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Weldon Spring Site Remedial Action Project

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Date: **September 9, 1999** Transmittal No.: **CD-0196-00**

Title of Document: **Southeast Drainage Closeout Report Vicinity Properties DA4 And MDC7**

Doc. Num.: 772 Rev. No.: **0** Date of Document: **September 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: **One**

for

Douglas E. Steffen
Project Director

DOE/OR/21548-772
CONTRACT NO. DE-AC05-86OR21548

SOUTHEAST DRAINAGE CLOSEOUT REPORT VICINITY PROPERTIES DA4 AND MDC7

WELDON SPRING SITE REMEDIAL ACTION PROJECT
WELDON SPRING, MISSOURI

SEPTEMBER 1999 **REV. 0**

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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Weldon Spring Site Remedial Action Project

Southeast Drainage Closeout Report Vicinity Properties DA4 and MDC7

Revision 0

September 1999

Prepared by

MK-FERGUSON COMPANY
and
JACOBS ENGINEERING GROUP
7295 Highway 94 South
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for the

U.S. DEPARTMENT OF ENERGY
Oak Ridge Operations Office
Under Contract DE-AC05-86OR21548

ABSTRACT

The *Southeast Drainage Closeout Report Vicinity Properties DA 4 and MDC7* summarizes various activities involved in the remediation of the Southeast Drainage. The Southeast Drainage consists of two vicinity properties. One vicinity property is located on the U.S. Department of Army property (DA 4) while the other is located on Missouri Department of Conservation property (MDC 7). Both areas are part of a natural drainage from the Weldon Spring Chemical Plant to the Missouri River. Pre-remediation chemical and radiological characterizations, remedial construction, and post-remediation sampling activities are detailed within this report.

TABLE OF CONTENTS

SECTION **PAGE**

APPENDIXES

LIST OF FIGURES

NUMBER **PAGE**

LIST OF TABLES

NUMBER **PAGE**

1. INTRODUCTION

1.1 Purpose

This close-out report has been prepared to document remedial actions at the Southeast Drainage located near the Weldon Spring Chemical Plant. The Southeast Drainage area consists of both Missouri Department of Conservation (MDC) Vicinity Property 7 and Army Vicinity Property (DA) 4.

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 Chemical Plant Operable Unit*, which will be prepared in accordance with *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (CERCLA) requirements.

1.3 Authorizing Document

The authorizing document for this report is the *Engineering Evaluation/Cost Analysis for the Proposed Removal Action at the Southeast Drainage near the Weldon Spring Site, Weldon Spring, Missouri.*

1.4 Background

The Weldon Spring site is located in St. Charles County, Missouri, approximately 48 km (30 mi) west of St. Louis. The site consists of two geographically distinct areas; the 88-ha (217 acre) chemical plant area and a 3.6 ha (9 acre) 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

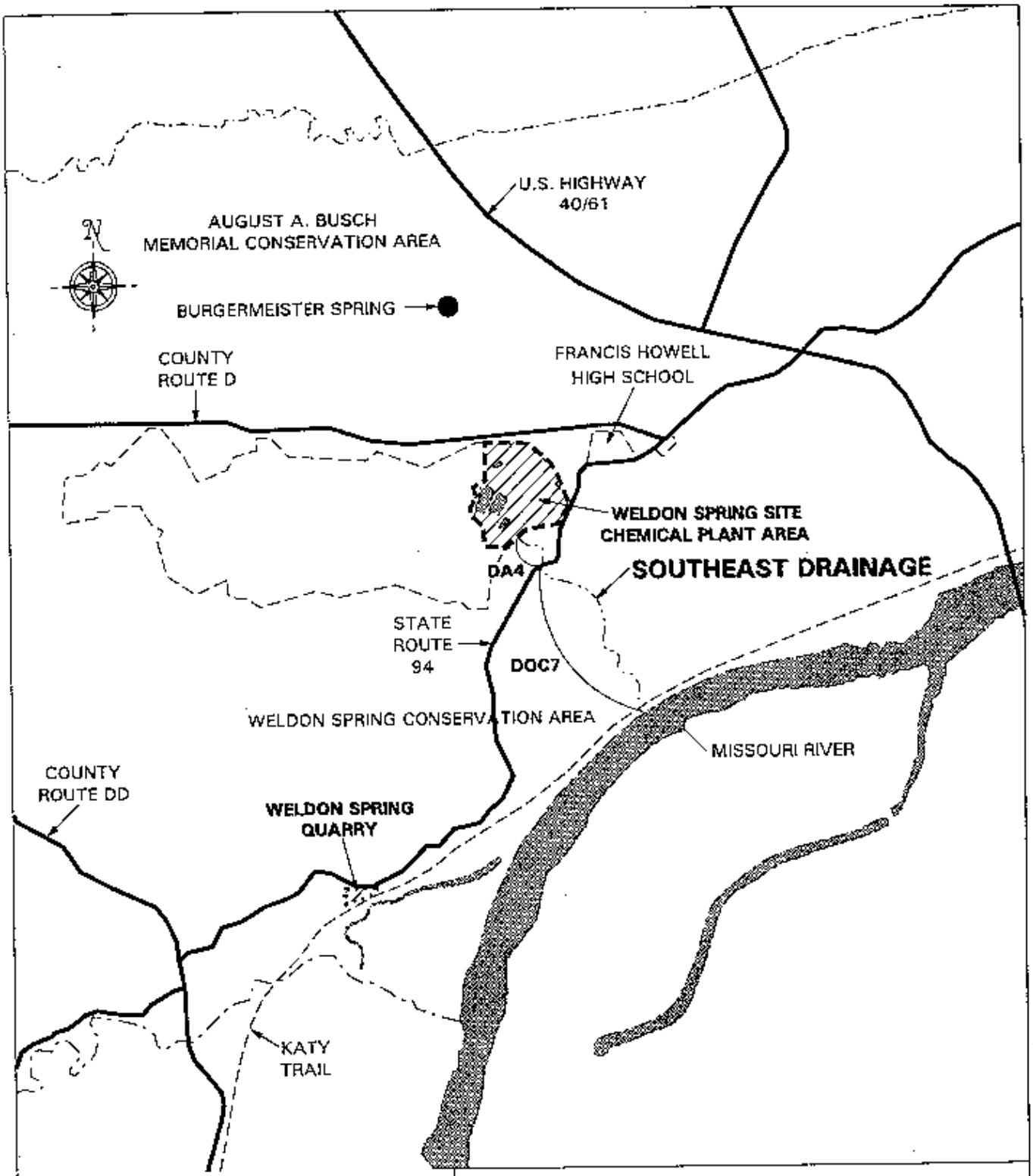
by the AEC to process uranium and thorium ore concentrates from 1957 to 1966. Radioactively and chemically contaminated waste was disposed of within the chemical plant during this period. Radioactive contaminants are primarily radionuclides of the natural uranium and Th-232 decay series. Chemical contaminants 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 operations 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 are 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 1969 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 and raffinate pits were added to the NPL in March 1989.

The Southeast Drainage is a natural drainage area with intermittent flow that traverses both the Army Property and the Weldon Spring Conservation Area from the Weldon Spring Chemical Plant to the Missouri River (Figure 1-1). Both the Army and AEC used the drainage for discharging wastewater to the Missouri River. Wastewater discharges consisted of water from sanitary and process sewers (Imhoff tank). As a result, sediments and soils in the Southeast Drainage were contaminated. Radioactive contaminants of concern are Uranium-238, Radium-226, Thorium-232, and Thorium-230.



LOCATION OF THE SOUTHEAST DRAINAGE AND THE WELDON SPRING CHEMICAL PLANT AREA

FIGURE 1-1

REPORT NO.: DOE/OR/21548-772		EXHIBIT NO.: A/VP/019/0395	
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1.5 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 previous ordnance works area (Ref. 1 and Ref. 2). The purpose of this 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. Background levels and baseline concentrations were taken of each matrix within the vicinity of the area. These levels and concentrations were used to determine the extent of radiological contamination within a surveyed area. ORAU used the following concentrations to determine radioactively contaminated soil:

Ra-226 and Th-232	5 pCi/g averaged over the first 6 in. of soil depth. 15 pCi/g if greater than 6 in. deep.
U-238	60 pCi/g averaged over the suspect area.

The results of the study revealed soils at several small locations on the U.S. Department of Army Ordnance Works property and the Missouri Department of Conservation property contained generally low levels of radioactivity as a result of previous site activities. In total, ORAU identified 17 vicinity properties, seven of which were located on the Weldon Spring Training Area and 10 of which were located on the Missouri Department of Conservation wildlife areas.

1.6 CERCLA Summary

The DOE decided to address remedial actions for the Southeast Drainage as a separate action under CERCLA. The *Engineering Evaluation/Cost Analysis for the Proposed Removal Action at the Southeast Drainage near the Weldon Spring Site, Weldon Spring, Missouri* (EE/CA) (Ref. 3) was prepared in August 1996 to evaluate the human and ecological health risks within the drainage. The EE/CA recommended that selected sediment in accessible areas of the drainage would be removed with track-mounted equipment and transported by off-road haul trucks to the chemical plant area. The excavated materials would be stored temporarily at an on-site storage area with final disposal in the planned engineered disposal cell for the Weldon Spring site. On the basis of stability testing previously performed for related wastes, the waste material from the excavations would not be treated before disposal. To complete the CERCLA compliance process, a *Decision Document* was drafted detailing the specific removal action proposed in the EE/CA (Appendix A).

2. PRE-REMEDIATION ACTIVITIES

2.1 Oak Ridge Associated Universities Survey

As stated previously, initial soil characterization for the Southeast Drainage was conducted by Oak Ridge Associated Universities (ORAU) from July 1984 through September 1985. During the survey, surface beta and gamma measurements, surface and subsurface soil samples, water samples, and sediment samples were collected. Both vicinity properties that make up the Southeast Drainage (DA 4 and MDC 7) were surveyed separately. During the soil and sediment sampling of MDC 7, five samples were analyzed for Th-230 in addition to Ra-226, Th-232, and U-238. The ORAU data for the Southeast Drainage (both surface and subsurface sediment and soil) are summarized in Table 2-1.

Table 2-1 ORAU Summary for Surface and Subsurface Soil

Southeast Drainage Area	Ra-226 Concentration Range (pCi/g)	Th-230 Concentration Range (pCi/g)	Th-232 Concentration Range (pCi/g)	U-238 Concentration Range (pCi/g)	Primary Contaminant	Estimated Volume (yd^3)
DA 4	0.76 - 210	Not Analyzed	0.43 – 69.1	<1.56 – 1,010	Ra-226 Th-232 U-238	3,270
MDC 7	2.57 – 130	570 – 10,100	<0.51 – 240	9.58 – 810	Ra-226 Th-230 Th-232 U-238	6,997

2.2 PMC Remedial Investigation of the Chemical Plant Area

The Project Management Contractor (PMC) did not characterize the Southeast Drainage during the time the chemical plant area remedial investigation was being conducted. At this time, the drainage was still affected by continued surface water discharge from the chemical plant. A decision was made to perform a full characterization of the drainage after major site remedial actions were completed.

2.3 PMC Soil/Sediment Characterization

In order to provide contaminant data for the development of the EE/CA, a soils review sampling (SRS) plan was initiated which would more fully characterize the Southeast Drainage. The first sampling phase under the SRS was performed in April 1995. It was conducted to determine the radiological concentrations at several locations previously identified in the 1985 ORAU survey. The sampling activity was also to obtain limited chemical data and determine whether or not elevated chemical compounds were colocated with elevated radiological locations. The second phase of sampling was performed in July 1995 and was conducted to obtain additional soil samples at the lower portion of the drainage to adequately characterize

radiological concentrations near the Katy Trail. The third phase of sampling was performed in August 1995 and was conducted to obtain soil samples at depths to 30 in. at the lower portion of the drainage.

The results of the SRS indicated that elevated radiological sediment and soil were still present in the Southeast Drainage. Additionally, the results revealed that the ORAU sample identification locations could be found in the same areas of DA 4. The length of that section of the drainage was relatively short and specific man-made features were used to bound the area. Most of the ORAU-defined locations at MDC 7, however, could not be located due to the overall length and meandering of the drainage channel. Several elevated locations were found by random scanning. Sodium iodide (NaI) instrument readings ranged from 20,000 to 210,000 counts per minute (cpm) above background. In general, radiological concentrations in soil samples were found to be similar to the concentration ranges previously reported by ORAU, except for Th-230, which was much lower.

In December 1995, the PMC performed an engineering characterization of the Southeast Drainage in accordance with the *Engineering Sampling Plan to Identify Areas for Remediation in the Southeast Drainage (Vicinity Properties DA 4 and DOC 7)* (Ref. 4). This characterization included comprehensive radiological walkover surveys in addition to the collection of soil samples that would more accurately delineate the lateral and vertical extent of radiological soil contamination. Soil samples were collected from locations greater than 1.5 times background levels in order to identify potential remediation areas. The analytical data were used to support engineering design for remediation of this area and to provide an estimate of the volume of soil requiring removal.

In August 1996, additional soil samples were taken at four locations where the volume of soil proposed for removal was greater than 50 cu yd and the analytical data previously collected at the maximum depth exceeded the proposed remediation levels. Soil sample were also taken at one location for additional polychlorinated biphenyl (PCB) analyses to confirm December 1995 data results. The analytical results of this sampling activity, in addition to the SRS and engineering characterization sampling activities, are summarized in the *Southeast Drainage Soils Sampling Report* (Ref. 5).

2.4 Proposed Remedial Alternative

Data from soil sampling within the Southeast Drainage was used to perform the human health and ecological risk assessment in the EE/CA. Soils were sampled at 6 in. intervals up to a depth of 3 ft at several locations. The removal action proposed for the Southeast Drainage was the excavation of soil and sediments in selected locations of the drainage where locations were accessible and the radiological concentrations exceed the 1×10^{-5} risk level as identified in Table 2-2. The EE/CA identified 38 locations within the Southeast Drainage where soil removal was to be implemented.

Table 2-2 Target 1 x 10^{-5} Soil Risk Levels for the Southeast Drainage

PARAMETER	1 X 10^{-5} RISK CONCENTRATION
Uranium-238	290 pCi/g
Radium-226	13 pCi/g
Radium-228	13 pCi/g
Thorium-230	350 pCi/g

Approximately 17 additional locations were selected for soil removal during the engineering design phase of the project. Construction of a temporary haul route was designed to allow construction vehicles to utilize the existing stream bed to enter the drainage. This haul road provided access to the upper portions of the drainage in order to remediate additional locations identified in the engineering design phase. Both areas are listed in Table 2-3 and are shown in Figure 2-1.

Table 2-3 Soil Locations Selected for Removal

Location	Vicinity Property	Selection Basis	Northing	Easting
001	DA 4	Exceeded 1 x 10^{-5} Risk Level	1041160.00	754807.00
005	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1040419.00	755136.00
012	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1038621.00	756386.00
025	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1038110.00	756434.00
027	DOC 7	Engineering Design Addition	1036613.00	757275.00
028	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1035625.00	757400.00
055	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1035104.00	757630.00
058	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1034588.00	757962.00
059	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1034893.00	757800.00
060	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1035520.00	757585.00
061	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1035499.00	757475.00
062	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1035600.00	757437.00
063	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1035659.00	757365.00
064	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1035812.00	757260.00
065	DOC 7	Engineering Design Addition	1035909.00	757145.00
066	DOC 7	Engineering Design Addition	1036026.00	757027.00
067	DOC 7	Engineering Design Addition	1036354.00	757143.00
068	DOC 7	Engineering Design Addition	1036406.00	757174.00
072	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1034845.03	757794.66
092	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1040494.37	755112.35
093	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1040418.97	755137.43
094	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1040344.58	755114.62
098	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1039128.80	756370.82
099	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1038993.20	756388.78
101	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1038930.57	756329.84

Table 2-3 Soil Locations Selected for Removal (Continued)

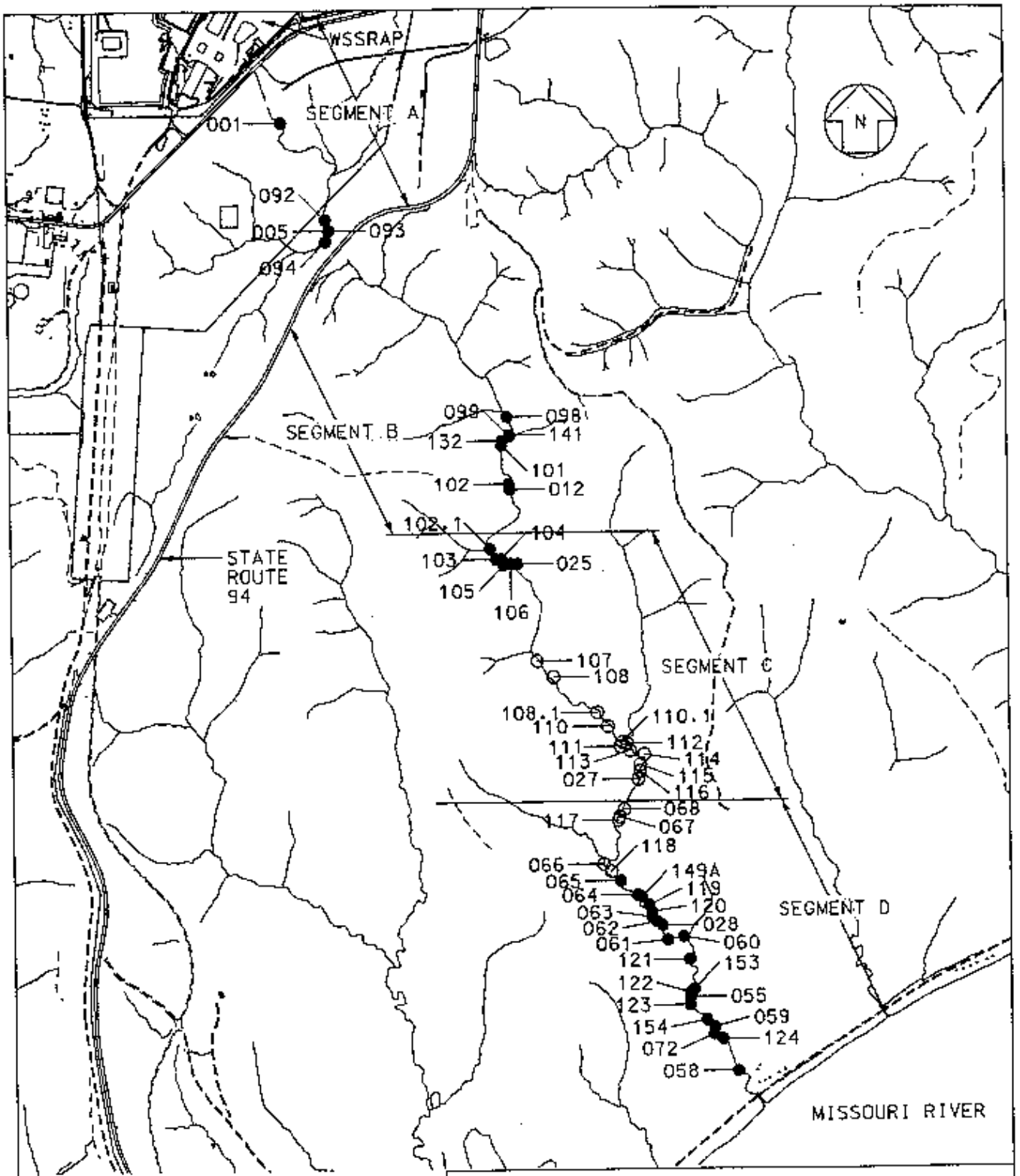
Location	Vicinity Property	Selection Basis	Northing	Easting
102	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1038662.05	756380.58
102.1	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1038214.90	756243.47
103	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1038142.50	756285.63
104	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1038143.81	756322.18
105	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1038103.49	756338.26
106	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1038113.03	756388.96
107	DOC 7	Engineering Design Addition	1037438.35	756567.22
108	DOC 7	Engineering Design Addition	1037326.75	756684.69
108.1	DOC 7	Engineering Design Addition	1037075.61	756991.60
110	DOC 7	Engineering Design Addition	1036978.57	757064.69
110.1	DOC 7	Engineering Design Addition	1036867.08	757163.40
111	DOC 7	Engineering Design Addition	1036837.77	757150.45
112	DOC 7	Engineering Design Addition	1036859.83	757197.61
113	DOC 7	Engineering Design Addition	1036809.34	757219.82
114	DOC 7	Engineering Design Addition	1036782.10	757318.82
115	DOC 7	Engineering Design Addition	1036712.74	757290.81
116	DOC 7	Engineering Design Addition	1036667.65	757288.07
117	DOC 7	Engineering Design Addition	1036329.22	757133.16
118	DOC 7	Engineering Design Addition	1035974.72	757060.29
119	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1035740.00	757345.54
120	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1035696.44	757360.88
121	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1035361.04	757625.39
122	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1035129.57	757632.96
123	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1035049.05	757626.79
124	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1034810.67	757855.06
132	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1038963.00	756336.00
141	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1039003.15	756387.87
149A	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1035797.65	757293.24
153	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1035154.51	757654.63
154	DOC 7	Exceeded 1 x 10^{-5} Risk Level	1034944.08	757742.89

2.5 Description of Completed Activities

The actions detailed below were performed to fulfill the removal action as proposed in the EE/CA and the Decision Document for the Southeast Drainage.

2.5.1 Engineering Design

The design of the removal action was prepared under Work Package 470 during 1996. Engineering specifications identified 55 locations for soil removal, including the 38 locations identified in the EE/CA and an additional 17 locations that were accessible or adjacent to these defined locations. One of the locations, Location 118, consisted of two separate areas (118A and 118B). In total, 56 locations within the Southeast Drainage were remediated and are summarized in Section 3.1 below. The depth of excavation at each location was based upon the radiological



● – EE/CA SOIL/SEDIMENT LOCATIONS WHICH EXCEED THE 1X10⁻⁶ HYPOTHETICAL CHILD RISK LEVEL AND ARE IN ACCESSIBLE AREAS

○ – ADDITIONAL LOCATIONS SELECTED DURING THE ENGINEERING DESIGN PHASE

0 1000 2000

SCALE FEET

TARGETED LOCATIONS FOR REMEDIATION

FIGURE 2-1

REPORT NO.: DOE/OR/21548-772		EXHIBIT NO.: A/VP/038/1198	
ORIGINATOR: ER	DRAWN BY: GLN	DATE: 9/8/99	

concentrations reported for each 6 in. interval. Between 6 in. to 3 ft of soil was excavated at each location within the drainage.

The drainage was divided into four separate segments (A, B, C, and D) to facilitate identification of exposure units and to determine technical feasibility with respect to mobilization of excavation and hauling equipment. The engineering specification identified two access points for entering the drainage; one located at the upper portion of the drainage (Segment A), and a second access location at the lowermost portion of the drainage from the Katy trail (Segment D). Two access locations were required since Highway 94 bisects the drainage at the upper portion making the lower portion inaccessible from the upper section. The use of both access locations would also minimize the environmental impact within the drainage.

2.5.2 Construction Activities

The work for soil removal in the drainage was performed under Work Package 470 and Work Package 470A. Work completed under WP-470 included:

- Constructing temporary unsurfaced and gravel surfaced access roads.
- Constructing protection for the explorer pipeline crossing.

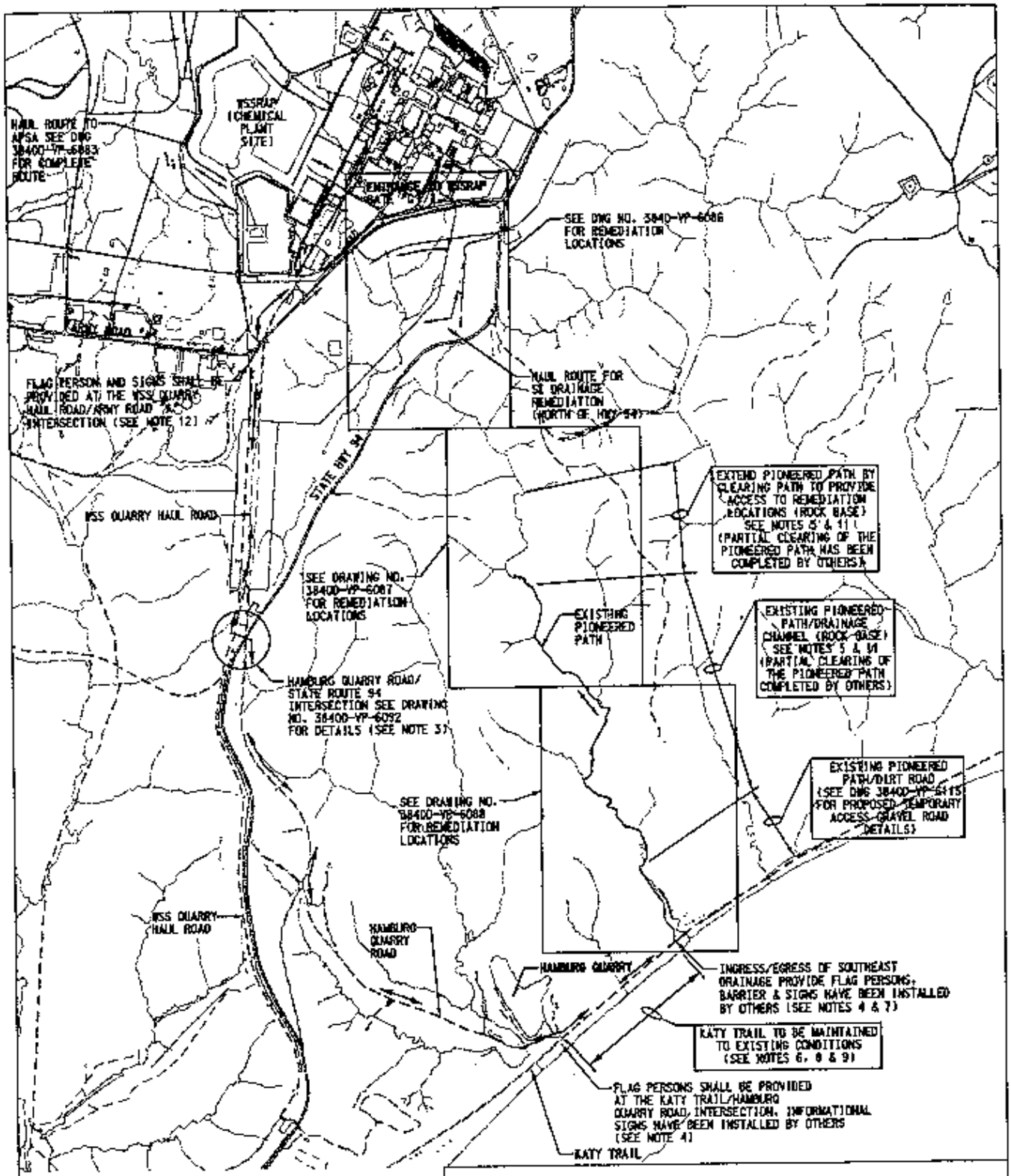
Further contract negotiations for soil removal were unresolved and a second contract was issued and identified as WP-470A. Work conducted under this contract included:

- Clearing of trees from the extended pioneered path and grading.
- Placement of aggregate on designated haul road.
- Construction of haul road turnouts.
- Reinforcing haul road overpasses above the Explorer Pipeline.
- Improvements at Hamburg Quarry road/Highway 94 intersection.
- Removal of contaminated soil.
- Grading of soil removal areas with surrounding soil.
- Restoration of the Katy Trail.

Construction activities began in November 1997 and the removal of contaminated soil was completed on February 19, 1998, five months ahead of the U.S. Department of Energy-Headquarters (DOE-HQ) milestone target date of July 1998. Final Katy Trail restoration was completed in August of 1998.

Soils were removed in accordance with engineering design and a total of 1,931 bank cubic yards of soil were excavated. Approximately 14 loads of soil were removed from the upper portion of the drainage (Segment A) and carried along the haul route from Segment A over the Army Road through Gate G to the Ash Pond Storage Area (Figure 2-2).

Figure 2-2 Haul Routes and Hamburg Quarry Road Improvements Plans



HAUL ROUTES AND HAMBURG QUARRY ROAD IMPROVEMENTS PLANS

FIGURE 2-2

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Approximately 90 loads of soils were removed from the lower portion of the Southeast Drainage (Segments B, C, and D). Access into the drainage from the Katy Trail consisted of two segments: the access road and the pioneered path. The access road consisted of natural terrain leading from the Katy Trail to a large section of natural aggregate drainage (pioneered path). In order to access remediation areas within Segment B, the pioneered path was extended approximately 1,000 ft. The extension consisted primarily of leveling stream bed aggregate within the drainage.

Contaminated soil was transported along this haul route along the Southeast Drainage over the Katy trail to the Hamburg Quarry Road. The trucks proceeded north on the Hamburg Quarry Road and crossed over Highway 94. After crossing Highway 94, the trucks turned onto the Weldon Spring Quarry haul road following it through Gate G into the chemical plant area with final destination at the Ash Pond storage area (Figure 2-2).

After soil removal, specific locations were re-graded or re-contoured to the surrounding area to avoid soil erosion or water pooling in the excavation area. As-built drawings of the drainage are detailed in Appendix B and are also available for review as part of WP-470A close-out documents.

2.6 Emergency Responses

No emergency response activities were required as a result of work conducted and completed within the Southeast Drainage under Work Package 470 or 470A. During the work activities under both contracts, there was no occurrence of a spill or contamination event.

2.7 Real Estate License Agreements

Real estate license agreements with the Missouri Department of Conservation (MDC), the Missouri Department of Natural Resources (MDNR), and the Explorer Pipeline Company were obtained before remediation of the Southeast Drainage began. Real estate license 7-96-0152 was executed between the DOE and MDC on July 29, 1996. The license granted the DOE permission to access and perform remediation activities within the Southeast Drainage. Real estate license 7-97-0100 was executed between the DOE and MDNR on October 15, 1996. The license granted the DOE permission to access and maintain the Katy Trail while remediation activities were taking place within the drainage. Real estate license 7-96-0159 was executed between the DOE and the Explorer Pipeline Company. The license granted the DOE permission to utilize a portion of the Explorer Pipeline Company's right-of-way across the MDC land. It also approved soil remediation atop the 24 in. pipeline and cross-over reinforcement of the pipeline in two separate locations.

3. SAMPLING RESULTS

3.1 Post-Remediation Sampling Activities

Post-remediation soil sampling was conducted at Southeast Drainage locations after soil excavation had been completed. The purpose of the post-remediation sampling was to determine the remaining radiological concentrations within the soil and sediment and calculate the risk reduction achieved from soil removal. Sampling activities were conducted in accordance with the *Post-Remediation Sampling Plan for the Southeast Drainage* (Ref. 6).

Specific sample locations for post-remediation sampling were selected by randomly placing a 10 m by 10 m grid over the remediation location. Samples were collected at each grid node or center location within the 10 m x 10 m grid, ensuring that at least one sample was collected at each remediation location. If the remediation location's area required more than one 10 x 10 m grid, multiple locations were sampled (A, B, & C). Samples were identified in accordance with the sampling plan and the sampling points were land surveyed for horizontal and vertical control as the remediation progressed across each remedial unit. All soil samples for post-remediation sampling were collected from the excavated soil surface at a depth of 0 in. to 6 in. Excavation areas were regraded after post-remediation sampling was completed.

In total, 66 samples were collected from the 55 remediated locations (Appendix C). The soil was analyzed for U-238, Ra-226, and Ra-228 by gamma spectroscopy, and Th-230 was analyzed by the UNC Field Method for Determining Th-230 in soils. All analyses were performed by the Weldon Spring Site Remedial Action Project (WSSRAP) on-site radiological laboratory under Chain-of-Custody Requests 3589-WSSRAP-RAD 343, 396, 411, 412, 413, 416, 419, and 439. A detailed summary of this sampling activity is provided in the *Closure Report for the Post-Remedial Sampling Plan for the Southeast Drainage* (Ref. 7).

All WP-470A post-remediation data results were used by Argonne National Laboratory to calculate risk reduction achieved by the removal action in the drainage. Risk calculations were performed using the same methodology as used in the EE/CA and were estimated for both the current hunter and future child scenarios. The exposure routes evaluated included incidental ingestion of sediment and external irradiation. Exposure point concentrations were calculated for each exposure unit (i.e., Southeast Drainage segment) by using the one-tailed upper confidence limit of the arithmetic average (UCL) or the maximum, whichever was lower (per U.S. Environmental Protection Agency [EPA] guidance). Post-cleanup data for each segment were aggregated with data from locations in each segment that were not targeted for cleanup. At locations where more than one sample was collected, the data was averaged to obtain a representative concentration for that location prior to aggregating the data for each segment.

Significant risk reduction was achieved for each segment with the highest amount of reduction observed in Segment C. The large reduction in residual risk for Segment C resulted

from the removal of 14 additional locations not originally targeted in the EE/CA. Additional removal of three locations in Segment D did not result in further risk reduction for this segment.

Upon evaluation, a decision was made to remove additional volumes of soil from two sample areas due to elevated Th-230 levels. The two areas of concern were Location 60 (Segment D) and Location 101 (Segment B). The Project Management Contractor (PMC) conducted a follow-up investigation and evaluation to determine the potential hazard of the two areas. It was determined that even though the drainage satisfactorily met the risk reduction criteria, the two areas would be remediated under a limited removal effort conducted by Work Package 505 Task J (WP-505J).

Under WP-505J, approximately 22.5 cu yd of contaminated soil was removed from the two locations within the drainage and transported to the WSSRAP disposal cell. Land surveying determined that an additional location (Location 132) had been excavated during the remediation of Location 101. Soil sampling activities were conducted immediately after the completion of excavation for each location under Addendum 5 of the *Engineering Soils Sampling Plan for Army and MDC Vicinity Properties* (Ref. 8). Sampling activities under Addendum 5 began on April 19, 1999 and were completed by April 29, 1999. WP-505J sample results showed a significant reduction in radiological contamination for Locations 60, 101, and 132 (Appendix D). These contaminant data were used to evaluate final post-cleanup risks and determine the amount of risk reduction achieved by both WP-470A and WP-505J removal actions (Appendix E). Results of the post-cleanup risk calculations for each segment are presented in Table 3-1.

Table 3-1 Estimated Risk Reduction from Exposure to Sediment

Segment	Current and Future Hunter		Hypothetical Child	
	Pre-Cleanup	Post-Cleanup	Pre-Cleanup	Post-Cleanup
A	1×10^{-5}	5×10^{-6}	5×10^{-5}	2×10^{-5}
B	2×10^{-5}	5×10^{-6}	1×10^{-4}	2×10^{-5}
C	2×10^{-5}	3×10^{-6}	9×10^{-5}	1×10^{-5}
D	1×10^{-5}	2×10^{-6}	5×10^{-5}	8×10^{-6}

3.2 QA/QC Results

Quality control samples were collected to ensure consistent and accurate performance of sample collection and laboratory analysis. Duplicate, replicate, and matrix spike samples were included to provide a measure of analytical precision and accuracy, and to document how the sample matrix affects analytical results. The sampling plan indicated that samples were to be taken at a frequency rate of 1 per 20 samples (5%). Out of the 66 samples taken, five quality control samples were included (8%) with all sample results well within the quality control criteria for acceptability. Blank quality control samples were not included with the post-remediation soil samples.

4. OPERATIONS AND MAINTENANCE

4.1 Long-Term Monitoring

No long-term monitoring is planned for the soils within the Southeast Drainage. The radiological concentrations reported from the post-remediation sampling of soils in the drainage showed an overall reduction in concentration at most locations. Surface water and spring samples conducted as part of the previous environmental monitoring programs and assessed as part of the EE/CA, showed no risk associated with surface waters or spring waters. Therefore, no long-term monitoring is pertinent for the Southeast Drainage.

A groundwater monitoring well exists at the lower portion of the drainage. This well was installed as part of the groundwater remedial investigation activities at the chemical plant area. This monitoring well will be assessed for long-term monitoring activities as part of the groundwater remedial actions.

4.2 Facilities and Equipment

No facilities or permanent equipment were constructed or installed as part of this remedial action. No long-term operations or maintenance activities are necessary. Institutional controls, as needed, will be addressed in the *WSSRAP Stewardship Plan*.

5. REFERENCES

1. 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.

2. 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.

3. Argonne National Laboratory. *Engineering Evaluation/Cost Analysis for the Proposed Removal Action at the Southeast Drainage Near the Weldon Spring Site, Weldon Spring, Missouri.* DOE/OR/21548-584. Prepared for the U.S. Department of Energy, Weldon Spring Site Remedial Action Project. Weldon Spring, MO. October 1995.

4. MK-Ferguson Company and Jacobs Engineering Group. *Engineering Sampling Plan to Identify Areas for Remediation in the Southeast Drainage (Vicinity Properties DA4 and DOC7).* Rev. 0. DOE/OR/21548-582. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. November 1995.

5. MK-Ferguson Company and Jacobs Engineering Group. *Southeast Drainage Soils Sampling Report.* Rev. 0. DOE/OR/21548-650. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. January 1997.

6. MK-Ferguson Company and Jacobs Engineering Group. *Post-Remediation Sampling Plan for the Southeast Drainage.* Rev. 0. DOE/OR/21548-616. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. July 1997.

7. MK-Ferguson Company and Jacobs Engineering Group. *Closure Report for the Post-Remediation Sampling Plan for the Southeast Drainage.* Rev. 0. DOE/OR/21548-794. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. July 1999.

8. MK- Ferguson Company and Jacobs Engineering Group. *Engineering Soils Sampling Plan for Army and MDC Vicinity Properties. Addendum 5.* Rev. 0. DOE/OR/21548-622. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. April 1999.

APPENDIX A

Engineering Evaluation/Cost Analysis for the Proposed Removal Action at the Southeast Drainage Near the Weldon Spring Site, Weldon Spring, Missouri Decision Document

DOE/OR/21548-584

DECISION DOCUMENT

ENGINEERING EVALUATION/COST ANALYSIS FOR THE PROPOSED REMOVAL ACTION AT THE SOUTHEAST DRAINAGE NEAR THE WELDON SPRING SITE, MISSOURI

November 1996

DECISION DOCUMENT

ENGINEERING EVALUATION/COST ANALYSIS FOR THE PROPOSED REMOVAL ACTION AT THE SOUTHEAST DRAINAGE NEAR THE WELDON SPRING SITE, MISSOURI

STATEMENT AND BASIS OF PURPOSE

The purpose of this decision document is to describe a specific removal action proposed for contaminated sediments in the Southeast Drainage near the Weldon Spring site, located in St. Charles County, Missouri. Cleanup activities at the Weldon Spring site are conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, incorporating values of the National Environmental Policy Act (NEPA). This decision document completes the CERCLA compliance process for the proposed action.

BACKGROUND

The Weldon Spring site is located near the town of Weldon Spring, about 48 km (30 mi) west of St. Louis. It consists of two noncontiguous areas: the chemical plant area and a limestone quarry about 6.4 km (4 mi) south-southwest of the chemical plant area. The Southeast Drainage is a natural channel, 2.4-km (1.5-mi) long, that carries surface runoff to the Missouri River from the southern portion of the chemical plant area and a small portion of the adjacent ordnance works area south of the groundwater divide. The drainage became contaminated as a result of past activities of the U.S. Department of the Army and the U.S. Department of Energy (DOE) and its predecessors.

ASSESSMENT OF CONTAMINATED SEDIMENT AND SURFACE WATER

Analytical data for sediment and surface water were compiled and analyzed to perform a risk assessment to support a decision regarding remediation of the Southeast Drainage. For planning purposes, the drainage was delineated into four segments: A, B, C, and D (see Figure 1). Factors considered in segmentation of the drainage into these four elements included accessibility by standard excavation and hauling equipment, main channel slope, side slope, channel width, vegetation characteristics, and safety and public access. Characterization data were collected from each segment, including radiological and chemical surface and subsurface sediment samples and a comprehensive gamma walkover survey. The number of samples collected in each segment was determined to be statistically adequate to support risk conclusions. Surface water samples were collected at four springs along the drainage as part of the ongoing environmental monitoring program, and these data were used to assess potential human health risks from surface water in the

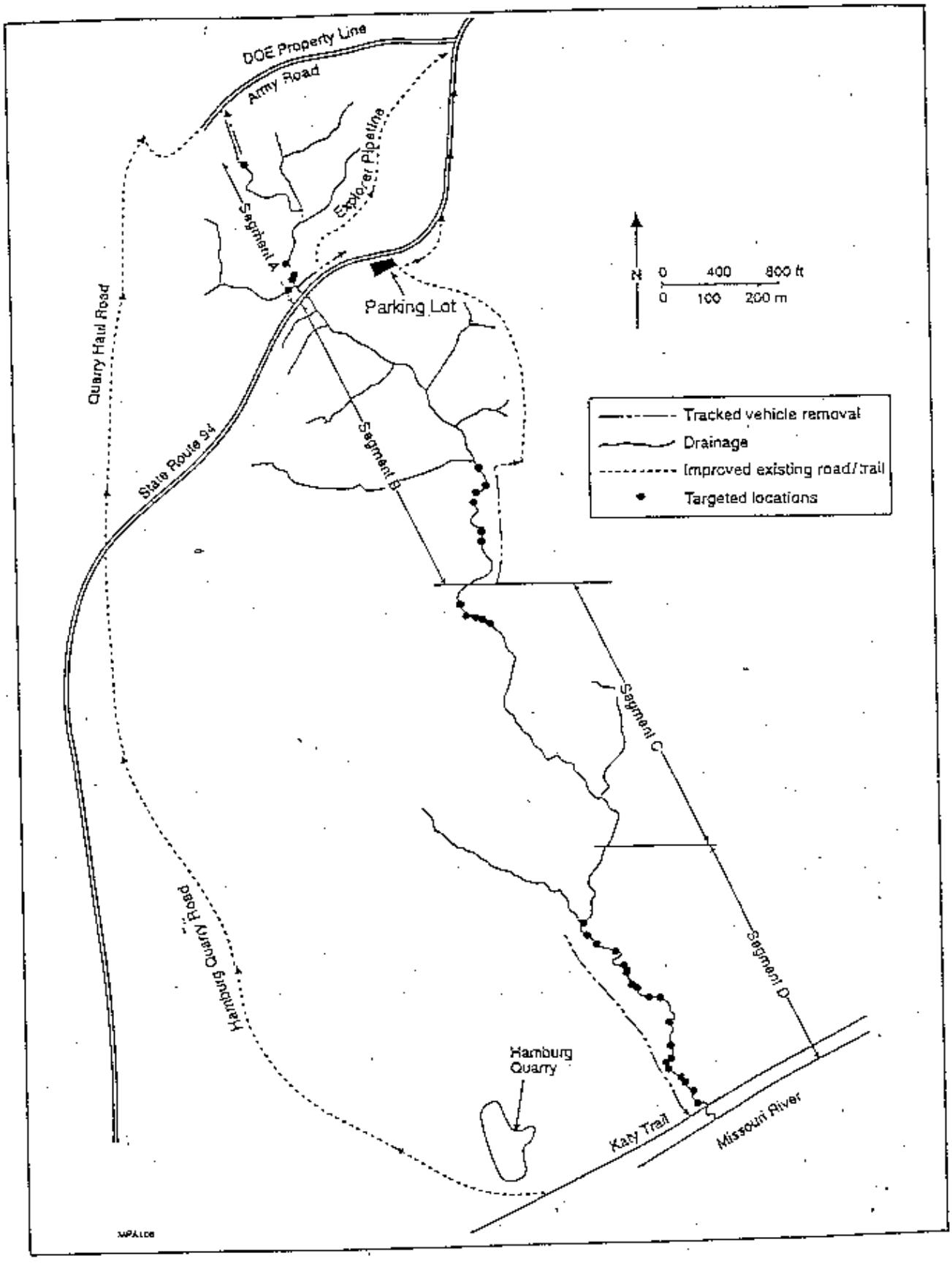


FIGURE 1 Proposed Excavation Locations and Haul Route

drainage. Sediment and surface water samples were also collected to support an ecological risk assessment of the drainage.

Human health risk evaluations were performed for current and hypothetical maximum future use conditions to assess hazards associated with potential exposure to contaminants in the drainage. The current land-use scenario assumed that a hunter would regularly hunt in the vicinity of the drainage. The future land-use scenario assumed that a home would be built in the vicinity of the drainage, allowing a child to access the drainage for use as a play area. In addition, an ecological risk evaluation was performed for current conditions, and this assessment indicated that surface water and sediment contamination in the drainage poses little risk to biota.

The human health risk analysis indicated that under current land-use conditions, contamination in the drainage does not pose an unacceptable risk to human health. For the future land-use scenario, the estimated risks for each segment are higher than those for the hunter scenario (current land use) but still within the acceptable risk range of 10^{-6} to 10^{-4} identified by the U.S. Environmental Protection Agency (EPA). The estimated risk is almost exclusively from radioactive contamination in sediment; the higher risks were calculated for Segments B and C.

Although a response action on the basis of risk is not strictly mandated by the National Contingency Plan, discretionary actions will be taken in the interest of minimizing total site risks in accordance with DOE's policy of reducing radiation exposures to levels "as low as reasonably achievable." The heterogeneous distribution of radioactive contamination in the drainage indicates that selective removal of contaminated areas will effectively reduce the risk to potential human and ecological receptors.

REMOVAL ACTION

On the basis of the analysis presented in the engineering evaluation/cost analysis (EE/CA), Subalternative 2.1 was selected as the proposed action for remediation of the Southeast Drainage. Under this alternative, selected contaminated sediment in accessible areas of the drainage will be removed with track-mounted equipment and transported on four minimal-access routes capable of supporting off-road haul trucks at slow speed. Representative routes that can be used were identified in the EE/CA and are described below. Use of these routes (Figure 1) will result in minimal disruption of the mature, high-quality forest community that exists in the drainage. The objective of this removal action will be to remove as much contaminated material as possible with no or minimal additional clearing.

Materials removed from the drainage will be managed through staging and decontamination areas. A variety of existing access routes and cleared areas will be utilized for transportation onto the chemical plant storage areas. Upper reaches of the drainage (Segment A) can be accessed overland from the Army road and along the Explorer Pipeline Company's access road and easement corridor. Lower reaches of the drainage (Segments B, C, and D) can be accessed through a cleared Union Electric power line right-of-way, through abandoned roadways within the Missouri

Department of Conservation area, and through Katy Trail (which will include a section of the Hamburg Quarry road, crossing State Route 94 to the quarry haul road). Segments of the granular alluvium within the drainage will be graded and utilized for transport within the drainage itself. A total of about 1,950 m^3 (2,550 yd^3) of materials are expected to be removed from the drainage. The excavated materials will be stored temporarily at a storage area on the Weldon Spring site (e.g., Ash Pond storage area or material staging area), with final disposal in the engineered disposal cell at the chemical plant area of the site.

Risk-based cleanup criteria were derived for the principal radioactive contaminants that correspond to a risk level of 1×10^{-5} for the hypothetical child scenario. The calculated risk-based concentrations are 13 pCi/g for radium-226, 13 pCi/g for radium-228, 350 pCi/g for thorium-230, and 290 pCi/g for uranium-238. The cleanup design will include sampling to determine residual concentrations at remediated locations. Efforts will be made to achieve the cleanup criteria in balance with the objective of minimizing environmental damage to the extent possible. It is expected that risk reduction will occur throughout the drainage such that following cleanup, the risk level for the hypothetical child scenario will be at or near 1×10^{-5}.

Standard worker practices and engineering controls will be in place during the removal action, including maintenance of haul roads, spraying of haul roads to minimize airborne dust, implementation of traffic controls, and temporary berming in certain areas to prevent storm-water runoff from flowing in the channel. During the removal action, erosion controls will be installed downgradient of all excavation areas to prevent the transport of silt down the drainage by minor storm-water runoff flowing out of the excavations. Restoration of the drainage will include grading, with minimal backfilling in excavated areas within the drainage, and reshaping, mulching, and reseeding of access routes and staging areas.

Air quality and noise impacts associated with the removal action could disturb ecological resources and recreational activities in the vicinity of the excavation activities and along haul routes. However, these impacts would be minor and temporary. Long-term positive environmental impacts will result from a reduction in contaminant levels in the drainage.

HIGHLIGHTS OF COMMUNITY PARTICIPATION

An EE/CA report was prepared to analyze alternatives for removal of contaminated sediment in the Southeast Drainage. This EE/CA was issued for public review and comment on August 23, 1996, and a notice of availability was published in the *St. Charles Journal* on the same day. Prior to issuance of the EE/CA document, meetings to discuss the proposed action were held with the Missouri Department of Conservation, Missouri Department of Natural Resources, EPA, and Weldon Spring Citizens Commission. The public comment period extended from August 23 to September 23, 1996, and included a public meeting on August 29, 1996.

At the public meeting, the EPA noted a need to balance human health risk reduction with potential ecological damage and supported DOE's selection of Subalternative 2.1 as the proposed

action. The Missouri Department of Natural Resources expressed preference for Subalternative 2.2, in which additional areas of contamination would be removed from the drainage. No additional comments were provided at the public meeting. Written comments were subsequently received from the Weldon Spring Citizens Commission stating their concurrence with DOE's proposed action.

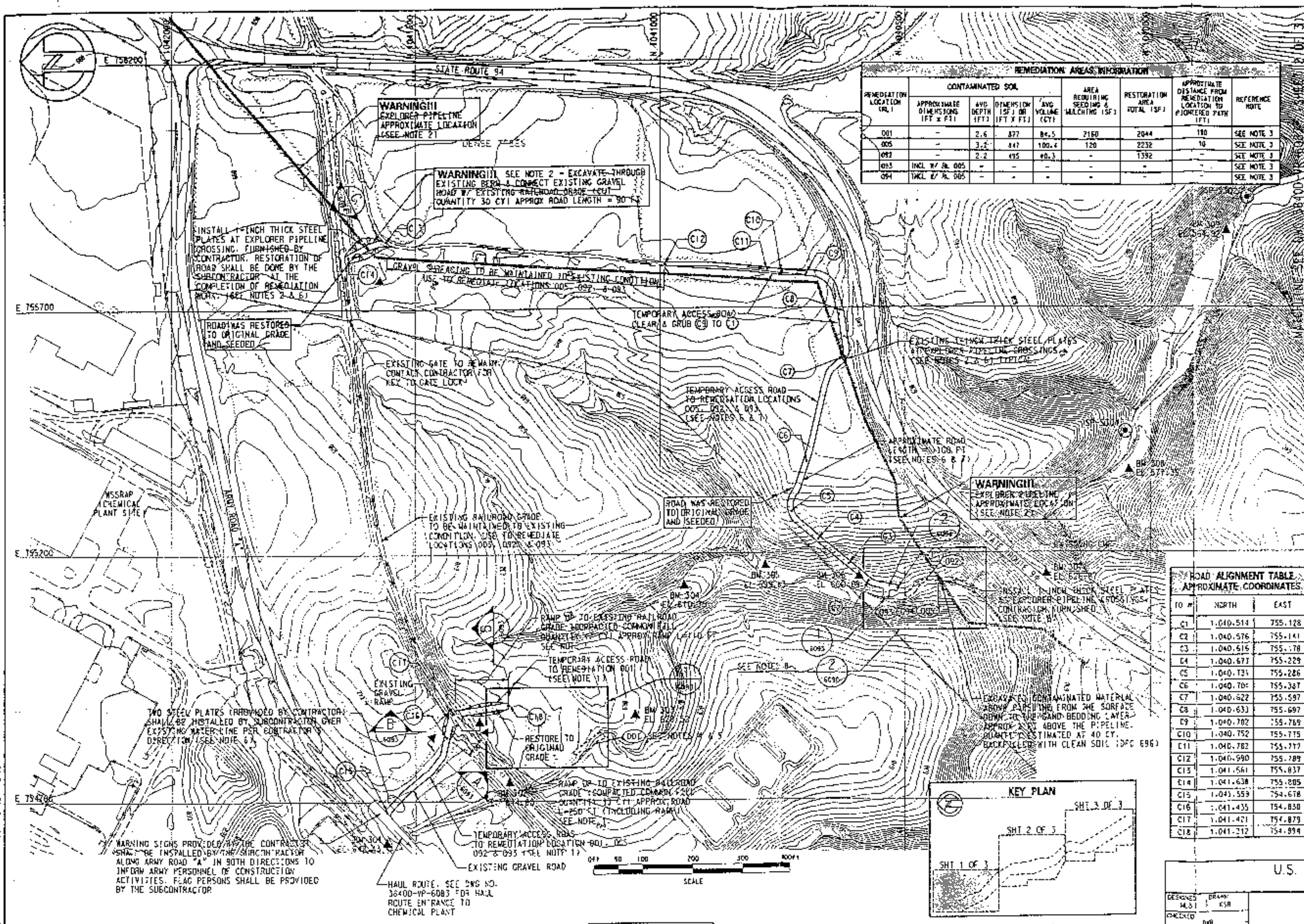
On the basis of comments received, Subalternative 2.1 was selected for implementation. Subalternative 2.2, which was preferred by the Missouri Department of Natural Resources, was not selected because the increased ecological damage resulting from removal of sediments from these additional areas (which would be significant) would not be balanced by the net risk reduction (which would be small). The DOE will coordinate with the state agencies and the EPA during implementation of the action to ensure that as much contaminated sediment as possible is removed from the drainage without causing extensive ecological drainage.

DECLARATION OF STATUTORY DETERMINATIONS

The removal action selected for the Southeast Drainage is protective of human health and the environment. In addition, the action can be implemented with standard technologies, it is cost-effective, and it is consistent with and will contribute to the efficient performance of the overall remedial action for the Weldon Spring site. In accordance with CERCLA, the action complies with federal and state requirements that are legally applicable or relevant and appropriate to the removal action. This action utilizes permanent solutions and resource recovery technologies to the maximum extent practicable, given its limited scope. The statutory preference for treatment as a principal element of the remedy is not practicable to this action because no methods are available that would significantly or effectively reduce toxicity, mobility, or volume and because the excavated materials are expected to be in a form that will allow for direct (untreated) disposal in the on-site cell.

Following remedial action of the Weldon Spring site, hazardous substances will remain on the site (within an engineered disposal facility) at concentrations higher than health-based levels; therefore, 5-year reviews of the Weldon Spring site will be required. Following removal activities, the Southeast Drainage will continue to be monitored within the scope of these comprehensive 5-year reviews.

APPENDIX B
Final As-Built Drawings of the Southeast Drainage



REMEDIATION AREAS INFORMATION								
REMEDIATION LOCATION (RL)	CONTAMINATED SOIL				AREA REQUIRING SEEDING & MULCHING (SF)	RESTORATION AREA TOTAL (SF)	APPROXIMATE DISTANCE FROM REMEDIATION LOCATION TO PIONEERED PATH (FT)	REFERENCE NOTE
	APPROXIMATE DIMENSIONS (FT x FT)	AVG DEPTH (FT)	DIMENSION (SF) OR (FT X FT)	AVG VOLUME (CY)				
001	-	2.6	877	84.5	2160	2044	110	SEE NOTE 3
005	-	3.2	847	100.4	120	2232	10	SEE NOTE 3
092	-	2.2	495	40.3	-	1392	-	SEE NOTE 3
093	INCL W/ RL 005	-	-	-	-	-	-	SEE NOTE 3
094	INCL W/ RL 005	-	-	-	-	-	-	SEE NOTE 3

NOTES

1. THE TEMPORARY ACCESS ROAD HAS BEEN COMPLETED. RAMPS ALONG BOTH SIDES OF THE EXISTING RAILROAD GRADE HAVE NOT BEEN BUILT. SOUTH RAMP TO BE INSTALLED AND REMOVED AT COMPLETION OF WORK WITHIN THE AREA. RAMP MATERIAL TO BE USED IN THE RESTORATION OF AREA 001. NORTHERN RAMP SHALL BE GRAVEL SURFACED USING EXISTING BALLAST ROCK NEAR RAMP; NO RESTORATION OF NORTHERN RAMP REQUIRED.
2. **WARNING!!!** EXPLORER PETROLEUM'S 24 INCH HIGH PRESSURE PETROLEUM PRODUCTS PIPELINE. CONTACT LAYTON WILSON AT 618-251-0250, 48 HOURS PRIOR TO ANY CONSTRUCTION WITHIN 50 FEET OF PIPELINE. HEAVY EQUIPMENT AND HAUL TRUCKS SHALL NOT CROSS PIPELINE WITHOUT STEEL PLATES IN PLACE AS SHOWN. THE TEMPORARY ACCESS ROAD IS APPROXIMATELY 50% COMPLETE. FINAL GRADE WILL BE DETERMINED BY THE CONTRACTOR. AFTER FINAL GRADE DETERMINATION, INSTALL GRAVEL SURFACING AS SHOWN ON DRAWING 38400-VP-6094 SECTION C.
3. SEE DRAWING 38400-VP-6090 FOR EXCAVATION AND REMEDIATION DETAILS.
4. HAUL TRUCKS SHALL WAIT ON STANDBY ON TEMPORARY ACCESS HAUL ROAD WHILE BACKHOE TRANSPORTS LOADS FROM REMEDIATION LOCATION.
5. TARP HAUL TRUCKS AT THE END OF THE TEMPORARY ACCESS ROAD.
6. STEEL PLATES SHALL BE REMOVED AND TRANSPORTED TO THE CONTRACTOR'S LAYDOWN AREA WITHIN THE CHEMICAL PLANT SITE AREA AFTER WORK IN AREA IS COMPLETE.
7. TEMPORARY ACCESS ROAD IS COMPLETE AND STEEL PLATES ARE INSTALLED. RESTORATION OF ROAD SHALL BE DONE BY THE SUBCONTRACTOR AT THE COMPLETION OF REMEDIATION WORK.
8. PARTIAL EXCAVATION OF CONTAMINATED AREA 005 DUE TO EXPLORER PIPELINE CROSSING REQUIREMENTS PERFORMED BY OTHERS AND STOCKPILED NEAR AREA 092. THIS CONTAMINATED SOIL SHALL BE TAKEN TO ASH POND STORAGE AREA PRIOR TO EXCAVATING AREA 092.

REFERENCE DRAWINGS

38400-VP-6083 CHEMICAL PLANT SITE MAP, VICINITY MAP, LIST OF DRAWINGS AND GENERAL NOTES
38400-VP-6084 SITE PLAN, ABBREVIATIONS AND GENERAL LEGEND
38400-VP-6085 HAUL ROUTES AND HAMBURG QUARRY ROAD IMPROVEMENTS PLANS
38400-VP-6087 SE DRAINAGE REMEDIATION LOCATIONS PLAN (SHEET 2 OF 3)
38400-VP-6088 SE DRAINAGE REMEDIATION LOCATIONS PLAN (SHEET 3 OF 3)
38400-VP-6090 CONTAMINATED SOIL EXCAVATION AND RESTORATION DETAILS (SHEET 1 OF 2)
38400-VP-6093 SECTIONS AND DETAILS (SHEET 1 OF 2)
38400-VP-6094 SECTIONS AND DETAILS (SHEET 2 OF 2)

ROAD ALIGNMENT TABLE APPROXIMATE COORDINATES		
ID #	NORTH	EAST
C1	1,040,514	755,128
C2	1,040,576	755,141
C3	1,040,615	755,178
C4	1,040,677	755,229
C5	1,040,734	755,286
C6	1,040,705	755,387
C7	1,040,622	755,597
C8	1,040,633	755,697
C9	1,040,702	755,769
C10	1,040,752	755,775
C11	1,040,782	755,777
C12	1,040,990	755,789
C13	1,041,561	755,837
C14	1,041,638	755,805
C15	1,041,553	754,678
C16	1,041,435	754,830
C17	1,041,421	754,879
C18	1,041,212	754,994

SET I.D. ______

QUALITY LEVEL 2
MKES DOCUMENT NO. 3840-V:EN-D-01-0457-03

NO.	DATE	REVISION	BY	CK	DES MGR	ENG'G MGR	QA	ENG'G MGR	QA
3	2/9/99	RECORD DRAWING (INCORP DFC 696 & 6901							
2	11/24/97	RE-ISSUED FOR CONSTRUCTION FOR PHASE II PER DCF 01-58	MLB	DWR	DWR	JPR	SH	JW	SW
1	8/15/97	RE-ISSUED FOR CONSTRUCTION PER DFC #669	MLB	DWR	DWR	JPR	SH	JW	PC
0	6/11/97	ISSUED FOR CONSTRUCTION	MLB	DWR	DWR	HH	SH	JEW	PC
B	3/28/97	ISSUED FOR REVIEW AND APPROVAL (100% SUBMITTAL)	MLB	DWR	DWR	N/A	N/A	N/A	N/A

U.S. DEPARTMENT OF ENERGY
OAK RIDGE, TENNESSEE

WELDON SPRING SITE REMEDIAL ACTION PROJECT
WELDON SPRING, MISSOURI
SOUTHEAST DRAINAGE REMEDIATION PHASE II

SE DRAINAGE REMEDIATION LOCATIONS PLAN
SHEET 1 OF 3

CIVIL — WP 410 A

DESIGNED MLB — DRAWN KSR — CHECKED DWR — INSPECTED DWR FOR S. PARE — RECOMMENDED K.9/MLB

APPROVED D.W. REPPOND 5/11/97 — ENG'R MGR/QA MGR. JEM FOR R. HEMPILL 6/12/97, J.C. JOTA FOR B. HALTON — PMC ENG'G MGR. J.C. FIELDING 6/25/97 — PMC QA MGR. S. WORINT FOR P. CATE 6/26/97

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL GROUP
ONE MARKET, STEUART TOWER
SAN FRANCISCO, CA 94105

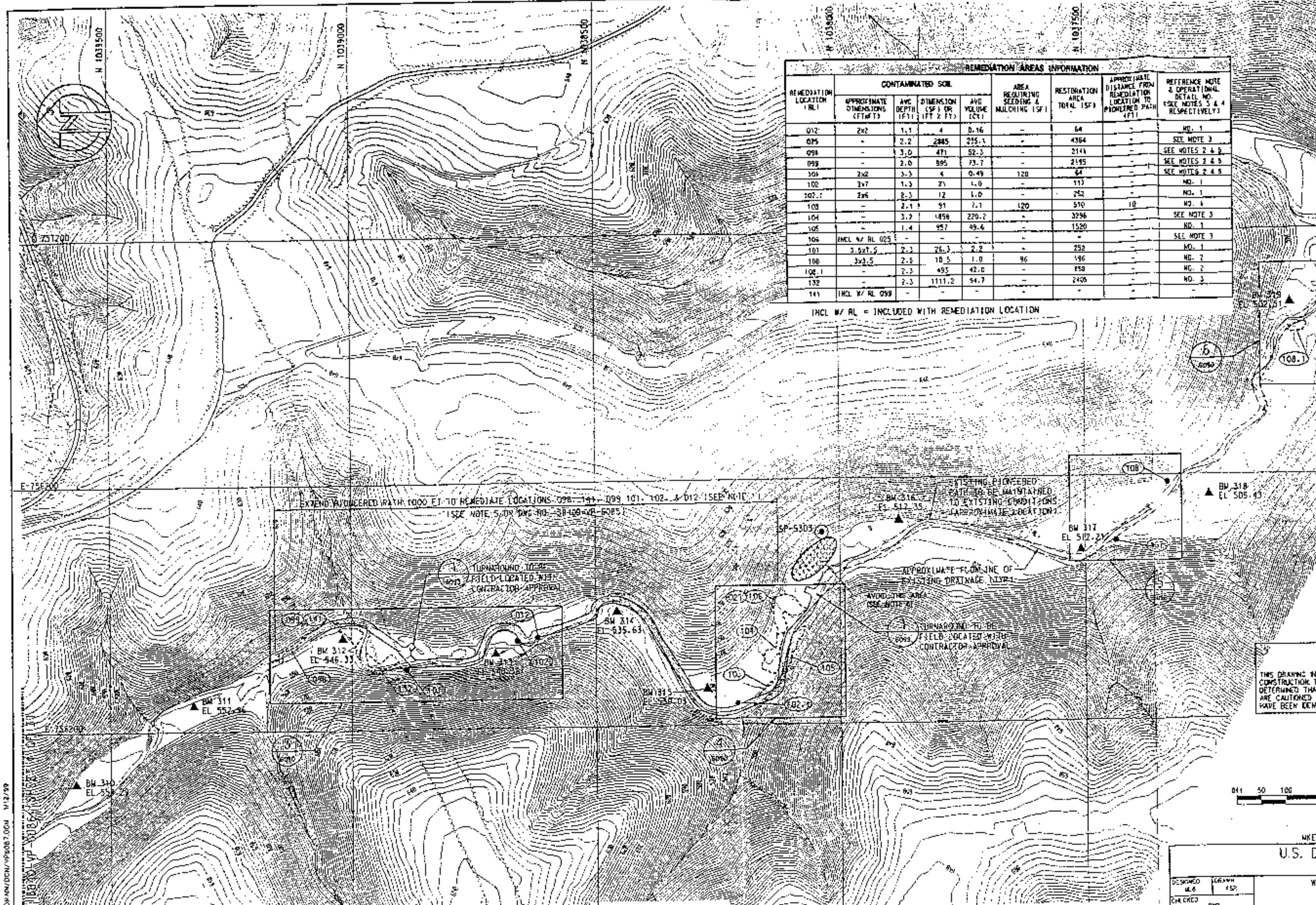
PROJECT NO. DE-AC05-86OR21548
DRAWING NO. 38400-VP-6086 — REV. 3

RECORD DRAWING

THIS DRAWING INCORPORATES CHANGES IDENTIFIED TO HAVE OCCURRED DURING CONSTRUCTION. THE CERTIFYING ENGINEER HAS REVIEWED THESE CHANGES AND DETERMINED THAT THEY DO NOT ADVERSELY AFFECT DESIGN OR OPERATIONS. USERS ARE CAUTIONED THAT SOME CHANGES OCCURRING DURING CONSTRUCTION MAY NOT HAVE BEEN IDENTIFIED AND MAY NOT HAVE BEEN INCORPORATED INTO THIS DRAWING.

PMC RECORD PRINT VALIDATION: (PROJECT ENGINEER)

FILENAME O:/38400P/SEDRAIN/DGN/VP6086.DGN DATE 1/12/99



REMEDIATION AREAS INFORMATION

REMEDIATION LOCATION (RL)	CONTAMINATED SOIL				AREA REQUIRING SEEDING & MULCHING (SF)	RESTORATION AREA TOTAL (SF)	APPROXIMATE DISTANCE FROM REMEDIATION LOCATION TO PIONEERED PATH (FT)	REFERENCE NOTE & OPERATIONAL DETAIL NO. (SEE NOTES 3 & 4 RESPECTIVELY)
	APPROXIMATE DIMENSIONS (FTxFT)	AVG DEPTH (FT)	DIMENSION (SF) OR (FT X FT)	AVG VOLUME (CY)				
012	2x2	1.1	4	0.16	-	64	-	NO. 1
025	-	2.2	2845	215.1	-	4364	-	SEE NOTE 3
098	-	3.0	471	52.3	-	2144	-	SEE NOTES 2 & 5
099	-	2.0	995	73.7	-	2195	-	SEE NOTES 2 & 5
101	2x2	3.3	4	0.49	120	64	-	SEE NOTES 2 & 5
102	3x7	1.3	21	1.0	-	117	-	NO. 1
102.1	2x6	2.3	12	1.0	-	252	-	NO. 1
103	-	2.1	91	7.1	120	510	10	NO. 1
104	-	3.2	1858	220.2	-	3296	-	SEE NOTE 3
105	-	1.4	957	49.6	-	1520	-	NO. 1
106	INCL W/ RL 025	-	-	-	-	-	-	SEE NOTE 3
107	3.5x7.5	2.3	26.3	2.2	-	252	-	NO. 1
108	3x3.5	2.5	10.5	1.0	96	196	-	NO. 2
108.1	-	2.3	493	42.0	-	858	-	NO. 2
132	-	2.3	1111.2	54.7	-	2405	-	NO. 3
141	INCL W/ RL 099	-	-	-	-	-	-	-

INCL W/ RL = INCLUDED WITH REMEDIATION LOCATION

NOTES

1. EXTENDED PIONEERED PATH SHALL BE FIELD DETERMINED WITH CONTRACTOR APPROVAL TO MINIMIZE CLEARING OF TREES AND BRUSH. EXISTING FLOWLINE OF DRAINAGE CHANNEL SHOULD BE FOLLOWED TO MINIMIZE DISTURBANCE OF AREA.
2. HAUL TRUCK SHALL WAIT ON STANDBY ON PIONEERED PATH WHILE BACKHOE TRANSPORTS LOADS FROM REMEDIATION LOCATION.
3. SEE DRAWING 38400-VP-6090 FOR REMEDIATED DETAILS.
4. FOR OPERATIONAL DETAILS SEE DRAWING NO. 38400-VP-6089 FOR APPROXIMATE SCENARIOS DEPICTING REMEDIATION.
5. SEE DRAWING NO. 38400 VP-6090 FOR DRAINA DIVERSION.
6. NO CONSTRUCTION OR FOOT TRAFFIC WHATSOEV WITHIN THIS AREA.

REFERENCE DRAWINGS

- 38400-VP-6085 HAUL ROUTES AND HAMBURG QUARI ROAD IMPROVEMENTS PLANS
- 38400-VP-6086 SE DRAINAGE REMEDIATION LOCATIONS PLAN (SHEET 1 OF 3
- 38400-VP-6088 SE DRAINAGE REMEDIATION LOCATIONS PLAN (SHEET 3 OF 3
- 38400-VP-6089 OPERATIONAL DETAILS
- 38400-VP-6090 CONTAMINATED SOIL AND RESTORATION DETAILS (SHEET 1 OF 2)
- 38400-VP-6093 SECTIONS AND DETAILS (SHEET 1 OF 2)

KEY PLAN

SHT 1 OF 3 SHT 2 OF 3 SHT 3 OF 3

RECORD DRAWING

THIS DRAWING INCORPORATES CHANGES IDENTIFIED TO HAVE OCCURRED DURING CONSTRUCTION. THE CERTIFYING ENGINEER HAS REVIEWED THESE CHANGES AND DETERMINED THAT THEY DO NOT ADVERSELY AFFECT DESIGN OR OPERATIONS. USERS ARE CAUTIONED THAT SOME CHANGES OCCURRING DURING CONSTRUCTION MAY NOT HAVE BEEN IDENTIFIED AND MAY NOT HAVE BEEN INCORPORATED INTO THIS DRAWING.

PMC RECORD DRWG VALIDATION (PROJECT ENGINEER)

SCALE 0 FT 50 100 200 300 400 FT

SET I.D. ______

QUALITY LEVEL 2
MKES DOCUMENT NO. 3840-V:EN-D-01-0458-03

NO.	DATE	REVISION	BY	CK	DES MGR	ENG'G MGR	QA	ENG'G MGR	QA	PMC
3	2/9/99	RECORD DRAWING								
2	11/24/97	RE-ISSUED FOR CONSTRUCTION FOR PHASE II PER DCF 01-58	MLB	DWR	DWR	APR	BK	JY	SN
1	6/15/97	RE-ISSUED FOR CONSTRUCTION PER DFC #669	MLB	DWR	DWR	RLM FOR APR	JJ FOR BK	DD FOR JY	PC
0	6/11/97	ISSUED FOR CONSTRUCTION	MLB	DWR	DWR	RLM FOR HH	EJ FOR BH	JEK	SF FOR PJ
B	3/28/97	ISSUED FOR REVIEW AND APPROVAL (100% SUBMITTAL)	MLB	DWR	DWR	N/A	N/A	N/A	N/A

MKES / PMC

U.S. DEPARTMENT OF ENERGY
OAK RIDGE, TENNESSEE

WELDON SPRING SITE REMEDIAL ACTION PROJECT
WELDON SPRING, MISSOURI
SOUTHEAST DRAINAGE REMEDIATION PHASE II

SE DRAINAGE REMEDIATION LOCATIONS PLAN SHEET 2 OF 3

DESIGNED MLB | DRAWN ESP | CHECKED DWR | INSPECTED DWR FOR S. PARK | RECOMMENDED MLB/ALP

CIVIL VP 470

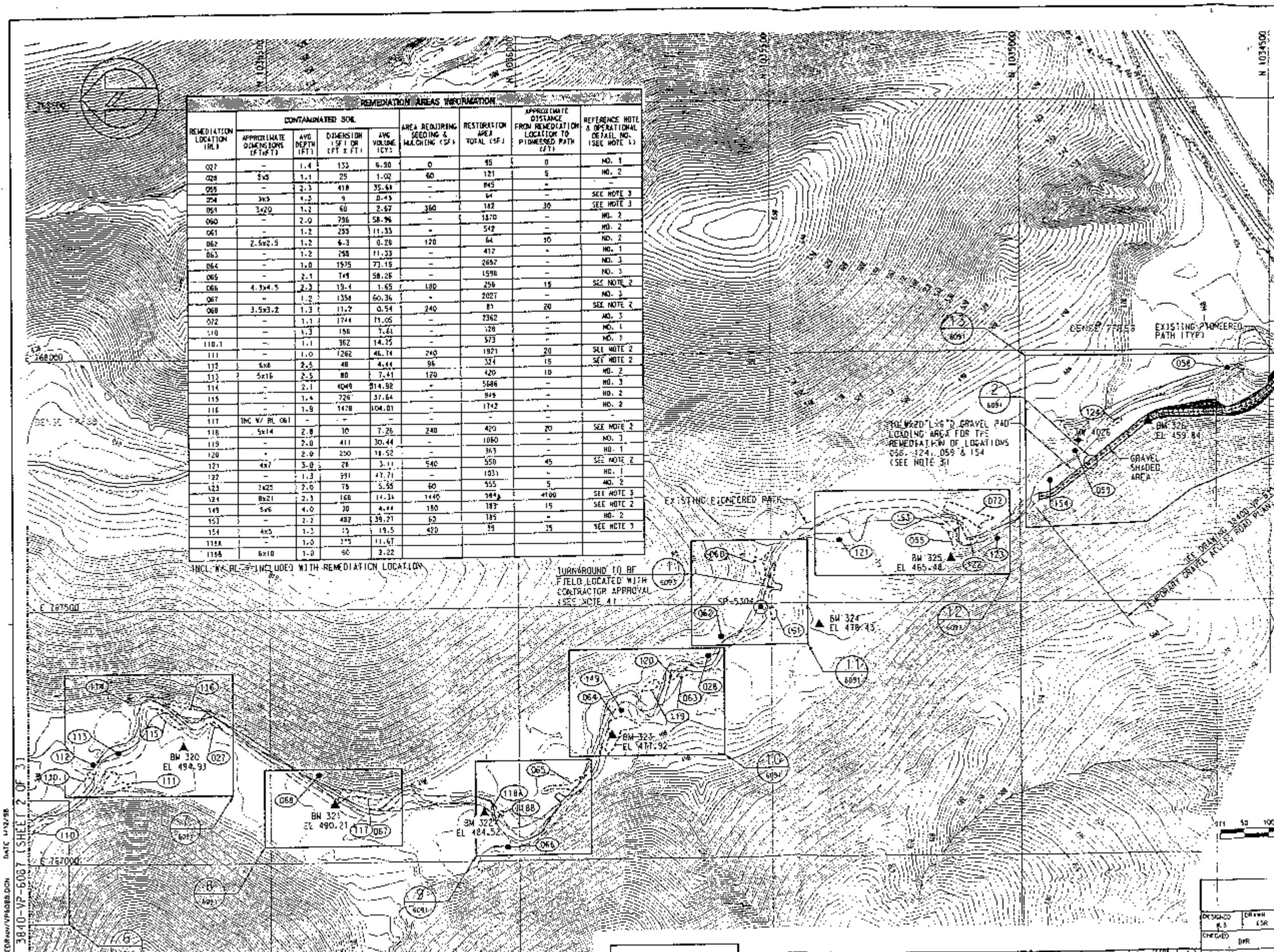
APPROVED D.N. REPPOND 6/11/97 | ENGR MGR/QA MGR. RLM FOR H. HEMPILL 6/12/97, E.E. JOYA FOR B. WALTON | PMC ENG'G MGR. J.E. WILLIAMS 6/25/97 | PMC QA MGR. S. WORTHY FOR P. CATE 6/26/97

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL GROUP
ONE MARKET, STEUART TOWER
SAN FRANCISCO, CA 94105

PROJECT NO. DE-AC05-86OR21548

DRAWING NO. 38400-VP-6087

FILENAME: O:/38400/VP/SEDRAIN/DGN/VP6087.DGN 1/12/99



REMEDIATION AREAS INFORMATION

REMEDIATION LOCATION (RL)	CONTAMINATED SOIL: APPROXIMATE DIMENSIONS (FTxFT)	AVG DEPTH (FT)	DIMENSION (SF) OR (FT X FT)	AVG VOLUME (CY)	AREA REQUIRING SEEDING & MULCHING (SF)	RESTORATION AREA TOTAL (SF)	APPROXIMATE DISTANCE FROM REMEDIATION LOCATION TO PIONEERED PATH (FT)	REFERENCE NOTE & OPERATIONAL DETAIL NO. (SEE NOTE 1)
027	-	1.4	133	6.90	0	95	0	NO. 1
028	5x5	1.1	25	1.02	60	121	5	NO. 2
055	-	2.3	418	35.61	-	845	-	-
056	3x3	1.3	9	0.43	-	64	-	SEE NOTE 3
059	3x20	1.2	60	2.67	360	182	30	SEE NOTE 3
060	-	2.0	796	58.96	-	1370	-	NO. 2
061	-	1.2	255	11.33	-	542	-	NO. 2
062	2.5x2.5	1.2	6.3	0.28	120	64	30	NO. 2
063	-	1.2	255	11.33	-	412	-	NO. 1
064	-	1.0	1975	73.15	-	2652	-	NO. 3
065	-	2.1	749	58.26	-	1598	-	NO. 3
066	4.5x4.5	2.3	19.4	1.65	180	256	15	SEE NOTE 2
067	-	1.2	1358	60.36	-	2027	-	NO. 3
068	3.5x3.2	1.3	11.2	0.54	240	81	20	SEE NOTE 2
072	-	1.1	1744	71.06	-	2362	-	NO. 3
110	-	1.3	158	7.61	-	128	-	NO. 1
110.1	-	1.1	362	14.25	-	573	-	NO. 1
111	-	1.0	1262	46.74	240	1921	20	SEE NOTE 2
112	6x8	2.5	48	4.44	96	324	15	SEE NOTE 2
113	5x16	2.5	80	7.41	120	420	10	NO. 2
114	-	2.1	4049	314.92	-	5686	-	NO. 3
115	-	1.4	726	37.64	-	949	-	NO. 2
116	-	1.9	1478	104.01	-	1742	-	NO. 2
117	INC W/ RL 061	-	-	-	-	-	-	-
118	5x14	2.8	70	7.26	240	420	20	SEE NOTE 2
119	-	2.0	411	30.44	-	1060	-	NO. 3
120	-	2.0	250	18.52	-	363	-	NO. 1
121	4x7	3.0	28	3.11	540	550	45	SEE NOTE 2
122	-	1.3	391	47.71	-	1031	-	NO. 1
123	3x25	2.0	75	5.55	60	555	5	NO. 2
124	8x21	2.3	168	14.34	1440	564	4100	SEE NOTE 3
149	5x6	4.0	30	4.44	150	183	15	SEE NOTE 2
153	-	2.2	482	39.21	60	185	-	NO. 2
154	4x5	1.3	15	19.5	420	59	35	SEE NOTE 3
118A	-	1.0	315	11.67				
118B	6x10	1.0	60	2.22				

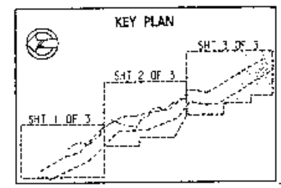
INCL W/ RL = INCLUDED WITH REMEDIATION LOCATION

NOTES

1. SEE OPERATIONAL DETAILS DRAWING NO. 38400-VP-6089 FOR APPROXIMATE SCENARIOS DEPICTING REMEDIATION.
2. HAUL TRUCK SHALL WAIT ON STANDBY ON PIONEERED PATH WHILE BACKHOE TRANSPORTS LOADS FROM REMEDIATION LOCATIONS.
3. SUBCONTRACTOR LOADING AREA ALONG PIONEERED PATH FOR HAUL TRUCKS TO WAIT ON STANDBY WHILE BACKHOE TRANSPORTS LOADS FROM REMEDIATION LOCATIONS. BACKHOE LOADS SHALL BE COVERED IF TRAVEL DISTANCE IS OVER 200 FEET. LOADING AREA LOCATION TO BE DETERMINED IN FIELD.
4. TURNAROUND LOCATIONS TO BE FIELD DETERMINED AND ARE IN ADDITION TO THE TURNAROUNDS THAT ARE USED IN OPERATIONAL DETAIL NO. "3", ON DRAWING NO. 38400-VP-6089.

REFERENCE DRAWINGS

38400-VP-6086	SOUTHEAST DRAINAGE REMEDIATION LOCATIONS PLAN (SHEET 1 OF 3)
38400-VP-6087	SOUTHEAST DRAINAGE REMEDIATION LOCATIONS PLAN (SHEET 2 OF 3)
38400-VP-6089	OPERATIONAL DETAILS
38400-VP-6091	CONTAMINATED SOIL EXCAVATION AND RESTORATION DETAILS (SHEET 2 OF 2)
38400-VP-6093	SECTIONS & DETAILS (SHEET 1 OF 2)
38400-VP-6094	SECTIONS & DETAILS (SHEET 2 OF 2)
38400-VP-6115	TEMPORARY ACCESS GRAVEL ROAD PLAN, PROFILE AND SECTIONS



PMC RECORD PRINT VERIFICATION: (PROJECT ENGINEER)

RECORD DRAWING

THIS DRAWING INCORPORATES CHANGES IDENTIFIED TO HAVE OCCURRED DURING CONSTRUCTION. THE CERTIFYING ENGINEER HAS REVIEWED THESE CHANGES AND DETERMINED THAT THEY DO NOT ADVERSELY AFFECT DESIGN OR OPERATIONS. USERS ARE CAUTIONED THAT SOME CHANGES OCCURRING DURING CONSTRUCTION MAY NOT HAVE BEEN IDENTIFIED AND MAY NOT HAVE BEEN INCORPORATED INTO THIS DRAWING.

SCALE: 0 FT 50 100 200 300 400 FT

SET I.D. ______

QUALITY LEVEL 2
MKES DOCUMENT NO. 3840-V:EN-D-0459-03

NO.	DATE	REVISION	DY	CK	DES MGR	ENG'G MGR	QA	ENG'G MGR.	QA
4	2/9/99	RECORD DRAWING							
3	11/2/98	RE-ISSUED FOR CONSTRUCTION FOR PHASE II PER DCF 01-59	MLB	DWR	DWR	APR	BH	JY	SN
2	9/15/97	RE-ISSUED FOR CONSTRUCTION PER DFC #669	MLB	DWR	DWR	APR	BH	JY	PC
0	6/11/97	ISSUED FOR CONSTRUCTION	MLB	DWR	DWR	ALM FOR GH	TEJ FOR BH	DU FOR JEN	SN FOR PC
B	3/28/97	ISSUED FOR REVIEW AND APPROVAL (100% SUBMITTAL)	MLB	DWR	DWR	N/A	N/A	N/A	N/A
			MKES					PMC	

U.S. DEPARTMENT OF ENERGY
OAK RIDGE, TENNESSEE

DESIGNED MLB | DRAWN ESR | CHECKED DWR | INSPECTED DWR FOR S. PARE | RECOMMENDED MLB/ALM

WELDON SPRING SITE REMEDIAL ACTION PROJECT
WELDON SPRING, MISSOURI
SOUTHEAST DRAINAGE REMEDIATION PHASE II

SE DRAINAGE REMEDIATION LOCATIONS PLAN SHEET 3 OF 3

CIVIL — WP 470 A

APPROVED	DATE	ENG'R MGR./QA MGR.	DATE	PMC ENG'G MGR.	DATE	PMC QA MGR.	DATE
D.B. REPPOND	6/11/97	ALM FOR K. HEMPILL / T.E. JOYA FOR B. WALTON	6/12/97	J.E. WILLIAMS	6/25/97	S. WORTHY FOR P. CATE	6/26/97

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL GROUP
ONE MARKET, STEUART TOWER
SAN FRANCISCO, CA 94105

PROJECT NO. DE-AC05-86OR21548

DRAWING NO. 3840D-VP-6098 REV. 3

MATCHLINE SEE DWG 3840-VP-6087 (SHEET 2 OF 3)

FILENAME 3840D/VP/CEDRAW/VP6098.DGN DATE 1/12/98

APPENDIX C
Southeast Drainage Radiological Data Results After WP-470A Remediation

Table C-1 Radiological Data Results from Post-Remediation Soil Sampling

Location	Sample ID #	Radium-226 (pCi/g)	Radium-228 (pCi/g)	Thorium-230 (pCi/g)	Uranium-238 (pCi/g)	Northing	Easting
001	SO-498001	12.3	1.66	4.72	37.8	1041167.2	754800
005	SO-498005	4.73	2.86	22.9	10.9	1040401.6	755141.8
012	SO-498012	1.68	1.07	2.19	< 4.32	1038618.2	756386.3
025A	SO-498025-A	24.9	1.33	29.1	142.0	1038124.8	756434.7
025B	SO-498025-B	3.55	1.25	5.64	5.48	1038092.0	756434.7
027	SO-498027	23.0	6.58	14.6	26.7	1036597.7	757268.4
028	SO-498028	11.3	< 1.29	3.20	3.69	1035597.1	75737.6
055	SO-498055	4.30	0.99	5.63	8.82	1035101.0	757647.7
058	SO-498055	4.99	1.21	2.91	4.96	1034586.7	757958.5
059	SO-498059	4.86	< 1.40	46.5	10.4	1034891.8	757800.6
060A	SO-498060-A	2.18	< 0.81	3.02	7.54	1035518.6	757578.3
060B	SO-498060-B	239	17.4	5090.0	150.0	1035518.6	757545.5
061	SO-498061	26.9	0.99	17.6	70.2	1035495.7	757482.7
062	SO-498062	1.25	1.06	1.25	< 2.33	1035597.1	757437.6
063	SO-498063	10.8	< 1.46	3.16	6.05	1035654.9	757366.3
064A	SO-498064-A	2.14	1.44	3.96	7.48	1035786.2	757267.9
064B	SO-498064-B	3.58	1.10	5.43	12.8	1035819.0	757235.1
065A	SO-498065-A	3.64	1.25	8.04	16.9	1035950.2	757141.1
065B	SO-498065-B	19.8	4.18	49.2	58.9	1035917.4	757141.4
066	SO-498066	10.1	1.54	70.4	15.7	1036023.6	757027.0
067	SO-498067	1.50	1.23	1.34	< 3.94	1036360.6	757133.6
068	SO-498068	1.54	1.23	1.32	2.08	1036403.6	757174.0
072A	SO-498072-A	11.1	1.79	16.3	19.0	1035101.0	757679.9
072B	SO-498072-B	11.6	1.85	16.8	16.8	1035133.8	757679.9
092	SO-498092	5.43	1.53	38.4	80.0	1040467.2	755141.8
093	SO-498093	1.95	1.24	0.76	76.3	1040434.4	755141.8
094	SO-498094	3.80	1.20	8.69	17.4	1040348.3	755118.8
098A	SO-498098-A	2.44	1.13	5.38	2.65	1039145.6	756345.9
098B	SO-498098-B	2.51	1.07	2.10	2.48	1039112.7	756378.7
099	SO-498099	2.51	1.22	2.53	2.99	1038993.9	756367.9
101	SO-498101	89.2	6.79	1920	18.9	1038928.0	756335.1
102	SO-498102	2.76	1.26	6.35	9.93	1038660.6	756379.7
102.1	SO-498102.1	1.40	1.40	1.59	< 3.65	1038213.1	756243.3
103	SO-498103	1.33	0.77	1.51	< 2.72	1038157.6	756270.6
104A	SO-498104-A	2.17	0.93	1.48	6.72	1038124.8	756336.3
104B	SO-498104-B	6.05	1.18	17.4	15.4	1038124.8	756369.7
105	SO-498105	16.2	0.82	3.57	29.3	1038092.0	756369.4
106	SO-498106	1.26	1.29	1.33	< 2.91	1038124.8	756401.9

Location	Sample ID #	Radium-226 (pCi/g)	Radium-228 (pCi/g)	Thorium-230 (pCi/g)	Uranium-238 (pCi/g)	Northing	Easting
107	SO-498107	33.9	1.83	44.5	40.1	1037435.4	756567.1
108	SO-498108	5.29	1.06	4.74	10.7	1037324.4	756684.2
108.1	SO-498108.1	7.05	0.98	3.33	9.64	1037042.7	757000.2
110	SO-498110	4.26	1.15	2.85	24.0	1036977.1	757065.6
110.1	SO-498110.1	1.82	< 1.19	2.07	5.55	1036869.9	757154.9
111A	SO-498111-A	7.43	0.92	42.1	29.4	1036837.1	757154.9
111B	SO-498111-B	1.74	1.46	1.35	< 4.13	1036804.2	757154.9
112	SO-498112	11.2	< 0.95	10.3	9.13	1036856.4	757197.5
113	SO-498113	36.2	0.96	11.4	11.4	1036806.5	757219.9
114A	SO-498114-A	1.36	< 0.71	1.40	10.4	1036794.5	757268.4
114B	SO-498114-B	2.99	0.86	2.33	6.31	1036827.3	757268.4
114C	SO-498114-C	3.76	1.23	2.38	12.1	1036794.6	757301.0
115	SO-498115	4.64	0.93	7.28	7.26	1036728.9	757301.2
116	SO-498116	2.15	1.35	1.78	5.29	1036663.3	757301.2
117A	SO-498117-A	17.8	1.57	23.0	18.9	1036328.0	757133.6
117B	SO-498117-B	1.04	< 0.74	1.04	1.16	1036295.1	757133.6
118	SO-498118	17.1	6.66	60.0	69.5	1035972.3	757080.3
119	SO-498119	1.52	0.99	0.69	10.6	1035753.4	757333.5
120	SO-498120	8.78	0.62	2.37	< 5.67	1035687.7	757386.3
121	SO-498121	14.8	1.06	7.80	10.6	1035358.9	757626.0
122	SO-498122	1.66	1.40	1.10	2.66	1035133.8	757614.3
123	SO-498123	5.04	1.11	7.10	3.81	1035046.8	757627.0
124	SO-498124	6.70	1.56	12.4	9.38	1034803.4	757861.2
132	SO-498132	65.3	< 2.57	124.0	14.7	1038961.1	756335.1
141	SO-498141	2.14	0.92	4.89	2.91	1038993.9	756367.9
149	SO-498149	10.4	1.39	18.2	34.2	1035794.9	757292.9
153	SO-498153	7.27	1.23	3.47	6.41	1035133.8	757647.1
154	SO-498154	5.08	1.70	8.58	8.33	1034941.7	757743.6

APPENDIX D
Southeast Drainage Radiological Data
Results after WP-505J Remediation

Location	Sample ID #	Radium-226 (pCi/g)	Radium-228 (pCi/g)	Thorium-230 (pCi/g)	Uranium-238 (pCi/g)	Northing	Easting
101 & 132	SO-499001-01	5.34	< 0.98	39.0	8.41	1038956.71	756337.85
101	SO-499002-01	7.49	1.13	36.7	< 4.48	1038931.41	756334.05
101	SO-499003-01	3.11	< 0.92	15.9	3.45	1038928.23	756345.06
101	SO-499004-01	7.01	< 0.83	50.1	< 5.27	1038908.42	756337.26
60	SO-499005-02	11.1	< 1.08	44.5	9.17	1035523.74	757574.58
60	SO-499006-02	12.7	0.76	15.2	< 4.91	1035523.24	757590.73
60	SO-499007-01	18.0	< 1.32	107	< 6.88	1035527.78	757577.83
60	SO-499008-01	21.2	1.86	54.8	33.5	1035525.69	757562.94
60	SO-499009-01	30.8	1.79	76.9	23.8	1035519.23	757572.16

APPENDIX E
Argonne National Laboratory Post-Cleanup Risk Assessment for the Southeast Drainage

Department of Energy
Oak Ridge Operations
Weldon Spring Site
Remedial Action Project Office
7295 Highway 94 South
St. Charles, Missouri 63304

August 31, 1999

Mr. Douglas E. Steffen
Project Director
MK-Ferguson Company
7295 Highway 94 South
St. Charles, MO 63304

Dear Mr. Steffen:

CORRECTED POST CLEANUP RISK CALCULATIONS FOR THE SOUTHEAST DRAINAGE

Enclosed find a corrected summary of the subject calculations and results. This document supercedes the version dated July 21, 1999.

If you have any questions, please contact Karen Reed or Yvonne Deyo.

Sincerely,

Stephen H. McCracken
Project Manager
Weldon Spring Site
Remedial Action Project

Enclosure:
As stated

cc w/o enclosure:
G. Valett, PMC

ATTACHMENT: POSTCLEANUP RISK ASSESSMENT FOR THE SOUTHEAST DRAINAGE

This attachment presents the results of the postcleanup risk assessment performed for the Southeast Drainage. The purpose of the assessment was to determine the amount of risk reduction achieved by the removal action. Figure 1 depicts specific locations in the drainage that were remediated.

Postcleanup risk estimates for each segment are presented in Table 1. Risk calculations were performed using the same methodology and scenario assumptions (i.e., hypothetical child and recreational visitor/hunter scenarios) presented in the Engineering Evaluation/Cost Analysis (EE/CA) (DOE 1996b). The exposure routes evaluated include external gamma irradiation and incidental ingestion of sediment. Exposure point concentrations for sediment were calculated for each exposure unit (i.e., segment) by using the one-tailed 95% upper confidence limit (UCL) of the arithmetic average for each radionuclide. The summary statistics for each segment are based on location-specific data as presented in Table 2. Risk calculations for each segment were based on postremediation data from locations that were remediated, in combination with data from locations that were not remediated in the segment. (Note that some locations not targeted for cleanup because they are not accessible have contaminant concentrations that exceed risk-based cleanup criteria.) At locations where more than one sample was collected, the data were averaged to obtain a representative concentration for that location prior to aggregating the data for each segment. Additional volumes were removed from Location 60 in Segment D and Locations 101 and 132 in Segment B. For these locations, data collected after removal of the additional volumes were used in the calculations.

Estimated residual risk or postcleanup risk estimates for the hypothetical child scenario for Segments A through D are 2×10^{-5}, 2×10^{-5}, 1×10^{-5}, and 8×10^{-6}, respectively. These results indicate that the risk reductions achieved are equal to or greater than those projected in the EE/CA. Additional risk reduction was achieved in Segments C and D due to removal of 17 additional locations not planned for in the EE/CA because they were originally thought to be inaccessible. These additional locations were determined to be accessible during the field planning stage and were remediated.

Location-specific baseline (precleanup) and postcleanup risk estimates for the hypothetical child are also presented in Table 2. Of the 55 locations that were remediated, postcleanup risk estimates at 48 locations are at or below 1×10^{-5}, and 7 locations are near 1×10^{-5} (i.e., 2×10^{-5} at 5 locations and 3×10^{-5} at 2 locations) for the hypothetical child scenario. These results indicate that the removal action accomplished the goals presented in the Decision Document for the Southeast Drainage (DOE 1996a).

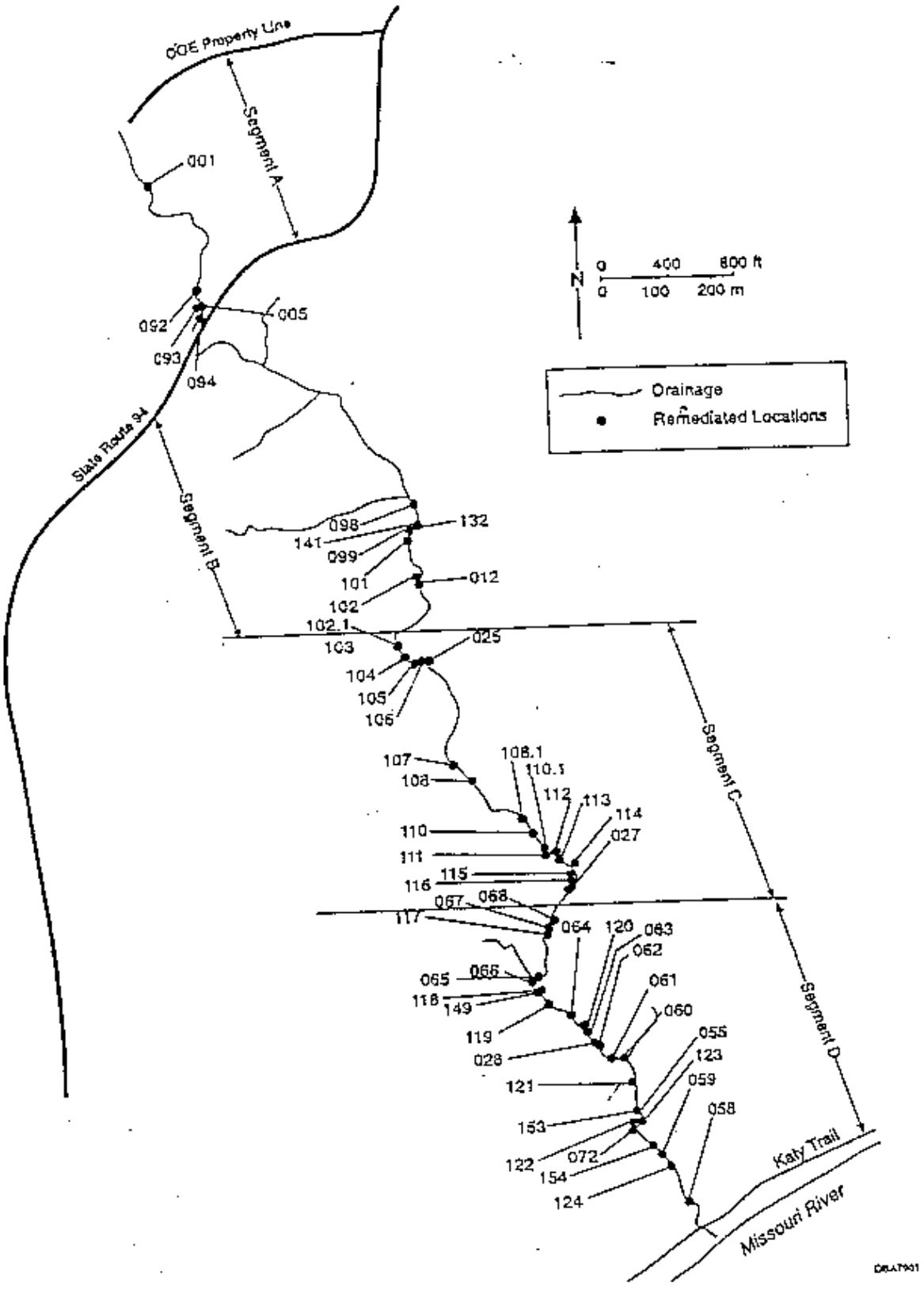


FIGURE 1 Remediated Locations in the Southeast Drainage

TABLE 1 Postcleanup Risk Estimates for the Southeast Drainage[a]

Segment		Summary Statistics[b] Ra-226	Ra-228	Th-230	U-238	Postcleanup Hypothetical[c] Child	Postcleanup Recreational Visitor/ Hunter[d]
A	Max. conc. (pCi/g)	39.0	5.0	38.0	200.0	2×10^{-5}	5×10^{-6}
	Min. conc. (pCi/g)	1.3	0.6	0.2	10.9		
	Avg. conc. (pCi/g)	15.8	1.8	12.4	52.4		
	St. dev	13.0	1.1	10.6	49.0		
	T-stat	1.753	1.753	1.753	1.753		
	Count	16	16	16	16		
	UCL[e] (pCi/g)	22	2.3	17	74		
B	Max. conc. (pCi/g)	110.0	4.0.	39.0	59.0	2×10^{-5}	5×10^{-6}
	Min. conc. (pCi/g)	1.2	0.5	0.3	2.0		
	Avg. conc. (pCi/g)	14.7	1.4	11.1	16.6		
	St. dev	25.7	0.9	10.4	18.9		
	T-stat	1.740	1.740	1.740	1.740		
	Count	18	18	18	18		
	UCL[e] (pCi/g)	25	1.8	15	24		
C	Max. conc. (pCi/g)	36.0	6.6	45.0	74.0	1×10^{-5}	3×10^{-6}
	Min. conc. (pCi/g)	1.1	0.8	1.3	1.3		
	Avg. conc. (pCi/g)	8.2	1.6	7.8	14.8		
	St. dev	10.2	1.2	10.1	17.1		
	T-stat	1.717	1.717	1.717	1.717		
	Count	23	23	23	23		
	UCL[e] (pCi/g)	12	2.0	11	21		
D	Max. conc. (pCi/g)	27.0	6.7	120.0	70.0	8×10^{-6}	2×10^{-6}
	Min. conc. (pCi/g)	1.1	0.6	0.7	2.0		
	Avg. conc. (pCi/g)	6.2	1.6	16	12		
	St. dev	5.4	1.0	25.7	15		
	T-stat	1.684	1.684	1.684	1.684		
	Count	44	44	44	44		
	UCL[e] (pCi/g)	7.6	1.9	23	16		

[a] Postcleanup risk estimates for each segment were calculated by using the UCLs derived from all postcleanup data for remediated locations, combined with data from remaining locations in the segment that were not remediated.

[b] Summary statistics presented for each segment were developed from the location-specific data that constitute each segment, as shown in Table 2 of this attachment.

[c] The postcleanup risk estimates for the hypothetical child scenario were calculated using the same methodology and scenario assumptions presented in the EE/CA (DOE 1996). In the EE/CA, baseline (before cleanup) risk estimates and projected postcleanup risk estimates for this scenario were presented for each segment as follows:

TABLE 1 (Cont.)

Segment	Baseline Risk	EE/CA-Projected Postcleanup Risk
A	5×10^{-5}	2×10^{-5}
B	1×10^{-4}	3×10^{-5}
C	9×10^{-5}	4×10^{-5}
D	5×10^{-5}	2×10^{-5}

Postcleanup risk estimates for the hypothetical child scenario indicate that the removal action performed at the Southeast Drainage attained the projected postcleanup risks presented for Alternative 2.1 in Table A.4, page 57, of the EE/CA (DOE 1996).

d The postcleanup risk estimates for the recreational visitor/hunter scenario were calculated using the same methodology and scenario assumptions presented in the EE/CA (DOE 1996). In the EE/CA, baseline (before cleanup) risk estimates and projected postcleanup risks for this scenario were presented for each segment as follows:

Segment	Baseline Risk	EE/CA-Projected Postcleanup Risk
A	1×10^{-5}	5×10^{-6}
B	2×10^{-5}	6×10^{-6}
C	2×10^{-5}	9×10^{-6}
D	1×10^{-5}	5×10^{-6}

Postcleanup risk estimates for the recreational visitor/hunter scenario indicate that the removal action performed at the Southeast Drainage attained the projected postcleanup risks presented for Alternative 2.1 in Table A.3, page 57, of the EE/CA (DOE 1996).

TABLE 2 Location-Specific Data Summary and Risk Estimates for the Southeast Drainage

		Concentration (pCi/g)[a]				Risk Estimates	
Segment	Location ID	Ra-226	Ra-228	Th-230	U-238	Baseline Hypothetical Child	Postcleanup Hypothetical Child
A	001[b]	12.3	1.6	4.7	37.8	9×10^{-5}	1×10^{-5}
	092[b]	5.4	1.5	38.0	80.0	2×10^{-6}	9×10^{-6}
	093[b]	1.9	1.2	0.8	76.0	2×10^{-5}	5×10^{-6}
	094[b]	3.8	1.2	8.9	17.0	1×10^{-5}	5×10^{-6}
	005[b]	4.7	2.9	22.9	10.9	2×10^{-4}	7×10^{-6}
	002	39.0	5.0	15.0	120.0	4×10^{-5}	[c]
	003	39.0	1.4	31.0	200.0	4×10^{-5}	-
	004	17.0	2.7	11.0	50.0	2×10^{-5}	-
	016	7.0	1.5	14.0	17.0	8×10^{-5}	-
	017	11.0	1.4	1.4	15.0	1×10^{-5}	-
	018	1.3	0.8	0.2	16.0	2×10^{-6}	-
	087	15.0	0.6	6.8	47.0	1×10^{-5}	-
	088	30.0	2.8	11.0	43.0	3×10^{-5}	-
	089	11.0	1.3	5.1	31.0	1×10^{-5}	-
	090	33.0	1.3	14.0	48.0	3×10^{-5}	-
	091	22.0	1.2	14.0	29.0	2×10^{-5}	-
B	012[b]	1.7	1.1	10.0	2.0	4×10^{-5}	2×10^{-6}
	098[b]	2.5	1.1	3.7	2.5	3×10^{-4}	3×10^{-6}
	099[b]	2.5	1.2	2.5	3.0	5×10^{-5}	3×10^{-6}
	101[b]	5.9	0.7	34.2	2.8	2×10^{-4}	6×10^{-6}
	102[b]	2.8	1.3	6.4	9.9	2×10^{-5}	4×10^{-6}
	132[b]	5.3	0.5	39.0	8.4	1×10^{-4}	6×10^{-6}
	141[b]	2.1	0.9	4.9	2.9	5×10^{-5}	2×10^{-6}
	006	25.0	2.8	18.0	56.0	3×10^{-5}	-
	007	12.0	4.0	11.0	49.0	2×10^{-5}	-
	008	36.0	1.5	12.0	17.0	3×10^{-5}	-
	009	110.0	1.7	13.0	59.0	9×10^{-5}	-
	010	21.0	2.2	13.0	17.0	2×10^{-5}	-
	011	1.3	0.7	0.3	2.6	2×10^{-5}	-
	019	18.0	1.1	7.5	7.8	2×10^{-5}	-
	020	1.2	0.9	3.0	2.6	2×10^{-5}	-
	021	2.2	1.0	2.8	14.0	3×10^{-6}	-
	095	4.6	1.5	6.8	16.0	6×10^{-6}	-
	096	11.0	1.7	12.0	27.0	1×10^{-5}	-

TABLE 2 (Cont.)

Segment	Location ID	Concentration (pCi/g)[a]				Risk Estimates	
		Ra-226	Ra-228	Th-230	U-238	Baseline Hypothetical Child	Postcleanup Hypothetical Child
C	025[b]	15.0	1.3	21.0	74.0	3×10^{-4}	2×10^{-5}
	027[b,d]	23.0	6.6	15.0	27.0	2×10^{-5}	2×10^{-5}
	102.1[b]	1.4	1.4	1.6	2.0	9×10^{-5}	2×10^{-6}
	107[b,d]	34.0	1.8	45.0	40.0	4×10^{-5}	3×10^{-5}
	108[b,d]	5.3	1.1	4.7	11.0	2×10^{-5}	5×10^{-6}
	108.1[b,d]	7.1	1.0	3.3	9.6	3×10^{-5}	6×10^{-6}
	110[b,d]	4.3	1.1	2.9	24.0	3×10^{-5}	5×10^{-6}
	110.1[b,d]	1.8	2.0	2.1	5.6	1×10^{-5}	3×10^{-6}
	111[b,d]	4.6	1.2	22.0	29.0	4×10^{-5}	6×10^{-6}
	112[b,d]	11.0	2.0	10.0	9.1	1×10^{-4}	1×10^{-5}
	113[b,d]	36.0	1.0	11.0	11.0	6×10^{-5}	3×10^{-5}
	114[b,d]	2.7	1.0	2.0	6.1	2×10^{-5}	3×10^{-6}
	115[b,d]	4.6	0.9	7.3	7.3	5×10^{-5}	5×10^{-6}
	116[b,d]	2.2	1.4	1.8	5.3	2×10^{-5}	3×10^{-6}
	103[b]	1.3	0.8	1.5	2.0	4×10^{-5}	2×10^{-6}
	104[b]	4.1	1.1	9.4	11.0	1×10^{-4}	4×10^{-6}
	105[b]	16.0	0.8	3.4	29.0	3×10^{-5}	1×10^{-5}
	106[b]	1.3	1.3	1.3	2.0	6×10^{-6}	2×10^{-6}
	049	6.5	1.7	1.3	26.0	8×10^{-6}	-
	143	1.8	1.6	4.6	3.7	3×10^{-6}	-
	144	1.1	1.5	2.4	1.4	2×10^{-6}	-
	145	1.3	0.9	4.6	2.3	2×10^{-6}	-
	146	1.4	2.6	1.7	1.3	3×10^{-6}	-
D	117[b,d]	9.4	1.6	12.0	10.0	9×10^{-5}	9×10^{-6}
	118[b,d]	17.1	6.7	60.0	69.5	2×10^{-5}	2×10^{-5}
	119[b]	1.5	1.0	0.7	10.6	2×10^{-5}	2×10^{-6}
	120[b]	8.8	0.6	2.9	2.0	1×10^{-4}	8×10^{-6}
	121[b]	14.9	1.1	7.8	10.6	2×10^{-5}	1×10^{-5}
	122[b]	1.7	1.4	1.1	2.7	3×10^{-5}	2×10^{-6}
	123[b]	5.0	1.1	7.1	3.8	5×10^{-5}	5×10^{-6}
	124[b]	6.7	1.6	12.4	9.4	1×10^{-4}	7×10^{-6}
	149[b]	10.4	1.4	18.2	34.2	2×10^{-5}	1×10^{-5}
	153[b]	7.3	1.2	3.5	6.4	9×10^{-6}	7×10^{-6}
	154[b]	5.1	1.5	8.6	8.3	5×10^{-6}	5×10^{-6}
	028[b]	11.0	2.0	3.2	3.7	3×10^{-6}	1×10^{-5}
	055[b]	4.3	1.0	5.6	8.8	2×10^{-5}	5×10^{-6}

TABLE 2 (Cont.)

Segment	Location ID	Concentration (pCi/g)[a] Ra-226	Ra-228	Th-230	U-238	Risk Estimates: Baseline Hypothetical Child	Risk Estimates: Postcleanup Hypothetical Child
Segment D (Cont.)	058[b]	5.0	1.2	2.9	5.0	5×10^{-5}	5×10^{-6}
	059[b]	4.9	2.0	46.0	10.0	5×10^{-5}	7×10^{-6}
	060[b]	16.8	1.0	49.7	12.1	5×10^{-5}	2×10^{-5}
	061[b]	27.0	1.0	18.0	70.0	8×10^{-5}	2×10^{-5}
	062[b]	1.3	1.1	1.3	2.0	1×10^{-5}	2×10^{-6}
	063[b]	11.0	2.0	3.2	6.1	5×10^{-5}	1×10^{-5}
	064[b]	2.9	1.3	4.7	10.0	2×10^{-5}	4×10^{-6}
	065	12.0	2.6	29.0	30.0	6×10^{-5}	1×10^{-5}
	066[b,d]	10.1	1.5	70.4	16.0	5×10^{-5}	1×10^{-5}
	067[b,d]	1.5	1.2	1.3	2.0	3×10^{-5}	2×10^{-6}
	068[b,d]	1.5	1.2	1.3	2.1	9×10^{-5}	2×10^{-6}
	072[b]	11.0	1.8	16.0	18.0	1×10^{-5}	1×10^{-5}
	026	3.6	1.4	95.0	10.2	7×10^{-6}	-
	030	2.4	1.4	6.5	2.9	3×10^{-6}	-
	050	9.3	1.0	6.8	7.7	9×10^{-6}	-
	051	8.2	3.2	120.0	33.0	1×10^{-5}	-
	052	1.9	1.3	4.3	5.7	3×10^{-6}	-
	053	5.6	1.2	8.9	23.0	7×10^{-6}	-
	054	2.1	1.2	4.1	3.3	3×10^{-6}	-
	056	3.9	1.3	11.0	16.0	5×10^{-6}	-
	057	2.7	1.3	3.8	3.6	3×10^{-6}	-
	069	1.5	1.3	2.9	4.1	2×10^{-6}	-
	070	3.6	1.3	15.0	6.4	5×10^{-6}	-
	071	1.6	1.1	3.6	5.5	2×10^{-6}	-
	073	1.5	1.0	3.3	3.8	2×10^{-6}	-
	074	1.5	1.1	2.7	4.2	2×10^{-6}	-
	147	1.6	3.3	4.0	2.9	4×10^{-6}	-
	148	1.1	2.6	3.2	2.2	3×10^{-6}	-
	150	3.3	1.9	9.1	11.0	5×10^{-6}	-
	151	5.3	2.9	12.0	14.0	7×10^{-6}	-
	152	3.8	2.6	3.1	6.2	5×10^{-6}	-

TABLE 2 (Cont.)

[a] Radionuclide concentrations for each location represent postcleanup concentrations as presented in the *Closure Report for the Post-Remedial Sampling Plan of the Southeast Drainage* (DOE 1999) for those locations that were remediated and precleanup concentrations (as presented in the EE/CA [DOE 1996b]) for those locations that were not remediated.

[b] Remediated locations.

[c] A hyphen designates that the location was not remediated because it was inaccessible; therefore, the postcleanup risk would be the same as the baseline risk.

[d] The location was remediated but not originally identified for remediation in the EE/CA (DOE 1996b). Access to these locations was determined during the field planning phase.

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