

CLOSE-OUT REPORT FOR VICINITY PROPERTIES MDC6 AND MDC9

WELDON SPRING SITE REMEDIAL ACTION PROJECT
WELDON SPRING, MISSOURI

APRIL 1999

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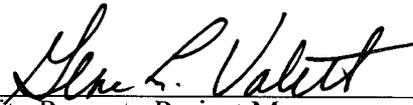
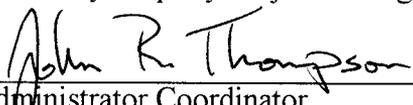
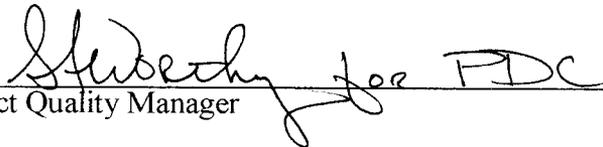


U.S. Department of Energy
Oak Ridge Operations Office
Weldon Spring Site Remedial Action Project

Prepared by MK-Ferguson Company and Jacobs Engineering Group

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DOE/OR/21548-775

Weldon Spring Site Remedial Action Project

Close-Out Report for Vicinity Properties MDC6 and MDC9

Revision 0

April 1999

Prepared by

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for the

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ABSTRACT

The *Close-out Report for Vicinity Properties MDC6 and MDC9* summarizes the numerous activities involved in the remediation of each respective property. Both properties are located on Missouri Department of Conservation property and were contaminated as a result of past U.S. Atomic Energy Commission activities. MDC 6 represented an area approximately 200 m² and is located on the northeast upper rim of the Weldon Spring quarry. MDC9 is located north of the Femme Osage slough and south of the Katy Trail and represented an area of approximately 0.9 acres. Pre-remediation chemical and radiological characterization, remedial construction, and clean-up verification activities are detailed within this report.

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1. INTRODUCTION

1.1 Purpose

This closeout report has been prepared to document remedial actions within Missouri Department of Conservation (MDC) properties 6 and 9 (MDC 6 and MDC 9). Both properties are located on Missouri Department of Conservation wildlife areas and are located near the Weldon Spring Quarry.

1.2 Scope

A close-out report for each vicinity property or grouping of vicinity properties will be prepared following remedial activities. These close-out reports will be included in the *Remedial Action Report for the Weldon Spring Quarry Residuals Operable Unit*, which will be prepared in accordance with *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (CERCLA) requirements. A final site close-out report will also be prepared to complete deletion of the Weldon Spring Site from the National Priorities Listing.

1.3 Background

The Weldon Spring site is located in St. Charles County, Missouri, approximately 48 km (30 miles) west of St. Louis. The site consists of two geographically distinct areas; the 88-ha (217 acres) chemical plant area and a 3.6 ha (9 acres) limestone quarry. The chemical plant area is approximately 3.2 km (2 mi) southwest of the junction of Missouri State Route 94 and U.S. Route 40/61. The quarry is located about 6.4 km (4 mi) south-southwest of the chemical plant area. The chemical plant area and the quarry are accessible from State Route 94 and both are currently fenced and closed to the public.

The chemical plant area was initially used by the U.S. Department of the Army (Army) to produce the explosives trinitrotoluene (TNT) and dinitrotoluene (DNT) from 1941 to 1946. By 1949, all but 810 ha (2,000 acres) of the ordnance works property had been transferred to the State of Missouri and the University of Missouri. Most of the remaining property became the chemical plant area of the Weldon Spring site and the adjacent U.S. Army Reserve and National Guard training area.

In May 1955, the U.S. Atomic Energy Commission (AEC), a predecessor of the U.S. Department of Energy (DOE), acquired 83 ha (205 acres) to construct a uranium feed materials plant. After extensive demolition, decontamination, and re-grading, the chemical plant was built by the AEC to process uranium and thorium ore concentrates from 1957 to 1966. Radioactively and chemically contaminated waste was disposed of within the chemical plant during this period. Radioactive contaminants are primarily radionuclides of the natural uranium and Thorium-232 decay series. Chemical contaminants of concern include heavy metals and inorganic anions in

excess of naturally occurring background levels, as well as organics including polychlorinated biphenyls (PCBs) and polynuclear (or polycyclic) aromatic hydrocarbons (PAHs).

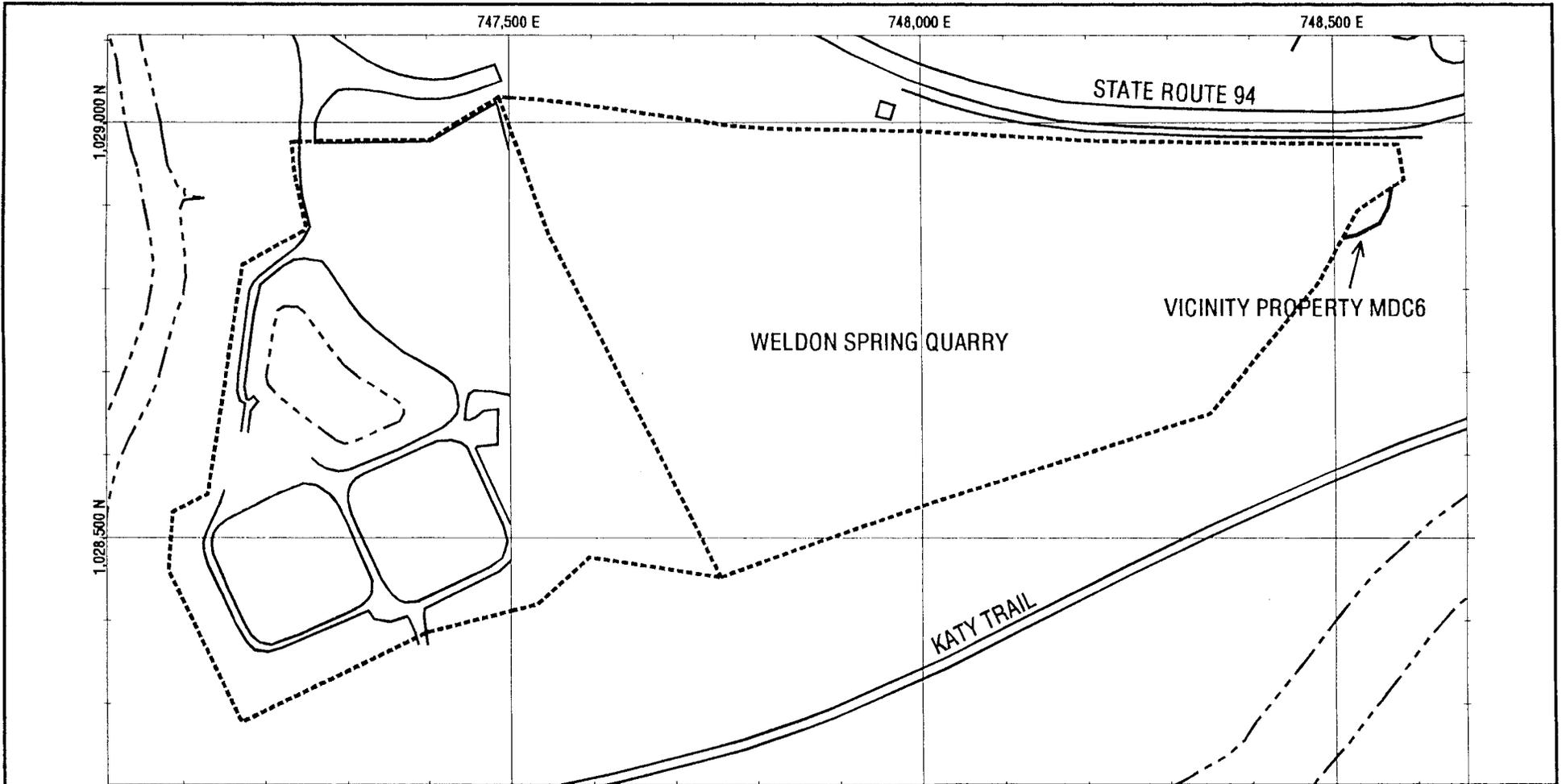
In 1958, the AEC acquired title to the Weldon Spring Quarry from the Army. The Army had used the quarry since 1942 for burning wastes from the manufacture of TNT and DNT and disposal of TNT-contaminated rubble during the operation of the ordnance works. Prior to 1942, the quarry was mined for limestone aggregate used in the construction of the ordnance works. The AEC used the quarry from 1963 to 1969 as a disposal area for uranium residues and a small amount of thorium residue. Material disposed of in the quarry during this time also consisted of building rubble and soils from the demolition of a uranium ore processing facility in St. Louis. These materials were contaminated with uranium and radium. Other radioactive materials in the quarry included drummed wastes, uncontained wastes, and contaminated process equipment.

The Army reacquired the chemical plant property in 1967 and began decontamination and dismantlement operations in order to prepare the facility for herbicide production. However, this project was cancelled in 1969 before production was initiated, and the Army returned responsibility for the property to the DOE.

The Weldon Spring site was placed in caretaker status from 1981 to 1985, when custody was transferred from the Army to the DOE. In 1985, the DOE proposed designating control and decontamination of the chemical plant, raffinate pits, and quarry as a major project. A Project Management Contractor (PMC) for the Weldon Spring Site Remedial Action Project was selected in February 1986. The quarry was placed on the Environmental Protection Agency National Priorities List (NPL) in July 1987. The DOE re-designated the site as a Major Acquisition System in May 1988. The chemical plant and raffinate pits were added to the NPL in March 1989.

Vicinity property MDC 6 was identified in the *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (ROD) (Ref. 1) as an unremediated radiologically contaminated vicinity property. MDC 6 is an area located adjacent to the perimeter fence along the northeast upper rim of the Weldon Spring Quarry (Figure 1-1). The area was defined as an isolated area of soil, 91 cm by 91 cm (3 ft. by 3 ft.). Contamination at this location was likely a result of dumping activities from the upper access area of Highway 94.

Vicinity property MDC 9 is located near the quarry between the Katy Trail and the Femme Osage Slough (Figure 1-2). The area is within the floodplain of the Missouri River and is often inundated for varying periods by the Femme Osage Slough and/or the Missouri River. This location consisted of approximately 0.9 acres with contamination varying at various depths. Contamination at this location was as a result of past activities within the Weldon Spring Quarry.

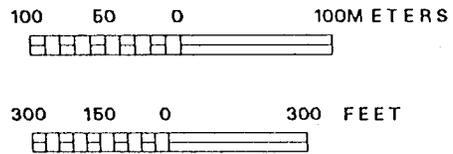
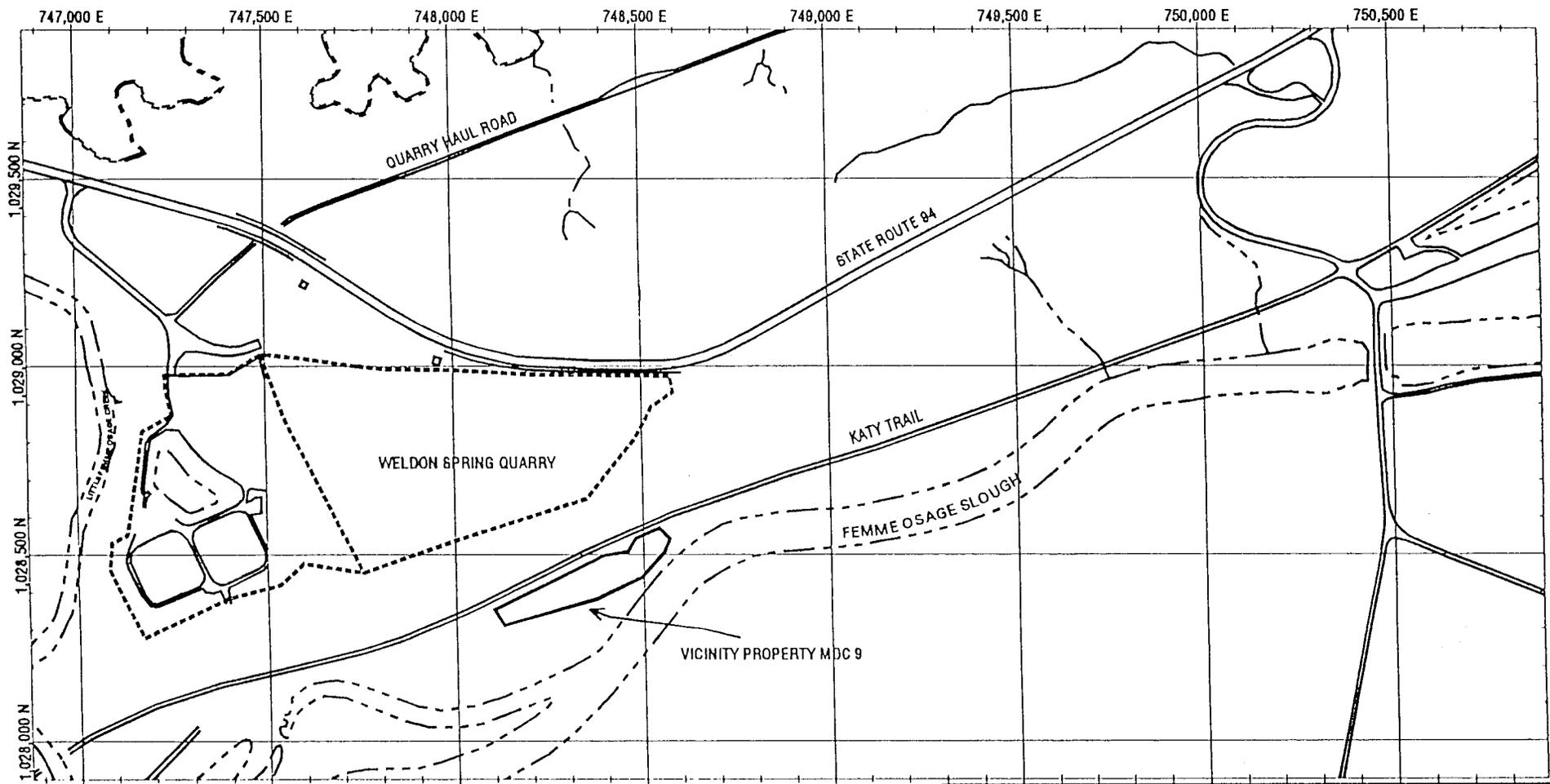


LOCATION OF VICINITY PROPERTY MDC 6

Figure: 1-1



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-  Surface Hydrology
-  Quarry Fence
-  Roads, Structures



LOCATION OF VICINITY PROPERTY MDC 9

Figure: 1-2

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ORIGINATOR:	E. RIPP	DRAWN BY:	WSSRAP GIS
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1.4 Vicinity Property and Operable Unit Description

In 1985, Oak Ridge Associated Universities (ORAU) conducted a comprehensive radiological survey of all areas outside the chemical plant boundary and within the boundary of the previous ordnance works area (Ref. 2 and Ref. 3). The purpose of the study was to assess the extent and levels of off-site radiological contamination resulting from the operation of the uranium feed materials plant. The study examined surface and subsurface soils, water, and sediment on the properties adjacent to the site.

Soils at several small locations on the U.S. Department of Army Ordnance Works Area and the Missouri Department of Conservation State conservation areas contain generally low levels of radioactivity as a result of previous site activities. In total, ORAU identified 17 vicinity properties, seven of which are located on the Weldon Spring Training Area and 10 that are located on the Missouri Department of Conservation wildlife areas.

1.5 CERCLA Summary

The *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (Ref. 1) is a remedial action decision document selected in accordance with the CERCLA. It was established for the chemical plant area operable unit and addresses selected remedial actions for various sources of contamination at the chemical plant and off-site vicinity properties. Remedial actions established within the ROD for vicinity properties involve soil removal and on-site disposal within a facility designed and constructed specifically for the Weldon Spring site wastes. The ROD was signed by the DOE on September 13, 1993 and by the Environmental Protection Agency (EPA) on September 28, 1993.

Cleanup criteria for soils identified within the ROD were developed from the results of the site-specific risk assessment for a residential scenario. Additionally, as low as reasonably achievable (ALARA) criteria were developed to represent lower levels that the remedial actions would aim to achieve during field excavation activities. Cleanup criteria and ALARA values are applicable to soils that will be surface soils (0 in. to 6 in.) or subsurface soils (greater in. than 6 in.). Radiological and chemical contaminants for the chemical plant area are defined in the ROD and listed in Table 1-1. Soils excavated will be transported to the chemical plant area for temporary storage and for final on-site disposal in an engineered disposal facility being constructed in accordance with the ROD.

Table 1-1 Radionuclide and Chemical Contaminant Soil Cleanup Criteria

Radionuclide (pCi/g)	SURFACE		SUBSURFACE	
	ALARA	Criteria	ALARA	Criteria
Radium-226	5.0	6.2	5.0	16.2
Radium-228	5.0	6.2	5.0	16.2
Thorium-230	5.0	6.2	5.0	16.2
Thorium-232	5.0	6.2	5.0	16.2
Uranium-238	30.0	120	30	120
Chemical (mg/kg)				
Arsenic	45	75	75	750
Chromium (total)	90	110	110	1,110
Chromium (VI)	90	100	100	1,000
Lead	240	450	450	4,500
Thallium	16	20	20	200
PAHs	0.44	5.6	5.6	56
PCBs	0.65	8	8	80
TNT	14	140	140	1,400

2. PRE-REMEDATION ACTIVITIES

2.1 MDC6 Soil Characterization Data

Initial soil characterization activities for MDC 6 were conducted by Oak Ridge Associated Universities (ORAU) in 1985 (Ref. 2). Radionuclide concentrations in the single surface soil sample collected consisted of 8.35 pCi/g Radium-226, 350 pCi/g Thorium-230, 25.7 pCi/g Thorium-232, and 8.35 pCi/g Uranium-238. Additional soil characterization activities were conducted by the Project Management Contractor (PMC) to delineate the boundaries and provide a more accurate estimate of the volumes within MDC 6. The PMC collected soil samples in 6 in. increments to a depth of 3 ft at one sample location. The results revealed Th-230 as the primary contaminant with a maximum concentration of 294 pCi/g in the 0 in.-to-6 in. sample. The remaining Th-230 values for the five subsurface samples were below the detection limits. Ra-226 concentrations ranged from 1.6 pCi/g to 7.9 pCi/g. Ra-228 concentrations ranged from 1.5 pCi/g to 12.6 pCi/g. Uranium values were below the detection limits. In situ gross gamma radiation levels measured in the borehole indicated that the vertical contamination extended 2.5 ft in depth.

To delineate the horizontal boundary of contamination at MDC 6, the PMC measured gross gamma radiation levels on the surface of the ground in 1-ft increments from the approximated center of the area in the north-south and east-west directions until background readings were detected. The measurements indicated a 3 ft by 3 ft area of contamination. The quantity of contaminated material was estimated to be less than 1 cu yd.

2.2 MDC9 Soil Characterization Data

Initial soil characterization activities for MDC 9 were conducted by ORAU in 1985 (Ref. 2). Four boreholes were drilled on the north side of the Femme Osage Slough directly south of the Weldon Spring Quarry. Elevated levels of U-238 were discovered and ORAU estimated approximately 11,771 cu yd of soil should be removed from the area.

In 1988, additional soil characterization of MDC 9 was conducted by UNC Geotech. Results of this sampling are presented in the *Radiologic Characterization of the Weldon Spring, Missouri Remedial Action Site* (Ref. 4). Thirteen boreholes were drilled south of the Katy Trail and north of the Femme Osage Slough (MDC 9). Out of the 13 boreholes, seven boreholes exhibited elevated radiological contamination at various depths greater than ALARA levels. All thirteen boreholes, however, contained U-238 concentrations below *Record of Decision* (ROD) cleanup criteria (Ref. 1).

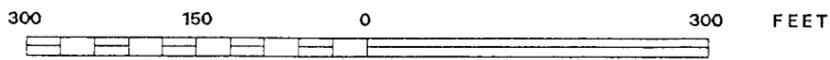
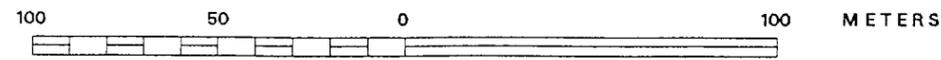
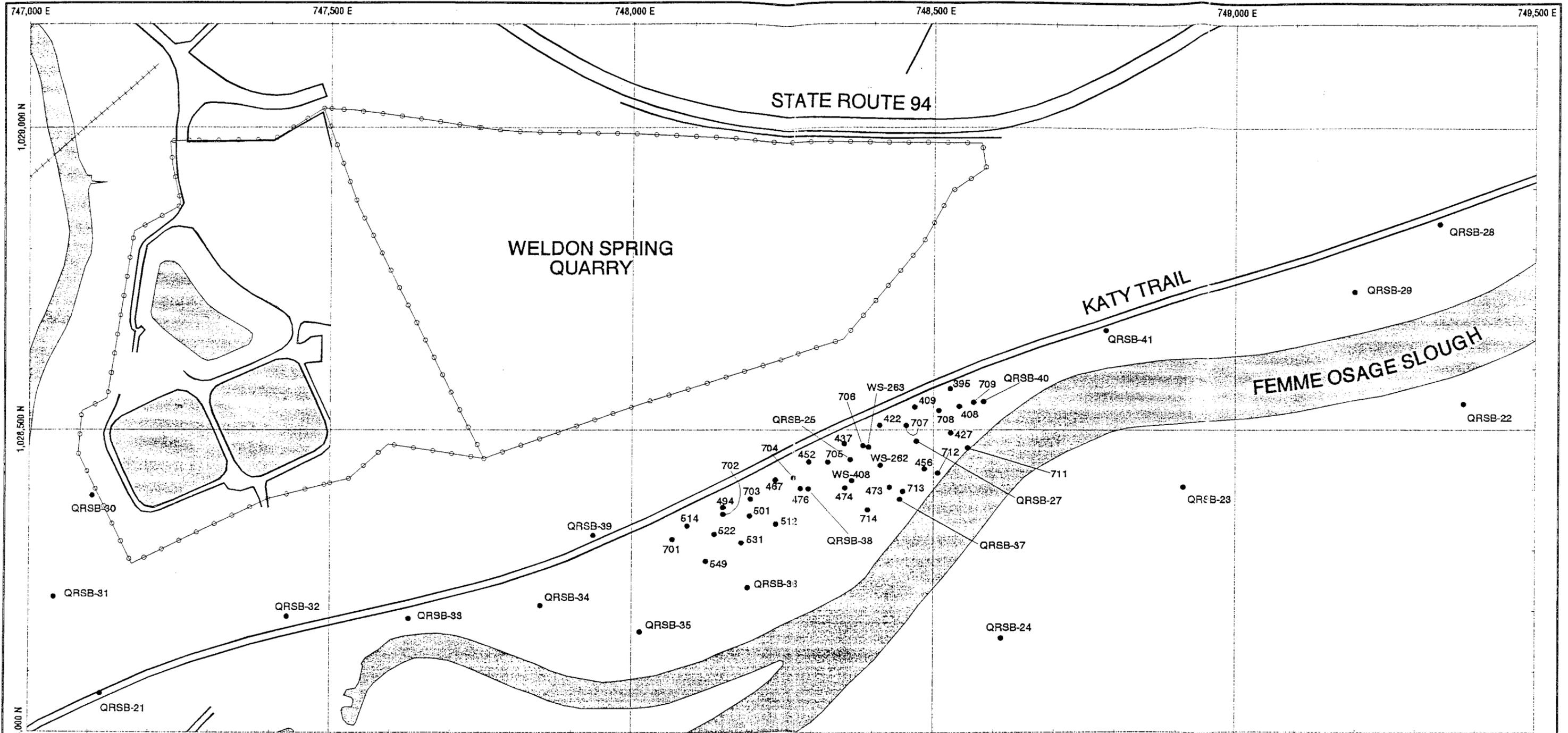
Based on both the ORAU and UNC Geotech sampling activity results, further characterization of MDC 9 was conducted by the PMC during 1994. This characterization was detailed in the *Quarry Residuals Sampling Plan* (Ref. 5) and included two Phase 1 soil sampling

events. These events encompassed collection of samples from both surface soils and soil borings that extended from the surface to bedrock.

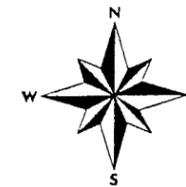
In the first Phase 1 sampling event (1A), composite surface samples were collected from 14 sampling areas. The 14 areas were defined as approximately 200 ft in width and extended from the Katy Trail to the Femme Osage Slough. Nine random samples were taken at the 0 in. to 6 in. depth within each of the 14 areas and composited. All 14 samples were analyzed for nitroaromatics, metals, and radionuclides. The results were detailed in the *Surface Soil Analytical Results for the Vicinity Property 9 Area* (Ref. 6). Results revealed that only uranium exceeded the as low as reasonably achievable (ALARA) criteria as defined in the ROD. No nitroaromatics were detected within the soil samples and none of the three metals (arsenic, chromium, and lead) were found above or near their ALARA levels.

In the second Phase 1 soil sampling event (1B), soil borings were taken from the alluvial soils south of the quarry and from several background locations. In addition to radiological analysis, extensive chemical analysis was run on the soil samples. The extensive chemical analysis consisted of heavy metals, nitroaromatics, and polychlorinated biphenyls (PCBs). Samples were collected from the following depth intervals: 0 in. - 6 in., 6 in. - 2 ft, 2 ft - 5 ft followed by 5 ft increments to the bedrock. In many of the soil borings, elevated levels of total uranium were present from the surface to bedrock. However, uranium levels above 100 pCi/g were not detected at depths exceeding 1 ft. The highest value from these borings was 355 pCi/g, which occurred in the 0 to 0.5 ft. depth interval. The highest uranium concentrations also occurred in the upper intervals of the other four borings. Extensive chemical analysis revealed that no sample location exceeded ROD cleanup criteria levels.

Based on this information, the calculated volume of soil to be removed within MDC 9 was primarily a function of the lateral extent of contamination and the depth of the water table. To delineate the boundary of MDC 9, the PMC collected engineering characterization data. All samples were analyzed for U-238 at 0 in. - 6 in. and 6 in. - 1 ft increments only. The results of the engineering characterization data delineated an area approximately 0.9 acres with a depth ranging from 1 ft to the capillary fringe (approximately 5 ft to 6 ft). Both Phase 1B soil borings and engineering characterization sample locations are detailed in Appendix A and Figure 2-1.



- Water Bodies
- Soil Sampling Location
- Railroads
- Roads
- Quarry Fence
- Other Drainage



Vicinity Property 9
Soil Sampling Locations

Figure 2-1

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ORIGINATOR: E. Ripp	DRAWN BY: WSSRAP GIS DATE: 03/03/99

3. REMEDIAL ACTIVITIES

3.1 MDC6 Construction Activities

The remediation of MDC 6 was conducted in November of 1993 as part of the construction activities for bulk waste removal at the Weldon Spring Quarry. The work was performed under Work Package 186 and began on November 11, 1993. Once remedial activities commenced, the area of contaminated soil removal increased from approximately 1 m² to 200 m² based upon the NaI 2x2 readings obtained during the walkover of the excavation. Depth of the excavation ranged from 6 in. to 12 in. with an approximate total soil volume between 109 yd³ and 219 yd³. The quarry perimeter fence was taken down and excavated soils were placed inside the fence line on the inner rim of the quarry. After the soil was placed inside the quarry proper, it was grouped with additional contaminated soil within the quarry and documented in the *Record of Decision for the Quarry Bulk Waste Removal*. The soil was removed at a later date and transported to the temporary storage area (TSA) for final disposal within the disposal cell.

During the evenings, the open excavation was covered with a 20 mil poly liner to control emissions and potential rainwater accumulation. Backfilling of MDC 6 was conducted on November 23, 1993. The backfill consisted of gravel and was spread by backhoe into the excavated area. Upon completion of the backfill, the perimeter fence was replaced. Confirmation sampling was not performed at MDC 6 immediately after excavation because cleanup criteria in the ROD had not yet been established.

3.2 MDC9 Construction Activities

Remediation of MDC 9 began on January 4, 1996, and was completed on February 29, 1996. The remediation was performed under Work Package 461. Road development activities were conducted prior to soil removal. Gravel was added and graded to the Katy Trail along with the access road leading into the quarry area. Hauling activities used a route from MDC 9 over the Katy Trail to Gate F of the Weldon Spring Quarry near the Quarry Water Treatment Plant. Haul trucks then traveled the quarry haul road to the chemical plant site and off-loaded either at the Ash Pond Storage Area or Chipped Wood storage area.

Because of the influence of local surface water bodies and shallow groundwater on the feasibility of excavation activities, the timing of the excavation activities was selected to maximize safe access to soils in the MDC 9 area. Trees in the area were cleared and grubbed and the vegetative debris was hauled to the Chipped Wood storage area at the chemical plant site. Surface water and runoff control structures were constructed to prevent uncontaminated water from entering the excavation zone and becoming contaminated. A soil berm was constructed from the Katy Trail to the Femme Osage Slough to divert surface water runoff during the excavation activities.

Vicinity property MDC 9 consisted of three work zones (Zone 1, 2, and 3). Excavation of soil to the depth defined in the work package, plus additional soil that was excavated based upon the radiological walkover surveys was transported to the Ash Pond Storage Area at the chemical plant. Any area exceeding 1.5 times background activity was excavated until the background activity fell below this criteria. Soil was removed in 1-ft lifts to a point approximately 6 in. above the groundwater level. Approximately 4,450 bank cubic yards of soil were removed from the area and transported to the Ash Pond storage area for final placement in the disposal cell. Dependent upon walkover surveys, final excavation depths ranged from 1 ft. to the capillary fringe (approximately 5 ft to 6 ft). No building foundations, utilities, or other potentially-contaminated materials were located within MDC 9. Hauling activities were completed on February 15, 1996. Clean soil from the Lost Valley Area (Drainage 5100, northwest of the quarry) was used as backfill material after confirmation sampling had been completed and the sampling results permitted unrestricted release of the vicinity property. Reseeding of MDC 9 was completed on February 22, 1996, and the subcontractor completed demobilization of equipment on February 28, 1996.

3.3 Changes Affecting CERCLA Compliance

No changes affecting the *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA) were required during the removal action at either MDC 6 or MDC 9.

3.4 Emergency Responses

No emergency response activities were required as a result of work conducted and completed within MDC 6 under Work Package 181 or within MDC 9 under Work Package 461. No spills or contamination events occurred during work activities performed under both contracts.

3.5 Real Estate License Agreements

The remediation of MDC 6 was conducted under a temporary construction easement granted to the U.S. Department of Energy (DOE) by the Conservation Commission of the State of Missouri. The easement was granted on November 4, 1988, and permitted the DOE to access and remediate specified property within and along the Weldon Spring Quarry. MDC 6 was located within this specified property. The easement will expire upon completion of remediation activities, which is currently scheduled for September 2002.

Prior to the remediation of MDC 9, real estate license agreements with the Missouri Department of Conservation (MDC) and the Missouri Department of Natural Resources (MDNR) were obtained. Real estate license 7-96-0101 was executed between the DOE and MDC on October 18, 1995. This license granted the DOE permission to access and perform

remediation of contamination within MDC 9. It also allowed the placement of a hose over MDC property running from the Katy Trail to the quarry area so that contaminated groundwater and/or surface water could be removed from MDC 9.

On November 16, 1995, real estate license 7-96-0106 was executed between the DOE and MDNR. This license permitted the DOE to access the Katy Trail and right-of-way property along the Katy Trail for the removal and transport of contaminated soil and sediment. In addition to the removal and transport of contaminated material, the license allowed the placement of one hose along the trail for the removal of potentially contaminated groundwater and/or surface water. The placement of two pump test pads and the installation/operation of groundwater monitoring wells were also granted by the license. The DOE and MDNR executed a "Supplemental Agreement of Ingrant" for this license on January 24, 1996, which detailed exactly when the work was to be performed and restricted the height of stockpiled soils on the weekends.

In addition to the real estate licenses obtained by the DOE, a Floodplain Development Permit was required for MDC 9 remediation activities. On September 25, 1995, the DOE obtained Floodplain Development Permit FP 95017 from St. Charles County. The permit mandated that no increase to the base flood (100 year) elevation was to result from remediation of MDC 9.

4. SAMPLING RESULTS

4.1 MDC6 Cleanup Verification

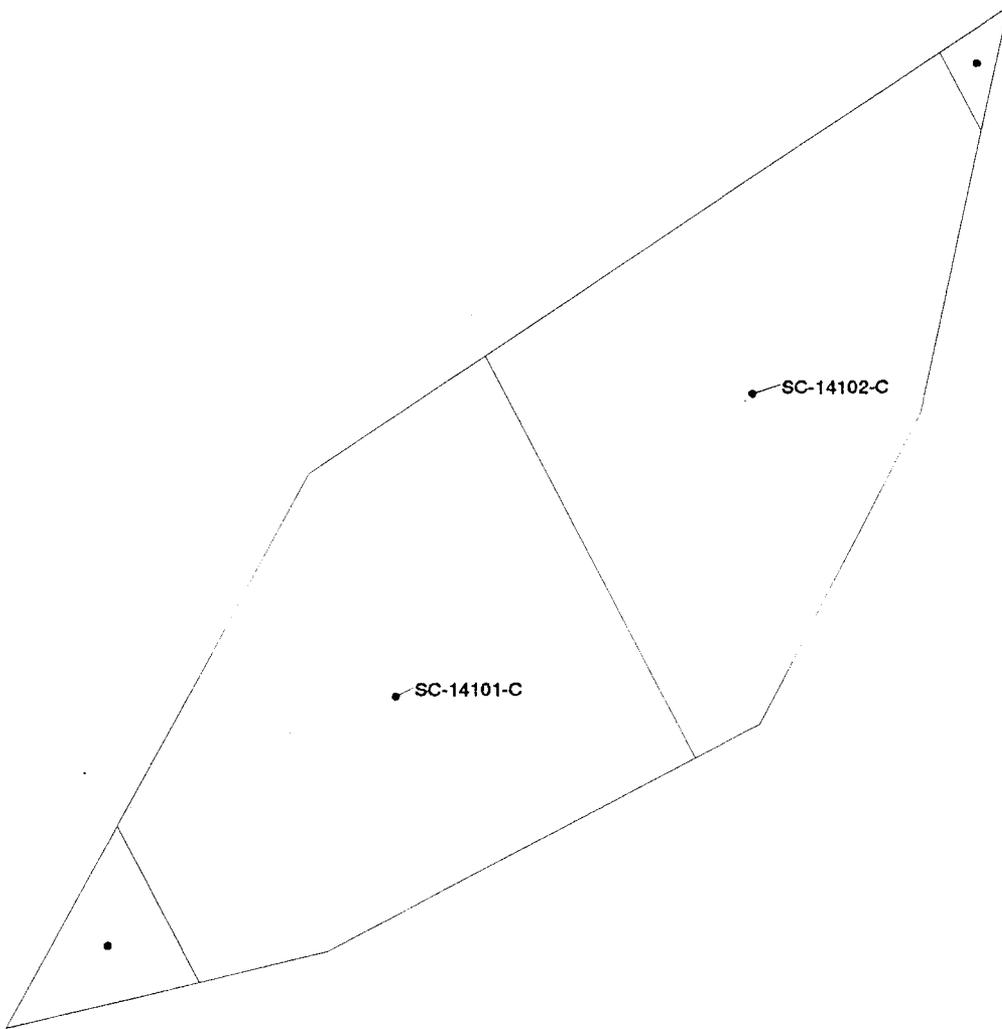
As stated previously, confirmation sampling was not performed on MDC 6 immediately after the contaminated soil had been excavated. In 1994, sampling was performed on MDC 6 using a 30 ft x 30 ft grid system (Appendix B). Forty-six sample locations were identified. Three sample depth increments were to be taken at each sample location (0 in. to 6 in., 12 in. to 18 in., and 24 in. to 30 in.). At some locations, augering was terminated at shallower depth due to auger refusal on rock. Results from the upper rim zone indicated detectable levels of U-238 at two of the 46 sampling points (4.53 and 6.12 pCi/g). These levels were within the upper 6 in. of the boring. Detectable levels of Ra-226 and Ra-228 were identified in all the samples obtained. The highest Ra-226 concentration was 3.25 pCi/g and the highest Ra-228 concentration was 1.45 pCi/g. Eleven of the 46 sample locations were selected for Th-230 analysis. Th-230 values ranged from 0.26 pCi/g to 6.07 pCi/g with the highest levels in the 0 in. to 6 in. boring interval.

In October of 1995, additional soil characterization sampling was performed on MDC 6 to ensure that no contamination was present at a depth greater than 3 ft. The gravel backfill was removed and samples were taken to a depth of 6 ft. As shown in Table 4-1, the as low as reasonably achievable (ALARA) values for Ra-226, Ra-228, Th-230 and Th-232 (5 pCi/g), U-238 (30 pCi/g) and 2,4,6-trinitrotoluene (TNT) (14 µg/g) were never met or exceeded. Results from this additional characterization revealed no radiological or 2,4,6-TNT contamination above ALARA 3 ft or greater in depth.

Table 4-1 MDC6 Characterization Data from Soil Borings to Bedrock

Sample ID #	Ra-226 (pCi/g)	Ra-228 (pCi/g)	Th-230 (pCi/g)	Th-232 (pCi/g)	ALARA (pCi/g)	U-238 (pCi/g)	ALARA (pCi/g)	2,4,6-TNT (ug/g)	ALARA (ug/g)
SO-195300-05	0.85	< 1.6	< 1.1	1.29	5.0	< 1.4	30.0	N/A	14.0
SO-195300-06	0.68	< 2.0	< 1.1	1.4	5.0	< 1.2	30.0	< 0.25	14.0
SO-195302-04	1.63	< 0.8	< 1.0	0.88	5.0	< 1.1	30.0	N/A	14.0
SO-195303-03	1.25	< 2.6	< 1.2	1.1	5.0	< 1.2	30.0	N/A	14.0
SO-195303-04	1.46	< 3.1	< 1.2	1.10	5.0	< 1.1	30.0	< 0.24	14.0
SO-195303-05	1.70	< 2.7	< 1.3	1.07	5.0	< 1.2	30.0	N/A	14.0
SO-195303-06	0.80	< 1.8	< 0.9	1.36	5.0	< 1.4	30.0	N/A	14.0

For confirmation purposes, MDC 6 was designated as Remedial Unit 12 (RU012). RU012 consisted of one confirmation unit (CU) approximately 200 m² based on the *Chemical Plant Area Cleanup Attainment Confirmation Plan* (Ref. 7). The remedial unit was referenced as Confirmation Unit 141 (CU141). Confirmation sample locations were selected by superimposing a 10 m grid across MDC 6. Because the area was small, two center points that were within the area targeted for contaminated soil removal were selected for sample locations (Figure 4-1).



5 2.5 0 METERS

15 7.5 0 FEET

**Sample Locations in Remedial Unit RU012
Confirmation Unit CU141**

Figure: 4-1

EXHIBIT NO.:	G/CP/094/0399	REPORT NO.:	DOE/OR/21548-775
ORIGINATOR:	EMR	DRAWN BY:	WSSRAP GIS
		DATE:	03/10/99

After surveying the sample locations, confirmation sampling was performed by collecting soil from the remediation cut surface to a depth of 6 in. Both samples were analyzed on site for the parameters Ra-226, Ra-228, Th-230, Th-232, and U-238. The results of the confirmation sampling activity for MDC 6 are detailed in Table 4-2.

Table 4-2 Confirmation Unit 141 Radionuclide Sample Summary

Sample Location ID No. and Parameter	Concentration (pCi/g)	ALARA Standard (pCi/g)	Cleanup Criteria Standard (pCi/g)
SC-14101-C			
Ra-226	1.11	5.0	6.2
Ra-228	1.05	5.0	6.2
Th-230	1.10	5.0	6.2
Th-232	0.66	5.0	6.2
U-238	< 3.52	30.0	120
SC-14102-C			
Ra-226	1.29	5.0	6.2
Ra-228	< 0.85	5.0	6.2
Th-230	1.76	5.0	6.2
Th-232	1.04	5.0	6.2
U-238	< 3.10	30.0	120

The guidelines for unrestricted release of this vicinity property were based on two criteria. The first criterion is whether the average radionuclide concentration of both sample points within the confirmation unit was below the ALARA goal concentration. The ALARA goal for Ra-226, Ra-228, Th-230, and Th-232 is 5.0 pCi/g. The ALARA goal for U-238 is 30.0 pCi/g. The average concentrations for all parameters in Table 4-2 are below each respective ALARA goal concentration.

The second criterion for unrestricted release is whether any single sample exceeds the cleanup criteria concentration (120 pCi/g). As shown in Table 4-2, all parameters were not only below cleanup criteria concentration but also below ALARA concentration. Based on satisfying both confirmation criteria, the entire confirmation unit was released for unrestricted use on July 8, 1996.

The Oak Ridge Institute for Science and Education (ORISE) was contracted by the U.S. Department of Energy (DOE) to audit the confirmation soil sampling in the chemical plant area and vicinity properties of the Weldon Spring site. This audit included walkover radiological surveys and independent collection and analysis of soil samples to verify proper disposition of the CUs. On July 29, 1996, ORISE conducted these verification activities within MDC 6. In response to the verification sampling results, ORISE drafted a correspondence letter report verifying the PMC's findings that remedial action objectives for MDC 6 had been met (Appendix C).

To determine whether the cleanup criteria established within the ROD for the chemical plant had been met, additional chemical characterization was required for MDC 6. The chemical contaminants of concern were arsenic, chromium, lead, thallium, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs). Two sample locations were chosen within close proximity to the radiological soil confirmation sample points. One sample was taken at each location with a sample depth interval of 3 ft to 4 ft. As shown in Table 4-3, the average concentration of both sample points for every parameter was below its respective ALARA goal concentration. Additionally, no single sample exceeded the cleanup criteria concentration. Thus, MDC 6 satisfied the criteria for unrestricted use. No chemical verification surveys were performed by ORISE on MDC 6.

Table 4-3 Confirmation Unit 141 Chemical Contaminant Sample Summary

Sample Location ID No. and Parameter	Concentration (mg/kg)	ALARA Standard (mg/kg)	Cleanup Criteria Standard (mg/kg)
SO-V97092-01			
Arsenic	12.7	45	75
Chromium	19.2	90	110
Lead	18.0	240	450
Thallium	2.7	16	20
PAHs	< 0.44	0.44	5.6
PCBs	< 0.42	0.65	8
SO-V97093-01			
Arsenic	9.3	45	75
Chromium	16.7	90	110
Lead	18.1	240	450
Thallium	1.3	16	20
PAHs	< 0.43	0.44	5.6
PCBs	< 0.41	0.65	8

4.2 MDC6 QA/QC Results

Confirmation sampling of MDC 6 was performed at the same time as the confirmation sampling for MDC 9. Radiological quality control samples for both vicinity properties were grouped together and the results can be referenced within the MDC 9 QA/QC results section of this closure report.

In the chemical confirmation sampling event, a field replicate was taken to assess the precision of the data set. This measurement is based on the relative percent differences between laboratory duplicates and their respective parent analysis. The data quality requirement for precision was met for MDC 6.

4.3 MDC9 Cleanup Verification

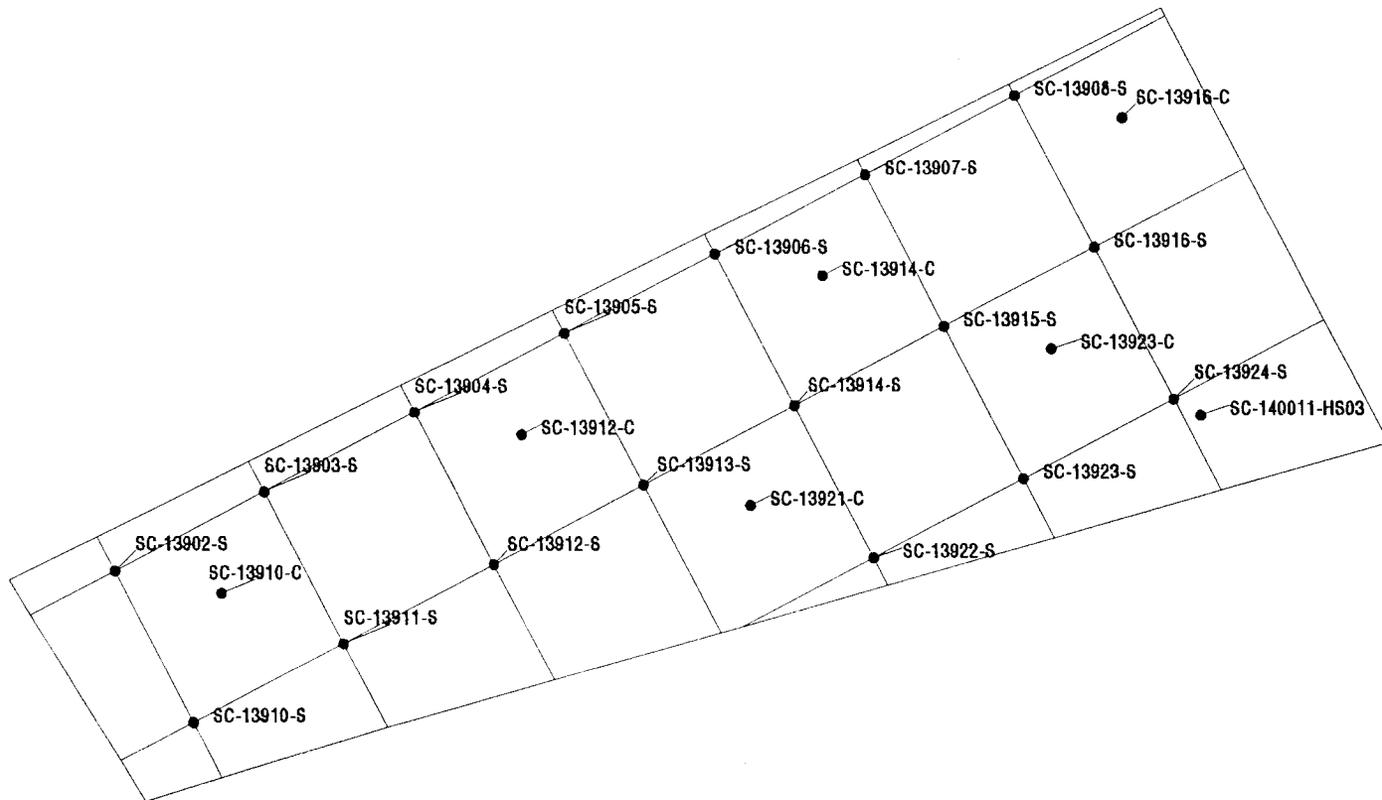
For confirmation purposes, MDC 9 was designated as Remedial Unit 11 (RU011). RU011 was divided into two CUs of approximately 2,000 sq m (approximately 0.5 acres) based on the *Chemical Plant Area Cleanup Attainment Confirmation Plan* (Ref. 7). The two contiguous CUs in RU011 were designated as CU139 and CU140. Surface radiological surveys were conducted upon initial completion of excavation using a 2 in. x 2 in. sodium iodide gamma detector. Further excavation was performed at any locations that reported surface gamma radioactivity more than 1.5 times background levels. The area was excavated until background activity fell below this criteria. After the entire CU was determined to be less than 1.5 times the background gamma radioactivity, confirmation sampling locations were surveyed and identified with pin flags. Soil samples were then collected in accordance with the *Confirmation Sampling Plan Details for Vicinity Property No. 9* (Ref. 8).

At three locations within CU140, soil exceeding the background activity level was excavated to capillary fringe depth. Excavating below the effective water table would require maintaining the integrity of the excavation slope and controlling groundwater influx into the excavation. This would result in significantly higher construction costs and was not considered "reasonably achievable" per the *Vicinity Property - MDC No. 9 Remediation ALARA Position Paper* (Ref. 9). Once this depth was reached, excavation was halted and the soil was sampled as a "hot spot." The three "hot spot" locations within MDC 9 are noted by a sample number suffix consisting of a "HS" and a sequential number (HS01, HS02, and HS03).

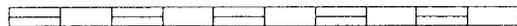
Sample locations were selected by superimposing a 10 m grid across the WP-461 work zone. All grid line intersections (nodes) and some center points that lie within the area targeted for contaminated soil removal were selected for sampling. The sampling locations were land surveyed for horizontal and vertical control and are shown in Figures 4-2 and 4-3. Confirmation sampling at each sample location was performed by collecting soil from the remediation cut surface to a depth of 6 in. for laboratory analysis. As stated previously, the only radiological contaminant of concern for MDC 9 was U-238.

Results of the confirmation sampling activity for MDC 9 are detailed in Table 4-4. The first criterion for unrestricted release of this vicinity property is whether the average U-238 concentration for all sample points within the confirmation unit was below the ALARA goal concentration. As stated previously, the ALARA goal concentration is 30 pCi/g. The average concentration for CU139 was 8.59 pCi/g and the average concentration for CU140 was 20.9 pCi/g.

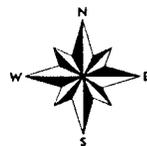
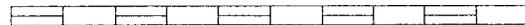
The second criterion is whether any single sample exceeds the cleanup criteria concentration (120 pCi/g). As shown in Table 4-2, the highest single sample concentration was



30 15 0 METERS



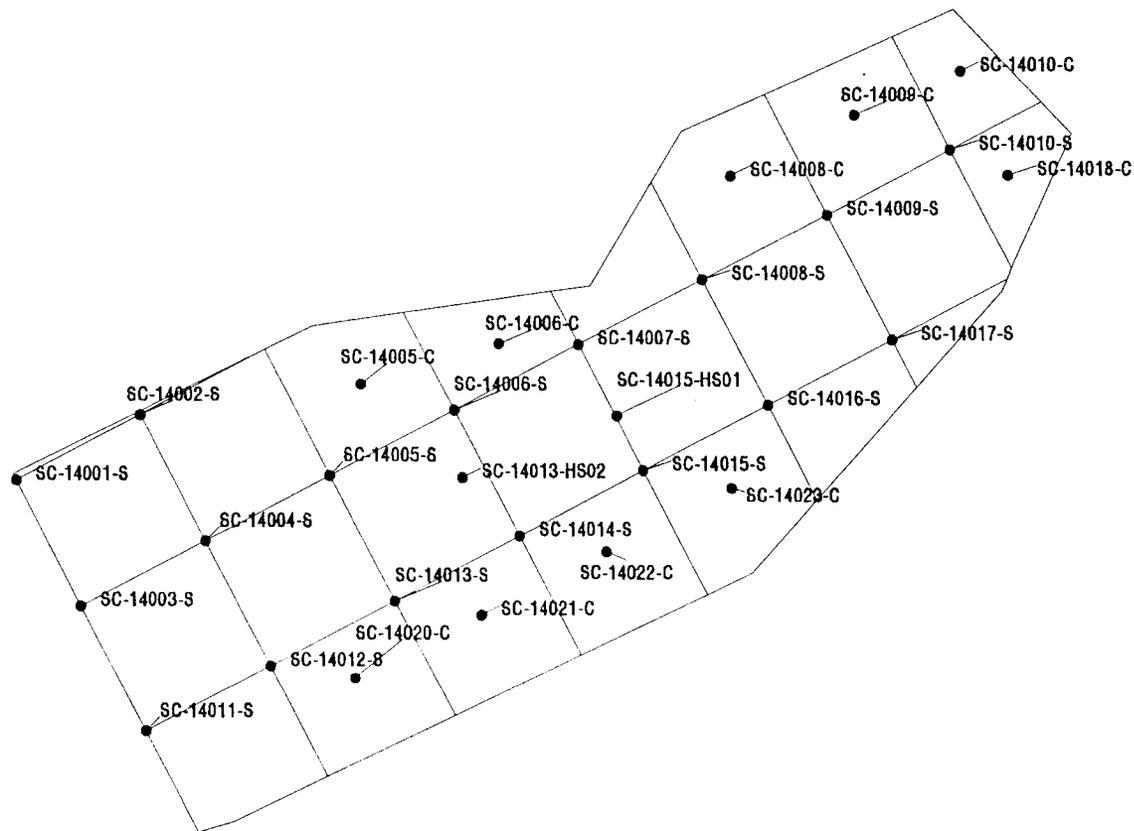
100 50 0 FEET



Sample Locations in Remedial Unit RU011 Confirmation Unit CU139

Figure: 4-2

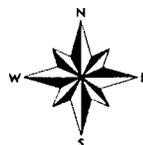
REPORT NO.:	DOE/OR/21548-775	EXHIBIT NO.:	G/CP/178/0499
ORIGINATOR:	E. RIPP	DRAWN BY:	WSSRAP GIS
		DATE:	04/04/99



30 15 0 METERS



100 50 0 FEET



Sample Locations in Remedial Unit RU011 Confirmation Unit CU140

Figure: 4-3

REPORT NO.:	DOE/OR/21548-775	EXHIBIT NO.:	G/CP/179/0499
ORIGINATOR:	E. RIPP	DRAWN BY:	WSSRAP GIS
		DATE:	04/04/99

81.1 pCi/g. Hence both confirmation units within MDC 9 (CU139 and CU140) met the requirements for unrestricted use. A portion of CU140 (Zone 1) was addressed in a partial release to provide an alternate route for transporting backfill to the site during the excavation activities. The partial release was requested to minimize the time the excavation was left open so that the volume of surface water run-on that required treatment would be minimized. The area denoted as Zone 1 was released for unrestricted use on January 30, 1996. The entire confirmation unit was released for unrestricted use on February 13, 1996. Confirmation unit 139 was released for unrestricted use on February 16, 1996.

Table 4-4 Confirmation Sampling Summary of MDC9
Confirmation Unit 139 Summary

Sample Location			U-238 Concentration	ALARA	Cleanup Criteria	
ID No.	Northing	Easting	(pCi/g)	Standard (pCi/g)	Standard (pCi/g)	Comments
SC-13902-S	1028356	748120	8.45	30.0	120	
SC-13903-S	1028371	748149	2.96	30.0	120	
SC-13904-S	1028386	748178	< 4.11	30.0	120	
SC-13905-S	1028401	748207	10.4	30.0	120	
SC-13906-S	1028417	748236	< 4.39	30.0	120	
SC-13907-S	1028432	748265	< 4.35	30.0	120	
SC-13908-S	1028447	748294	< 2.57	30.0	120	
SC-13910-C	1028352	748140	34.0	30.0	120	Exceeds ALARA
SC-13910-S	1028327	748135	5.09	30.0	120	
SC-13911-C	1028367	748169	11.5	30.0	120	
SC-13912-C	1028382	748199	4.56	30.0	120	
SC-13912-S	1028357	748193	< 2.76	30.0	120	
SC-13913-S	1028372	748222	13.0	30.0	120	
SC-13914-C	1028412	748257	9.43	30.0	120	
SC-13914-S	1028388	748251	12.2	30.0	120	
SC-13915-S	1028403	748280	14.6	30.0	120	
SC-13916-C	1028443	748315	< 4.50	30.0	120	
SC-13916-S	1028418	748309	16.6	30.0	120	
SC-13921-C	1028368	748243	3.00	30.0	120	
SC-13922-S	1028358	748266	< 4.79	30.0	120	
SC-13923-C	1028398	748301	4.01	30.0	120	
SC-13923-S	1028374	748296	8.06	30.0	120	
SC-13924-S	1028389	748325	25.9	30.0	120	

Table 4-4 Confirmation Sampling Summary of MDC9
Confirmation Unit 140 Summary

Sample Location			U-238	ALARA	Cleanup Criteria	
ID No.	Northing	Easting	(pCi/g)	Standard (pCi/g)	Standard (pCi/g)	Comments
SC-14001-S	1028462	748323	< 4.11	30.0	120	
SC-14002-S	1028477	748353	2.99	30.0	120	
SC-14003-S	1028433	748339	12.3	30.0	120	
SC-14004-S	1028448	748368	55.1	30.0	120	Exceeds ALARA
SC-14005-C	1028484	748404	26.5	30.0	120	
SC-14005-S	1028463	748397	37.1	30.0	120	Exceeds ALARA
SC-14006-C	1028494	748436	33.7	30.0	120	Exceeds ALARA
SC-14006-S	1028478	748426	16.6	30.0	120	
SC-14007-S	1028493	748455	6.79	30.0	120	
SC-14008-C	1028533	748491	11.2	30.0	120	
SC-14008-S	1028509	748484	15.9	30.0	120	
SC-14009-C	1028547	748520	14.3	30.0	120	
SC-14009-S	1028524	748513	19.0	30.0	120	
SC-14010-C	1028557	748545	3.92	30.0	120	
SC-14010-S	1028539	748542	30.1	30.0	120	Exceeds ALARA
SC-14011-HS03	1028386	748330	13.5	30.0	120	
SC-14011-S	1028404	748354	15.3	30.0	120	
SC-14012-S	1028419	748383	21.2	30.0	120	
SC-14013-HS02	1028463	748428	81.1	30.0	120	Exceeds ALARA
SC-14013-S	1028434	748412	22.8	30.0	120	
SC-14014-S	1028449	748441	24.3	30.0	120	
SC-14015-HS01	1028477	748464	34.7	30.0	120	Exceeds ALARA
SC-14015-S	1028464	748470	12.3	30.0	120	
SC-14016-S	1028479	748499	19.0	30.0	120	
SC-14017-S	1028495	748528	31.7	30.0	120	Exceeds ALARA
SC-14018-C	1028533	748556	18.5	30.0	120	
SC-14020-C	1028416	748403	14.7	30.0	120	
SC-14021-C	1028430	748432	9.08	30.0	120	
SC-14022-C	1028446	748461	4.51	30.0	120	
SC-14023-C	1028460	748491	18.0	30.0	120	

ORISE performed verification surveys in MDC 9 on February 12, 1996. A letter report verifying that remedial action objectives for this vicinity property had been met was drafted on April 25, 1996 (Appendix D).

4.4 MDC9 QA/QC Results

Specific data quality requirements (DQRs) were developed for the WSSRAP in accordance with Environmental Protection Agency guidance. Quality control sample results were compared to DQR goals to assess the precision and accuracy of the data and to identify samples that may require further validation activities.

To assess the precision of the MDC 9 data set, five duplicate soil samples and one field replicate soil sample were collected. Precision is a measurement, expressed as a percentage, which represents the repeatability of the result by the analytical system. Both relative percent differences between laboratory duplicates and their respective parent analysis and duplicate error ratios were calculated for the soil samples. As summarized in the *Post-Remedial Action Report for Vicinity Property No. 9* (Ref. 10), all data quality requirements for precision were met for MDC 9.

No matrix spike samples were initially collected during the confirmation sampling activity for MDC 9. However, matrix spike samples were collected during the sampling activities associated with Work Package 253 to satisfy the overall quality program requirements for accuracy. Accuracy is a statistical measurement, expressed as a percentage, that represents how close the analytical data is to the "true" value. All data quality requirements for accuracy were met for MDC 9.

5. OPERATIONS AND MAINTENANCE

5.1 Long-Term Monitoring

No long-term monitoring of soils is planned for either MDC 6 or MDC 9. The soil radiological concentrations in both vicinity properties satisfy the established criteria for unrestricted use.

5.2 Facilities and Equipment

No facilities or permanent equipment was constructed or installed as part of this remedial action. No long-term operations or maintenance activities are necessary.

6. REFERENCES

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2. Boerner, A.J. *Radiological Survey of the August A. Busch and Weldon Spring Wildlife Areas Weldon Spring Site, St. Charles County, Missouri*, Final Report. Prepared by Oak Ridge Associated Universities, for U.S. Department of Energy, Division of Remedial Action Projects. April 1986.
3. Deming, E.J. *Radiological Survey U.S. Army Reserve Property Weldon Spring Site, St. Charles County, Missouri, Final Report*. Prepared for U.S. Department of Energy, Division of Remedial Action Projects, by Oak Ridge Associated Universities. January 1986.
4. UNC Geotech. *Radiologic Characterization of the Weldon Spring Remedial Action Site*. Rev. 0. Prepared for U.S. Department of Energy, Grand Junction Projects Office. Grand Junction, Colorado. February 1988.
5. MK-Ferguson Company and Jacobs Engineering Group. *Quarry Residuals Sampling Plan*. Rev. 1. DOE/OR/21548-382. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. January 1994.
6. MK-Ferguson Company and Jacobs Engineering Group. *Surface Soil Analytical Results for the Vicinity Property 9 Area*. Rev. 1. DOE/OR/21548-463. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. June 1994.
7. MK-Ferguson Company and Jacobs Engineering Group. *Chemical Plant Area Cleanup Attainment Confirmation Plan*. Rev. 3. DOE/OR/21548-491. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. December 1995.
8. MK-Ferguson Company and Jacobs Engineering Group. *Confirmation Sampling Plan Details for Vicinity Property No. 9 (WP-461)*. Rev. 0. DOE/OR/21548-598. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. December 1995.

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10. MK-Ferguson Company and Jacobs Engineering Group. *Post-Remedial Action Report for Vicinity Property No. 9 (WP-461)*. Rev. 0. DOE/OR/21548-685. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. June 1997.

APPENDIX A
Soil Characterization Results from Phase 1B and Engineering
Sampling Activities

**Vicinity Property MDC 9 Phase 1B and Engineering
Soil Characterization Summary**

Sample # on Figure 2-1	Sample # within Wizard Database	Northing	Easting	U-238 Maximum Concentration (pCi/g)	Comments
QRSB-21	SO-194021	1028063	747120	1.80	
QRSB-22	SO-194022	1028543	749380	0.94	
QRSB-23	SO-194023	1028405	748912	1.09	
QRSB-24	SO-194024	1028155	748612	1.21	
QRSB-25	SO-194025	1028451	748362	355	Exceeds both ALARA & Criteria
QRSB-27	SO-194027	1028481	748472	134	Exceeds both ALARA & Criteria
QRSB-28	SO-194028	1028841	749340	1.59	
QRSB-29	SO-194029	1028728	749198	1.26	
QRSB-30	SO-194030	1028390	747106	1.16	
QRSB-31	SO-194031	1028223	747042	1.35	
QRSB-32	SO-194032	1028191	747429	2.23	
QRSB-33	SO-194033	1028188	747631	2.45	
QRSB-34	SO-194034	1028209	747849	3.58	
QRSB-35	SO-194035	1028166	748014	2.69	
QRSB-36	SO-194036	1028239	748190	2.12	
QRSB-37	SO-194037	1028385	748444	18.2	
QRSB-38	SO-194038	1028402	748294	29.5	
QRSB-39	SO-194039	1028325	747936	3.41	
QRSB-40	SO-194040	1028547	748582	17.1	
QRSB-41	SO-194041	1028665	748783	2.74	
395	SO-195395	1028568	748527	2.42	
408	SO-195408	1028539	748542	145.5	Exceeds both ALARA & Criteria
409	SO-195409	1028538	748469	2.02	
422	SO-195422	1028507	748411	2.32	
427	SO-195427	1028495	748528	35.87	Exceeds ALARA
437	SO-195437	1028477	748353	2.31	
452	SO-195452	1028447	748294	3.69	
456	SO-195456	1028435	748485	12.92	
467	SO-195467	1028417	748236	11.96	
473	SO-195473	1028405	748427	14.49	
474	SO-195474	1028404	748354	46.98	Exceeds ALARA
476	SO-195476	1028403	748280	40.81	Exceeds ALARA
494	SO-195494	1028371	748149	17.4	
501	SO-195501	1028357	748193	42.95	Exceeds ALARA
512	SO-195512	1028343	748237	25.57	
514	SO-195514	1028341	748091	12.39	
522	SO-195522	1028327	748135	30.76	Exceeds ALARA
531	SO-195531	1028313	748179	7.24	
549	SO-195549	1028283	748121	5.18	
701	SO-195701	1028318	748067	19.13	
702	SO-195702	1028360	748149	86.53	Exceeds ALARA
703	SO-195703	1028385	748194	14.81	
704	SO-195704	1028420	748268	82.25	Exceeds ALARA
705	SO-195705	1028447	748326	32.09	Exceeds ALARA
706	SO-195706	1028474	748383	72.53	Exceeds ALARA

Sample # on Figure 2-1	Sample # within Wizard Database	Northing	Easting	U-238 Maximum Concentration (pCi/g)	Comments
707	SO-195707	1028507	748455	5.71	
708	SO-195708	1028532	748509	91.85	Exceeds ALARA
709	SO-195709	1028546	748566	20.95	
711	SO-195711	1028470	748556	7.93	
712	SO-195712	1028428	748507	5.62	
713	SO-195713	1028398	748449	4.33	
714	SO-195714	1028368	748391	6.67	

APPENDIX B
Soil Characterization Results for the Quarry Rim
Zone and the Drainage Within the Quarry



DATE: May 10, 1995

TO: Gene Valett

FROM: Rebecca Cato-Johnston *acc 5/10/95*

SUBJECT: ADDITIONAL SOIL CHARACTERIZATION RESULTS FOR THE QUARRY RIM ZONE AND THE DRAINAGE WITHIN THE QUARRY

1 INTRODUCTION

This characterization was performed to delineate the areal and vertical extent of radiochemical contamination at two area at the quarry:

- (1) The quarry rim zone, which encompasses VP #6 and the adjacent area within the fence line, and a nearby intermittent drainage (Figure 1).
- (2) A drainage located on the northwestern slope where process materials were identified (Figure 2).

2 SAMPLING

In accordance with the sampling plan (3/94), sampling was performed on a 9.2 m by 9.2 m (30 ft by 30 ft) grid spacing, which resulted in 46 locations from the quarry rim zone and 12 locations from the northwestern slope. Samples were collected from three: (1) 0 cm - 15 cm (0 in - 6 in), (2) 30 cm - 45 cm (12 in - 18 in), and (3) 60 cm - 75 cm (24 in - 30 in). At some locations, augering was terminated at a shallower depth due to auger refusal on rock.

3 ANALYSIS

Samples were analyzed at the on-site radiological laboratory for the following radiochemical parameters:

U-238	Ra-226
Ra-228	Th-230

4 RESULTS

4.1 Quarry Rim Zone and Associated Drainage

Results from the upper rim zone indicate detectable levels of U-238 at 2 of the 46 sampling points: SO-109061-01 (4.53

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pCi/g) and SO-194064-01 (6.12 pCi/g). These levels were within the upper 15 cm (6 in) of the boring. Detectable levels of Ra-226 and Ra-228 were identified in all the samples obtained. The highest Ra-226 level was 3.25 pCi/g (SO-194098-01) from a sample located inside the fence area. The highest Ra-228 level was 1.45 pCi/g (SO-194061-01) from a sample located adjacent to the upper rim gate.

Based on the results of the U-238 and Ra-226 results, 11 locations were selected for Th-230 analysis:

SO-194057	SO-194093	SO-194097
SO-194060	SO-194094	SO-194098
SO-194061	SO-194095	SO-194099
SO-194064	SO-194096	

These results indicate that the highest levels are in the 0 cm to 15 cm (0 in - 6 in) interval of the borings. These values range from 0.26 pCi/g to 6.07 pCi/g. High levels were also identified in the 60 cm to 75 cm (24 in - 30 in) interval in two samples: SO-194057-03 (5.30 pCi/g) and SO-194060-03 (2.40 pCi/g) located along the fenceline near the upper rim gate.

No other samples from the rim zone were selected for additional Th-230 analysis. This determination was made based on the comparison of these results with the target risk levels for soil at the quarry (Section 5).

A summary of the results for the upper rim zone are contained in Attachment A.

4.2 Northwestern Slope

Results from the northwestern slope indicate no detectable levels of U-238 in any of the 12 sampling locations. Detectable levels of Ra-226 ranging from 0.67 pCi/g to 1.20 pCi/g and Ra-228 ranging from 0.78 pCi/g to 1.28 pCi/g were reported for this area. Based on these results, no locations were selected for Th-230 determination.

A summary of the results for the northwestern slope are contained in Attachment B.

5 CONCLUSIONS

The data for the upper rim zone was compared to the soil concentrations of radionuclides associated with several target risk levels (DOE/OR/21548-243, ANL, January 1994).

TABLE 1 Summary of Soil Concentrations with a Target Risk Level of 1×10^{-5}

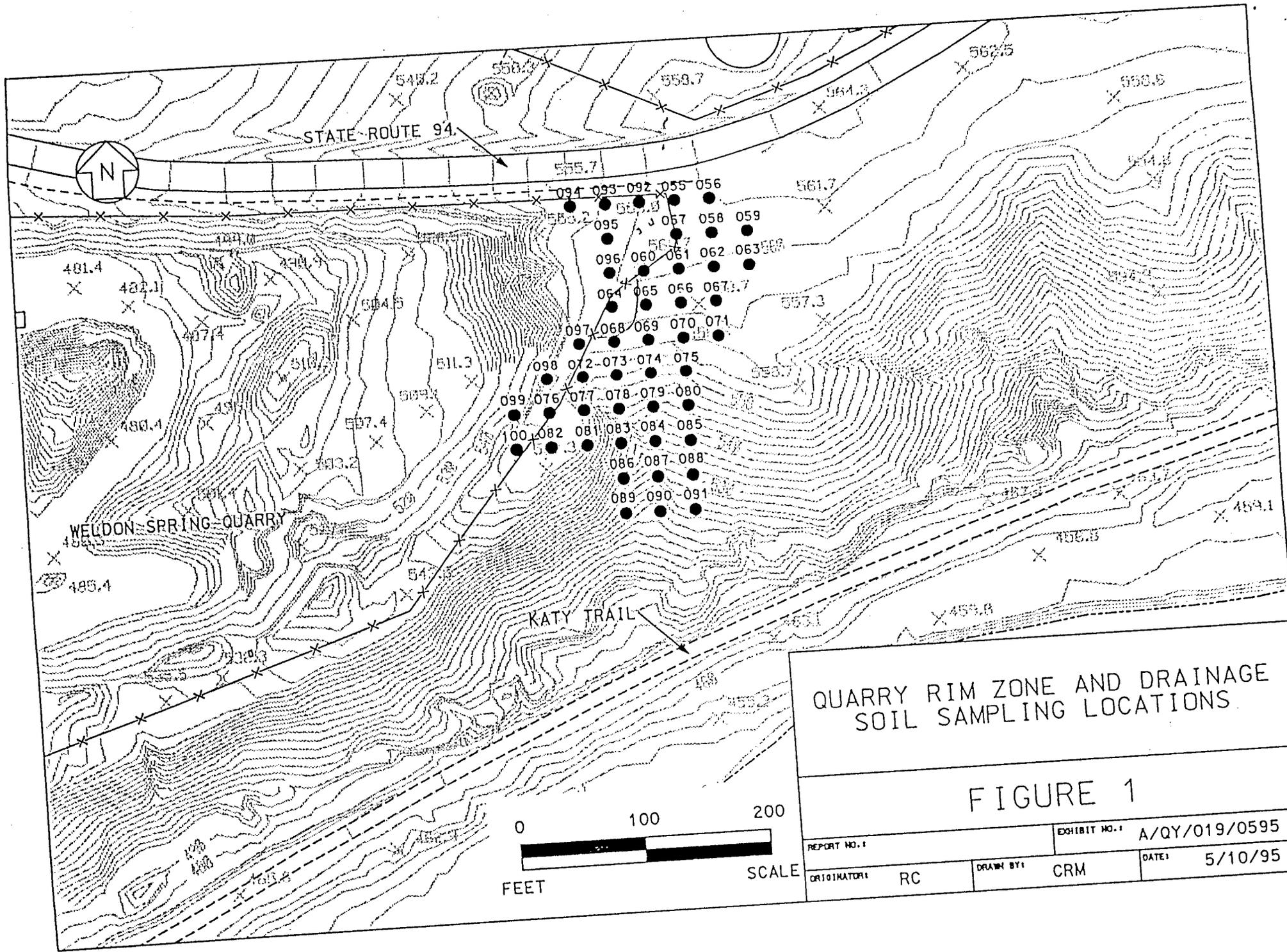
Radionuclide	Soil Concentration (pCi/g) Relative to Risk		
	1×10^{-6}	1×10^{-5}	1×10^{-4}
U-238	24	240	2400
Ra-226	0.14	1.4	14
Ra-228	0.43	4.3	43
Th-230	42	420	4200

Comparison of the results with these target levels indicates:

- None of the U-238 levels exceed the relative risk level of 1×10^{-6} .
- The relative risk level for Ra-226 of 1×10^{-5} is exceeded at 4 of the location in the upper rim zone.
- None of the Ra-228 levels exceed the relative risk level of 1×10^{-5} .
- None of the Th-230 levels exceed the relative risk level of 1×10^{-6} .

If you have any questions or comments, please contact me at extension 3507.

cc: Bill Goldkamp
 Steve Warren
 Lee Koehmstedt
 RC-26-05-03



QUARRY RIM ZONE AND DRAINAGE
SOIL SAMPLING LOCATIONS

FIGURE 1

REPORT NO. 1	EXHIBIT NO. 1	A/QY/019/0595
ORIGINATOR: RC	DRAWN BY: CRM	DATE: 5/10/95

A T T A C H M E N T A

Summary of Radiochemical Results
from Soil Characterization Sampling
Quarry Rim Zone

Summary of Radiochemical Results from Soil Characterization Sampling
Quarry Rim Zone

Sample ID		U-238 (pCi/g)	Ra-226 (pCi/g)	Ra-228 (pCi/g)	Th-230 (pCi/g)
194055	01	<1.67	1.24	1.10	NS
	02	<1.76	1.03	1.18	
	03	<1.58	0.68	0.96	
194056	01	<1.81	1.11	1.38	NS
	02	<1.51	0.77	1.10	
	03	<1.67	0.87	1.12	
194057	01	<1.73	1.10	0.97	2.40 0.20 5.30
	02	<1.72	1.04	0.93	
	03	<1.58	0.72	1.17	
194058	01	<1.76	1.18	1.58	NS
	02	<1.74	0.92	0.98	
	03	<1.63	1.16	1.02	
194059	01	<1.23	1.49	1.53	NS
	02	<1.58	0.83	1.22	
	03	<2.01	1.17	1.14	
194060	01	<1.39	1.10	1.09	3.30 0.40 2.40
	02	<1.28	1.09	0.88	
	03	<1.45	0.78	1.32	
194061	01	4.53	1.35	1.45	3.93 ND 0.15
	02	<1.60	1.00	0.89	
	03	<1.57	0.88	0.77	
194062	01	<1.75	1.26	1.13	NS
	02	<1.49	0.94	1.01	
	03	<2.00	1.06	1.13	
194063	01	<1.96	1.08	1.30	NS
	02	<1.46	0.74	1.03	
	03	<1.69	1.10	1.20	
194064	01	6.12	1.20	1.44	5.30 ND ND
	02	<1.47	0.74	1.08	
	03	<1.52	1.27	1.00	
194065	01	<2.08	1.00	1.28	NS
	02	<1.52	1.04	1.06	
	03	<1.67	1.16	1.32	
194066	01	<1.89	0.87	1.04	NS
	02	<1.36	1.02	1.19	
	03	<1.65	1.00	0.97	
194067	01	<1.71	1.20	1.15	NS
	02	<1.92	1.52	1.33	
	03	<1.90	1.28	1.18	
194068	01	<1.90	0.98	1.09	NS
	02	<1.14	0.99	1.16	
	03	<1.50	1.15	1.00	
194069	01	<1.65	1.30	1.36	NS
	02	<1.70	1.25	1.04	
	03	<1.30	1.21	1.17	

Sample ID		U-238 (pCi/g)	Ra-226 (pCi/g)	Ra-228 (pCi/g)	Th-230 (pCi/g)
194070	01	<1.72	1.26	1.15	NS
	02	<1.86	1.17	1.10	
	03	<1.76	1.02	1.05	
194071	01	<1.95	1.19	1.16	NS
	02	<1.93	1.35	1.09	
	03	<1.41	0.92	1.19	
194072	01	<1.87	1.46	0.90	NS
	02	<1.56	1.15	1.22	
	03	<1.70	1.44	1.13	
194073	01	<1.84	0.95	1.03	NS
	02	<1.87	1.18	1.31	
	03	<1.67	0.92	1.01	
194074	01	<1.25	1.51	1.17	NS
	02	<1.71	0.95	1.34	
	03	<1.46	1.30	1.15	
194075	01	<1.83	1.33	0.94	NS
	02	<1.66	0.79	0.94	
	03	<1.53	0.86	1.28	
194076	01	<1.54	0.86	1.18	NS
	02	<1.78	1.05	1.14	
	03	<1.62	1.08	1.19	
194077	01	<1.43	0.94	1.11	NS
	02	<1.61	0.72	1.26	
	03	<1.54	1.11	1.17	
194078	01	<1.54	1.41	0.98	NS
	02	<1.60	1.16	1.22	
	03	<1.61	1.29	1.14	
194079	01	<1.96	1.05	1.21	NS
	02	<1.65	1.25	1.38	
	03	<2.14	1.54	1.49	
194080	01	<1.88	1.38	1.67	NS
	02	<1.87	0.97	1.43	
	03	<1.85	1.26	1.19	
194081	01	<1.65	1.03	1.07	NS
	02	<1.83	1.03	1.25	
	03	---	---	---	
194082	01	<1.70	1.26	1.06	NS
	02	<1.68	0.93	1.28	
	03	<1.63	1.13	1.06	
194083	01	<1.71	0.93	1.14	NS
	02	<1.66	0.93	1.34	
	03	<2.02	0.85	1.43	
194084	01	<1.88	1.19	1.02	NS
	02	<1.83	1.26	1.54	
	03	<1.91	0.91	1.11	
194085	01	<1.64	1.11	1.16	NS
	02	<1.60	1.38	1.35	
	03	<2.12	1.38	1.53	

Sample ID		U-238 (pCi/g)	Re-226 (pCi/g)	Re-228 (pCi/g)	Th-230 (pCi/g)
194086	01	<1.88	1.37	1.12	NS
	02	<1.77	0.69	1.28	
	03	<1.40	1.49	1.18	
194087	01	<1.92	1.24	1.34	NS
	02	<1.93	0.90	1.09	
	03	<1.56	1.01	1.01	
194088	01	<1.93	1.12	1.32	NS
	02	<1.52	1.19	1.13	
	03	<1.89	0.79	1.19	
194089	01	<1.73	1.14	1.19	NS
	02	<1.86	1.07	1.03	
	03	<1.77	1.48	1.02	
194090	01	<1.12	0.96	1.07	NS
	02	<1.69	0.82	1.24	
	03	<1.66	0.76	1.10	
194091	01	<1.57	0.90	0.90	NS
	02	<1.96	1.17	1.08	
	03	<2.01	1.10	1.34	
194092	01	<1.30	1.21	0.90	NS
	02	<1.24	0.95	0.96	
	03	<1.67	1.21	1.02	
194093	01	<1.58	1.13	1.02	0.28
	02	<1.35	0.91	1.03	ND
	03	<1.52	1.06	1.07	0.65
194094	01	<1.96	1.99	1.04	6.07
	02	<1.64	1.39	0.96	0.09
	03	<1.52	1.00	1.25	---
194095	01	<1.72	1.28	1.09	0.33
	02	<1.59	1.23	1.11	ND
	03	<1.57	1.07	1.03	ND
194096	01	<1.71	1.49	1.34	2.35
	02	<1.43	1.14	1.21	ND
	03	<1.78	1.37	1.27	0.39
194097	01	<1.46	1.05	1.17	ND
	02	<1.46	1.20	1.09	0.05
	03	<1.54	0.80	1.19	ND
194098	01	<1.81	3.25	1.12	0.26
	02	<1.43	1.13	1.15	ND
	03	<1.23	1.17	1.19	---
194099	01	<1.65	1.65	1.00	2.11
	02	<1.51	1.17	1.17	ND
	03	<1.56	1.09	1.04	ND
194100	01	<1.54	1.23	1.06	NS
	02	<1.47	1.10	0.98	
	03	<1.55	1.02	1.27	

NS Location not selected for Th-230 analysis
ND Result less than detection limit

A T T A C H M E N T B

Summary of Radiochemical Results
from Soil Characterization Sampling
Northwestern Slope

Summary of Radiochemical Results from Soil Characterization Sampling
Northwestern Slope

Sample ID		U-238	Ra-226	Ra-228
194101	01	<1.40	1.13	0.98
	02	<1.39	1.03	1.15
	03	<1.60	1.19	1.00
194102	01	<1.75	1.18	1.00
	02	<1.40	0.87	0.88
	03	--	--	--
194103	01	<1.58	1.00	1.20
	02	<1.28	0.95	1.01
	03	--	--	--
194104	01	<1.27	1.10	0.94
	02	<1.50	0.95	0.84
	03	<1.52	0.97	0.85
194105	01	<1.33	1.05	1.21
	02	<1.62	0.92	1.10
	03	<1.37	1.30	0.93
194106	01	<1.76	1.20	1.30
	02	<1.57	0.84	1.12
	03	<1.37	0.98	1.00
194108	01	<1.44	1.11	1.28
	02	<1.54	1.05	1.07
	03	<1.71	1.13	1.22
194109	01	<1.23	0.75	0.94
	02	<1.41	1.08	0.87
	03	<1.25	0.67	0.80
194107	01	<1.41	0.75	0.87
	02	<1.46	0.99	0.78
	03	<1.00	0.72	0.91
194110	01	<1.27	1.12	1.05
	02	<1.24	0.78	1.05
	03	<1.30	0.87	0.86
194111	01	<1.29	0.96	1.00
	02			
	03			
194112	01	<1.44	0.99	0.92
	02	<1.34	1.05	1.05
	03	<1.17	0.88	0.82

APPENDIX C
ORISE Letter Report – Verification Survey of MDC6

January 29, 1997

W. Alexander Williams, PhD
Designation and Certification Manager
U.S. Department of Energy
EM-421
Cloverleaf Building
Washington, DC 20585-0002

SUBJECT: LETTER REPORT—VERIFICATION SURVEY OF VICINITY PROPERTY-6, REMEDIAL UNIT 012 (WORK PACKAGE-468), WELDON SPRING SITE REMEDIAL ACTION PROJECT, ST. CHARLES COUNTY, MISSOURI

Dear Dr. Williams:

The Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) conducted a verification survey of the Work Package-468 (WP-468) area at the Weldon Spring Site Remedial Action Project (WSSRAP) on July 29, 1996. This area, also referred to as Vicinity Property-6 (VP-6), is located adjacent to the fence along the northeast rim of the Weldon Spring Quarry (Figure 1). Previous site characterization determined that the property was contaminated as a result of past activities at the quarry. Characterization data showed that U-238, Ra-226, Ra-228, Th-232, and Th-230 were present as contaminants in the soil, with Th-230 being the primary contaminant. MK-Ferguson and Jacobs Engineering Group, the WSSRAP Project Management Contractor (PMC) designated the contaminated area of VP-6 as Remedial Unit (RU) 012. RU012 covers approximately 100 m² of soil area (Figure 2).

The PMC remediated the contaminated soil from VP-6 to a depth down to approximately 1 meter in November 1993. Confirmatory sampling was not performed at that time and the excavation was backfilled with clean gravel. In July 1996, the PMC removed the gravel to the cut line of the excavation and performed confirmatory scans and sampling in accordance with the site's confirmation plan (MKC 1995). The area was designated as Confirmatory Unit (CU) 141 for this effort. The results of the PMC's post-remedial action (post-RA) activities indicated that the radiological contamination, for all radionuclides of concern, had been reduced to levels below the site-specific cleanup criteria published in the Weldon Spring Site Chemical Plant Area Record of Decision (ROD) (DOE 1993).

It is the policy of the U.S. Department of Energy's (DOE) Headquarter's Office of Environmental Restoration to perform independent verification in order to provide independent survey and analytical data for use by the DOE in determining the adequacy and accuracy of the PMC's conclusions as to the remediated area's radiological status. ESSAP's verification survey of VP-6 included review of the PMC's post-RA data, gamma surface scans using NaI scintillation detectors coupled to ratemeters with audible indicators, and soil sampling. Five systematic soil samples were collected from one randomly selected grid block in VP-6 (Figure 2). Samples were analyzed by solid-state gamma spectrometry and the spectra were reviewed for each radionuclide of concern and any other identifiable photopeaks.

January 29, 1997

Verification surface scans did not identify any areas of elevated direct gamma radiation in VP-6. Gamma spectrometry results are presented in Table 1. Radionuclide concentration ranges in soil samples were as follows: Ra-226, 0.6 to 1.0 pCi/g; Ra-228, 0.6 to 1.1 pCi/g; Th-230, all less than 4.6 pCi/g; Th-232, 0.6 to 1.1 pCi/g; and U-238, 0.8 to 1.4 pCi/g.

ESSAP's survey and sample results were compared to the WSSRAP site-specific cleanup criteria which are presented in Table 2. All radionuclide concentrations were less than the cleanup criteria and also less than the more restrictive ALARA (As Low As Reasonably Achievable) goals. These data verify the PMC's findings that the remedial action objectives were met.

Please contact me at (423) 576-5073 or Eric Abelquist at (423) 576-3740 should you have any questions, comments, or require additional information.

Sincerely,



Timothy J. Vitkus
Survey Projects Manager
Environmental Survey and Site
Assessment Program

TJV:tsf

cc: B. Boettner, DOE/HQ
S. McCracken, DOE/WSSRAP
J. VanFossen, DOE/WSSRAP
T. Pauling, DOE/WSSRAP
W. Beck, ORISE/ESSAP
E. Abelquist, ORISE/ESSAP
File/333

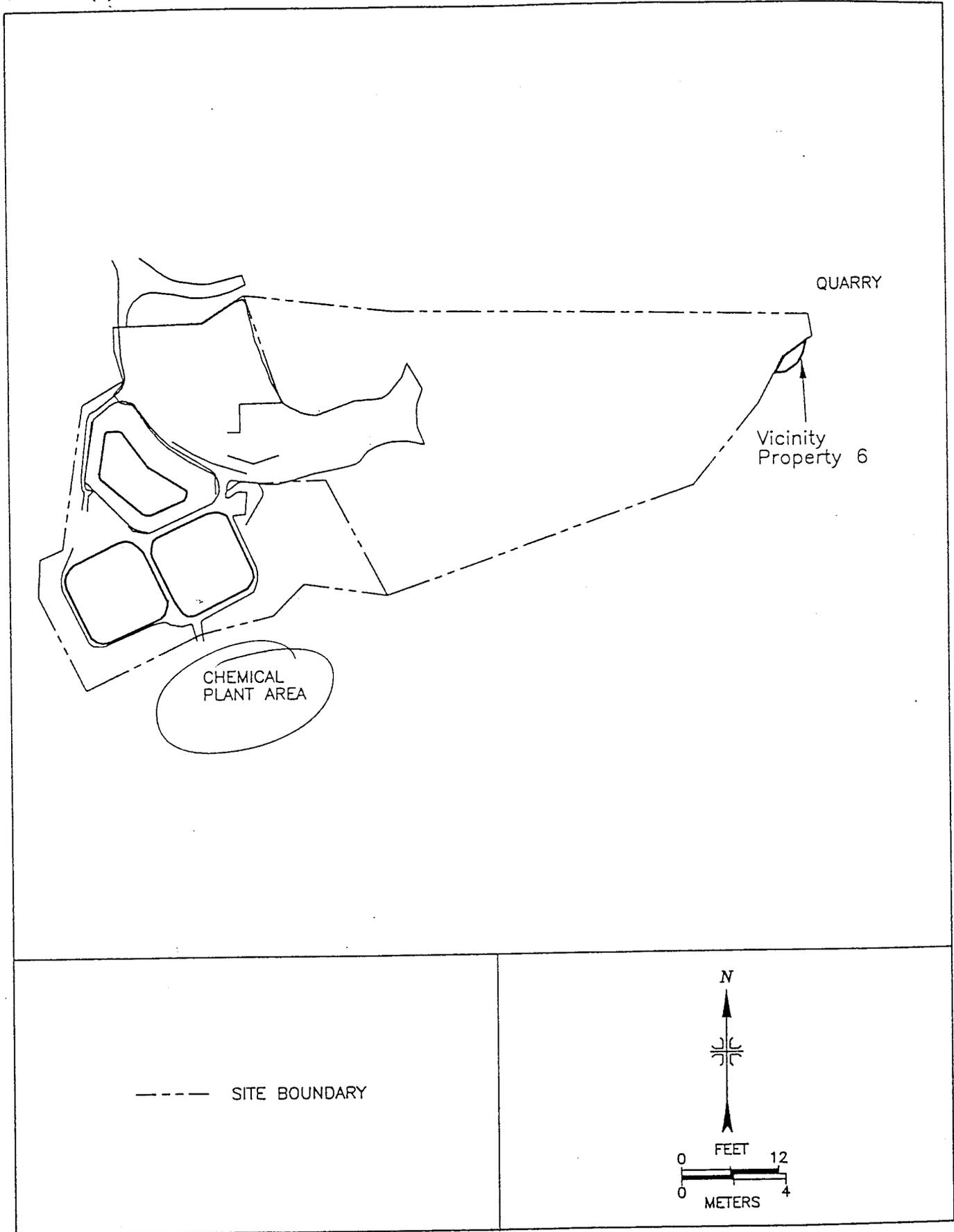


FIGURE 1: Plot Plan of Weldon Spring Site Showing the Location of Vicinity Property 6

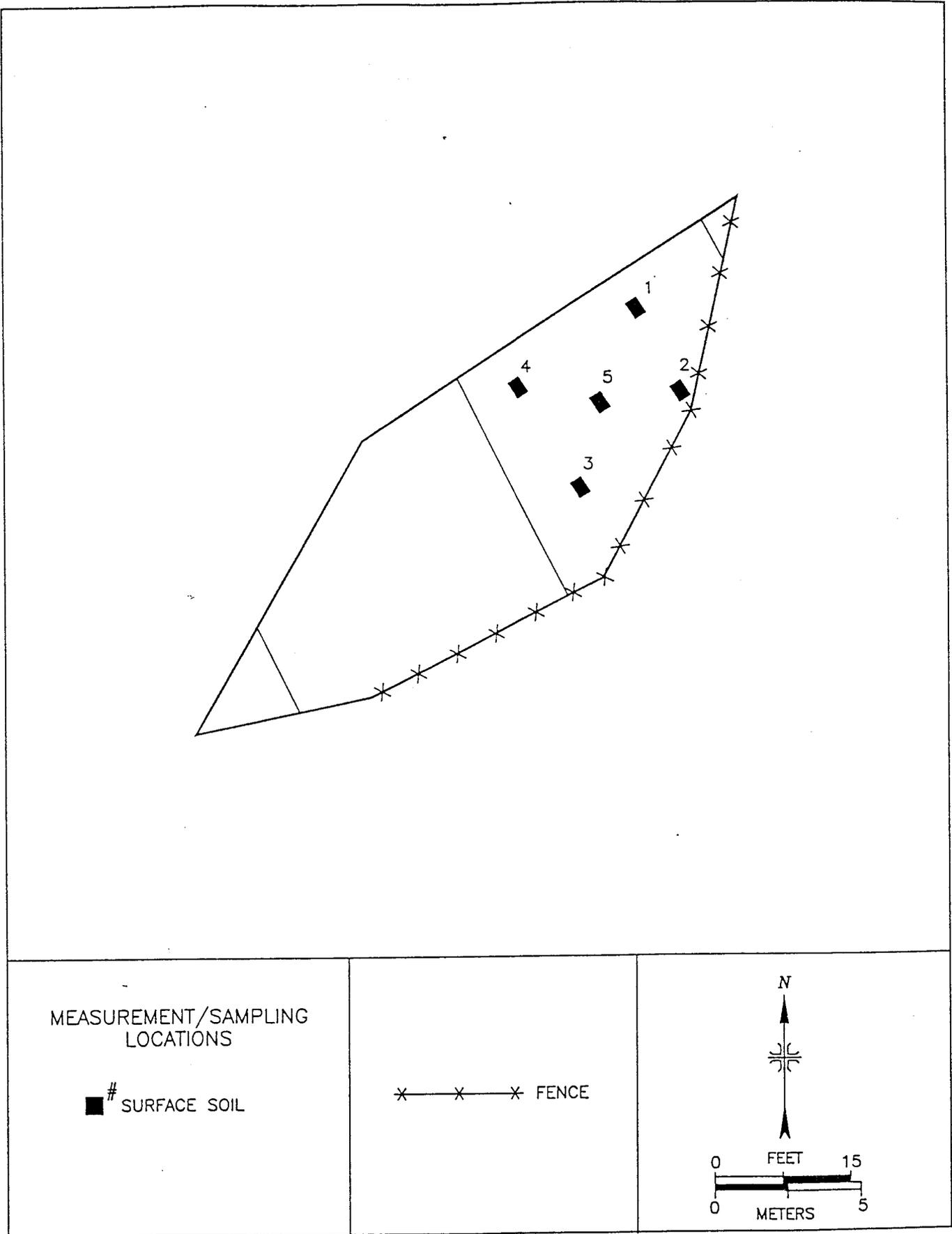


FIGURE 2: Layout of Vicinity Property 6 – Measurement and Sampling Locations

TABLE 1

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES
VICINITY PROPERTY 6
WELDON SPRING SITE REMEDIAL ACTION PROJECT
ST. CHARLES COUNTY, MISSOURI

Sample Location ^a	Radionuclide Concentration (pCi/g)				
	Ra-226	Ra-228	Th-230	Th-232	U-238
Location 1	0.9 ± 0.1 ^b	1.0 ± 0.1	<3.1	1.0 ± 0.1	1.1 ± 0.3
Location 2	0.6 ± 0.1	0.6 ± 0.1	<3.5	0.6 ± 0.1	0.8 ± 0.3
Location 3	0.9 ± 0.1	0.8 ± 0.1	<4.0	0.8 ± 0.1	0.9 ± 0.3
Location 4	1.0 ± 0.1	1.1 ± 0.1	<4.6	1.1 ± 0.1	1.4 ± 0.4
Location 5	0.9 ± 0.1	1.1 ± 0.1	<4.3	1.1 ± 0.1	1.4 ± 0.3

^aRefer to Figure 2.

^bUncertainties represent the 95% confidence level, based only on counting statistics.

TABLE 2

RADIONUCLIDE CONTAMINANT CLEANUP STANDARDS
 WELDON SPRING SITE REMEDIAL ACTION PROJECT
 ST. CHARLES COUNTY, MISSOURI

Radionuclide (pCi/g)	Surface ^c		Subsurface ^d	
	ALARA	Criteria	ALARA	Criteria
Radium-226 ^{a,b}	5.0	6.2	5.0	16.2
Radium-228 ^{a,b}	5.0	6.2	5.0	16.2
Thorium-230 ^a	5.0	6.2	5.0	16.2
Thorium-232 ^a	5.0	6.2	5.0	16.2
Uranium-238	30.0	120	30	120

^aIf both Th-230 and Ra-226, or both Th-232 and Ra-228, are present and not in secular equilibrium, the cleanup criterion applies for the radionuclide with the higher concentration.

^bAt locations where both Ra-226 and Ra-228 are present, the cleanup criterion of 6.2 pCi/g (including background) in the top 15 cm (6-in.) of soil, and 16.2 pCi/g (including background) in each 15-cm (6-in.) layer of soil more than 15 cm (6-in.) below the surface, applies to the sum of the concentrations of these two radionuclides.

^cValues listed for surface soils apply to contamination within the upper 15 cm (6-in.) of the soil column.

^dValues for subsurface apply to contamination in soils below 15 cm (6-in.) unless otherwise noted.

Source: U.S. Department of Energy. "Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site." September 1993.

REFERENCES

MK-Ferguson Company and Jacobs Engineering Group (MKC). Confirmation Sampling Plan for Soils in Vicinity Property 6 (B-6). Rev. 0. DOE/OR/21548-580, St. Charles, MO; October 1995.

U.S. Department of Energy (DOE). Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site. DOE/OR/21548-376. Oak Ridge Field Office. St. Charles, MO; September 1993.

APPENDIX D
ORISE Letter Report – Verification Survey of MDC9

April 25, 1996

W. Alexander Williams, PhD
Designation and Certification Manager
U.S. Department of Energy
EM-421
Cloverleaf Building
Washington, DC 20585-0002

SUBJECT: LETTER REPORT - VERIFICATION SURVEY OF VICINITY PROPERTY-9, REMEDIAL UNIT 011 (WORK PACKAGE-461), WELDON SPRING SITE REMEDIAL ACTION PROJECT, ST. CHARLES COUNTY, MISSOURI

Dear Dr. Williams:

The Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) conducted a verification survey of a portion of the Work Package-461 (WP-461) area at the Weldon Spring Site Remedial Action Project (WSSRAP) on February 12, 1996. This area, also referred to as Vicinity Property-9 (VP-9), is located near the Weldon Spring Quarry between the Katy Trail and the Femme Osage Slough (Figure 1). Previous site characterization had determined that the area was contaminated as a result of past activities at the quarry. Characterization data indicated that only uranium-238 (U-238) contamination was present at VP-9. MK-Ferguson and Jacobs Engineering Group, the WSSRAP Project Management Contractor (PMC) designated the contaminated area of VP-9 as Remedial Unit (RU) 011. RU011 consists of approximately 0.36 hectares (0.88 acres) and was divided into two Confirmation Units (CU's), CU139 and CU140, each covering approximately 2000 m². Additionally, CU140 was further subdivided and designated Zones 1 and 2, and CU139 was designated as Zone 3 (Figure 2).

The PMC remediated the contaminated soil from within each zone to groundwater depth. Because this area is located in the floodplain of the Missouri River, depth to groundwater varies from 0 to 4.5 meters, with an average depth of approximately 1 meter. The PMC performed post-remedial action (post-RA) surveys and sampling in each excavation zone. The results of the PMC's post-RA activities indicated that the U-238 contamination had been reduced to levels below the site-specific cleanup criteria published in the Weldon Spring Site Chemical Plant Area Record of Decision (ROD).

It is the policy of the U.S. Department of Energy's (DOE) Headquarter's Office of Environmental Restoration to perform independent verification in order to provide independent survey and analytical data for use by the DOE in determining the adequacy and accuracy of the PMC's conclusions as to the remediated areas radiological status. ESSAP performed a verification survey of Zone 2, which included review of the PMC's post-RA data, gamma surface scans using NaI scintillation detectors coupled to ratemeters with audible indicators, and soil sampling. A total of fifteen soil samples was collected from five individual points within three randomly selected Zone 2 grid blocks. Verification activities for Zones 1 and 3, consisted of

confirmation gamma spectrometry analysis of selected WSSRAP post-RA samples (four from Zone 1, and 6 from Zone 3). Figures 3 and 4 show the locations of ESSAP sampling and WSSRAP post-RA samples obtained by ESSAP for confirmatory analysis. All samples were analyzed by solid-state gamma spectrometry and the spectra were reviewed for U-238 concentrations and any other identifiable photopeaks. Samples from Zone 2 were compared to site-specific cleanup criteria and ALARA (As Low As Reasonably Achievable) goals. Analytical results for samples collected by the PMC in Zones 1 and 3 were compared to the PMC's results.

Surface scans did not identify any areas of elevated direct gamma radiation in Zone 2. Uranium-238 concentrations for ESSAP-collected samples from Zone 2, and results of confirmatory analysis of WSSRAP post-RA samples collected from Zones 1 and 3 are presented in Tables 1 and 2, respectively. The U-238 concentration in soil samples collected by ESSAP in Zone 2 ranged from 7.0 to 43.4 pCi/g and averaged 21.0 pCi/g. The average U-238 concentration in confirmation samples collected and analyzed by the PMC was 20.4 pCi/g. Comparison of ESSAP's and the PMC's analytical results for soil samples collected by the PMC in Zones 1 and 3, showed that the U-238 activity concentration levels agreed within the expected statistical deviation of the analytical procedure.

Verification sample results from CU140, Zone 2, were compared to both the 30 pCi/g ALARA goal and the 120 pCi/g cleanup criteria for U-238. Four samples contained concentrations greater than or equal to the ALARA goal, but were less than the soil cleanup criteria. This data verifies the PMC's findings that the remedial action objectives have been met; that is, soil contaminant levels will range between cleanup criteria and ALARA goals, reaching the goals in most cases.

Please contact me at (423) 576-5073 or W.L. (Jack) Beck at (423)576-5031 should you have any questions, comments, or require additional information.

Sincerely,



Timothy J. Vitkus
Survey Projects Manager
Environmental Survey and
Site Assessment Program

TJV:tsf

cc: J. Wagoner, DOE/HQ
J. Van Fossen, DOE/WSSRAP
T. Pauling, DOE/WSSRAP
W. Beck, ORISE/ESSAP
E. Abelquist, ORISE/ESSAP
File/333

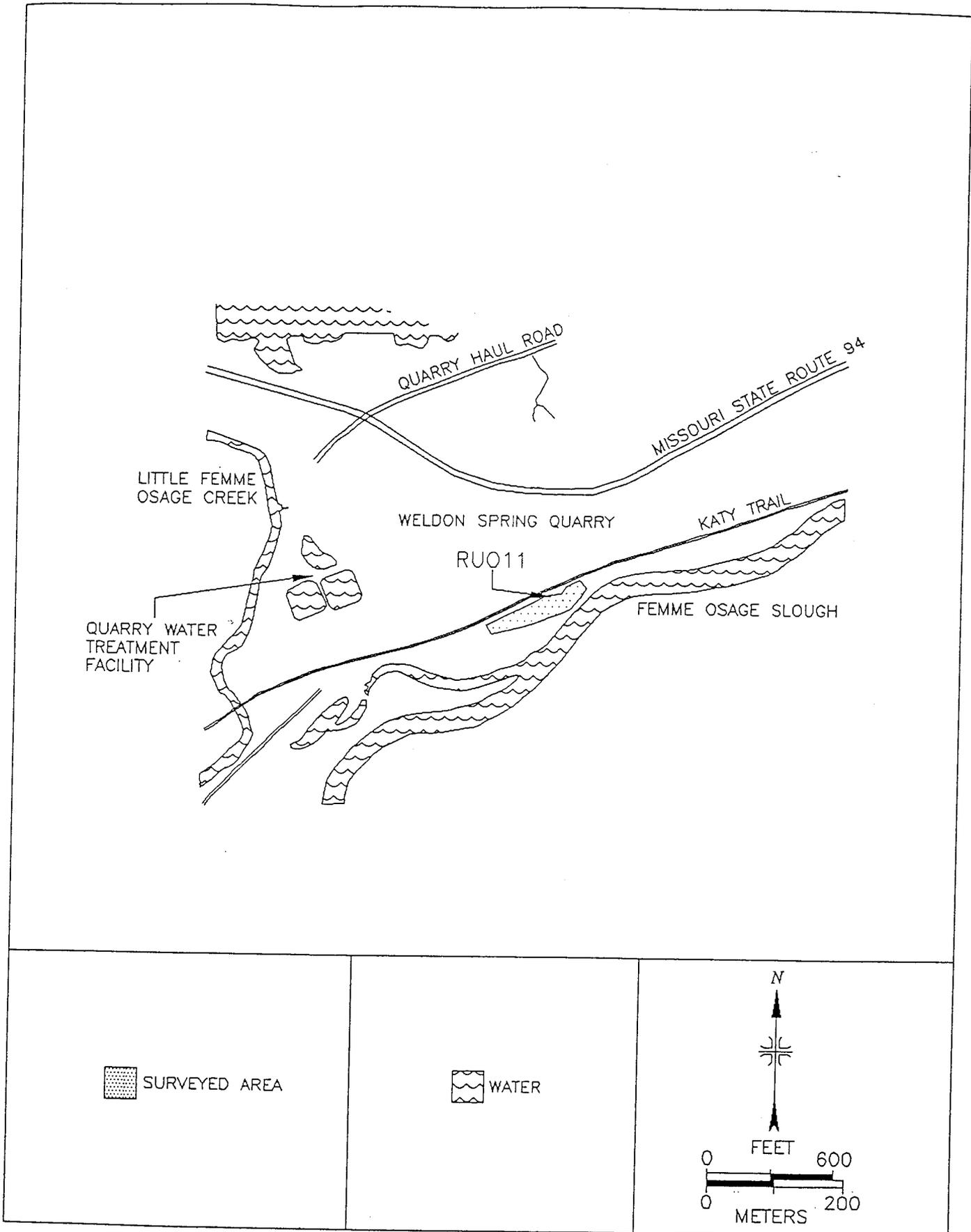


FIGURE 1: Location of Vicinity Property 9, Remedial Unit 011

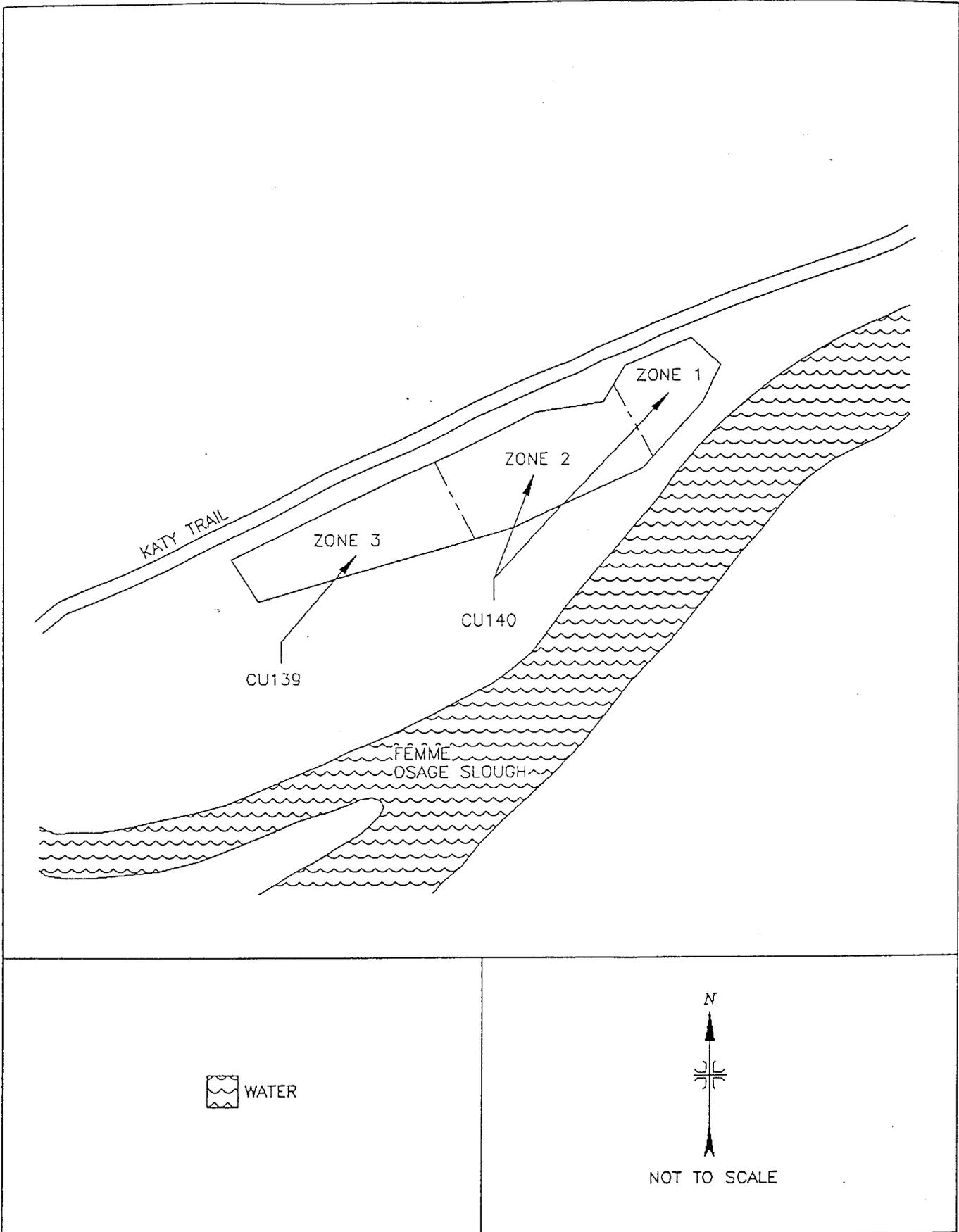


FIGURE 2: Plot Plan of Vicinity Property 9 (RU011), Showing Confirmation Unit and Zone Designations

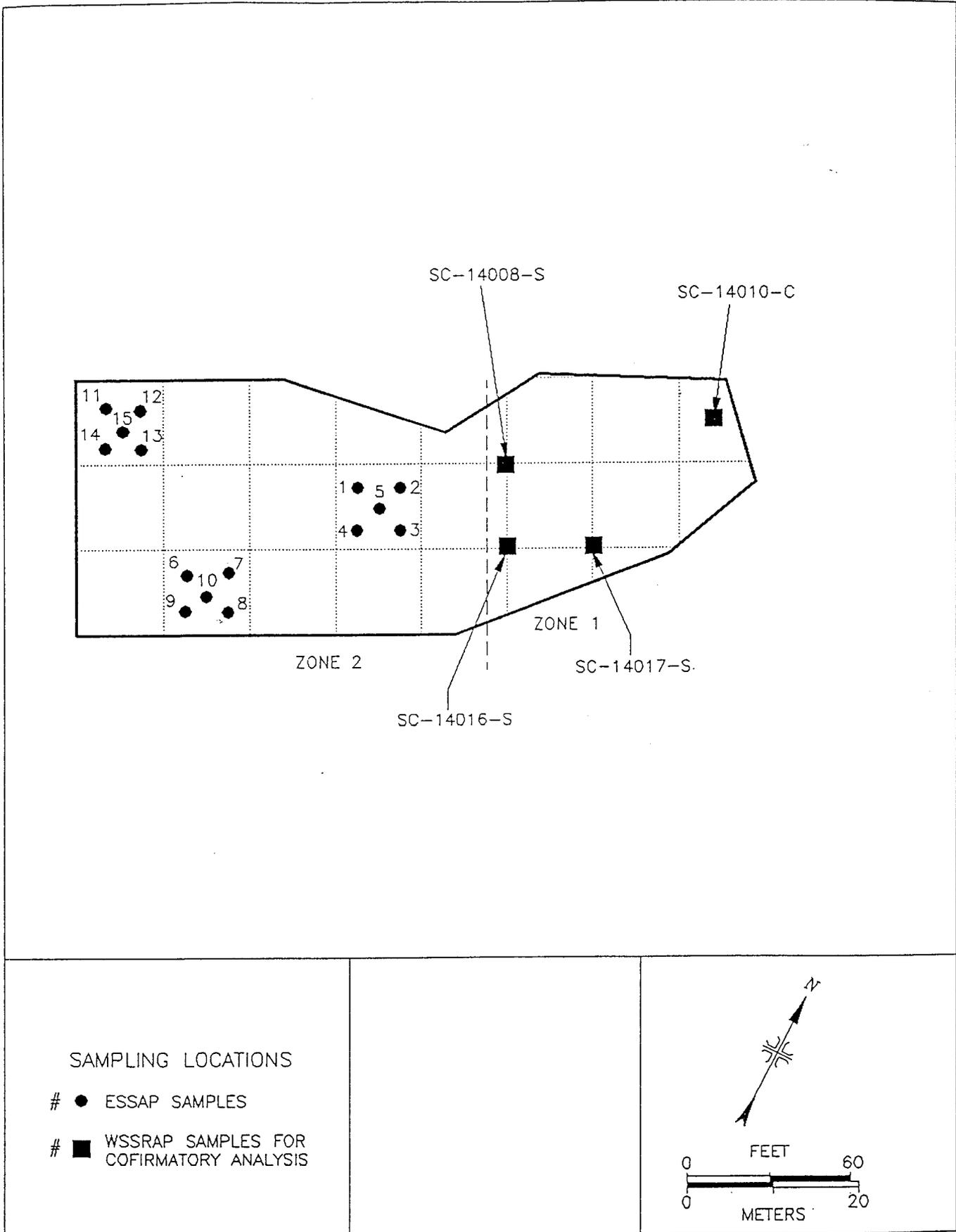
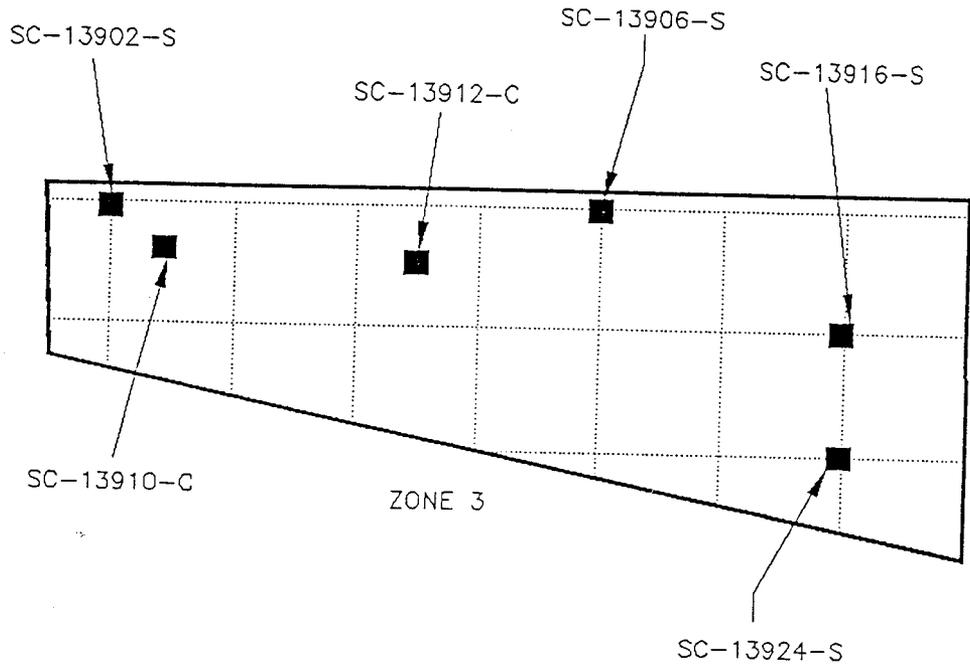


FIGURE 3: Vicinity Property 9 (RU011), Confirmation Unit 140, Zones 1 and 2 - Sampling Locations



SAMPLING LOCATIONS

■ WSSRAP SAMPLES FOR CONFIRMATORY ANALYSIS

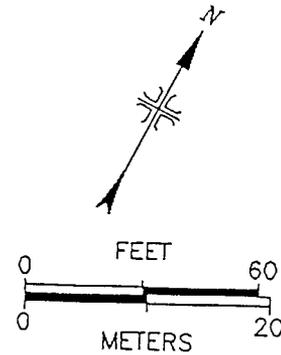


FIGURE 4: Vicinity Property 9 (RU011), Confirmation Unit 139, Zone 3 - Sampling Locations

TABLE 1
 URANIUM-238 CONCENTRATIONS IN SOIL SAMPLES
 VICINITY PROPERTY-9, ZONE 2
 WELDON SPRING SITE REMEDIAL ACTION PROJECT
 ST. CHARLES COUNTY, MISSOURI

Sample Location ^a	Uranium-238 Concentration (pCi/g)
Location 1	14.3 ± 2.5 ^b
Location 2	29.4 ± 2.8
Location 3	14.9 ± 2.0
Location 4	30.1 ± 3.0
Location 5	21.5 ± 2.4
Location 6	17.9 ± 2.7
Location 7	32.8 ± 3.2
Location 8	11.5 ± 2.0
Location 9	12.2 ± 1.8
Location 10	15.3 ± 2.1
Location 11	15.8 ± 2.5
Location 12	7.0 ± 1.7
Location 13	43.4 ± 3.9
Location 14	32.6 ± 2.9
Location 15	16.4 ± 2.1

^aRefer to Figure 3.

^bUncertainties represent the 95% confidence level, based only on counting statistics.

TABLE 2
 COMPARISON OF ANALYTICAL RESULTS
 OF URANIUM-238 CONCENTRATIONS IN SOIL SAMPLES
 COLLECTED BY WSSRAP
 VICINITY PROPERTY-9, ZONES 1 AND 3
 WELDON SPRING SITE REMEDIAL ACTION PROJECT
 ST. CHARLES COUNTY, MISSOURI

Sample Location ^a	Uranium-238 Concentrations (pCi/g)	
	ESSAP	WSSRAP
Zone 1^b		
SC-14008-S	18.6 ± 2.5 ^c	15.9 ± 3.3
SC-14010-C	3.8 ± 1.6	3.9 ± 3.0
SC-14016-S	21.0 ± 1.9	19.0 ± 5.5
SC-14017-S	25.1 ± 2.6	31.7 ± 5.3
Zone 3^d		
SC-13902-S	14.4 ± 2.6	8.5 ± 6.0
SC-13906-S	4.1 ± 1.5	ND ^e
SC-13910-C	34.6 ± 2.6	34.0 ± 7.0
SC-13912-C	6.3 ± 2.1	4.5 ± 2.3
SC-13916-S	19.5 ± 2.1	16.6 ± 5.5
SC-13924-S	29.3 ± 2.9	25.9 ± 8.8

^aSample location based on WSSRAP sample ID.

^bRefer to Figure 3.

^cESSAP uncertainties represent the 95% confidence level, based only on counting statistics.

^dRefer to Figure 4.

^eND = Non-Detectable

MK-Ferguson Company
Weldon Spring Site Remedial Action Project

TRANSMITTAL OF CONTRACT DELIVERABLE

Date: **May 5, 1999**

Transmittal No.: **CD-0201-00**

Title of Document: **Close-Out Report For Vicinity Properties MDC 6 And MDC 9**

Doc. Num.: **775**

Rev. No.: **0**

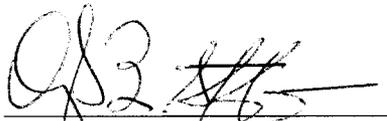
Date of Document: **April 1999**

Purpose of Transmittal: Request for Department of Energy acceptance of contract deliverable.

In compliance with the Project Management Contract, MK-Ferguson Company hereby delivers the attached document to the U.S. Department of Energy, Weldon Spring Site Office. The document has been reviewed and approved by Project Management Contractor management.

The document will be considered accepted unless we receive written notification to the contrary within 30 days of the date of this transmittal.

Number of copies transmitted: **1**



Douglas E. Steffen

Project Director