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**U.S. Army
Environmental
Center**

**FINAL
RADIOLOGICAL SURVEY
AND REMEDIATION REPORT
DRMO YARD**

**CONTRACT DACA31-94-D-0061
DELIVERY ORDER NUMBER 0003**

**U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND**

November 1996

20070206238

PRINTED ON RECYCLED PAPER

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**FINAL
RADIOLOGICAL SURVEY AND REMEDIATION REPORT FOR
DEFENSE REUTILIZATION AND MARKETING OFFICE (DRMO) YARD
FORT DEVENS, MASSACHUSETTS**

CONTRACT DACA31-94-D-0061
DELIVERY ORDER NUMBER 0003

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NOVEMBER 1996

**FINAL
RADIOLOGICAL SURVEY AND REMEDIATION REPORT
FOR
DEFENSE REUTILIZATION AND MARKETING OFFICE (DRMO) YARD
FORT DEVENS, MASSACHUSETTS**

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EXECUTIVE SUMMARY

This Radiological Survey Report has been prepared in accordance with the U.S. Army Environmental Center (USAEC) scope of work for Contract No. DACA31-94-D-0061, Delivery Order No. 0003, Modification 1. The scope of work modification sets forth the requirements for performing a radiological survey at the Defense Reutilization and Marketing Office (DRMO) Yard, Fort Devens, Massachusetts.

The DRMO Yard is currently undergoing environmental restoration as Area of Contamination (AOC) 32 in accordance with Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The pavement and surface soils have been contaminated primarily with inorganics and polychlorinated biphenyls (PCBs) from yard operations. In addition to these findings, the U.S. Army Center for Health Promotion and Preventative Medicine (USACHPPM) conducted a preliminary survey to establish the history of radioactive sources at Fort Devens. The locations of sources, the activity of those sources, and the uses, accidents, and leaks that may have contaminated any areas at Fort Devens are presented by USACHPPM in an industrial radiation historical data review report entitled "Industrial Radiation Historical Data Review No. 27-43-E3QX-95 Fort Devens, Massachusetts" and dated November 7, 1994.

One of the outdoor sites identified in the report is the DRMO Yard which is located at the north end of the Main Post on the corner of Cook Street and Market Street in the town of Ayer. The DRMO Yard is comprised of three fenced enclosures. These fenced yards are identified in this report as the west yard, east yard and the tire recycling yard. According to the historical data review report by USACHPPM, there was a potential for radium contamination from jeep crushing activities that occurred within these yards. For an undetermined period of time, jeeps were crushed without removal of speedometer, fuel, temperature, battery and oil pressure gages with radium faces. Based on a record search, crushing potentially occurred within the north end of the east yard, the tire recycling yard, and on a 40- by-100-foot concrete pad (former building slab) east of Building 204. No crushing was reported to be performed within the west yard.

As a result of the preliminary survey by USACHPPM, the USAEC contracted ABB Environmental Services, Inc. (ABB-ES) to perform a radiological survey at the DRMO Yard to investigate for potential contamination from radium 226 (Ra-226) in soils and on paved surfaces. The Army identified the following areas as "affected" areas as defined by NUREG/CR-5849 *Manual for Conducting Radiological Surveys in Support of License Termination*, (NRC, 1992):

- The tire recycling yard (an approximate 2,915 square meter [m²] unpaved area).

- The north portion of the east yard (an approximate 6,980 m² paved area with 690 m² unpaved perimeter). Existing concrete barriers, which demarcated a PCB spill area, were used as a conservative definition of the "northern portion" of the east yard. The PCB spill occurred where transformers were stored and crushing operations were once performed.
- The 12- by-31-meter (m) concrete pad east of Building T-204 and approximate 10-m-wide perimeter around the pad (1,000 m² unpaved and 220 m² paved perimeter).

The Army identified the area south of the concrete barrier in the east yard as an "unaffected" area requiring survey as defined by NUREG/CR-5849, due to the uncertainty of the boundary where crushing was performed in the north end of the yard.

The radiological field work was subcontracted to Radiation Science, Inc., a radiological contractor from Cranbury, New Jersey. In August 1995, Radiation Science, Inc. performed an initial site survey within the defined affected and unaffected areas of the DRMO Yard. The work was performed in accordance with the Final Radiological Work Plan DRMO Yard, Fort Devens Massachusetts, dated August 4, 1995. A grid, consisting of 10-m-by-10-m grid squares was established over all surveyed areas to establish a survey reference system. One hundred percent of the affected areas and 10 percent of the unaffected area were scanned using a sodium iodide (NaI) detector.

Measurements of total alpha and total beta/gamma surface activity were made at any location exhibiting elevated count rates (hot spot areas) plus 30 random locations within paved areas within affected and unaffected areas. Dose equivalent measurements were collected with a Bicon tissue equivalent MicroRem meter from every grid square within affected areas and from 30 randomly selected grid squares in the unaffected area.

Soil samples for laboratory analyses were collected at a rate of four samples per grid square in unpaved affected areas and one sample per 30 randomly selected grid squares in the unpaved portions of the unaffected area. Analysis was for Ra-226 using gamma spectroscopy. Ten locations were selected from an area approximately 300 to 500 feet west of the site survey area to determine background levels for dose rates, gamma count rates and Ra-226 concentrations in soil.

Results from the August 1995 radiological site survey revealed the presence of one radium dial indicator, one gage, and 10 hot spots under paved areas within the north end of the east yard. Maximum readings at the site were obtained within the 10- by-10-m grid containing the radium dial indicator and an unidentified source below the pavement. Measurements within this grid square were as follows: background up to 112,300 counts per minute (cpm) (gamma scan); 15 to 55 micro Rem per hour (μ Rem/hr) (dose rate);

total beta/gamma measurements measured $28,623 \pm 1303$ beta/gamma disintegrations per minute (dpm)/100 square centimeters (cm^2) and 55 total alpha dpm/100 cm^2 . The survey discovered no surface contamination on paved areas at any of the yards and no soil contamination within the tire recycling yard, the concrete pad area east of Building T-204, and the south portion of the east yard.

Following the radiological site survey, Radiation Science, Inc. returned to the site to excavate through the pavement and investigate/remediate the hot spot areas detected during the site survey at the north end of the east yard. Hot spot areas were found to be predominantly contaminated soil (only one fully intact dial was found below the pavement). Contaminated soil was containerized in five 55-gallon drums and relinquished to the Army for disposal. Composited samples were collected for each drum for laboratory analyses of Ra-226, PCBs, and Toxicity Characteristic Leaching Procedure (TCLP) Lead. Maximum concentrations were 89 picocuries per gram (pCi/g) above background Ra-226, 1,800 micrograms per kilogram ($\mu\text{g}/\text{kg}$) PCBs (Aroclor 1254), and 107,000 microgram per liter ($\mu\text{g}/\text{L}$) TCLP Lead. TCLP lead concentrations in two of the five drums exceeded the TCLP regulatory limit of 5,000 $\mu\text{g}/\text{L}$.

Upon soil removal, a composite soil sample was collected from the walls and bottom of each of the 10 hot spot excavations and from around the radium dial indicator and gage. All samples revealed Ra-226 concentrations below the release limit of 3.75 pCi/g. The average Ra-226 concentration of the 12 soil samples was 1.13 pCi/g, above background. This average value is approximately 30 percent of the release limit. Based upon the initial site survey and the remedial results, the east yard, tire recycling yard, and concrete pad area east of Building T-204 meet the release criteria established for total alpha contamination and Ra-226 concentrations in soil.

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1.0 INTRODUCTION

The U.S. Army Environmental Center (USAEC) has directed ABB Environmental Services, Inc. (ABB-ES), under Contract No. DACA31-94-D-0061, Delivery Order No. 0003 Modification 1, to conduct radiological survey work at the Defense Reutilization and Marketing Office (DRMO) Yard, Fort Devens, Massachusetts.

The U.S. Army Center for Health Promotion and Preventative Medicine (USACHPPM) conducted a preliminary survey to establish the history of radioactive sources at Fort Devens. The locations of sources, the activity of those sources, and the uses, accidents, and leaks that may have contaminated any areas at Fort Devens are presented by USACHPPM in an industrial radiation historical data review report (USACHPPM, 1994). One of the outdoor sites identified in the report is the DRMO Yard which is located at the north end of the Main Post on the corner of Cook Street and Market Street in the town of Ayer. The DRMO Yard is comprised of three fenced enclosures on both sides of Cook Street (Figure 1). These fenced yards are identified in this report as the west yard, east yard and the tire recycling yard. According to the historical data review report by USACHPPM, there was a potential for radium contamination from jeep crushing activities that occurred within these yards. For an undetermined period of time, jeeps were crushed without removal of speedometer, fuel, temperature, battery and oil pressure gages with radium faces. As a result of the preliminary survey by USACHPPM, the USAEC contracted ABB-ES to perform a radiological survey within the DRMO Yard to investigate for potential contamination from radium 226 (Ra-226) in surface soils and on paved surfaces.

USAEC also requested that ABB-ES search and review historical information to define more precisely where jeep crushing may have occurred within the DRMO Yard. The search for historical information involved interviewing Fort Devens personnel; reviewing historical aerial photographs, Fort Devens record vault drawings, and Department of Defense (DoD) regulations; and visiting the site to inspect topography and other site conditions (ABB-ES, 1995). The following information regarding site background and crushing operations was derived from this background research.

1.1 Site History

Formerly, the Army cut jeeps (in half or quarter following a predetermined and precise procedure) in the DRMO yard so that they could not be resold for use by the general public. Later, the Army discovered that buyers who bought the jeeps for "scrap metal" were welding the frames back together and selling them as operable jeeps. For liability purposes, the Army began to crush the jeeps. Army personnel crushed the jeeps using tank retrievers and other tracked vehicles. Later, contractors hired by the buyer crushed the jeeps by using the clam shell bucket of the crane as the jeeps were loaded to be

taken away. At other times, a mobile car crusher was used. Although exact dates could not be recalled, crushing likely occurred before the Directorate of Logistics (DOL) was instructed to remove the radium gages prior to sending the chassis to DRMO.

Jeep *cutting* was initially performed in the east yard. When the Army started *crushing* jeeps, they were concerned that the paved areas would be dug-up by the operation. As a result, for "a few summers" they crushed jeeps on a 40- by-100-ft concrete pad (former building slab) east of Building 204 (Figure 1). When contractors began crushing jeeps, it was performed in the northern portion of the east yard and tire recycling yard.

No evidence was found that would suggest that jeep crushing was performed in the west yard. Historically, the west yard was used as a staging area for merchandise which was recycled, sold as scrap, or auctioned. Items typically staged in the west yard included office furniture, batteries, and scrap metal. The east yard was used for storage of larger items such as transformers, vehicles, and storage tanks, as well as for cutting and crushing operations.

Based on this information, the Army identified the following areas as "affected" areas as defined by NUREG/CR-5849 *Manual for Conducting Radiological Surveys in Support of License Termination*, (NRC, 1992):

- The tire recycling yard (an approximate 2,915 square meter [m²] unpaved area).
- The north portion of east yard (an approximate 6,980 m² paved area with 690 m² unpaved perimeter). The existing concrete barriers (Figure 1), which demarcated a polychlorinated biphenyl (PCB) spill area, were used as a conservative definition of the "northern portion" of the east yard. The PCB spill occurred where transformers were stored and where crushing operations were once performed.
- The 370 m² concrete pad east of Building T-204 and approximate 10-meter (m) wide perimeter around the pad (1,000 m² unpaved and 220 m² paved perimeter).

No crushing was reportedly performed at the south end of the east yard. However, due to the uncertainty of the boundary where crushing was performed in the east yard, the Army surveyed the area south of the concrete barriers as an "unaffected area", as defined by NUREG/CR-5849 (NRC, 1992).

1.2 Surface Conditions

The west yard was constructed and paved in August 1979 when DRMO took over the property west of Cook Street and constructed Building P-213 (warehouse). Record drawings for Building P-213 and the west yard show that there was a layer of approximately 10 inches (in) of coal that remained from a former coal pile over the area prior to construction of the west yard.

Aerial photographs show that the entire east yard was completely paved sometime between 1969 and 1972. Based on conversations with DRMO personnel, jeep crushing was believed to have started after the east yard was paved. Between the fence that surrounds the east yard and the paved surface is an approximate 10-ft-wide perimeter that is covered with sporadic vegetation, gravel, and sand. There are two unpaved spots (approximately 20 to 30 feet [ft] in diameter) located in the northern portion of the east yard where pavement has been removed (believed to be associated with PCB spill cleanup). The yard most recently used for tire recycling at the north end of the east yard is totally unpaved.

During a site visit, ABB-ES noted the presence of coal fragments intermixed with the sand and gravel along the west fence of the east yard. In an aerial photograph taken in 1965, approximately 25 percent of the east yard (southwest side) appears noticeably stained (black), presumably with coal from the coal pile which, at the time, was located directly across Cook Street. Coal ash was also formerly hauled down Cook Street, past the DRMO Yard, for disposal in the Shepley's Hill landfill. The presence of coal and coal ash in the east yard (and perhaps the tire recycling yard) could influence the results of a radiological survey due the potential presence of naturally occurring radioactive uranium, radium or potassium. As a result, a background survey was performed in consideration of these possible influences (refer to Section 3.0, Survey Methods).

The concrete pad located east of Building T-204 is surrounded by pavement on the west end and vegetation on the remaining three sides.

1.3 Other Contaminants

The DRMO Yard is also currently undergoing environmental restoration as Area of Contamination (AOC) 32 in accordance with Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The pavement and surface soils have been contaminated primarily with inorganics and PCBs from yard operations.

1.4 Project Summary

The purpose of the radiological work was to assess the potential for surface soil and paved surface contamination from Ra-226. It is the Army's intent that the radiological work described in this report demonstrates that the site meets the required release criteria for unrestricted use, from the radiological standpoint, based upon guidelines established by the U.S. Nuclear Regulatory Commission (NRC).

This report represents the final release survey of the east yard, tire recycling yard, and concrete pad east of Building T-204 at the DRMO Yard. Radiation Science, Inc. (RSI) conducted an initial site survey and characterization, remediation, and final release survey over a period beginning August 1995 until the date of this report.

The initial survey for radioactive material was performed as described in the Radiological Survey Work Plan (ABB-ES, 1995). The systematic survey methods discovered one radium dial indicator (needle), one gage, and 10 hotspots under paved areas of the east yard (north end) indicating the presence of radioactive material. The dial indicator and gage were recovered and secured from open soil off the edge of paved areas. The survey discovered no paved surface contamination and no soil contamination outside these areas.

Site remediation and final release of the contaminated areas were performed in accordance with the Radiological Survey Work Plan Addendum (ABB-ES, 1996) and completed in June 1996. Confirmatory soil samples were analyzed and the results are presented in this report. The east yard now meets the release criteria established for total alpha contamination and Ra-226 concentrations in soil. The tire recycling yard and concrete pad east of Building T-204 met all release criteria as found, with no remediation necessary.

Waste generated as a result of this project was containerized and relinquished to the Army for disposal. The results of radiological characterization of the waste are included in this final report.

The sections that follow in this report discuss the work summarized above. Section 2.0 defines the release criteria used during the radiological survey. Section 3.0 recounts the methods used to perform the background survey and site (pre-remediation) survey within the east DRMO Yard, tire recycling yard and the concrete pad area east of Building T-204. Section 4.0 summarizes the survey results from the pre-remediation and resultant post-remediation work. Section 5.0 reviews the data quality of the field survey and laboratory results. Section 6.0 presents the conclusions realized from the radiological work performed at the DRMO Yard.

2.0 RELEASE CRITERIA

The release criteria for this project are based on NUREG-1500, "Working Draft Regulatory Guide on Release Criteria for Decommissioning". A discussion of the release criteria and their derivation is provided in the Radiological Work Plan (ABB-ES, 1995). These release criteria are 1,020 disintegrations per minute (dpm)/100 square centimeters (cm²) total surface alpha contamination, and 3.75 picocuries (pCi) of Ra-226 per gram (g) of soil, above locally determined background levels.

3.0 SURVEY METHODS

The site survey was conducted as described in the Radiological Survey Work Plan (ABB-ES, 1995) and follows the recommendations provided in NUREG-5849, "Manual for Conducting Radiological Surveys in Support of License Termination" (NRC, 1992). Table 1 summarizes the type and frequency of survey that was performed in each area.

Ten locations (Figure 2) approximately 300 to 500 ft west of the site survey area were used to determine background levels for dose rates, gamma count rate, and Ra-226 concentration in soil. This area included both paved and unpaved surfaces, as well as areas where coal was stored previously. Background for each type of surface, as well as soil concentrations were determined and results are reported in Appendix B.

The DRMO Yard was divided into four survey units: (1) tire recycling yard (unpaved), (2) east yard north (paved with unpaved areas), (3) east yard south of the concrete barriers (paved with unpaved areas), and the concrete pad east of Building T-204 (concrete surface and unpaved perimeter). Only the east yard south of the concrete barriers was designated an "unaffected unit". A 10-m-by-10-m grid was established over all areas, as depicted in Figure 3. All survey results are keyed to those grid identification numbers.

Each grid was scanned with a 2- by-2-inch sodium iodide (NaI) crystal, with the meter in ratemeter mode. Using the audio output to identify hotspots, the detector was held 3 inches above ground level and was moved over the area at a slow pace. Any location exhibiting elevated count rates was identified for further investigation. The range of count rates detected in each grid is reported.

Measurements of the total alpha and total beta/gamma surface activity were made at any hotspots identified during the gamma scan. In addition 30 random locations were selected for measurement in each paved survey unit, the east yard (north and south of the concrete barrier) and the concrete pad.

Dose equivalent measurements were obtained at waist level with a Bicon tissue

equivalent microRem meter. Thirty random grid squares were selected in the unaffected area. One measurement was collected per randomly selected grid square in the unaffected area. One measurement per every grid square was collected in the affected areas.

Soil samples were obtained to a depth of 6 inches and at the rate of four samples per grid square in unpaved affected areas and at a rate of one sample in each of 30 randomly selected grid squares in unpaved, unaffected areas. One soil sample was also collected from each background location.

4.0 SURVEY RESULTS

4.1 Pre-Remediation

The field survey results recorded for the initial characterization (pre-remediation) are reported in Appendix A. The total alpha, total beta-gamma measurements as well as the dose rate and results of the gamma scan are presented by grid for each area. No total activity measurements are recorded for the tire recycling yard as this area contains no paved surfaces.

The gamma scan results for each grid are reported (Appendix A); however, these values are used for diagnostic purposes and not used for comparison to any regulatory limit. Areas exhibiting gamma count rates greater than twice background were outlined in paint and classified as "hotspots" for further study in the remediation phase. Figure 4 indicates the locations of all identified hotspots. No areas exceeded the total alpha contamination limit of 1,020 dpm/100 cm². No dose rates (excluding hotspots) exceeded 5 microRem per hour above background.

The laboratory results of the soil analysis are presented in Appendix B. Soil samples obtained during the characterization were analyzed by PACE Environmental Laboratories (PACE). Post remediation samples were analyzed by Quanterra, in St. Louis, Missouri, and Environmental Science & Engineering (ESE) of Gainesville, Florida. At all laboratories, samples were analyzed by gamma spectroscopy.

The average Ra-226 concentration in soil for all areas is within two standard deviations of background. The highest value from the 200 soil samples obtained in unpaved areas was 1.6 pCi/g of Ra-226. This is less than half the release limit of 3.75 pCi/g.

4.2 Post-Remediation

The hot spot areas were remediated by cutting and removing the pavement, locating the areas of elevated radioactivity with a NaI detector, and excavating the soil with hand

tools. The pieces of pavement were scanned and disposed as radioactive or non-radioactive based on the scan results. Five 55-gallon drums of waste were generated and relinquished to the Army for disposal at an approved disposal facility as directed by the Radiation Waste Division of the Industrial Operations Command (IOC), Rock Island, Illinois. Hot spot areas were found to be predominantly contaminated soil (only one fully intact dial was found below the pavement). Compositing samples were collected for each drum for laboratory analyses of Ra-226, PCBs, and Toxicity Characteristic Leaching Procedure (TCLP) Lead. Maximum concentrations were 89 pCi/g above background Ra-226, 1,800 micrograms per kilogram ($\mu\text{g}/\text{kg}$) PCBs (Aroclor 1254), and 107,000 microgram per liter ($\mu\text{g}/\text{L}$) TCLP Lead. TCLP lead concentrations in two of the five drums exceeded the TCLP regulatory limit of 5,000 $\mu\text{g}/\text{L}$. Drum characterization results are summarized in Table 2. PCB and TCLP Lead QC Summaries and Chain of Custody documentation for Drums 1 through 5 are provided in Appendix E. Data quality review for Ra-226 analyses is summarized in Section 5.0. The results of radiological dose rate and smear surveys performed on the drums for staging and transportation purposes are included in Appendix F.

At the end of each phase of remediation, a soil sample was obtained from the bottom and sides of the excavation for each hotspot. The average value from the 12 soil samples obtained in the excavated hotspots was 1.13 pCi/g of Ra-226, above background. This is approximately 30 percent of the release limit.

5.0 DATA QUALITY REVIEW

Providing quality data for a remediation project is based on certain key elements as discussed in EPA guidance documents (EPA 504/G-93/071). These are known as PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters. In addition, the sensitivity of measurements, expressed as the Minimum Detectable Activity (MDA) must be sufficiently low to detect contamination that is less than or equal to 25 percent of the release criteria (NRC, 1992). The process for assessing these parameters, as well as the project specific results, are discussed below.

Field measurements and quality control were provided by RSI. Laboratory measurements and quality control were provided by PACE, ESE and Quanterra, with the data quality review conducted by RSI.

5.1 Field Measurements

Precision. Precision is a test of how closely a measurement can be replicated. Replicate measurements for total alpha and beta contamination were made by obtaining two one-minute counts in sequence at the same location. Slightly more than 4 percent of the total measurements were duplicated in this manner. The formula below was used to

determine the relative percent difference (RPD). The average RPD for alpha was 22 percent and for beta 9 percent. The higher RPD for alpha contamination is because the small values, i.e. near background, are hard to replicate. This is acceptable however, because one is most concerned with precision for contamination measurements near the release limits, not near background. Better reproducibility is expected as the count rate approaches the release criteria. The RPD for the dose rate measurements was 2 percent. One could expect measurements of contaminated areas at this site to be reproduced within \pm RPD for each category with similar instrumentation and count times.

$$RPD = \frac{\text{Measurement} - \text{Replicate Measurement}}{(\text{Measurement} + \text{Replicate Measurement}) / 2} \times 100\%$$

Accuracy. Accuracy is a test of how close the meters response is to a known value. The beta standard used for this project was a Technetium-99 two-inch diameter nickel plated source (serial# 1699-94) with a radioactivity level of 15,000 dpm as certified by the National Institute of Standards and Testing (NIST). The alpha standard was a Thorium-230 source of the same configuration, also NIST traceable. Counting efficiencies were based on these two standards. Contamination in a geometry different from the calibration standards may be detected with a different efficiency. The difference between the meters efficiency for a point source and large areas of contamination is estimated to be less than 6 percent (NRC, 1995a).

To ensure continued accuracy in the field a check log was established at the beginning of the project. Operational and source checks for field instruments were performed each day of use, and recorded on the logsheet. A source check "jig" was used to ensure the source and meter were always in the same position relative to one another. All recorded measurements in this report were obtained with meters which met the criteria for useability.

Representativeness. Representative data is that data which accurately reflects the environment where the measurement was obtained. One measurement of this parameter is to simply compare the number of times the premise the data is intended to show fails, compared to the number of times the premise is tested. For this project, the premise is elevated count rates on or above the surface indicate subsurface contamination. The equation used is:

$$\text{Representativeness} = (1 - F/N) \times 100\%$$

where: F = number of times the premise fails
N = number of times the premise is tested

For this project the data is 100 percent representative. All hotspots identified during the scanning survey were subsequently proven to be hotspots based on the samples obtained during the remediation phase.

Completeness. Completeness is a measure of the amount of valid data obtained compared to the amount that was specified. For the purposes of evaluation, data defined as invalid through a QA review is subtracted from the complete data set to determine the number of valid data points. Generally, completeness greater than 95 percent is desirable. For the field measurements of dose rate, alpha, and beta contamination, all data obtained was valid, thereby providing 100 percent completeness.

Comparability. Comparability is a non-quantitative evaluation of the agreement between different types of data sets which should be, intuitively, related to each other. For example, on this project, all locations exhibiting elevated dose rates, also exhibited elevated gamma count rates, illustrating total comparability of these two data sets. Although the beta contamination has a relatively short range, it too is comparable with the gamma data. The alpha results are not comparable with any other data, as its range of affect is limited to several centimeters.

Sensitivity. To determine the suitability of a meter for a measurement, the MDA is compared with the project specific release limits. The minimum detectable activity was calculated using an equation from NUREG-5849, and the average of the daily background and source checks. The MDA for total alpha measurements (55 dpm/100 cm²) was 5.4 percent of the fixed contamination release limit (1,020 dpm/100 cm²). Therefore, the instrumentation employed was suitable for detecting contamination at the release limit and distinguishing it from background. MDA calculations are presented in Appendix D, as well as calibration certificates for field instrumentation.

5.2 Laboratory Analysis

For the initial survey, PACE analyzed 210 soil samples by gamma spectroscopy to determine the Ra-226 concentration. In the next phase, 18 soil samples were analyzed by Quanterra and ESE to confirm the efficacy of remediation. The first contract laboratory, PACE, was no longer in business at the time of the data review.

Precision. To assess the precision, (reproducibility) of laboratory analysis, PACE re-analyzed 20 samples out of 210, roughly 10 percent. The re-analysis was an immediate recount of a sample on the same detector. The average RPD was 6 percent with a range of zero to 14 percent. However, an error was discovered in the reporting of QA data. A duplicate analysis was reported as 0.75 pCi/g for both counts, yet the raw data provides two different values, 0.73 pCi/g and 0.75 pCi/g. This is merely a transcription error and does not affect the quality of the data.

Duplicate samples, that is two samples collected from the "same" location, were also collected for post-remediation analyses. Two out of 18 samples were duplicated providing an average RPD of 31 percent. While this value is higher than the pre-remediation analysis RPD, it also includes the error in trying to reproduce a sampling event in the field, with a high activity, small-sized discrete contaminant, i.e. radioluminescent paint chips. Six samples generated after the last phase of remediation were analyzed by ESE. Of those six, four were duplicated under acceptable counting conditions. The average RPD was 6 percent.

Accuracy. Accuracy for laboratory analysis is based on the efficiency and energy calibration of the detector, and how close the standard simulates the unknown sample. PACE provided documentation of energy and efficiency calibrations during the time frame the samples were analyzed. However, the standard was geometry "X", a 0.5-liter Marinelli beaker, while the samples were counted in a 1.0-liter Marinelli beaker (geometry "T"). Also the density of the standard, 3.2 grams per cubic centimeter (g/cc), was almost twice the density of some of the samples at 1.8 g/cc. This is a conservative error in that the detector will "see" gamma rays with a lower efficiency in the higher density material, as compared with the lower density samples. As a result, the total activity in the samples may be slightly overestimated.

Quanterra also utilized NIST traceable standards. However, in one instance, the standard was out of calibration for more than one year prior to use. Generally decay corrections for standards are not propagated past four or five half-lives. Use of this "old standard" reduced the 11 point standard to a 6 point standard. Because of this, there are no efficiency points between 166 keV and 662 keV. The probable effect is that the reported uncertainty is slightly underestimated. In addition, the energy calibration was conducted with a 0.5-liter Marinelli, while the efficiency calibration and samples were in a 45-g Petri dish geometry. However, the difference in geometry between samples and standards is much less important for the energy calibration than it is for the efficiency calibration.

ESE provided a certificate of calibration for a NIST traceable source used for the efficiency calibration of their counting system. The standard was in the same geometry as the samples and prepared within the previous 12 months. The count times were of sufficient duration to produce acceptable minimum detectable activities.

Representativeness. Whether or not the laboratory analysis of soil samples is representative of the contaminant levels on site is really a function of the sampling program, i.e. the number of samples per unit area. Because the sampling was designed using guidance in NUREG-5849 (NRC, 1992), it is assumed the NRC or any other state or federal regulatory agency would consider the number and location of soil samples to be representative of the contaminant levels on site.

Completeness. For the first phase of laboratory analysis, conducted by PACE, 210 soil samples were specified. Chain of custody forms and analytical results indicate all 210 samples were received, prepared, analyzed, and reported, with no losses or rejections. Therefore, the laboratory data for this phase was 100 percent complete.

In the second phase, a minimum of one sample from each remediated hotspot was expected, and a minimum of one sample from each hotspot was obtained. All samples collected were received by the laboratories intact and subsequently analyzed. Those results, as reported here, are acceptable and provide 100 percent completeness of the laboratory data for this project.

Comparability. Because this parameter relates two data sets, and the laboratory data only produced a single data set (Ra-226 in soil) it is difficult to compare the results within a laboratory. However, comparability between the laboratory and field data was high. That is, hotspots identified in the field produced soil samples with elevated Ra-226 concentrations.

Sensitivity. MDA calculations were provided by all laboratories as part of the computer generated data report. The counting error due solely to random statistical fluctuations, expressed as sigma, was evaluated as part of the analytical sensitivity. NUREG-5849 recommends the 2 sigma error be less than 20 percent of the reported value.

The MDA values for PACE (pre-remediation) were on the order of 0.2 to 0.3 pCi/g, less than 10 percent of the Ra-226 release criteria of 3.75 pCi/g. The statistical counting error at the 95 percent level, (2 sigma) was generally less than 20 percent of the reported value.

Quanterra results were reported with MDAs at an average value of 1.2 pCi/g, approximately 32 percent of the release criteria. In addition, the two sigma errors are on the order of 40 to 50 percent of the reported results. This may be due to the small sample size (45 g), and the inhomogeneity of the contaminant, as previously discussed in the paragraph entitled "Precision".

ESE counted all samples for a sufficient length of time to ensure all results were above their minimum detectable activity.

5.3 Overall Data Evaluation

The data is suitable for use, and adequately characterizes the contamination levels on site. Comparing the 95 percent confidence level upper limit of the measured values (i.e. result \pm 2 sigma) to the release criteria provides an added margin of safety in assuring compliance with the release criteria.

6.0 CONCLUSIONS

The initial survey for radioactive material performed in August 1995 revealed the presence of one radium dial indicator (needle), one gage, and 10 hotspots under paved areas of the east yard (north end) indicating the presence of radioactive material. The dial indicator and gage were recovered and secured from open soil off the edge of paved areas. The survey discovered no paved surface contamination and no soil contamination at the other three survey areas (south end of the east yard, the tire recycling yard, and the concrete pad area east of Building T-204). The average Ra-226 concentration in soil for all unpaved areas is within two standard deviations of background. The highest value from the 200 soil samples obtained in unpaved areas was 1.6 pCi/g of Ra-226. This is less than half the release limit of 3.75 pCi/g.

Site remediation of detected hot spot areas and final release of the north end of the east yard was completed in June 1996. The remediation resulted in generating five 55-gallon drums of waste. Hot spot areas were predominantly found to be contaminated soil. Following soil removal, a confirmation soil sample was obtained from the bottom and sides of the excavation for each hotspot. Final confirmation samples which were collected from the hotspot areas revealed that Ra-226 concentrations were all below the release criteria of 3.75 pCi/g, above background. The average value from the 12 soil samples obtained in the excavated hotspots was 1.13 pCi/g of Ra-226, above background. This is approximately 30 percent of the release limit.

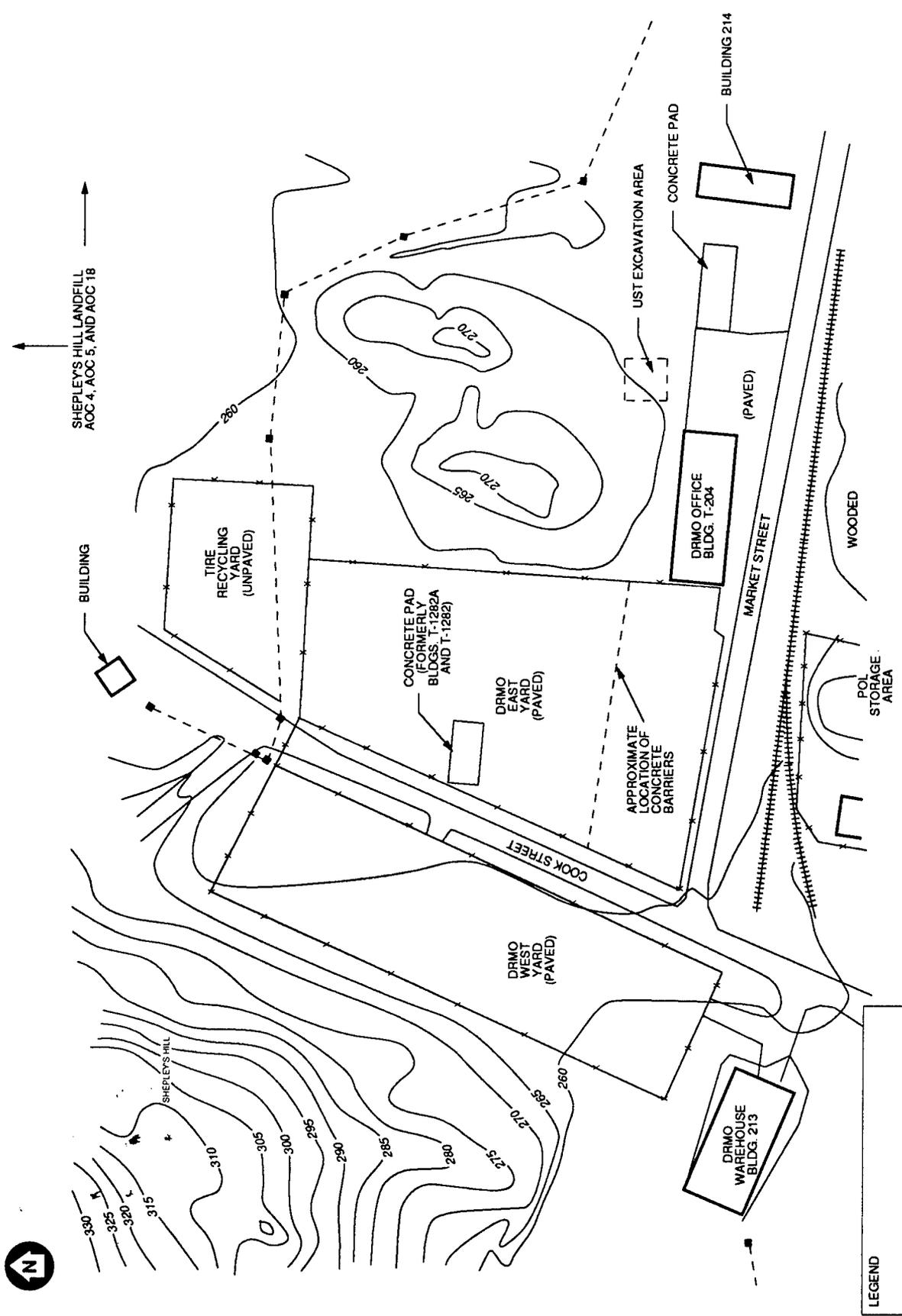
Based upon the initial site survey and the remedial results, the paved and unpaved portions of the east yard, tire recycling yard, and concrete pad area east of Building T-204 meet the required release criteria for unrestricted use based upon guidelines established by the NRC.

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- U.S. Nuclear Regulatory Commission (NRC), 1995 NUREG-1506 Measurement Methods for Radiological Surveys in Support of New Decommissioning Criteria. Draft Report for Comment, August 1995.
- U.S. Nuclear Regulatory Commission (NRC), 1995a NUREG-1507 Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions. Draft Report for Comment, August 1995.

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FIGURE 1
YARD LOCATIONS
RADIOLOGICAL SURVEY
DRMO YARD
FORT DEVENS, MA
 ABB Environmental Services, Inc.



SHEPLEY'S HILL LANDFILL
 AOC 4, AOC 5, AND AOC 18



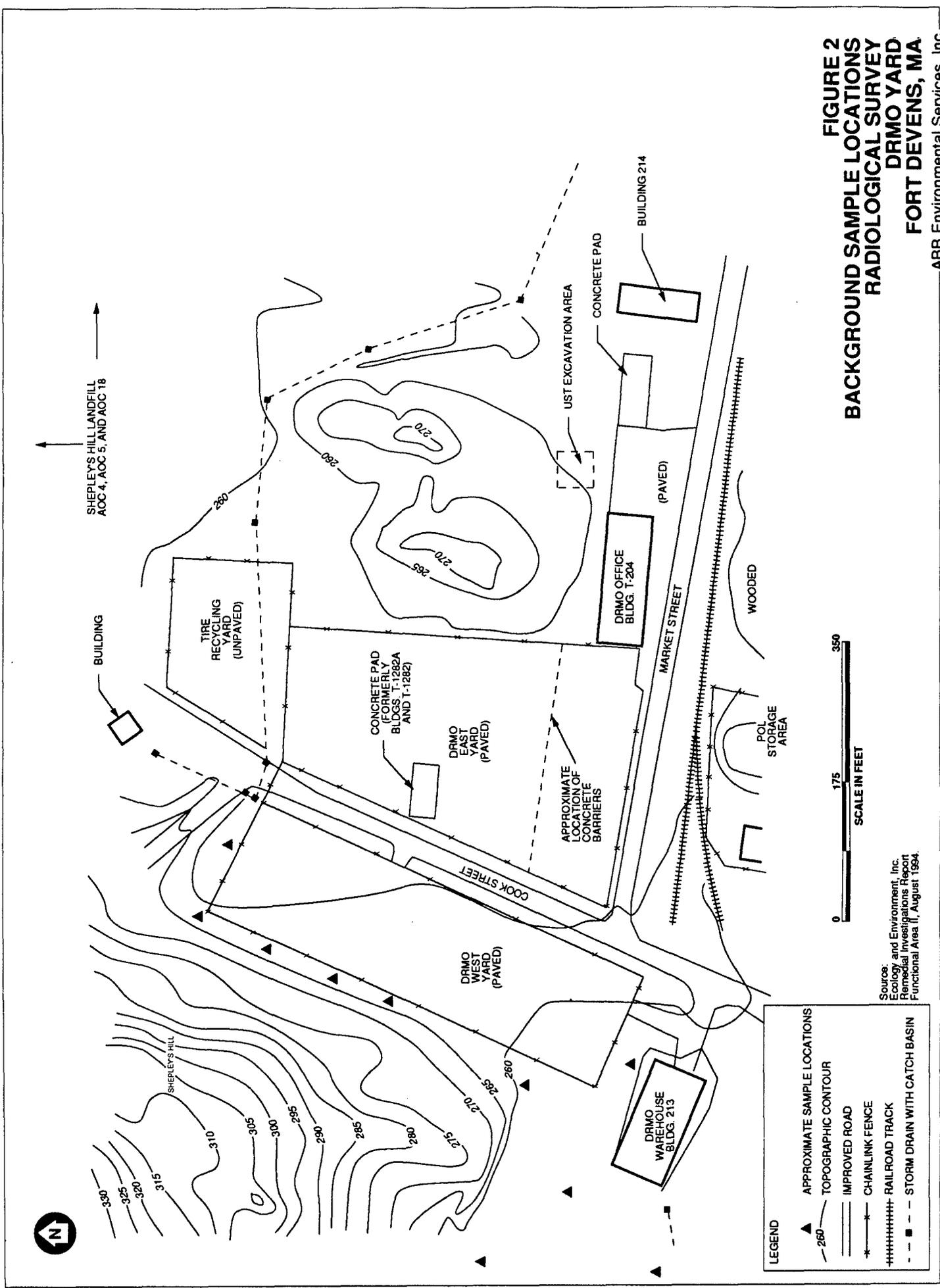
LEGEND

- 260 TOPOGRAPHIC CONTOUR
- IMPROVED ROAD
- * CHAINLINK FENCE
- + + + + + RAILROAD TRACK
- - - - STORM DRAIN WITH CATCH BASIN

Source:
 Ecology and Environment, Inc.
 Remedial Investigations Report
 Functional Area II, August 1994.

FIGURE 2
BACKGROUND SAMPLE LOCATIONS
RADIOLOGICAL SURVEY
DRMO YARD
FORT DEVENS, MA

ABB Environmental Services, Inc.



Source:
 Ecology and Environment, Inc.
 Remedial Investigations Report
 Functional Area II, August 1994.

DRMO Grid Identification Map

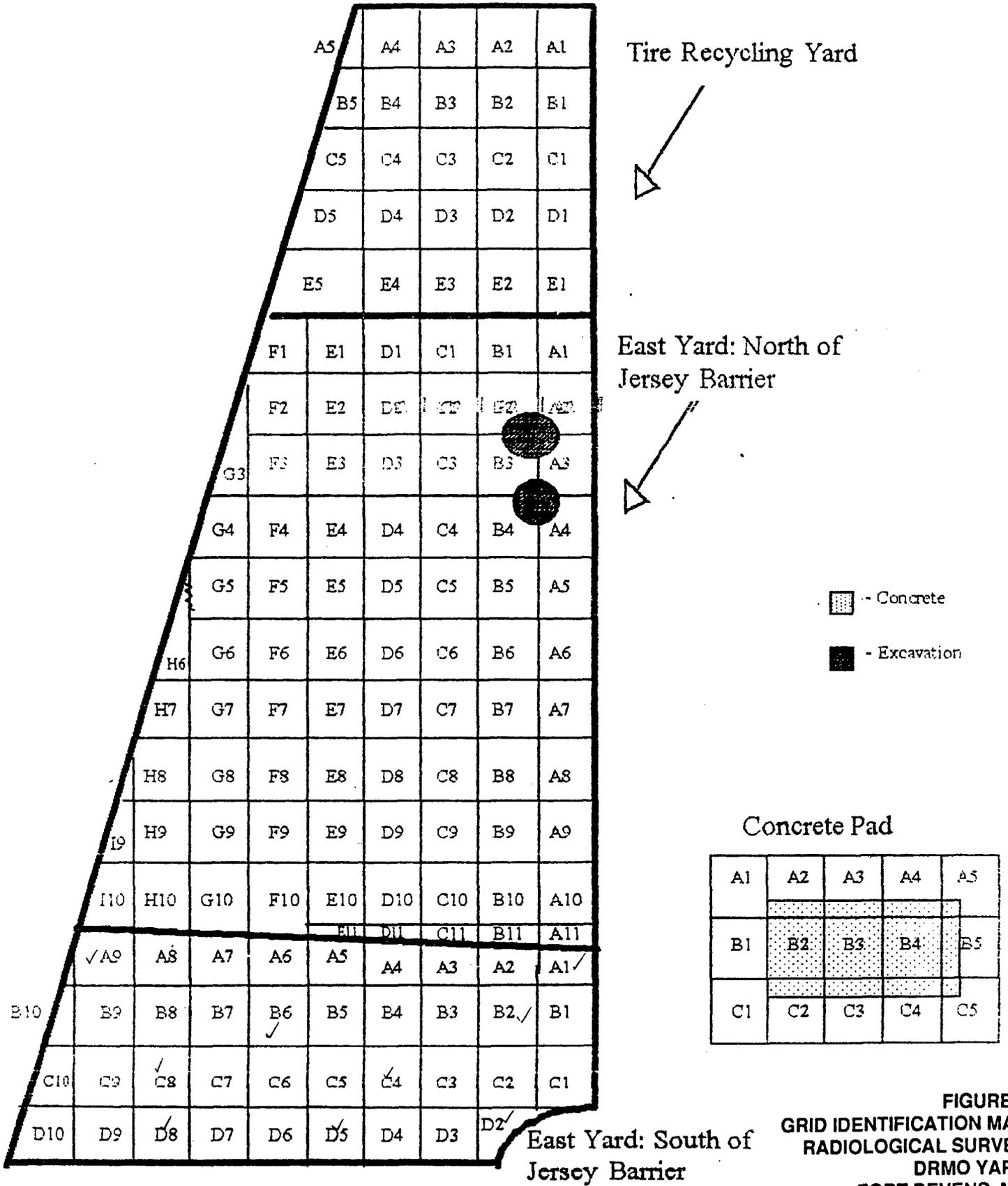


FIGURE 3
GRID IDENTIFICATION MAP
RADIOLOGICAL SURVEY
DRMO YARD
FORT DEVENS, MA

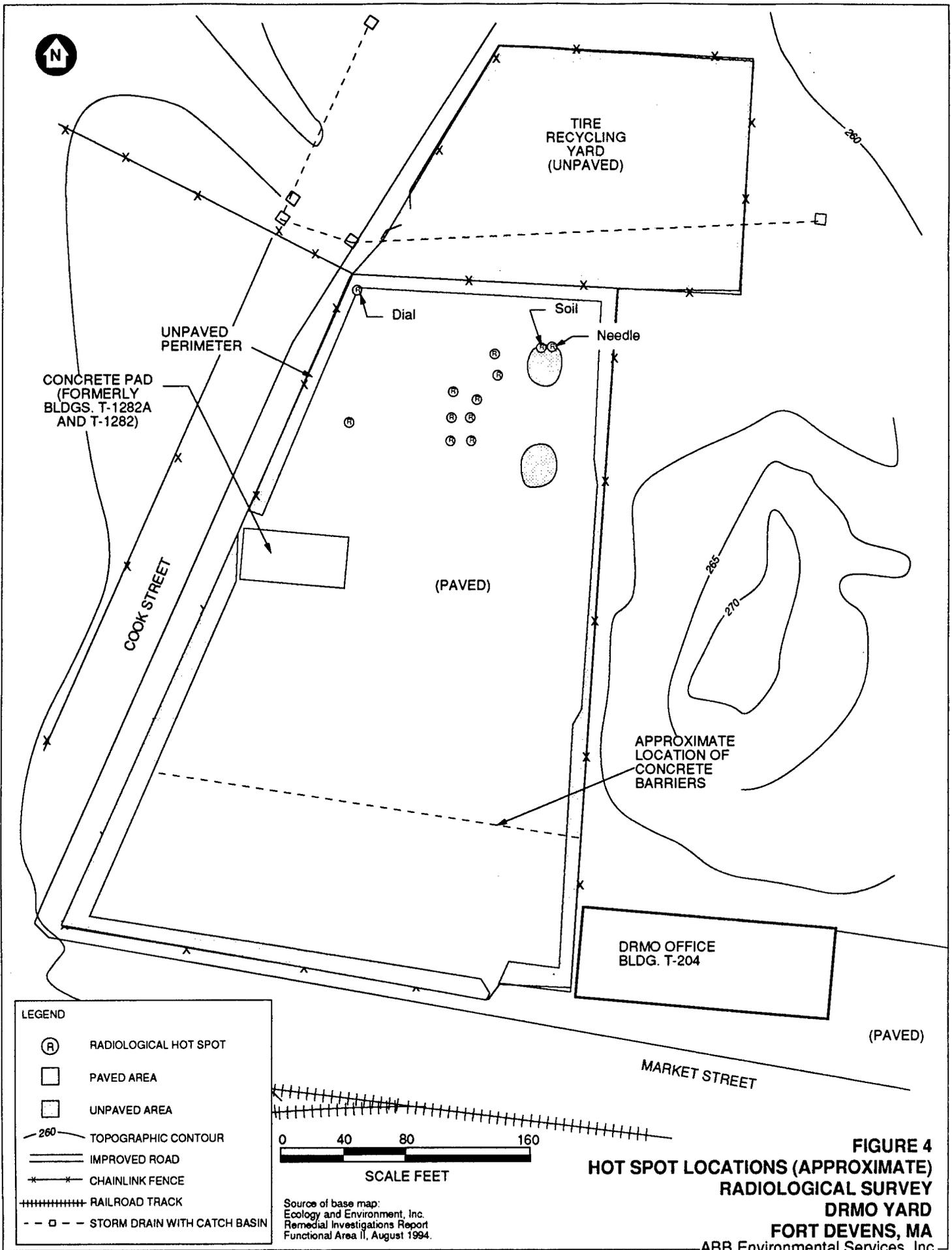


FIGURE 4
HOT SPOT LOCATIONS (APPROXIMATE)
RADIOLOGICAL SURVEY
DRMO YARD
FORT DEVENS, MA
 ABB Environmental Services, Inc.

**TABLE 1
RADIOLOGICAL SURVEY
DRMO YARD
FORT DEVENS, MASSACHUSETTS**

SITE AREA	AREA CLASSIFICATION	SURVEY ELEMENTS	MEASUREMENT/SAMPLING FREQUENCY
East Yard - North of Jersey Barriers (6,980 m ² paved; 690 m ² unpaved)	Affected Area; Paved surface w/ unpaved perimeter	(1) Gamma surface scan (cpm); (2) Direct measurements for: a) Surface activity (dpm/100cm ²); b) Dose rate (μ R/hr); and (3) Soil sampling at unpaved perimeter.	(1) scanning 100% of paved and unpaved area (7,670 m ²); (2a) 30 randomly selected locations (paved area); (2b) 1 measurement/100 m ² of paved and unpaved areas; and (3) 4 samples every 100 m ² within unpaved borders (690 m ²)
East Yard - South of Jersey Barriers (2,330 m ² paved; 500 m ² unpaved)	Unaffected Area; Paved surface w/ unpaved perimeter	(1) Gamma surface scan (cpm); (2) Direct Measurements of: a) Surface activity (dpm/100cm ²); b) Dose rate (μ R/hr); and (3) Soil sampling at unpaved perimeter.	(1) scanning 10% of paved and unpaved areas (283 m ²); (2a) 30 randomly selected locations (paved area); (2b) 30 randomly selected locations (paved and unpaved area); and (3) 30 randomly selected samples within unpaved areas.
Tire Recycling Yard (2,915 m ² unpaved)	Affected Area; Unpaved surface	(1) Gamma surface scan (cpm); (2) Direct measurements of dose rate (μ R/hr); and (3) Soil sampling of surface soils	(1) scanning 100% of area (2,915 m ²); (2) 4 measurements every 100 m ² ; and (3) 4 samples every 100 m ² .
Concrete Pad (east of Bldg T-204) (370 m ² concrete; and 1,000 m ² unpaved and 220 m ² paved perimeter area)	Affected Area; Concrete surface w/ grass and paved perimeter	(1) Gamma surface scan (cpm); (2) Direct measurements of: a) Surface activity (dpm/100cm ²); b) Dose rate (μ R/hr); (3) Soil sampling at unpaved perimeter of concrete pad.	(1) scanning 100% of concrete area and 10 meter wide perimeter area (approx. 1,600 m ²); (2a) 30 (total) randomly selected locations (concrete pad and paved perimeter area); (2b) 1 measurement/100 m ² of entire area; and (3) 4 samples every 100 m ² within 10 m unpaved perimeter of pad.
Background	—	(1) Gamma surface scan (cpm); (2) Direct measurements 1 meter above the surface for dose rate (μ R/hr); and (3) Soil sampling.	(1,2,& 3) 10 off-site locations representative of coal pile/coal ash areas.

TABLE 2
DRUM CHARACTERIZATION RESULTS
RADIOLOGICAL SURVEY
DRMO YARD
FORT DEVENS, MASSACHUSETTS

DRUM	TOTAL PCBs ($\mu\text{g}/\text{kg}$)	TCLP LEAD ($\mu\text{g}/\text{L}$)	RA-226 ^(g) (pCi/g)
1	1,800 ^(a)	107,000 ^(d)	89.3
2	380 ^(b)	71,000 ^(d)	56.7
3 ^(c)	480 ^(a)	2,290	10.6
4	ND ^(e)	471	4.4
5	259 ^(f)	29,900 ^(d)	1.1

- (a) Concentrations reported are for Aroclor 1254. Aroclor 1016, 1221, 1232, 1242, 1248, and 1260 were below the detection limit ($< 33 \mu\text{g}/\text{kg}$)
(b) Concentration reported is for Aroclor 1260. Aroclor 1016, 1221, 1232, 1242, 1248, and 1254 were below the detection limit ($< 33 \mu\text{g}/\text{kg}$).
(c) Drum 3 also contains dials and needles (separated from the soil in a container) located during the August and February radiological work
(d) TCLP lead concentrations exceed the TCLP regulatory limit of $5,000 \mu\text{g}/\text{L}$.
(e) Below detection limits ($< 32 \mu\text{g}/\text{kg}$ except Aroclor 1254; $< 490 \mu\text{g}/\text{kg}$ for Aroclor 1254).
(f) Concentration reported is for Aroclor 1254. Aroclor 1016, 1221, 1232, 1242, 1248, and 1260 were below the detection limit ($< 15.1 \mu\text{g}/\text{kg}$)
(g) Concentrations are above site background ($0.77 \text{ pCi}/\text{g}$) at 95% confidence level.

Analysis was by the following analytical methods:

- PCBs - Method 8080
- TCLP Lead - Method 1311 (extraction) and Method 6000/7000 (analysis)
- Ra-226 Gamma Spectroscopy - Method 901.1

Appendix A
Field Measurements

CONTAMINATION MEASUREMENT RESULTS

September 11, 1995

Location: Fort Devens, MA, Background Area

Location	Dose Rate (μ Rem /hr)	Gamma Scan Range (cpm x 10 ³)
----------	-------------------------------	--

1	6	9.8 - 10.9
2	6	10.0 - 11.5
3	5	9.9 - 11.2
4	7	9.6 - 11.0
5	6	11.4 - 12.0
6	7	11.3 - 15.0
7	7	10.2 - 12.8
8	5	10.6 - 13.7
9	6	11.4 - 14.0
10	7	10.8 - 12.2

Radiation Science, Inc.

Approved by: Thomas P. Bunde

Date: 9/15/95

CONTAMINATION MEASUREMENT RESULTS

September 13, 1996

Location: Fort Devens, MA, East Yard- North

Grid ID *hotspot	Total Alpha (dpm /100 cm ²)	Total Beta/Gamma (dpm /100 cm ²)	Dose Rate (μRem / hr)	Gamma Scan Range (cpm x 10 ³)
---------------------	--	---	--------------------------	--

A1	l.t. 55	3626 ± 708	8	10.3 - 12.5
A2			8	10.5 - 12.4
A3	l.t. 55	2592 ± 672	7	11.5 - 12.5
A4			6	11.3 - 12.6
A5	l.t. 55	2567 ± 672	7	11.5 - 12.6
A6			8	11.5 - 12.7
A7	l.t. 55	2629 ± 674	7	11.3 - 12.7
A8			6	11.4 - 12.6
A9	l.t. 55	4137 ± 725	5	11.0 - 12.6
A10			7	11.0 - 12.7
A11			6	10.9 - 12.6
B1			7	11.2 - 12.4
B2*			15	10.9 - 28.2
B2*			25	10.9 - 43.7
B2*	l.t. 55	28623 ± 1303	55	10.9 - 112.3
B3			7	11.2 - 12.6
B4			6	11.0 - 12.6
B5			8	10.8 - 12.4
B6	l.t. 55	4436 ± 735	8	11.3 - 12.6
B7			7	11.4 - 12.5
B8	l.t. 55	l.t. 995	7	11.6 - 12.7
B9			8	11.4 - 12.6
B10			6	11.5 - 12.7
B11	l.t. 55	3240 ± 695	6	11.5 - 12.8
C1			6	11.7 - 12.6

Radiation Science, Inc.

Approved by: Thomas P. Rade

Date: 9/15/95

CONTAMINATION MEASUREMENT RESULTS

September 13, 1996

Location: Fort Devens, MA, East Yard- North

Grid ID *hotspot	Total Alpha (dpm / 100 cm ²)	Total Beta/Gamma (dpm / 100 cm ²)	Dose Rate (μRem / hr)	Gamma Scan Range (cpm x 10 ³)
---------------------	---	--	--------------------------	--

C2*	l.t. 55	19551 ± 1124	45	11.4 - 71.8
C3*	l.t. 55	21009 ± 1155	30	11.3 - 83.6
C4	l.t. 55	3738 ± 712	6	11.4 - 12.9
C5			5	11.4 - 12.7
C6	l.t. 55	3352 ± 699	5	11.5 - 12.8
C7			5	11.2 - 12.6
C8			7	11.3 - 12.7
C9			7	11.3 - 12.8
C10	l.t. 55	4349 ± 732	7	11.5 - 12.5
C11			7	11.5 - 12.5
D1	l.t. 55	3614 ± 708	8	11.6 - 13.2
D2			7	11.6 - 13.1
D3*	l.t. 55	8847 ± 867	30	11.4 - 37.0
D4*	l.t. 55	11639 ± 941	18	11.6 - 42.4
D4*	l.t. 55	6143 ± 789	10	11.6 - 20.7
D4*	l.t. 55	5433 ± 738	10	11.6 - 22.3
D4*	l.t. 55	4536 ± 867	10	11.6 - 21.0
D5			7	11.3 - 12.9
D6			5	11.1 - 12.8
D7	l.t. 55	3364 ± 699	7	11.5 - 12.7
D8			7	11.4 - 12.6
D9			5	11.4 - 12.7
D10			6	11.3 - 12.8
D11	l.t. 55	3751 ± 712	6	11.4 - 12.8
E1			8	11.4 - 13.2

Radiation Science, Inc.

Approved by: James J. Boyle

Date: 9/15/95

CONTAMINATION MEASUREMENT RESULTS

September 13, 1996

Location: Fort Devens, MA, East Yard- North

Grid ID *hotspot	Total Alpha (dpm /100 cm ²)	Total Beta/Gamma (dpm /100 cm ²)	Dose Rate (μRem / hr)	Gamma Scan Range (cpm x 10 ³)
---------------------	--	---	--------------------------	--

E2	l.t. 55	3713 ± 711	7	11.5 - 12.9
E3			7	11.4 - 12.8
E4			7	11.4 - 12.9
E5	l.t. 55	3477 ± 703	7	11.4 - 12.7
E6			6	10.0 - 12.7
E7			5	11.1 - 12.6
E8	l.t. 55	3265 ± 696	6	11.3 - 12.5
E9	l.t. 55	3938 ± 719	6	11.0 - 12.5
E10	l.t. 55	3427 ± 702	7	11.2 - 12.6
E11			6	11.1 - 12.5
F1*	l.t. 55	3389 ± 700	20	11.2 - 37.4
F2			7	11.4 - 12.5
F3	l.t. 55	3614 ± 708	6	11.5 - 12.9
F4*	l.t. 55	4673 ± 743	13	11.5 - 21.3
F5	67 ± 42	4012 ± 721	6	11.2 - 12.7
F6			6	10.6 - 11.9
F7	l.t. 55	3601 ± 707	6	11.4 - 12.8
F8			6	11.3 - 12.7
F9	l.t. 55	3813 ± 715	7	11.4 - 12.8
F10			7	11.3 - 12.6
G3			6	11.4 - 12.7
G4	l.t. 55	3290 ± 697	6	11.5 - 12.7
G5			6	11.5 - 14.7
G6	97 ± 47	2069 ± 654	7	9.3 - 12.1
G7			6	11.4 - 12.5

Radiation Science, Inc.

Approved by: Francis P. Parde

Date: 9/15/95

CONTAMINATION MEASUREMENT RESULTS

September 13, 1996

Location: Fort Devens, MA, East Yard- North

Grid ID *hotspot	Total Alpha (dpm /100 cm ²)	Total Beta/Gamma (dpm /100 cm ²)	Dose Rate (μRem / hr)	Gamma Scan Range (cpm x 10 ³)
---------------------	--	---	--------------------------	--

G8			7	11.3 - 12.7
G9			6	11.4 - 12.6
G10	l.t. 55	3664 ± 710	7	11.4 - 12.5
H6			5	11.3 - 12.6
H7			6	11.4 - 12.9
H8	l.t. 55	3826 ± 715	7	11.4 - 12.8
H9			6	11.2 - 12.7
H10			5	11.4 - 12.8
I8			6	11.3 - 12.8
I9			6	11.2 - 12.7
I10			6	11.4 - 12.8

Radiation Science, Inc.

Approved by:

Thomas R. Bode

Date:

9/15/95

CONTAMINATION MEASUREMENT RESULTS

September 11, 1996

Location: Fort Devens, MA, East Yard- South

Grid ID	Total Alpha (dpm /100 cm ²)	Total Beta/Gamma (dpm /100 cm ²)	Dose Rate (μRem /hr)	Gamma Scan Range (cpm x 10 ³)
---------	--	---	-------------------------	--

A1	-	-	-	-
A2	l.t. 55	3664 ± 710	5	-
A3	l.t. 55	3900 ± 717	6	-
A4	l.t. 55	1981 ± 650	6	-
A5	l.t. 55	3738 ± 712	6	-
A6	l.t. 55	3489 ± 704	7	-
A7	l.t. 55	4100 ± 724	7	-
A8	l.t. 55	3763 ± 713	6	-
A9	-	-	-	-
A10	l.t. 55	3801 ± 714	7	-
B1	l.t. 55	3165 ± 393	7	-
B2	-	-	-	-
B3	l.t. 55	2766 ± 679	6	-
B4	l.t. 55	3514 ± 704	7	-
B5	l.t. 55	3551 ± 706	6	11.3 - 12.7
B6	-	-	-	-
B7	l.t. 55	2717 ± 677	7	-
B8	l.t. 55	3364 ± 699	6	-
B9	l.t. 55	3913 ± 718	7	-
B10	l.t. 55	3776 ± 713	7	-
C1	l.t. 55	3713 ± 711	7	-
C2	l.t. 55	3477 ± 703	6	-
C3	l.t. 55	3265 ± 696	6	11.2 - 12.6
C4	-	-	-	-

Radiation Science, Inc.

Approved by: Thomas P. Bense

Date: 9/15/95

CONTAMINATION MEASUREMENT RESULTS

September 11, 1996

Location: Fort Devens, MA, East Yard- South

Grid ID	Total Alpha (dpm /100 cm ²)	Total Beta/Gamma (dpm /100 cm ²)	Dose Rate (μRem /hr)	Gamma Scan Range (cpm x 10 ³)
---------	--	---	-------------------------	--

C5	l.t. 55	3938 ± 719	6	-
C6	l.t. 55	3427 ± 702	7	-
C7	l.t. 55	3389 ± 700	8	-
C8	-	-	-	11.6 - 13.1
C9	l.t. 55	3614 ± 708	7	-
C10	l.t. 55	3776 ± 713	6	-
D1	-	-	-	-
D2	-	-	-	-
D3	l.t. 55	4100 ± 724	6	-
D4	l.t. 55	4137 ± 725	6	-
D5	-	-	-	-
D6	l.t. 55	3065 ± 689	7	-
D7	l.t. 55	2766 ± 679	7	-
D8	-	-	-	-
D9	l.t. 55	3601 ± 707	7	-
D10	l.t. 55	3676 ± 710	6	-

Radiation Science, Inc.

Approved by:



Date:

9/15/95

CONTAMINATION MEASUREMENT RESULTS

September 13, 1996

Location: Fort Devens, MA, Concrete Pad

Grid ID	Total Alpha (dpm / 100 cm ²)	Total Beta (dpm / 100 cm ²)	Dose Rate (μRem / hr)	Gamma Scan Range (cpm x 10 ³)
---------	---	--	--------------------------	--

A1	l.t. 55	3315 ± 698	5	11.4 - 12.9
A2	l.t. 55	1358 ± 627	7	11.6 - 13.0
A3	l.t. 55	2642 ± 674	7	11.7 - 13.0
A4	l.t. 55	2143 ± 656	7	12.0 - 14.4
A5	l.t. 55	1969 ± 650	5	11.8 - 14.5
B1-1	l.t. 55	3352 ± 699	6	10.5 - 11.9
B1-2	l.t. 55	2679 ± 676		
B1-3	l.t. 55	2928 ± 684		
B1-4	l.t. 55	2642 ± 674		
B2-1	l.t. 55	1732 ± 641	5	11.0 - 12.1
B2-2	l.t. 55	1682 ± 639		
B2-3	l.t. 55	1994 ± 651		
B2-4	l.t. 55	1919 ± 648		
B3-1	l.t. 55	2019 ± 652	6	10.9 - 11.7
B3-2	l.t. 55	2330 ± 663		
B3-3	l.t. 55	2081 ± 654		
B3-4	l.t. 55	2143 ± 656		
B4-1	59 ± 40	1570 ± 635	5	11.0 - 11.7
B4-2	l.t. 55	1371 ± 627		
B4-3	l.t. 55	1782 ± 643		
B4-4	l.t. 55	1595 ± 636		
B5	l.t. 55	1894 ± 647	6	11.3 - 13.6

Radiation Science, Inc.

Approved by:

Thomas P. Beale

Date:

9/15/95

CONTAMINATION MEASUREMENT RESULTS

September 13, 1996

Location: Fort Devens, MA, Concrete Pad

Grid ID	Total Alpha (dpm /100 cm ²)	Total Beta (dpm /100 cm ²)	Dose Rate (μ Rem / hr)	Gamma Scan Range (cpm x 10 ³)
---------	--	---	--------------------------------	--

C1-1	l.t. 55	2654 \pm 675	6	10.6 - 11.7
C1-2	l.t. 55	2530 \pm 670		
C1-3	l.t. 55	2941 \pm 685		
C1-4	l.t. 55	2492 \pm 669		
C2	l.t. 55	1894 \pm 647	6	11.1 - 13.5
C3	l.t. 55	2405 \pm 666	7	11.2 - 14.0
C4	l.t. 55	2729 \pm 677	6	11.2 - 13.7
C5	l.t. 55	1682 \pm 639	6	10.8 - 14.0

Radiation Science, Inc.

Approved by: Thomas P. Boudle

Date: 9/15/95

CONTAMINATION MEASUREMENT RESULTS

September 11, 1995

Location: Fort Devens, MA, Tire Yard

Grid ID	Dose Rate (μ Rem /hr)	Gamma Scan Range (cpm $\times 10^3$)
---------	-------------------------------	--

A1-1	6	11.2 - 12.3
A1-2	6	
A1-3	6	
A1-4	7	
A2-1	7	11.4 - 12.0
A2-2	6	
A2-3	6	
A2-4	6	
A3-1	7	11.5 - 12.0
A3-2	7	
A3-3	6	
A3-4	6	
A4-1	5	11.8 - 13.4
A4-2	7	
A4-3	7	
A4-4	6	
A5-1	7	11.6 - 14.1
A5-2	7	
A5-3	6	
A5-4	8	
B1-1	6	11.2 - 12.6
B1-2	8	
B1-3	7	
B1-4	6	

Radiation Science, Inc.

Approved by:

Thomas P. Bando

Date:

9/15/95

CONTAMINATION MEASUREMENT RESULTS

September 11, 1995

Location: Fort Devens, MA, Tire Yard

Grid ID	Dose Rate (μ Rem /hr)	Gamma Scan Range (cpm x 10 ³)
---------	-------------------------------	--

B2-1	7	11.0 - 12.3
B2-2	7	
B2-3	6	
B2-4	6	
B3-1	7	11.6 - 12.8
B3-2	6	
B3-3	6	
B3-4	7	
B4-1	7	11.7 - 13.7
B4-2	5	
B4-3	7	
B4-4	7	
B5-1	5	11.5 - 13.8
B5-2	7	
B5-3	6	
B5-4	6	
C1-1	6	10.9 - 11.7
C1-2	6	
C1-3	7	
C1-4	6	
C2-1	6	11.5 - 12.3
C2-2	6	
C2-3	6	
C2-4	7	

Radiation Science, Inc.

Approved by:



Date:

9/15/95

CONTAMINATION MEASUREMENT RESULTS

September 11, 1995

Location: Fort Devens, MA, Tire Yard

Grid ID	Dose Rate (μ Rem /hr)	Gamma Scan Range (cpm x 10^3)
---------	-------------------------------	-------------------------------------

C3-1	7	11.3 - 12.8
C3-2	8	
C3-3	7	
C3-4	7	
C4-1	6	11.7 - 13.7
C4-2	8	
C4-3	7	
C4-4	7	
C5-1	6	11.8 - 14.2
C5-2	7	
C5-3	7	
C5-4	7	
D1-1	6	11.3 - 12.5
D1-2	7	
D1-3	7	
D1-4	6	
D2-1	6	11.3 - 12.2
D2-2	8	
D2-3	6	
D2-4	6	
D3-1	6	11.2 - 12.5
D3-2	7	
D3-3	7	
D3-4	7	

Radiation Science, Inc.

Approved by:

Thomas P. Bardo

Date:

9/15/95

CONTAMINATION MEASUREMENT RESULTS

September 11, 1995

Location: Fort Devens, MA, Tire Yard

Grid ID	Dose Rate (μ Rem /hr)	Gamma Scan Range (cpm x 10 ³)
---------	-------------------------------	--

D4-1	7	11.4 - 14.0
D4-2	5	
D4-3	6	
D4-4	7	
D5-1	8	11.6 - 14.2
D5-2	8	
D5-3	7	
D5-4	7	
E1-1	7	11.4 - 12.6
E1-2	7	
E1-3	8	
E1-4	6	
E2-1	7	11.2 - 12.6
E2-2	6	
E2-3	7	
E2-4	7	
E3-1	6	11.3 - 12.5
E3-2	8	
E3-3	6	
E3-4	7	
E4-1	7	11.4 - 13.9
E4-2	7	
E4-3	7	
E4-4	8	

Radiation Science, Inc.

Approved by: Thomas P. Bode

Date: 9/15/95

CONTAMINATION MEASUREMENT RESULTS

September 11, 1995

Location: Fort Devens, MA, Tire Yard

Grid ID	Dose Rate (μ Rem /hr)	Gamma Scan Range (cpm $\times 10^3$)
---------	-------------------------------	--

E5-1	6	11.2 - 14.0
E5-2	8	
E5-3	7	
E5-4	8	

Radiation Science, Inc.

Approved by: Thomas R. Beale

Date: 9/15/95

Appendix B

Pre-Remediation Soil Analysis Results

Ft. Devens Bkgd

PACE ID	Location	Ra-226	2 sigma
69699	Bckgd 1	0.75	0.13
69702	Bckgd 2	0.47	0.12
69710	Bckgd 3	0.56	0.11
69729	Bckgd 4	0.77	0.15
69737	Bckgd 5	0.68	0.14
69745	Bckgd 6	1.1	0.21
69753	Bckgd 7	0.89	0.16
69761	Bckgd 8	0.87	0.17
69800	Bckgd 9	0.93	0.17
69818	Bckgd 10	0.75	0.14

Mean	0.777
Standard Error	0.05787055
Median	0.76
Mode	0.75
Standard Deviat	0.18300273
Variance	0.03349
Range	0.63
Minimum	0.47
Maximum	1.1
Count	10

East DRMO Yard North

PACE ID	Location	Ra-226 pCi/g	2 sigma
69770	1	0.81	0.16
69788	2	0.76	0.14
69796	3	0.88	0.16
69966	4	0.78	0.12
69974	5	0.68	0.1
69982	6	0.86	0.14
69990	7	0.97	0.16
70000	8	0.96	0.15
70026	9	0.89	0.15
70034	10	1	0.18
70069	11	1.3	0.17
70077	12	0.96	0.16
70085	13	0.93	0.16
70093	14	1.1	0.2
70107	15	1	0.18
70115	16	0.71	0.11
69826	17	0.87	0.14
69834	18	0.79	0.12
69842	19	0.7	0.1
69850	20	1.2	0.15
69869	21	0.9	0.12
69877	22	0.86	0.12
69885	23	0.8	0.12
69893	24	0.57	0.1
69907	25	0.72	0.11
69915	26	0.61	0.11
69923	27	0.78	0.13
69931	28	1.2	0.16
73904	HS1	287	15
73912	HS2	1.9	0.22

With hotspots

Mean	10.4496667
Standard Error	9.53632933
Median	0.875
Mode	0.78
Standard Deviat	52.2326269
Variance	2728.24731
Range	286.43
Minimum	0.57
Maximum	287
Count	30

Without hotspots

Mean	0.87821429
Standard Error	0.03319038
Median	0.865
Mode	0.78
Standard Deviat	0.17562699
Variance	0.03084484
Range	0.73
Minimum	0.57
Maximum	1.3
Count	28

East DRMO Yard South

PACE ID	Location	Ra-226	2 sigma
69940	1	0.9	0.15
70255	2	0.6	0.11
70263	3	1.1	0.18
70271	4	0.77	0.11
70280	5	0.8	0.11
70298	6	0.74	0.14
70301	7	0.59	0.09
70310	8	0.54	0.12
70328	9	0.68	0.14
70336	10	0.69	0.1
70344	11	0.75	0.14
70352	12	0.59	0.14
70360	13	0.71	0.11
70379	14	0.76	0.22
70123	15	0.63	0.1
70131	16	0.71	0.12
70140	17	0.72	0.12
70158	18	0.62	0.1
70166	19	0.76	0.16
70174	20	0.56	0.1
70182	21	0.64	0.09
70190	22	0.73	0.17
70204	23	0.72	0.14
70212	24	0.66	0.13
70220	25	0.62	0.09
70239	26	0.71	0.1
70247	27	0.63	0.1
71880	28	0.56	0.1
71898	29	0.82	0.14
71901	30	0.9	0.14

Mean	0.707
Standard Error	0.02166702
Median	0.71
Mode	0.71
Standard Devia	0.11867516
Variance	0.01408379
Range	0.56
Minimum	0.54
Maximum	1.1
Count	30

Concrete Pad

PACE ID	Location	Ra-226	2 sigma
71910	A1-1	0.7	0.1
71928	A1-2	0.61	0.11
71936	A1-3	0.56	0.1
71944	A1-4	0.66	0.1
71952	A2-1	0.74	0.12
71960	A2-2	0.81	0.25
71979	A2-3	0.5	0.1
71987	A2-4	0.81	0.13
71995	A3-1	0.86	0.14
72002	A3-2	0.83	0.17
71324	A3-3	0.87	0.16
71332	A3-4	0.87	0.2
71340	A4-1	1.3	0.24
71359	A4-2	0.68	0.14
71367	A4-3	0.7	0.13
71375	A4-4	0.88	0.14
71383	A5-1	0.77	0.13
71391	A5-2	0.66	0.12
71405	A5-3	0.67	0.13
71413	A5-4	0.58	0.12
71421	B5-1	0.73	0.13
71430	B5-2	0.61	0.13
71448	B5-3	0.76	0.14
71456	B5-4	0.55	0.09
71464	C2-1	0.57	0.09
71472	C2-2	0.52	0.13
71480	C2-3	0.67	0.09
71499	C2-4	0.62	0.1
71502	C3-1	0.7	0.12
71510	C3-2	0.68	0.1
71529	C3-3	0.81	0.11
71537	C3-4	0.71	0.12
71545	C4-1	0.72	0.12
71533	C4-2	0.57	0.09
71561	C4-3	0.53	0.09
71570	C4-4	0.65	0.1
71588	C5-1	0.54	0.09
71596	C5-2	0.45	0.08
71863	C5-3	0.71	0.12
71871	C5-4	0.79	0.13

ND

Mean	0.69875
Standard Error	0.02346899
Median	0.69
Mode	0.7
Standard Deviat	0.1484309
Variance	0.02203173
Range	0.85
Minimum	0.45
Maximum	1.3
Count	40

Ft. Devens Tire Yard

PACE ID	Location	Ra-226	2 sigma
71731	A1-1	0.95	0.17
71740	A1-2	0.072	0.013
71758	A1-3	0.92	0.17
71766	A1-4	0.86	0.16
71774	A2-1	0.85	0.15
71782	A2-2	0.99	0.15
71790	A2-3	1	0.17
71804	A2-4	0.99	0.18
71812	A3-1	0.7	0.13
71820	A3-2	0.75	0.14
71839	A3-3	0.64	0.12
71847	A3-4	0.82	0.13
74048	A4-1	0.55	0.19
74056	A4-2	0.5	0.09
74064	A4-3	0.57	0.08
74072	A4-4	0.48	0.09
74080	A5-1	0.53	0.09
74099	A5-2	0.62	0.08
74102	A5-3	0.67	0.21
74110	A5-4	0.63	0.11
71855	B1-1	0.68	0.14
72010	B1-2	0.7	0.15
72029	B1-3	0.76	0.14
72037	B1-4	0.58	0.11
72045	B2-1	0.84	0.16
72053	B2-2	0.89	0.17
72061	B2-3	1.2	0.17
72070	B2-4	0.7	0.14
72088	B3-1	0.56	0.1
72096	B3-2	0.59	0.12
72100	B3-3	0.86	0.13
72118	B3-4	0.64	0.12
74129	B4-1	0.9	0.11
74137	B4-2	0.77	0.11
74145	B4-3	0.57	0.1
73696	B4-4	0.95	0.18
73700	B5-1	0.62	0.13
73718	B5-2	0.54	0.12
73726	B5-3	1.1	0.18
73734	B5-4	0.64	0.12
72126	C1-1	0.85	0.19
72134	C1-2	0.72	0.16
72142	C1-3	0.67	0.14
72150	C1-4	0.73	0.15
71600	C2-1	0.82	0.12

Mean	0.75172
Standard Error	0.02082609
Median	0.72
Mode	0.64
Standard Deviation	0.20826091
Variance	0.04337261
Range	1.528
Minimum	0.072
Maximum	1.6
Count	100

Ft. Devens Tire Yard

71618	C2-2	0.99	0.16
71626	C2-3	0.91	0.12
71634	C2-4	0.93	0.15
71642	C3-1	0.74	0.11
71650	C3-2	0.72	0.11
71669	C3-3	0.75	0.1
71677	C3-4	0.72	0.1
73742	C4-1	0.75	0.13
73750	C4-2	0.78	0.15
73769	C4-3	1.1	0.2
73777	C4-4	0.64	0.14
73785	C5-1	1.1	0.16
73793	C5-2	1	0.17
73807	C5-3	1	0.17
73815	C5-4	1.2	0.18
71685	D1-1	0.67	0.01
71693	D1-2	0.8	0.12
71707	D1-3	0.79	0.13
71715	D1-4	0.79	0.13
71723	D2-1	0.76	0.12
71170	D2-2	0.59	0.12
71189	D2-3	0.7	0.12
71197	D2-4	0.36	0.08
71200	D3-1	0.57	0.12
71219	D3-2	0.65	0.12
71227	D3-3	0.55	0.011
71235	D3-4	0.58	0.12
73823	D4-1	0.68	0.12
73831	D4-2	0.66	0.12
73920	D4-3	0.73	0.1
73939	D4-4	0.68	0.11
73947	D5-1	0.65	0.11
73955	D5-2	0.63	0.1
73963	D5-3	0.68	0.1
73971	D5-4	0.77	0.11
71243	E1-1	1	0.17
71251	E1-2	1.2	0.17
71260	E1-3	0.66	0.11
71278	E1-4	0.6	0.13
71286	E2-1	0.47	0.1
71294	E2-2	0.55	0.12
71308	E2-3	0.63	0.11
71316	E2-4	0.53	0.11
74005	E3-1	0.47	0.09
74013	E3-2	0.47	0.09
74021	E3-3	0.64	0.1

Ft. Devens Tire Yard

74030	E3-4	0.64	0.11
73980	E4-1	0.74	0.11
73998	E4-2	0.95	0.14
73840	E4-3	1.6	0.2
73858	E4-4	0.98	0.13
73866	E5-1	0.86	0.12
73874	E5-2	0.92	0.13
73882	E5-3	0.82	0.11
73890	E5-4	0.85	0.12

Appendix C
Post-Remediation Soil Analysis Results

Post Remediation Samples

Sample ID	Location	Ra-226	2 sigma
10427-001	Hotspot 1	2.07	0.9
DVRAD*1	Hotspot 2	0.924	0.065
DVRAD*3	Hotspot 3	0.886	0.067
10427-004	Hotspot 4	2.7	0.88
10427-005	Hotspot 5	3.15	0.97
10427-006	Hotspot 6	3.49	0.97
DVRAD*3	Hotspot 7	1.66	0.142
10882-001	Hotspot 8	1.85	1.04
10427-009	Hotspot 9	2.38	0.82
DVRAD*4	Hotspot 10	0.908	0.065
650073912	Hotspot 11	1.9	0.22
DVRAD*5	Hotspot 12	0.841	0.065

Mean	1.89658333
Standard Error	0.26308451
Median	1.875
Standard Devi:	0.91135149
Variance	0.83056154
Range	2.649
Minimum	0.841
Maximum	3.49
Count	12

Appendix D
Calibration Certificates



Instrument Calibration Certificate

1689

Customer RADIATION SCIENCE Order Number 14002
Instrument MICRO REM S/N B260U - NEW

Calibration Data

Range	Exposure Rate uR/h	Instrument Reading uR/h	% Error	Exposure Rate uR/h	Instrument Reading uR/h	% Error
X1000	160,000.0	160,000.0	0.0	40,000.0	40,000.0	0.0
X100	16,000.0	16,000.0	0.0	4,000.0	4,000.0	0.0
X10	1,600.0	1,600.0	0.0	400.0	400.0	0.0
X1	160.0	160.0	0.0	40.0	40.0	0.0
X0.1	16.0	16.0	0.0	4.0	4.0	0.0

Calibration Source Intensity at 1 meter = 227 mR/H Date 06/13/95 Source to Detector Geometry PERPENDICULAR

Zero Check OK HV Check OK Threshold Set N/A

Battery Ok OK Scaler Rate N/A Geotropic Check OK
Checkband Response +/- 1% +/- 2%

Reproducibility OK (Checked 3 times, identical conditions +/- 10%)

Check Source N/A Check Source Reading N/A

Quality Assurance Review By: TB Date 07/26/95

Calibrated By RC Date 07/26/96

Re-Cal Due 07/26/96

INSTRUMENT FIELD CHECK LOG

Meter: Bicron Micro Rem meter Serial # B260U
 Source: Cesium-137 Serial # Cs-7A

Activity: 5 microcuries

Meas #	Date	Time	BAT (OK)	HV (OK)	Back-ground	Source dose rate	Initials	Meas #	Date	Time	BAT (OK)	HV (OK)	Back-ground	Source dose rate	Initials
1	8/7/95	8:40	✓	✓	5-7 ^{μR}	10 ^{μR}	SUD	17	8/17/95	1900	✓	✓	5-7 ^{μR}	10 ^{μR}	MR
2	8/7/95	1400hr	✓	✓	5-7	10	SUD	18	8/18/95	0930	✓	✓	5-7 ^{μR}	10 ^{μR}	MR
3	8/8/95	1400hr	✓	✓	5-7	10 ^{μR}	GMSA	19	8/18/95	1530	✓	✓	5-7 ^{μR}	10 ^{μR}	MR
4	8/9/95	07:00	✓	✓	5-7	10 ^{μR}	GMSA	20	8/22/95	1000	✓	✓	5-7 ^{μR}	10 ^{μR}	MR
5	8/9/95	1530	✓	✓	5-7	10 ^{μR}	MR	21	8/22/95	1430	✓	✓	5-7 ^{μR}	10 ^{μR}	MR
6	8/10/95	0730	✓	✓	5-7	10 ^{μR}	MR								
7	8/10/95	1500	✓	✓	5-7	10 ^{μR}	MR								
8	8/11/95	0730	✓	✓	5-7	10 ^{μR}	MR								
9	8/11/95	1530	✓	✓	5-7	10 ^{μR}	MR								
10	8/14/95	0830	✓	✓	5-7	10 ^{μR}	MR								
11	8/14/95	1530	✓	✓	5-7	10 ^{μR}	MR								
12	8/15/95	0800	✓	✓	5-7	10 ^{μR}	MR								
13	8/15/95	1900	✓	✓	5-7	10 ^{μR}	MR								
14	8/16/95	0830	✓	✓	5-7	10 ^{μR}	MR								
15	8/16/95	1730	✓	✓	5-7	10 ^{μR}	MR								
16	8/17/95	0830	✓	✓	5-7	10 ^{μR}	MR								

* Lid Not use

INSTRUMENT FIELD CHECK LOG

Meter: Ludlum Model 2223 Scaler Ratemeter
Detector: Ludlum Model 43-1-1 Phoswich detector
Source: Thorium-230 Activity: 6,410 DPM
Source: Technecium-99 Activity: 15,000 DPM

Serial #: 102933
 Serial #: 010421
 Serial #: S-3689B
 Serial #: 1699-94

C-MAK
 calibration
 8/11/95

Meas. #	Date	Time	BAT (OK)	HV (Vdc)	Δt (min)	Bckgrnd Beta	Source Beta	Net Beta (cpm)	Bckgrnd Alpha	Source Alpha	Net Alpha	Initials
1	8/8/95	15:00	✓	650	2	257	3077	2920	0	3329	3329	MA
2	8/9/95	07:00	✓	650	2	268	2985	2717 2477 2348	8	3548	3540	MA
3	8/9/95	15:30	✓	620	2	248	2591	2535	8	3015	3007	MA
4	8/10/95	07:30	✓	650	2	278	2813	2535	7	2909	2902	MA
5	8/10/95	15:00	✓	650	2	258	2634	2378 2629	5	3064	3059	MA
6	8/11/95	07:30	✓	650	2	297	2667	2370 2446	1	2975	2974	MA
7	8/11/95	15:30	✓	650	2	276	2558	2282 2554	4	2953	2949	MA
8	8/14/95	08:00	✓	650	2	272	2967	2635 2401	6	2996	2990	MA
9	8/14/95	15:30	✓	650	2	261	2711	2450 2705	6	3156	3150	MA
10	8/15/95	08:00	✓	650	2	293	2821	2528 2815	6	3052	3046	MA
11	8/15/95	19:00	✓	650	2	302	2888	2546 2874	9	3026	3015	MA
12	8/16/95	08:30	✓	650	2	228	2718	2490 2773	5	2943	2938	MA
13	8/16/95	17:30	✓	650	2	251	2490	2239 2484	1	3012	3011	MA
14	8/17/95	08:30	✓	650	2	279	2796	2517 2792	4	3101	3097	MA
15	8/17/95	19:00	✓	650	2	301	2802	2501 2797	5	3066	3061	MA
16	8/18/95	09:30	✓	650	2	303	2773	2470 2768	5	2993	2988	MA

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Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER RADIATION SCIENCE, INC. ORDER NO. 208285

Mfg. Ludlum Measurements, Inc. Model 2223 Serial No. 102933

Mfg. Ludlum Measurements, Inc. Model 43-1-1 Serial No. RN 010421

Cal. Date 09/13/94 Cal Due Date 09/13/95 Cal. Interval 1 Year Meterface 202-601

Check mark applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 45 % Alt 707.8 mm Hg

New Instrument Instrument Received Within Toler. +-10% 10-20% Out of Tol. Requiring Repair

Mechanical ck. Meter Zeroed Background Subtract Input Sens. Linearity

F/S Resp. ck Reset ck. Window Operation

Audio ck. Alarm Setting ck. Batt. ck. (Min. Volt) 2.2 VDC

Instrument Volt Set 725 V Input Sens. Comments mV Det. Oper. 725 V at Comments mV Threshold Dial Ratio = mV

HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 2000 / 2000 V

COMMENTS:

Alpha threshold = 170mV
~~120mV~~
Beta threshold = 3.5 mV.
Beta window = 30 mV.

HV set with det. connected

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*

*Uncertainty within ± 10% C.F. within ± 20% Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	Log Scale	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
500 K cpm	500 113	500 113		500 K cpm	500k	500k
50 K cpm	500 11	500 11		50 K cpm	50k	50k
5 K cpm	500 1	500 1		5 K cpm	5k	5k
500 cpm	500	500		500 cpm	500	500
50 cpm	50	50		50 cpm	50	50

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of MIL-STD-45662A and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N 1162 G112 M565 5105 T1008 T879 Neutron Am-241 Be S/N T-304

Alpha S/N Pu239 #8743 Beta S/N C-14 Sr-90 Other

m 500 S/N 63893 Oscilloscope S/N Multimeter S/N 57770262

Calibrated By: Michael Moore Date 9-13-94

Reviewed By: Jimmy Fleming Date 9-13-94



Thermo Analytical Inc.

TMA/Eberline Albuquerque Laboratory

7021 Pan American Hwy. NE

Albuquerque, NM 87109

(505) 345-3461 • FAX # (505) 761-5416

CERTIFICATE OF CALIBRATION

Electroplated Beta Standard

S.O.# S-02780
P.O.# 94001

Description of Standard:

Model No. DNS-12 Serial No. 1699-94 Isotope Technetium-99

Electroplated on polished Stainless Steel disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2 pi beta emission rate was measured using an internal gas flow proportional chamber. Absolute counting of beta particles emitted in the hemisphere above the active surface was verified by counting above, below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated beta source S/N 2393/91.

Measurement Result:

The observed beta count rate from the surface of the disc per minute (cpm) on the calibration date was

9,340 ± 467

The total disintegration rate (dpm) assuming 25 % backscatter of beta particles from the surface of the disc, was

15,000 ± 748 (0.00673 μCi)

The uncertainty of the measurement is 5 % which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arlene Gutierrez

Reviewed by: Charles London

Calibration technician: Arlene Gutierrez

O.A. Representative: Kathy Burdman

Calibration date: 1/10/94

Reviewed date: 1-12-94



Thermo Analytical Inc.

TMA/Eberline Albuquerque Laboratory

7021 Pan American Hwy. NE

Albuquerque, NM 87109

(505) 345-3461 • FAX # (505) 761-5416

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-02780
P.O.# 94001

Description of Standard:

Model No. DNS-11 Serial No. S-3689B Isotope Thorium-230

Electroplated on polished Stainless Steel disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above, below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was

3,210 ± 128

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc, was

6,410 ± 256 (0.00289 μCi)

The uncertainty of the measurement is 4 % which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Arlene Gutierrez

Reviewed by: Charles Lamborn

Calibration technician: Arlene Gutierrez

O.A. Representative: Kathy Burman

Calibration date: 1/10/94

Reviewed date: 1-12-94

Appendix E

PCB/TCLP Lead QC Summaries and
Chain of Custody Records

PCB QC SUMMARY

Drums 1, 2 + 3

609.05

10427

2F
PCB SURROGATE RECOVERY

Lab Name: QUANTERRA, MO

Contract: 609-05

Lab Code: ITMO Case No.: _____

SAS No.: _____ SDG No.: 10427

Level: (low/med) LOW

	EPA SAMPLE NO.	S1 (DCB) #	S2 (TCMX) #
	=====	=====	=====
01	PBLK01	136	114
02	PSPK01	143	116
03	DRUM#1	125	103
04	DRUM#1DL	137	
05	DRUM#1MS	123	101
06	DRUM#1MSDL	131	
07	DRUM#1MSD	120	101
08	DRUM#1MSDDL	146	
09	DRUM#2	132	96
10	DRUM#3	140	105
11			
12			
13			
14			
15			
16			
17			
18			

ADVISORY
QC LIMITS

S1 (DCB) = Decachlorobiphenyl
S2 (TCMX) = Tetrachlorom-m-xylene (10-267)

Column to be used to flag recovery values

* Values outside of QC limits

D Surrogates diluted out

3F
SOIL PESTICIDE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: QUANTERRA, MO Contract: 609-05
 Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: 10427
 Matrix Spike - EPA Sample No.: DRUM#1 Level: (low/med) LOW

COMPOUND	SPIKE ADDED (ug/kg)	SAMPLE CONCENTRATION (ug/Kg)	MS CONCENTRATION (ug/Kg)	MS % REC #	QC LIMITS REC.
Aroclor-1016	170	0	360	216 *	50-114
Aroclor-1260	170	0	360	215 *	8-127

COMPOUND	SPIKE ADDED (ug/kg)	MSD CONCENTRATION (ug/Kg)	MSD % REC #	% RPD	QC LIMITS RPD REC.
Aroclor 1016	170	210	127 *	52	50-114
Aroclor 1260	170	230	138 *	44	8-127

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: _____ out of _____ outside limits
 Spike Recovery: 4 out of 4 outside limits

COMMENTS: _____

FORM III PEST-2

0002

3F
SOIL PCB SPIKE BLANK(LCS) RECOVERY

Lab Name: QUANTERRA, MO Contract: 609-05
 Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: 10427
 Spike Blank No.: SPK92640

COMPOUND	SPIKE ADDED (ug/kg)	SPIKE CONCENTRATION (ug/kg)	SPK % REC #	QC LIMITS REC.
Aroclor-1016	170	150	92	50-114
Aroclor-1260	170	170	107	8-127

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

ND: not determined

Spike Recovery: 0 out of 2 outside limits

COMMENTS: _____

FORM III PEST-2

0003

4C
PCB METHOD BLANK SUMMARY

Lab Name: QUANTERRA, MO Contract: 609-05
 Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: 10427
 Lab Sample ID: BLK92640 Lab File ID: _____
 Matrix: (soil/water) SOIL Level (low/med) LOW
 Date Extracted: 02-28-96 Extraction: (SepF/Cont/Sonc) SONC
 Date Analyzed (1): 02-28-96 Date Analyzed (2): _____
 Time Analyzed (1): 14:59 Time Analyzed (2): _____
 Instrument ID (1): GCA Instrument ID (2): _____
 GC Column ID (1): DB-5MS GC Column ID (2): _____

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	DATE ANALYZED 1	DATE ANALYZED 2
01	PSPK01	SPK92640	02-28-96	
02	DRUM#1	10427-012	02-28-96	
03	DRUM#1DL	10427-012DL	02-29-96	
04	DRUM#1MS	10427-012MS	02-28-96	
05	DRUM#1MSDL	10427-012MSDL	02-29-96	
06	DRUM#1MSD	10427-012MSD	02-28-96	
07	DRUM#1MSDDL	10427-012MSDDL	02-29-96	
08	DRUM#2	10427-013	02-28-96	
09	DRUM#3	10427-014	02-28-96	
10				
11				
12				
13				
14				

COMMENTS: _____

METHOD BLANK.

Drums 1, 2+3

=====
Software Version: 3.3 <4811>

Sample Name : BLK 92640 Time : 02/28/96 15:14
Sample Number: 27 Study :
Operator :

Instrument : GC_A(DB-5MS,DB-1701) Channel : A A/D mV Range : 1000
AutoSampler : HP 7673A
Rack/Vial : 0/0

Interface Serial # : 8116920948 Data Acquisition Time: 02/28/96 14:59
Delay Time : 1.00 min.
End Time : 15.00 min.
Sampling Rate : 2.9412 pts/sec

Raw Data File : G:\USERS\ACQUIRE\GC1\AA18992.RAW
Result File : G:\USERS\ACQUIRE\GC1\AA18992.RST
Instrument File: g:\users\acquire\method\A8080.ins
Process File : AAPCB
Sample File : AA1660
Sequence File : G:\USERS\ACQUIRE\METHOD\A960228.seq

Inj. Volume : 0 ul Area Reject : 200.000000
Sample Amount : 30.0000 Dilution Factor : 10.00

Noise Threshold: 10 Area Threshold : 100 Bunch Factor: 1
Multiplier : 1.0000 Divisor : 1.0000 Adder : 0.0000

Instrument Conditions:

/GCA,,,,;
Instrument: GC A -
Column Ch A :DB-5MS 30M X .32mm X 1.0um
Ch B :DB-608 30M X .32mm X 0.5um
Carrier Gas :H (12 ml/min)
Temperature :170C-->20C/min-->220c-->4c/min.-->250C(2min)
Notes :Inj. Vol is 2.0 ul split into 1.0ul/col
Divisor = % Solids/100
Dil. Factor = Final Vol X Any Dilutions

Total Number of Peaks Detected: 27
=====

PCB REPORT

Peak #	Time [min]	Area [uV*sec]	Component Name	Conc. ppb	XREC. TCMX	XREC. DBC
1.96		385907.5	SURR. Group	73.77	1e+03	221.32
2.83		2310.0	AR 1016 Group	0.77	11.62	2.32

				388217.4	74.55	

Group Report For : AR 1016 Group

Peak #	Time [min]	Area [uV*sec]	Component Name	Conc. ppb	XREC. TCMX	XREC. DBC
10	2.50	337.6	AR 1016 (1-3)	0.11	1.70	0.34
11	2.83	1972.3	AR 1016 (2-3)	0.66	9.92	1.98
0	3.60	0.0	AR 1016 (3-3)	0.00	0.00	0.00

				2310.0	0.77	

Group Report For : AR 1260 Group

Peak #	Time [min]	Area [uV*sec]	Component Name	Conc. ppb	XREC. TCMX	XREC. DBC
0	7.03	0.0	AR 1260 (1-4)	0.00	0.00	0.00
0	7.16	0.0	AR 1260 (2-4)	0.00	0.00	0.00
0	7.61	0.0	AR 1260 (3-4)	0.00	0.00	0.00
0	8.38	0.0	AR 1260 (4-4)	0.00	0.00	0.00

				0.0	0.00	

Group Report For : SURR. Group

Peak Time	Area	Component	Conc.	XREC.	XREC.
-----------	------	-----------	-------	-------	-------

0148

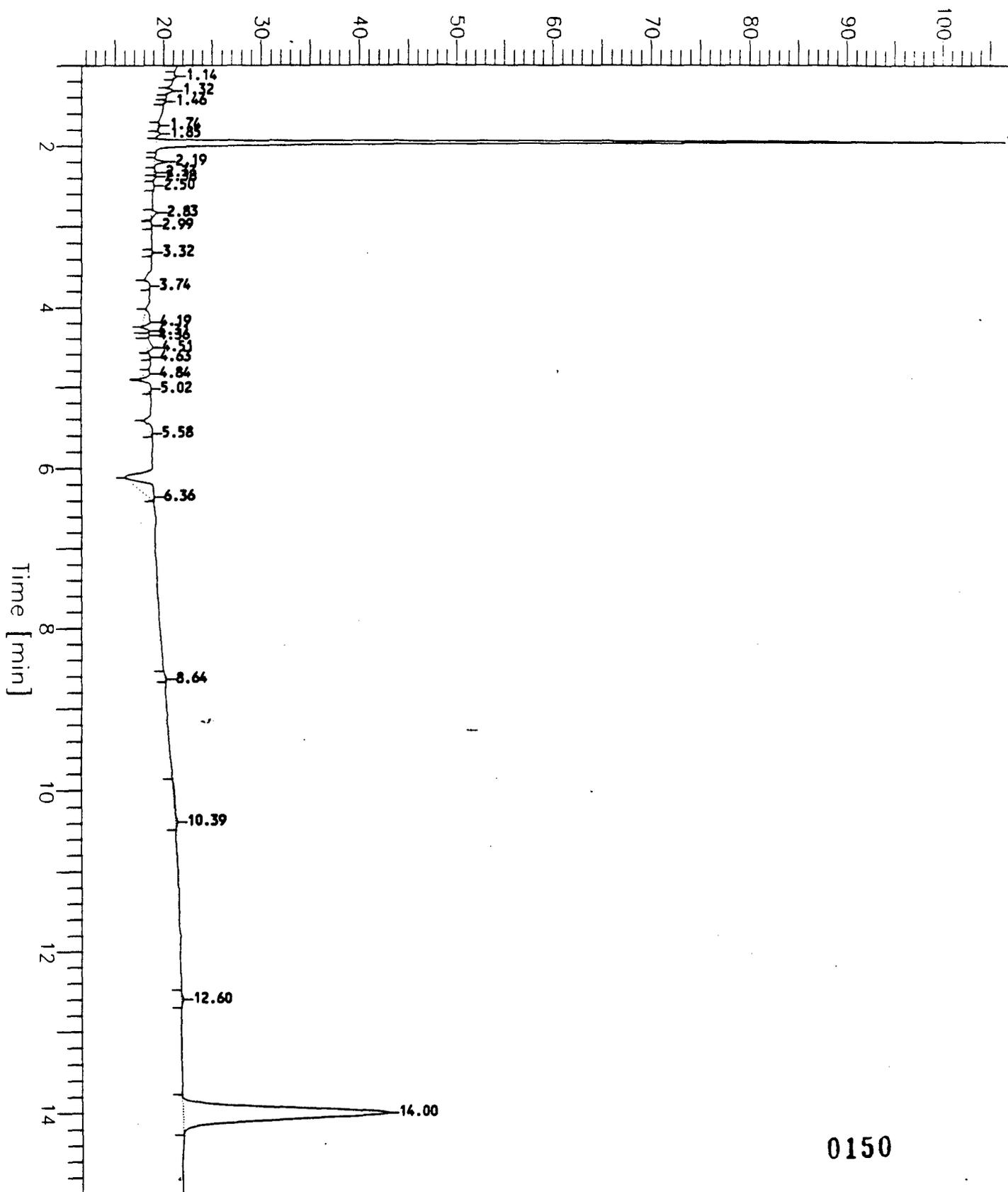
PCB

Sample Name : BLK 92640
FileName : g:\users\acquire\gc1\AA18992.raw
Method : A8080.ins
Start Time : 1.00 min
Scale Factor: 1.0

Sample #: 27
Date : 02/28/96 15:14
Time of Injection: 02/28/96 14:59
Low Point : 11.56 mV
Plot Scale: 94.0 mV

Page 1 of 1

Response [mV]



0150

INORGANIC SAMPLE DATA

Drums 1, 2 & 3

609.05

10427

U.S. EPA - CLP

14
ANALYSIS RUN LOG

Lab Name: QUANTERRA_MO _____

Contract: 609.05 _____

Lab Code: ITMO _____ Case No.: _____

SAS No.: _____ SDG No.: 10427 _____

Instrument ID Number: TJA1100 _____

Method: P_

Start Date: 03/01/96

End Date: 03/01/96

EPA Sample No.	D/F	Time	% R	Analytes																			
				P	B																		
SO	1.00	1535		X																			
S	1.00	1538		X																			
S	1.00	1541																					
S	1.00	1545																					
ICV	1.00	1548		X																			
ICB	1.00	1551		X																			
CRI	1.00	1554		X																			
S	1.00	1557		X																			
ICSA	1.00	1600		X																			
ICSAB	1.00	1604		X																			
PBW93089	1.00	1607		X																			
LCSW93089-1	1.00	1610		X																			
ZZZZZZ	1.00	1613																					
CCV	1.00	1616		X																			
CCB	1.00	1620		X																			
ZZZZZZ	1.00	1623																					
ZZZZZZ	1.00	1626																					
ZZZZZZ	1.00	1629																					
ZZZZZZ	5.00	1632																					
ZZZZZZ	1.00	1635																					
ZZZZZZ	1.00	1639																					
ZZZZZZ	1.00	1642																					
CCV	1.00	1645		X																			
CCB	1.00	1648		X																			
DRUM #1	1.00	1651		X																			
DRUM #2	1.00	1655		X																			
DRUM #3	1.00	1658		X																			
ZZZZZZ	1.00	1701																					
PBT92922	1.00	1704		X																			
ICSA	1.00	1707		X																			
ICSAB	1.00	1710		X																			
CCV	1.00	1714		X																			

FORM XIV - IN

TCLP

0017

**CHAIN OF CUSTODY
SAMPLE LOG-IN/RECEIPT RECORDS**

Drums 1, 2 & 3

Quanterra February 26, 1996 04:19 pm
 Account: 11084 Project: 609.05 ABB GAS No. 609.05 Rev. 0
 Master Sample Login: 10427

Project Manager: A. Field
 Draft: Final Entered and Reviewed by: S. Janner PH Review: Allen M. Field

Sample No.	Client ID	C-Matrix	Date: Collected	Received	Due	Shipper	Rad Category	Rad Sample No.
#	Container Type	Analysis	Class	Preservative	Anal. Due Date	Hold Date	Site	(Container Numbers: % Filled)
10427-001	SOIL #1 GAMMA=radium 226 only	Soil	21-FEB-96 15:00	26-FEB-96 09:00	18-MAR-96	FED EX	3*	R6731-001
1	PH - Plastic-1L	RAD/GAMMA/04	S COLD	11-MAR-96	21-AUG-96	R14B		(216339:100)
1		RAD/SCREEN/04	S COLD	11-MAR-96	24-AUG-96	R14B		(216339:100)
10427-002	SOIL #2 GAMMA=radium 226 only	Soil	21-FEB-96 15:00	26-FEB-96 09:00	18-MAR-96	FED EX	3*	R6731-002
1	PH - Plastic-1L	RAD/GAMMA/04	S COLD	11-MAR-96	21-AUG-96	R14B		(216340:100)
1		RAD/SCREEN/04	S COLD	11-MAR-96	24-AUG-96	R14B		(216340:100)
10427-002DUP	SOIL #2 REPLICATE GAMMA=radium 226 only	Soil	23-FEB-96 10:10	26-FEB-96 09:00	18-MAR-96	FED EX	3*	R6730-001
1	PH - Plastic-1L	RAD/GAMMA/04	S COLD	11-MAR-96	23-AUG-96	R14B		(216341:100)
1		RAD/SCREEN/04	S COLD	11-MAR-96	26-AUG-96	R14B		(216341:100)
10427-003	SOIL #3 GAMMA=radium 226 only	Soil	23-FEB-96 10:00	26-FEB-96 09:00	18-MAR-96	FED EX	3*	R6731-003
1	PH - Plastic-1L	RAD/GAMMA/04	S COLD	11-MAR-96	23-AUG-96	R14B		(216342:100)
1		RAD/SCREEN/04	S COLD	11-MAR-96	26-AUG-96	R14B		(216342:100)
10427-004	SOIL #4 GAMMA=radium 226 only	Soil	23-FEB-96 10:00	26-FEB-96 09:00	18-MAR-96	FED EX	3*	R6731-004
1	PH - Plastic-1L	RAD/GAMMA/04	S COLD	11-MAR-96	23-AUG-96	R14B		(216343:100)
1		RAD/SCREEN/04	S COLD	11-MAR-96	26-AUG-96	R14B		(216343:100)
10427-005	SOIL #5 GAMMA=radium 226 only	Soil	23-FEB-96 10:10	26-FEB-96 09:00	18-MAR-96	FED EX	3*	R6731-005
1	PH - Plastic-1L	RAD/GAMMA/04	S COLD	11-MAR-96	23-AUG-96	R14B		(216344:100)
1		RAD/SCREEN/04	S COLD	11-MAR-96	26-AUG-96	R14B		(216344:100)
10427-006	SOIL #6 GAMMA=radium 226 only	Soil	23-FEB-96 10:20	26-FEB-96 09:00	18-MAR-96	FED EX	3*	R6731-006
1	PH - Plastic-1L	RAD/GAMMA/04	S COLD	11-MAR-96	23-AUG-96	R14B		(216345:100)
1		RAD/SCREEN/04	S COLD	11-MAR-96	26-AUG-96	R14B		(216345:100)

3*-Sample has not been rad screened.

0074
30

Quanterra February 26, 1996 04:19 pm
 Account: 11084 Project: 609.05 ABB GAS No. 609.05 Rev. 0
 Master Sample Login: 10427

Project Manager: A. Field

Draft: Final: Entered and Reviewed by: _____

PH Review: _____

Sample Header Template: _____

Sample No.	Comments	Client ID	C-Matrix	Date: Collected	Received	Due	Shipper	Rad Category	Rad Sample No.
#	Container Type	Analysis	Class	Preservative	Anal. Due Date	Hold Date	Site		(Container Numbers: % Filled)
1	AM - Amber Glass-250ML	RAD/SCREEN/04 EXTMETAL/TCLP/04 ICAP/TCLP/04 PCB/8080/04	S	COLD	11-MAR-96	24-AUG-96	R14B		(216353:100)
1			S	COLD	11-MAR-96	22-MAR-96	R14B		(216354:100)
1			S	COLD	11-MAR-96	21-AUG-96	R14B		(216354:100)
1			S	COLD	11-MAR-96	08-MAR-96	R14B		(216354:100)
10427-014 DRUM #3 GAMMA-Radium 226 only//TCLP METALS=Pb Only. Soil									
1	PM - Plastic-1L	RAD/GAMMA/04 RAD/SCREEN/04 EXTMETAL/TCLP/04 ICAP/TCLP/04 PCB/8080/04	S	COLD	11-MAR-96	23-FEB-96 11:10 26-FEB-96 09:00	18-MAR-96 FED EX	3*	R4731-014
1			S	COLD	11-MAR-96	23-AUG-96	R14B		(216355:100)
1			S	COLD	11-MAR-96	24-AUG-96	R14B		(216355:100)
1			S	COLD	11-MAR-96	22-MAR-96	R14B		(216356:100)
1			S	COLD	11-MAR-96	21-AUG-96	R14B		(216356:100)
1			S	COLD	11-MAR-96	08-MAR-96	R14B		(216356:100)

0076

32

3*-Sample has not been rad screened.

TEMP 66 CUC# 6456

Chain of Custody Record



Client: **ARB Environmental Services, Inc**
 Address: **Corp. Place 128, 107 Audubon Rd.**
 City: **Wakefield, MA 01880**
 Project Name: **DMC Yard Rad Survey**
 Contract/Purchase Order/Quote No.:

Project Manager: **Herb Colby**
 Telephone Number (Area Code)/Fax Number: **(617) 245-6606 / (617) 246-5060**
 Site Contact: **Jake Jacobsen**
 Carrier/Waybill Number: **FedEx # 4978717634**

Date: **2/23/96** Chain Of Custody Number: **11557**
 Lab Number: _____ Page **1** of **1**

Sample I.D. No. and Description	Date	Time	Sample Type	Total Volume	Containers		Preservative	Condition on Receipt
					Type	No.		
1 Soil #1	2/23/96	1500	Soil	1L	poly-caps	1	ice	100%
2 Soil #2	2/23/96	1500			poly-caps	1	ice	
10 Soil #2 Replicate	2/23/96	1010				1	ice	
11 Soil #3	2/23/96	1000				1	ice	
12 Soil #4	2/23/96	1000				1	ice	
13 Soil #5	2/23/96	1000				1	ice	
14 Soil #6	2/23/96	1000				1	ice	
15 Soil #7	2/23/96	1035				1	ice	
16 Soil #8	2/23/96	1025				1	ice	
17 Soil #9	2/23/96	1030				1	ice	
18 Soil #10	2/23/96	1035				1	ice	
19 Soil #11	2/23/96	1040				1	ice	
20 Soil #12	2/23/96	1045				1	ice	
21 Drum #1	2/23/96	0900				2	ice	X2
22 Drum #2	2/23/96	1055				2	ice	
23 Drum #3	2/23/96	1110				2	ice	

Special Instructions: _____

Possible Hazard Identification:
 Non-Hazard Flammable Skin Irritant Poison B Unknown
 Normal Rush

Turn Around Time Required: _____

1. Relinquished By: **Herb Colby** Date: _____ Time: _____
 2. Relinquished By: _____ Date: _____ Time: _____
 3. Relinquished By: _____ Date: _____ Time: _____

Sample Disposal:
 Return To Client Disposal By Lab Archive For _____ Months

Project Specific (Specify):
 1. Received By: **Herb Colby** Date: **2-26-96** Time: **09:00**
 2. Received By: _____ Date: _____ Time: _____
 3. Received By: _____ Date: _____ Time: _____

Comments: _____



COPIED TO: BW+AF
 DATE: 2-26-96
 TIME: 09:30
 BY: Jm

Login No.: 10427

**Condition Upon Receipt Variance Report
 St. Louis Laboratory**

Client: AAB
 Project No: 609.05
 Shipper/No: Fed EX 497 8717 634

Date: 2-26-96 Time: 0900
 Initiated by: [Signature]
 RFA/COC Numbers: 11557

Condition/Variance (Check all that apply):

1. <input type="checkbox"/> Sample received broken/leaking.	8. <input type="checkbox"/> Sample ID on container does not match sample ID on paperwork. Explain: _____
2. <input type="checkbox"/> Sample received without proper preservative. <input type="checkbox"/> Cooler temperature not within $4C \pm 2C$ Record temperature: _____ <input type="checkbox"/> pH _____ <input type="checkbox"/> other: _____	9. <input type="checkbox"/> All coolers on airbill not received with shipment.
3. <input type="checkbox"/> Sample received in improper container.	10. <input type="checkbox"/> Other (explain below): _____
4. <input type="checkbox"/> Sample received without proper paperwork. Explain: _____	
5. <input type="checkbox"/> Paperwork received without sample.	
6. <input type="checkbox"/> No sample ID on sample container.	
7. <input type="checkbox"/> Custody tape disturbed/broken/missing.	

No variances were noted during sample receipt. Cooler Temperature Upon Receipt: 6 °C

Notes:

Corrective Action:

- Client's Name: _____ Informed verbally on: _____ By: _____
- Client's Name: _____ Informed in writing on: _____ By: _____
- Sample(s) processed "as is". _____
- Sample(s) on hold until: _____ If released, notify: _____

Sample Control Supervisor Review: (or designee) [Signature] Date: 2-26-96
 Project Management Review: [Signature] Date: 2-26-96

PCB QC SUMMARY

Drum 4

609.05
10882

2F
PCB SURROGATE RECOVERY

Lab Name: QUANTERRA, MO

Contract: 609-05

Lab Code: ITMO Case No.: _____

SAS No.: _____ SDG No.: 10882

Level: (low/med) LOW

#5 Sample
(#4 Drum) →

	EPA SAMPLE NO.	S1 (DCB) #	S2 (TCMX) #
01	PBLK01		116
02	PSPK01		126
03	#5 WASTE DRUM	141	117
04			
05			
06			
07			
08			
09			
10			
11			
12			
13			
14			
15			
16			
17			
18			

ADVISORY
QC LIMITS
(58-205)
(48-180)

S1 (DCB) = Decachlorobiphenyl
S2 (TCMX) = Tetrachlorom-m-xylene

Column to be used to flag recovery values

* Values outside of QC limits

D Surrogates diluted out

3F
SOIL PCB SPIKE BLANK(LCS) RECOVERY

Lab Name: QUANTERRA, MO Contract: 609-05
 Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: 10882
 Spike Blank No.: SPK98205

COMPOUND	SPIKE ADDED (ug/kg)	SPIKE CONCENTRATION (ug/kg)	SPK % REC #	QC LIMITS REC.
Aroclor-1016	170	160	94	50-114
Aroclor-1260	170	160	99	8-127

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

ND: not determined

Spike Recovery: 0 out of 2 outside limits

COMMENTS: _____

FORM III PEST-2

4C
PCB METHOD BLANK SUMMARY

Lab Name: QUANTERRA, MO Contract: 609-05
 Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: 10882
 Lab Sample ID: BLK98205 Lab File ID: _____
 Matrix: (soil/water) SOIL Level (low/med) LOW
 Date Extracted: 04-24-96 Extraction: (SepF/Cont/Sonc) SONC
 Date Analyzed (1): 04-25-96 Date Analyzed (2): _____
 Time Analyzed (1): 14:54 Time Analyzed (2): _____
 Instrument ID (1): GCA Instrument ID (2): _____
 GC Column ID (1): DB-5MS GC Column ID (2): _____

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO.	LAB SAMPLE ID	DATE ANALYZED 1	DATE ANALYZED 2
01	PSPK01	SPK98205	04-25-96	
02	#5 WASTE DRUM	10882-005	04-26-96	
03				
04				
05				
06				
07				
08				
09				
10				
11				
12				
13				
14				

COMMENTS: _____

METHOD BLANK.

1D
PCB ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

PBLK01

Lab Name: QUANTERRA, MO Contract: 609-05

Lab Code: ITMO Case No.: _____ SAS No.: _____ SDG No.: 10882

Matrix: (soil/water) SOIL Lab Sample ID: BLK98205

Sample wt/vol: 30.0 (g/ml) G Lab File ID: _____

Level: (low/med) LOW Date Sampled: _____

% Moisture: not dec. _____ dec. _____ Date Extracted: 04-24-96

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 04-25-96

GPC Cleanup: (Y/N) N pH: _____ Dilution Factor: 1

CAS NO.	Compound	CONCENTRATION UNITS: (ug/L or ug/Kg) <u>UG/KG</u>	<u>Q</u>
12674-11-2-----	Aroclor-1016	33	U
11104-28-2-----	Aroclor-1221	33	U
11141-16-5-----	Aroclor-1232	33	U
53469-21-9-----	Aroclor-1242	33	U
12672-29-6-----	Aroclor-1248	33	U
11097-69-1-----	Aroclor-1254	33	U
11096-82-5-----	Aroclor-1260	33	U

U: Concentration of analyte is less than the value given.

FORM I PEST

00122

40 :

Software Version: 3.3 <4811>

Sample Name : BLK 98205 Time : 04/25/96 15:10
Sample Number: 24 Study :
Operator :

Instrument : GC A(DB-5MS,DB-608) Channel : A A/D mV Range : 1000
AutoSampler : HP 7673A
Rack/Vial : 0/0

Interface Serial # : 8116920948 Data Acquisition Time: 04/25/96 14:54
Delay Time : 1.00 min.
End Time : 15.00 min.
Sampling Rate : 2.9412 pts/sec

Raw Data File : G:\USERS\ACQUIRE\GC1\AA20235.RAW
Result File : G:\USERS\ACQUIRE\GC1\AA20235.RST
Instrument File: g:\users\acquire\method\A8080.ins
Process File : AAPCB
Sample File : AA1660
Sequence File : G:\USERS\ACQUIRE\METHOD\A960425.seq

Inj. Volume : 0 ul Area Reject : 200.000000
Sample Amount : 30.0000 Dilution Factor : 10.00

Noise Threshold: 10 Area Threshold : 100 Bunch Factor: 1
Multiplier : 1.0000 Divisor : 1.0000 Adder : 0.0000

Instrument Conditions:

/GCA,,,,;
Instrument: GC A -
Column Ch A :DB-5MS 30M X .32mm X 1.0um
Ch B :DB-608 30M X .32mm X 0.5um
Carrier Gas :H (12 ml/min)
Temperature :170C-->20C/min-->220c-->4c/min.-->250C(2min)
Notes :Inj. Vol is 2.0 ul split into 1.0ul/col
Divisor = % Solids/100
Dil. Factor = Final Vol X Any Dilutions

Total Number of Peaks Detected: 32

PCB REPORT

Peak #	Time [min]	Area [uV*sec]	Component Name	Conc. ppb	XREC. TC9X	XREC. DBC
1.96	399106.6	SURR. Group	76.30	1e+03	228.89	
2.82	3352.9	AR 1016 Group	1.12	16.87	3.37	
8.20	23946.2	AR 1260 Group	4.58	68.67	13.73	
426405.7			82.00			

Group Report For : AR 1016 Group

Peak #	Time [min]	Area [uV*sec]	Component Name	Conc. ppb	XREC. TC9X	XREC. DBC
13	2.49	451.9	AR 1016 (1-3)	0.15	2.27	0.45
14	2.82	2901.1	AR 1016 (2-3)	0.97	14.59	2.92
0	3.60	0.0	AR 1016 (3-3)	0.00	0.00	0.00
3352.9			1.12	EDV		

Group Report For : AR 1260 Group

Peak #	Time [min]	Area [uV*sec]	Component Name	Conc. ppb	XREC. TC9X	XREC. DBC
0	7.02	0.0	AR 1260 (1-4)	0.00	0.00	0.00
0	7.16	0.0	AR 1260 (2-4)	0.00	0.00	0.00
0	7.61	0.0	AR 1260 (3-4)	0.00	0.00	0.00
29	8.20	23946.2	AR 1260 (4-4)	4.58	68.67	13.73
23946.2			4.58	EDV		

Group Report For : SURR. Group

00123

41 :

Peak #	Time [min]	Area [uV*sec]	Component Name	Conc. ppb	XREC. TCXK	XREC. DBC
8	1.96	188053.3	TCXK	7.76	116.39	23.28
30	8.65	734.7	DBC	0.06	0.89	0.18
32	14.02	210318.6	DCB	9.49	142.36	28.47
				399106.6	17.31	

Types and reasons for Manual Analysis if performed on this sample:

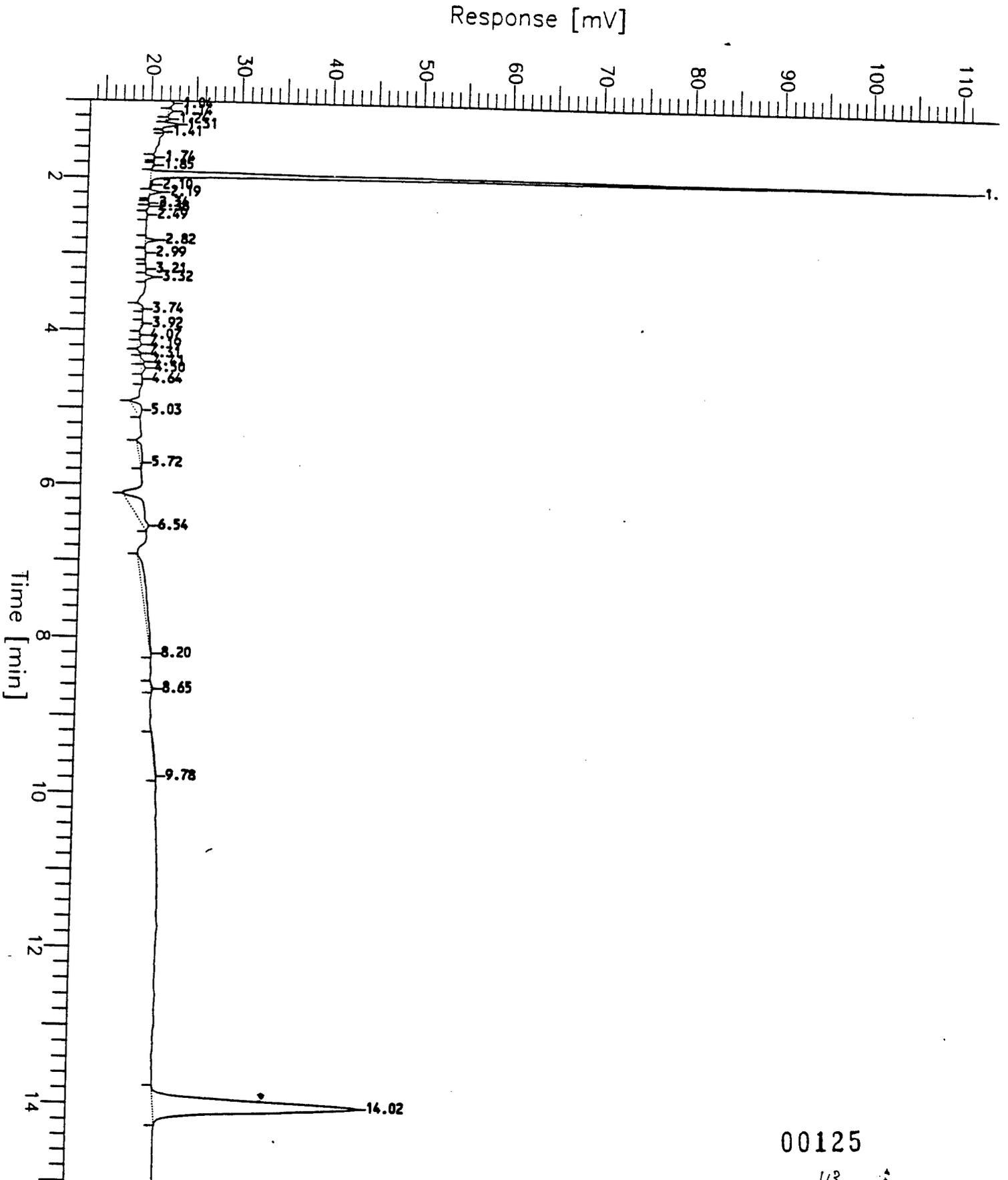
1. Manual Identification: RT shift, Wrong peak, Interference from...
2. Manual Integration: Incorrect integration, Interference from...
3. Other
4. No Manual Analysis were performed on this sample.

Analyst: J. Forsythe 0430ab

PCB

Sample Name : BLK 98205
FileName : g:\users\acquire\gc1\AA20235.raw
Method : A8080.ins
Start Time : 1.00 min
Scale Factor: 1.0
End Time : 15.00 min
Plot Offset: 13 mV

Sample #: 24
Date : 04/25/96 15:10
Time of Injection: 04/25/96 14:54
Low Point : 13.20 mV
Plot Scale: 98.2 mV
Page 1 of 1
High Point : 111.43 mV



00125

43

INORGANIC SAMPLE DATA

Drum 4

609.05
10882

U.S. EPA - CLP

COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: QUANTERRA MO Contract: 609.05
Lab Code: ITMO Case No.: SAS No.: SDG No.: 10882
SOW No.: SW846

Table with 2 columns: EPA Sample No. and Lab Sample ID. Row 1: #5 WA DR #4, P10882-005. Row 2: PBT98878, PBT98878.

Were ICP interelement corrections applied ? Yes/No YES
Were ICP background corrections applied ? Yes/No YES
If yes - were raw data generated before application of background corrections ? Yes/No NO

Comments:

Three horizontal lines for comments.

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: Name:
Date: Title:

COVER PAGE - IN TCLP

U.S. EPA - CLP

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ANALYSIS RUN LOG

Lab Name: QUANTERRA_MO _____

Contract: 609.05 _____

Lab Code: ITMO Case No.: _____

SAS No.: _____ SDG No.: 10882 _____

Instrument ID Number: TJA1100 _____

Method: P_

Start Date: 04/30/96

End Date: 04/30/96

EPA Sample No.	D/F	Time	% R	Analytes																											
				P	B																										
S0	1.00	1301		X																											
S	1.00	1304		X																											
S	1.00	1307																													
S	1.00	1311																													
ICV	1.00	1314		X																											
ICB	1.00	1317		X																											
CRI	1.00	1320		X																											
S	1.00	1324		X																											
ICSA	1.00	1329		X																											
ICSAB	1.00	1332		X																											
PBW99006	1.00	1336		X																											
LCSW99006	1.00	1339		X																											
ZZZZZZ	1.00	1342																													
CCV	1.00	1345		X																											
CCB	1.00	1348		X																											
#5 WA DR #4	1.00	1352		X																											
ZZZZZZ	1.00	1355																													
ZZZZZZ	1.00	1358																													
ZZZZZZ	1.00	1401																													
ZZZZZZ	1.00	1404																													
ZZZZZZ	1.00	1408																													
ZZZZZZ	1.00	1411																													
ZZZZZZ	5.00	1414																													
PBT98878	1.00	1417		X																											
ZZZZZZ	1.00	1420																													
CCV	1.00	1424		X																											
CCB	1.00	1427		X																											
ZZZZZZ	3.00	1430																													
ZZZZZZ	3.00	1433																													
ZZZZZZ	3.00	1436																													
PBT98878	1.00	1440																													
ICSA	1.00	1443		X																											

FORM XIV - IN

TCLP

00015

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**CHAIN OF CUSTODY
SAMPLE LOG-IN/RECEIPT RECORDS**

DRUM 4

Account: 11084 Project: 609.05 ABB QAS No. 609.05 Rev. 0
 Master Sample Login: 10882

Quanterra April 18, 1996 03:44 pm
 Entered and Reviewed by: *[Signature]* PM Review: *[Signature]*

Project Manager: A. Field

Draft: Final

Sample Header Template:

Sample No.	Comments	Client ID	C-Matrix	Date: Collected	Received	Due	Shipper	Rad Category	Rad Sample No.
#	Container Type		Analysis	Class	Preservative	Anal. Due Date	Hold Date Site		(Container Numbers: % Filled)
10882-001	#1 HOLE #6		Soil	16-APR-96 08:30	17-APR-96 09:20	08-MAY-96	FED-EX	3*	R4896-001
1	PN - Plastic-1L		RAD/GAMMA/Q4	S COLD	01-MAY-96	15-OCT-96	S4J		(225557:100)
1			RAD/SCREEN/Q4	S COLD	01-MAY-96	14-OCT-96	S4J		(225557:100)
10882-002	#2 HOLE #10		Soil	16-APR-96 08:40	17-APR-96 09:20	08-MAY-96	FED-EX	3*	R4896-002
1	PN - Plastic-1L		RAD/GAMMA/Q4	S COLD	01-MAY-96	15-OCT-96	S4J		(225558:100)
1			RAD/SCREEN/Q4	S COLD	01-MAY-96	14-OCT-96	S4J		(225558:100)
10882-003	#3 DUPLICATE #10		Soil	16-APR-96 08:40	17-APR-96 09:20	08-MAY-96	FED-EX	3*	R4896-003
1	PN - Plastic-1L		RAD/GAMMA/Q4	S COLD	01-MAY-96	15-OCT-96	S4J		(225559:100)
1			RAD/SCREEN/Q4	S COLD	01-MAY-96	14-OCT-96	S4J		(225559:100)
10882-004	#4 WASTE DRUM #4		Soil	16-APR-96 08:45	17-APR-96 09:20	08-MAY-96	FED-EX	3*	R4896-004
1	PN - Plastic-1L		RAD/GAMMA/Q4	S COLD	01-MAY-96	15-OCT-96	S4J		(225560:100)
1			RAD/SCREEN/Q4	S COLD	01-MAY-96	14-OCT-96	S4J		(225560:100)
10882-005	#5 WASTE DRUM #4 ICAP/TCLP - PB ONLY.		Soil	16-APR-96 08:56	17-APR-96 09:20	08-MAY-96	FED-EX	3*	R4896-005
2	PN - Plastic-1L		EXTMETAL/TCLP/Q4	S COLD	01-MAY-96	14-MAY-96	S4J		(225561:100 225577:99)
2			ICAP/TCLP/Q4	S COLD	01-MAY-96	13-OCT-96	S4J		(225561:100 225577:99)
1			PCB/8080/Q4	S COLD	01-MAY-96	30-APR-96	S4J		(225578:98)
1			RAD/SCREEN/Q4	S COLD	01-MAY-96	14-OCT-96	S4J		(225561:100)

00076
62

3-Sample has not been rad screened.

Temp 4°C Cur # 6922

Chain of Custody Record



Client: **ABB Environmental Services** Project Manager: **Herb Colby** Date: **4/16/95** Chain Of Custody Number: **11746**

Address: **107 Audubon Rd STE 25** Telephone Number (Area Code)/Fax Number: **617 245-6606** Lab Number: **9011**

City: **Wakefield** State: **MA** Zip Code: **01880** Site Contact: **Jake Jacobson** Page **1** of **11**

Project Name: **DRMO Yard - Ft. Devens** Carrier/Waybill Number: **Fed-X 316 9794 057** Analysis: **PCBs**

Sample I.D. No. and Description	Date	Time	Sample Type	Total Volume	Containers		Preservative	Condition on Receipt
					Type	No.		
#1 Hole #8	4/16/96	0830	Soil	1L	1L	1	None	100%
#2 Hole #10	4/16/96	0840	Soil	1L	1L	1	None	100%
#3 Duplicate #10	4/16/96	0840	Soil	1L	1L	1	None	100%
#4 Waste Drum #4	4/16/96	0845	Soil	1L	1L	1	None	100%
#5 Waste Drum #4	4/16/96	0856	Soil	250ml	250ml	1	Cold	3X100
#6 Waste Drum #4	4/16/96	0850	Soil	250ml	250ml	1	Cold	
#7 Waste Drum #4	4/16/96	0850	Soil	250ml	250ml	1	Cold	

Possible Hazard Identification: Non-Hazard Flammable Skin Irritant Poison B Unknown

Turn Around Time Required: Normal Rush

Relinquished By: **Herb Colby** Date: **4/16/95** Time: **0915**

Relinquished By: **Jake Jacobson** Date: **4/16/96** Time: **14:30**

Relinquished By: **Jake Jacobson** Date: **4/16/96** Time: **14:30**

Sample Disposal: Return To Client Disposal By Lab Archive For _____ Months

Project Specific (Specify): **PCBs**

Received By: **Jake Jacobson** Date: **4-17-96** Time: **09:20**

Special Instructions: **PCBs**

Comments: **PCBs**

DISTRIBUTION: WHITE. Please with Complete Chain of Custody



Environmental Services

REC'D
TO BWS/DS
DATE: 4-17-96
TIME: 11:45
BY: [Signature]

Condition Upon Receipt Variance Report
St. Louis Laboratory

Login No.: 10882

Client: ABB
Project No: SN 534 CT 609.05
Shipper/No: FedEx 316 9734 057

Date: 4-17-96 Time: 09:20
Initiated by: [Signature]
RFA/COC Numbers: 11746

Condition/Variance (Check all that apply):

1. <input type="checkbox"/> Sample received broken/leaking.	8. <input type="checkbox"/> Sample ID on container does not match sample ID on paperwork. Explain: _____
2. <input type="checkbox"/> Sample received without proper preservative. <input type="checkbox"/> Cooler temperature not within $4C \pm 2C$ Record temperature: _____	9. <input type="checkbox"/> All coolers on airbill not received with shipment.
<input type="checkbox"/> pH _____	10. <input type="checkbox"/> Other (explain below): _____
<input type="checkbox"/> other: _____	
3. <input type="checkbox"/> Sample received in improper container.	
4. <input type="checkbox"/> Sample received without proper paperwork. Explain: _____	
5. <input type="checkbox"/> Paperwork received without sample.	
6. <input type="checkbox"/> No sample ID on sample container.	
7. <input type="checkbox"/> Custody tape disturbed/broken/missing.	

No variances were noted during sample receipt. Cooler Temperature Upon Receipt: 4°C

Notes: _____

Corrective Action:

- Client's Name: _____ Informed verbally on: _____ By: _____
- Client's Name: _____ Informed in writing on: _____ By: _____
- Sample(s) processed "as is".
- Sample(s) on hold until: _____ If released, notify: _____

Sample Control Supervisor Review: (or designee) [Signature] Date: 4-17-96
Project Management Review: [Signature] Date: 4-18-96

SIGNED ORIGINAL MUST BE RETAINED IN THE PROJECT FILE

QC Summary

Drum 5

ESE BATCH : G73308
 ANALYSIS : EPA 8080/3540

E TYPE : FDER/SW REPORT DATE/TIME : 07/31/96 09:47
 ANALYST : VICTOR BAUDER ANALYSIS DATE/TIME : 07/14/96
 EXTRACTOR : CURTIS GUINYARD EXTRACT DATE : 07/16/96
 DATA ENTRY : VICTOR BAUDER

STATUS : FINAL

METHOD BLANK CORRECTION METHOD : NONE
 BATHAMA LOT: QEES

FIELD GRP QC TYPE PROJECT NUMBER PROJECT NAME LAB COORDINATOR
 V5S ESE 1296066G 0201 ABB FT DEVENS TASK 7 JOSEPH VONDRICK

SAMPLE CLIENT DATE TIME
 CODE ID ANALYZED ANALYZED
 V5S*99 DRUM 5 07/22/96 06:07PM

HOLDING TIMES CHECK

SAMPLE ANALYTE ANL DATE EXT DATE SMP DATE H.T. OVER

ALL HOLDING TIMES MET

Method Blank Sample Summary

DATE	SAMPLE	STORET	PARAMETER	UNITS	FOUND	DET LMT
07/19/96	MB*THAMA*1	39514*8080/3540-G	PCB-1016	UG/KG- ND	13.3	
07/19/96	MB*THAMA*1	39491*8080/3540-G	PCB-1221	UG/KG- ND	13.3	
07/19/96	MB*THAMA*1	39495*8080/3540-G	PCB-1232	UG/KG- ND	13.3	
07/19/96	MB*THAMA*1	39499*8080/3540-G	PCB-1242	UG/KG- ND	13.3	
07/19/96	MB*THAMA*1	39503*8080/3540-G	PCB-1248	UG/KG- ND	13.3	
07/19/96	MB*THAMA*1	39507*8080/3540-G	PCB-1254	UG/KG- ND	13.3	
07/19/96	MB*THAMA*1	39511*8080/3540-G	PCB-1260	UG/KG- ND	13.3	

Surrogate Spike Recovery Summary

DATE	SAMPLE	STORET	PARAMETER	UNITS	TARGET	FOUND	%RECV	RECV CRIT
07/19/96	CCS*1060*133	96798*SUR	TETRACHLORO-M-XYLENE {8080,354UG/KG	UG/KG	200	219	110	67-119
07/19/96	CCS*1060*133	96519*SUR	DECACHLOROBIPHENYL	UG/KG	200	221	111	51-169
07/19/96	MB*THAMA*1	96798*SUR	TETRACHLORO-M-XYLENE {8080,354UG/KG	UG/KG	66.7	58.3	87.4	67-119
07/19/96	MB*THAMA*1	96519*SUR	DECACHLOROBIPHENYL	UG/KG	66.7	73.4	110	51-169
07/19/96	SP1*THAMA*1	96798*SUR	TETRACHLORO-M-XYLENE {8080,354UG/KG	UG/KG	66.7	55.4	83.1	67-119
07/19/96	SP1*THAMA*1	96519*SUR	DECACHLOROBIPHENYL	UG/KG	66.7	71.4	107	51-169
07/22/96	DA*DV5S*99	96798*SUR	TETRACHLORO-M-XYLENE {8080,354UG/KG	UG/KG	66.7	60.9	91.3	67-119
07/22/96	DA*DV5S*99	96519*SUR	DECACHLOROBIPHENYL	UG/KG	66.7	82.3	123	51-169
07/19/96	SPM1*DV5S*99	96798*SUR	TETRACHLORO-M-XYLENE {8080,354UG/KG	UG/KG	66.7	48.2	72.3	67-119
07/19/96	SPM1*DV5S*99	96519*SUR	DECACHLOROBIPHENYL	UG/KG	66.7	63.9	95.8	51-169
07/19/96	SPM2*DV5S*99	96798*SUR	TETRACHLORO-M-XYLENE {8080,354UG/KG	UG/KG	66.7	49.1	73.6	67-119
07/19/96	SPM2*DV5S*99	96519*SUR	DECACHLOROBIPHENYL	UG/KG	66.7	67.0	100	51-169
07/19/96	CCS*1060*143	96798*SUR	TETRACHLORO-M-XYLENE {8080,354UG/KG	UG/KG	200	223	112	67-119
07/19/96	CCS*1060*143	96519*SUR	DECACHLOROBIPHENYL	UG/KG	200	207	104	51-169
07/22/96	CCS*1254*14	96798*SUR	TETRACHLORO-M-XYLENE {8080,354UG/KG	UG/KG		NA		67-119
07/22/96	CCS*1254*14	96519*SUR	DECACHLOROBIPHENYL	UG/KG		NA		51-169

Batch Narrative - G73308 Analysis: EPA 8080/3540

Updated by 1781

CCS*1060*143 HAS PCB-1016 AT 21.0% DIFFERENCE WHICH IS SLIGHTLY ABOVE THE 20.0% CRITERIA. THE SAMPLE DOES NOT HAVE ANY PCB-1016 IN IT. ALL OTHER CCS COMPOUNDS ARE WITHIN CRITERIA. VSB 7-23-96

Updated by 3377

PROBLEM:

Sample matrix spike not within acceptance criteria:

PB UN*DV5SL*99 Exceeds criteria. (Recovery Limit 100 +/- 15)

EXPLANATION: Sample concentration is greater than 4 times the spike concentration.

PROBLEM:

Sample matrix spike duplicate not within acceptance criteria:

PB UN*DV5SL*99 Exceeds criteria. (Recovery Limit 100 +/- 15)

EXPLANATION: Sample concentration is greater than 4 times the spike concentration.

Analyst _____ DATE _____

Reviewer _____ DATE _____

Standard Matrix Spike (SP) Recovery and Replicate Summary

NAME	UNITS	STOR*METH	BATCH	SAMPLE	DATE	TARGET	FOUND	%RECV	RECV CRIT	R.P.D.	R.P.D. CRIT.
PCB-1016	UG/KG-	39514*8080/3540-G	G73308	SP1*THAMA*1	07/19/96	267	294	110.1	N/A	N/A	N/A
PCB-1260	UG/KG-	39511*8080/3540-G	G73649	SP1*THAMA*1	07/30/96	267	312	116.9	N/A	N/A	N/A
LEAD, TOTAL	UG/L	1051*6020-G	G73649	SP*QC*1	07/30/96	20.0	19.6	98.0	75-137	31	31

Environmental Science & Engineering, Inc.
FT DEVENS SOIL QC SUMMARY
Sample Matrix Spike (SPM) Recovery Summary

NAME	UNITS	STOR*METH	BATCH	SAMPLE	DATE	TARGET	FOUND	%RECV	RECV CRIT	UNSPIKED	R.P.D.	R.P.D. CRIT.
PCB-1016	UG/KG-	39514*8080/3540-G	G73308	SPM1*DV5S*99	07/19/96	303	360	118.9	N/A	0.0	0.0	N/A
PCB-1016	UG/KG-	39514*8080/3540-G	G73308	SPM2*DV5S*99	07/19/96	303	324	107.0	N/A	0.0	0.0	N/A
PCB-1260	UG/KG-	39511*8080/3540-G	G73649	SPM1*DV5S*99	07/31/96	303	482	159.2	N/A	0.0	0.0	N/A
PCB-1260	UG/KG-	39511*8080/3540-G	G73649	SPM2*DV5S*99	07/31/96	303	506	167.2	N/A	0.0	0.0	N/A
LEAD, TOTAL	UG/L	1051*6020-G	G73649	SPM1*DV5SL*99	07/31/96	22.2	800	3600	75-137	29900	31	31
LEAD, TOTAL	UG/L	1051*6020-G	G73649	SPM2*DV5SL*99	07/31/96	22.2	800	3600	75-137	29900	0.1	31

Environmental Science & Engineering, Inc.
FT DEVENS SOIL QC SUMMARY
Spike into Matrix (SPX) Recovery Summary

NAME	UNITS	STOR*METH	BATCH	SAMPLE	DATE	TARGET	FOUND	%RECV	RECV CRIT	UNSPIKED
LEAD, TOTAL	UG/L	1051*6020-G	G73649	SPX*DV5SL*99	07/30/96	5.6	-318	-5679	N/A	29900

Environmental Science and Engineering, Inc.
FT DEVENS SOIL QC SUMMARY

Standard Matrix Spike Recovery and Replicate Statistics Summary

STORET*METHOD NAME

STORET*METHOD NAME	N	MINIMUM	MAXIMUM	AVERAGE	STANDARD DEVIATION
39514*8080/3540PCB-1016	1	110.1	110.1	110.1	0.0
39511*8080/3540PCB-1260	1	116.9	116.9	116.9	0.0
1051*6020-G LEAD, TOTAL	1	98.0	98.0	98.0	0.0

Environmental Science and Engineering, Inc.
FT DEVENS SOIL QC SUMMARY

Sample Matrix Spike Recovery Statistics Summary

STORET*METHOD NAME

STORET*METHOD NAME	N	MINIMUM	MAXIMUM	AVERAGE	STANDARD DEVIATION
39514*8080/3540PCB-1016	2	107.0	118.9	113.0	8.4
39511*8080/3540PCB-1260	2	159.2	167.2	163.2	5.7
1051*6020-G LEAD, TOTAL	2	3600	3600	3600	0.0

Environmental Science and Engineering, Inc.
FT DEVENS SOIL QC SUMMARY

Spike into Matrix Recovery Statistics Summary

STORET*METHOD NAME

STORET*METHOD NAME	N	MINIMUM	MAXIMUM	AVERAGE	STANDARD DEVIATION
1051*6020-G LEAD, TOTAL	1	-5679	-5679	-5679	0.0

Chains of Custody (copies)

Drum 5

Environmental Science & Engineering, Inc. 07-03-96 *** FIELD LOGSHEET *** FIELD GROUP: DV55L
PROJECT NUMBER 1296066G 0201 FG NAME: FT DEVENS ABB LEACHATE LAB COORD. JOSEPH VONDRICK

ESE # *99 SITE/STA HAZ? DRUM 5 FRACTIONS (CIRCLE) DATE TIME PARAMETER LIST
NF 7/2/96 4p - ATGAL cc per JVV DV55L

NOTE - CHANGE OR ENTER SITE ID AS NECESSARY; UP TO 9 ALPHANUMERIC CHARACTERS MAY BE USED
- CIRCLE FRACTIONS COLLECTED. ENTER DATE, TIME, FIELD DATA (IF REQUIRED), HAZARD CODE AND NOTES
- HAZARD CODES: I-IGNITABLE C-CORROSIVE R-REACTIVE T-TOXIC WASTE H-OTHER ACUTE HAZARD; IDENTIFY SPECIFICS IF KNOWN
- PLEASE RETURN COMPLETED LOGSHEETS WITH SAMPLES TO Environmental Science & Engineering, Inc.

SAMPLED BY: (Name/Organization)

RELINQUISHED (Name/Organization/Date/Time) VIA: REC'D BY (Name/Organization/Date/Time)

1 A. BRAMAN JACOB/ESE/7/3/96 for receiving
2
3
7/3/96 1300
cc 7/3/96

SAMPLER: Shipped on Ice? Yes/No; I anticipate shipping (#) more samples on /
SAMPLE CUSTODIAN: Custody Seals Used? Yes/No If Yes, Seals Intact? Yes/No Interior Temp? N Deg C
Preservatives Audited? Yes/No Any Problems? Yes/No; If Yes, describe:

Hand Delivered Cust Instruct

Appendix F

Radioactive Package Shipment Survey Record

Radioactive Package Shipment Record

Drum # 1

Date Surveyed 2/23/96 Surveyed By Tom Bracke

Transported By _____ License Plate # _____

Type of Package 55 gallon drum Label (circle one) White I
Yellow II
Yellow III

Dose rate survey

Survey Instrument & serial # Bicron # B966N

Reading at Contact 50 Reading at 3 ft. 10

Smear Survey

Survey Instrument & serial # Ludlum Model #2223 Scaler/Ratemeter SERIAL # 102933

Results 226 dpm/100 cm² α

Results 496 dpm/100 cm² β/γ

Contamination greater than 2,2000 dpm/100 cm² removable must be decontaminated prior to shipment.

Describe Radioactive Material (activity, physical form, and quantity)

Radium 226 in soil and asphalt mix

Reviewed By: [Signature] Date: 2/27/96

Radioactive Package Shipment Record

DRUM # 2

Date Surveyed 2/23/96 Surveyed By TOM BRADY

Transported By _____ License Plate # _____

Type of Package 55 gallon drum Label (circle one) White I
 Yellow II
 Yellow III

Dose rate survey

Survey Instrument & serial # BICRON # B966N

Reading at Contact 50 Reading at 3 ft. 10

Smear Survey

Survey Instrument & serial # Ludium scaler/Ratemeter
Model # 2223 Serial # 162933

Results 226 dpm/100 cm² α

Results 2496 dpm/100 cm² β/γ

Contamination greater than 2,200 dpm/100 cm² removable must be decontaminated prior to shipment.

Describe Radioactive Material (activity, physical form, and quantity)

Radium 226 in soil and asphalt mix

Reviewed By: [Signature] Date: 2/27/96

Radioactive Package Shipment Record

Drum #3

Date Surveyed 2/23/96 Surveyed By TOM BRUCKE

Transported By _____ License Plate # _____

Type of Package 55 gallon drum Label (circle one) White I
Yellow II
Yellow III

Dose rate survey

Survey Instrument & serial # BICRON # B966N

Reading at Contact 55 Reading at 3 ft. 10

Smear Survey

Survey Instrument & serial # Ludlum scales/Ratemeter
model # 2223 Serial # 102933

Results 226 dpm/100 cm² α

Results 2496 dpm/100 cm² β/γ

Contamination greater than 2,2000 dpm/100 cm² removable must be decontaminated prior to shipment.

Describe Radioactive Material (activity, physical form, and quantity)

Radium 226 in soil and asphalt mix, Radium 226
in DAW - paper, plastic, + metal

Reviewed By: [Signature] Date: 2/27/96

Radioactive Package Shipment Record

Drum # 4

Date Surveyed 4/16/96 Surveyed By Scott Dennenlein

Transported By _____ License Plate # _____

Type of Package 55 gallon drum Label (circle one)
 White I
 Yellow II
 Yellow III

Dose rate survey

Survey Instrument & serial # Bicron # B966N

Reading at Contact 15 μ R/hr Reading at 3 ft. 10 μ R/hr

Smear Survey

Survey Instrument & serial # Ludlum 2223 # 102933

Results < 30 dpm/100 cm² α

Results < 500 dpm/100 cm² β/γ

Contamination greater than 2,2000 dpm/100 cm² removable must be decontaminated prior to shipment.

Describe Radioactive Material (activity, physical form, and quantity)

Radium-226 in soil/asphalt

Reviewed By: Thomas P. Beado

Date: 8/8/96

Radioactive Package Shipment Record

Drum # 5
Date Surveyed 6/12/96 Surveyed By Scott Deenerlein

Transported By _____ License Plate # _____

Type of Package 55 gallon drum Label (circle one) White I
Yellow II
Yellow III

Dose rate survey

Survey Instrument & serial # Biran # B966N

Reading at Contact 9 mR/hr Reading at 3 ft. 9 mR/hr

Smear Survey

Survey Instrument & serial # Ludlum 2223 # 102433

Results < 30 dpm/100 cm² α

Results < 500 dpm/100 cm² β/γ

Contamination greater than 2,200 dpm/100 cm² removable must be decontaminated prior to shipment.

Describe Radioactive Material (activity, physical form, and quantity)

Radium-226 in soil/asphalt

Reviewed By: Thomas Rado

Date: 2/8/96

Radiation Science, Inc.

Form XX