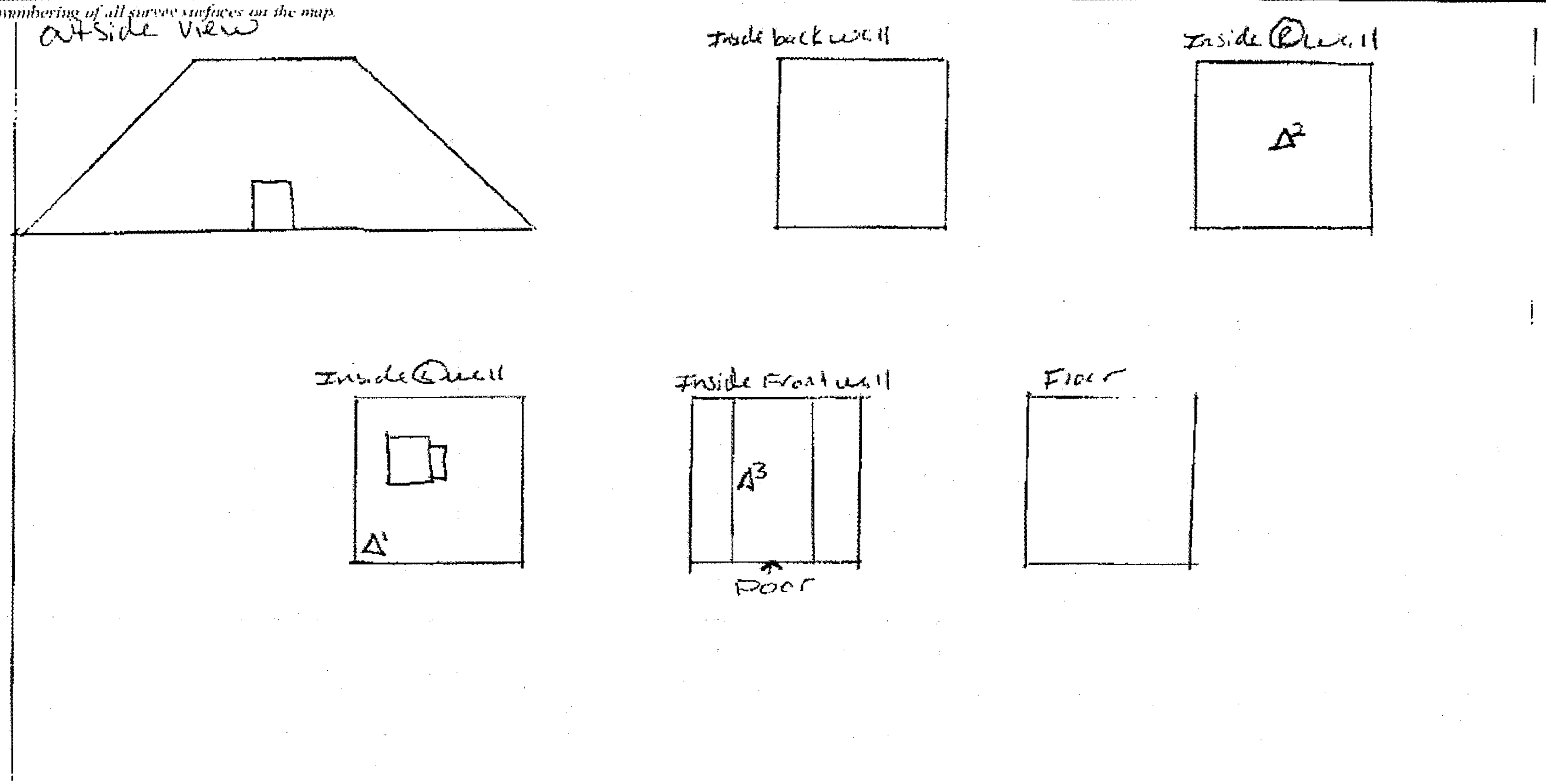
REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [3]

Survey Number: BG-4 | Page 4 of 6

Legend: (Fill in blank) ______ = Smear Location ______ = G/A Dose Rate ☐ mR/hr ☐ µR/hr

Show numbering of all survey surfaces on the map.



REMARKS: Based Beta scan surveys were performed in areas w/the highest potential for contamination in accordance with Section 4.3.2.2 of the Survey Plan.
Scans: 150-300cpm (Beta)
Door Scan: 150-250cpm (Beta)

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 5/24/04 /

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

5064

Survey Number:	Date:	8/18/2004	Inst. Letter:	G

Alpha

$Static\ MDC = \dfrac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **113.1** (dpm/100cm²)
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.98** (should be ≥ 0.85)

Alpha Information

Background count rate (R_b)	0.3	(cpm)
Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.157	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)
Probe area (PA)	125	(cm²)
Width of the probe face (d) or (w)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)
-----	-----	-----
-----	-----	-----
Investigation level (G)	480	(dpm/100cm²)

Beta

$Static\ MDC = \dfrac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **414** (dpm/100cm²)
$i = \frac{w}{s}$ $MDCR = d'\sqrt{b*\left(\frac{i}{60}\right)}*\left(\frac{60}{i}\right)$ $MDC = \dfrac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	i = 3.0 $MDCR$ = 88 Beta Scan *MDC* = **738** (dpm/100cm²)

Beta Information

Background count rate (R_b) or (b)	208	(cpm)
Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.271	(cpm/dpm)
Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm²)
Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (s) or (v)	2.5	(cm/sec)
Index of detectability (d')	1.38	-----
Surveyor efficiency (p)	0.5	-----
-----	-----	-----

1 in/sec = 2.5 cm/sec 2 in/sec = 5.1 cm/sec 3 in/sec = 7.6 cm/sec : The width of the probe face for a Ludlum 43-89 is 7.6 cm

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

6076

Survey Number:	Date: 8/18/2004	Inst. Letter: J

Alpha		Beta	
$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **170.1** (dpm/100cm²)	$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **415** (dpm/100cm²)
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = 0.97 (should be ≥ 0.85)	$i = \frac{w}{s}$ $MDCR = d'\sqrt{b*\left(\frac{i}{60}\right)}*\left(\frac{60}{i}\right)$ $MDC = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	i = 3.0; $MDCR$ = 85; Beta Scan *MDC* = **739** (dpm/100cm²)

Alpha Information			Beta Information		
Background count rate (R_b)	1	(cpm)	Background count rate (R_b) or (b)	192	(cpm)
Background count time (t_b)	1	(minutes)	Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)	Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.144	(cpm/dpm)	Instrument efficiency (e_i)	0.26	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)	Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm²)	Probe area (PA)	125	(cm²)
Width of the probe face (d) or (w)	7.6	(cm)	Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)	Scan speed (s) or (v)	2.5	(cm/sec)
-----	-----	-----	Index of detectability (d')	1.38	-----
-----	-----	-----	Surveyor efficiency (p)	0.5	-----
Investigation level (G)	480	(dpm/100cm²)	-----	-----	-----

1 in/sec = 2.5 cm/sec 2 in/sec = 5.1 cm/sec 3 in/sec = 7.6 cm/sec : The width of the probe face for a Ludlum 43-89 is 7.6 cm

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [1]

Survey Location: **IAAAP EDA BG-3**	HSWP: S-04.001.0	Page 1 of 4
Purpose Of Survey: Scoping Survey Survey Number:	Date: 8/24/04	Time: 1017

Instrument Type(s): (√ if used)	Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector		Lab Bkgd: (CPM)❶ Alpha (α)	Lab Bkgd: (CPM)❶ Beta (βγ)	Lab Efficiency (0.00)❷ Alpha (α)	Lab Efficiency (0.00)❷ Beta (βγ)
☐ Ludlum 2360/43-89 (Q)	125	156373	167715	06/15/05	06/15/05	Before→	0.6	254	15.7	27.1
☐ Other ______	______					After→	0.7	179	15.7	27.1

Instrument Letter (A-H): C (for this survey)

Survey Type: ☐ Verification ☐ QC Duplicate ☐ Characterization ☐ 1m² Averaging ☒ Scoping Survey

Survey Method: ☐ NUREG-5849 Style ☐ MARSSIM Class 1 ☐ MARSSIM Class 2 ☐ MARSSIM Class 3

Alpha (α) Source S/N: SAIC 0007		Field Bkgd (cpm) Alpha (α)❸ Initial		Final (if needed)		Field Bkgd (cpm) Beta (βγ)❹ Initial		Final (if needed)		Contamination Limits (dpm/100cm²)	
Eff. Count (cpm)	439 476										
Decayed dpm	3103	Count 1	1	Count 4		Count 1	269	Count 4		Alpha (α) Limit	600
Beta (βγ) Source S/N: SAIC 0002		Count 2	0	Count 5		Count 2	243	Count 5		Alpha (α) Inv. Level	480
Eff. Count (cpm)	4683 4316	Count 3	1	Count 6		Count 3	229	Count 6		Beta (βγ) Limit	6000
Decayed dpm	15909	Average	0.7	6 Ave		Average	247	6 Ave		Beta (βγ) Inv. Level	4800

a priori Action Levels: (CPM)	Alpha (α) Limit	Alpha (α) Inv. Level	Beta (βγ) Limit	Beta (βγ) Inv. Level
$CPM = \left(Limit \times Inst.Eff \times 0.25 \times \left(\frac{ProbeArea}{100}\right) + fieldBKGD\right)$	30	24	755	654

REMARKS:

❶ 10 minute BKGD counts, or ____ min. Efficiency was determined at calibration.
❷ 1 min source count, or ____ min.
❸ 1 minute BKGD counts, or ____ min.
❹ 1 minute BKGD counts, or ____ min.

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 ______ /

REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: **IAAAP EDA BG-3**	HSWP: S-04.001.0	Page 2 of 4
PURPOSE OF SURVEY: Scoping Survey	DATE: 8/24/04	TIME: 1017

Instrument Type(s): (√ if used)	Detector Area (cm^2)	Serial Number: meter	Serial Number: detector	Cal. Due Date: meter	Cal. Due Date: detector	Background (CPM): Alpha (α)	Background (CPM): Beta (βγ)	Efficiency (%): Alpha (α)	Efficiency (%): Beta (βγ)
☒ Ludlum 2221/43-10-1	N/A	180850	194700	04/27/05	04/27/05	0.2	43	34.1	38.0
☒ Ludlum 2360/43-89 Q	125	156373	167715	06/15/05	06/15/05	0.7	247	15.7	27.1
☐ Ludlum 2221/44-9	15.5								
☐ Micro-R	N/A								

Contamination Limits: (dpm/100cm²) Removable α 60 Removable βγ 600 Total α 600 Total βγ 6000

Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM βγ Removable	Net CPM βγ Removable	dpm/100cm² βγ Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM βγ Total	Net CPM βγ Total	dpm/100cm² βγ Total	mR/hr or µR/hr
1	Inside Left Wall	0	0	<60	45	2	<600	5	5	<MDC	330	83	490	NA
2	Inside Right Wall	2	2	<60	45	2	<600	1	1	<MDC	323	76	<MDC	NA
3	Front Right inside Door	0	0	<60	44	1	<600	3	3	<MDC	203	0	<MDC	NA

REMARKS: 43-10-1 MDA for alpha is 13 dpm and for beta is 67 dpm. 43-89 MDA for alpha is 141 dpm/100cm² and for beta is 449 dpm/100cm². Concrete scans: 250-350 cpm (beta). Steel scans: 150-250 cpm (beta)

TECHNICIAN(S) SIGNATURE/DATE: [signature] / 8/24/04 /

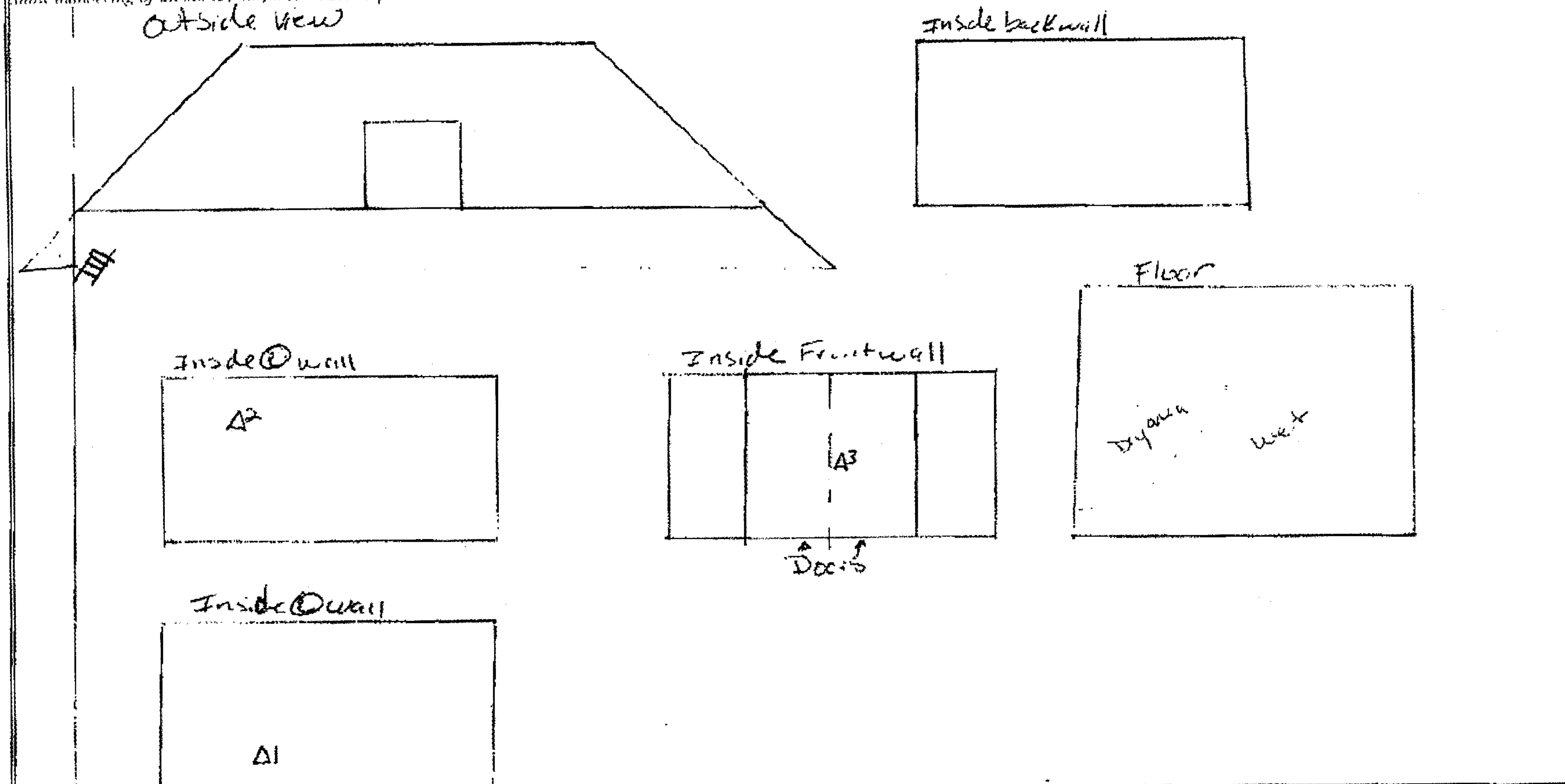
REVIEWER SIGNATURE/DATE: [signature] / 11/16/04

SAIC - TOTAL SURFICIAL CONTAMINATION SURVEY DATASHEET [3]

Survey Number: 3G-3 | Page 3 of 4

Legend: (Fill in blank) Δ = Smear Location ____ = G/A Dose Rate ☐ mR/hr ☐ μR/hr

Show numbering of all survey surfaces on the map.



REMARKS: Based beta scan surveys were performed in areas with the highest ~~Prob~~ Potential for contamination in accordance w/ Section 4.3.2.2 of the Survey Plan.

TECHNICIAN(S) SIGNATURE/DATE: [signature] 11/24/04

REVIEWER SIGNATURE/DATE: [signature] 11/16/04

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

Survey Number:	Date: 8/18/2004	Inst. Letter: C

Alpha		Beta	
$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Alpha *Static MDC* = **140.5** (dpm/100cm^2)	$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	Beta *Static MDC* = **449** (dpm/100cm^2)
$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$	Alpha Scan Probability = **0.98** (should be ≥ 0.85)	$i = \frac{w}{s}$ $MDCR = d'\sqrt{b*\left(\frac{i}{60}\right)}*\left(\frac{60}{i}\right)$ $MDC = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s)\left(\frac{Probe\ Area}{100}\right)}$	i = 3.0 $MDCR$ = 96 Beta Scan *MDC* = **805** (dpm/100cm^2)

Alpha Information			Beta Information		
Background count rate (R_b)	0.7	(cpm)	Background count rate (R_b) or (b)	247	(cpm)
Background count time (t_b)	1	(minutes)	Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)	Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.157	(cpm/dpm)	Instrument efficiency (e_i)	0.271	(cpm/dpm)
Surface efficiency (e_s)	0.25	(decimal)	Surface efficiency (e_s)	0.5	(decimal)
Probe area (PA)	125	(cm^2)	Probe area (PA)	125	(cm^2)
Width of the probe face (d) or (w)	7.6	(cm)	Width of the probe face (w) or (d)	7.6	(cm)
Scan speed (v) or (s)	2.5	(cm/sec)	Scan speed (s) or (v)	2.5	(cm/sec)
-----	-----	-----	Index of detectability (d')	1.38	-----
-----	-----	-----	Surveyor efficiency (p)	0.5	-----
Investigation level (G)	480	(dpm/100cm^2)	-----	-----	-----

1 in/sec = 2.5 cm/sec 2 in/sec = 5.1 cm/sec 3 in/sec = 7.6 cm/sec : The width of the probe face for a Ludlum 43-89 is 7.6 cm