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MISSOURI DEPARTMENT OF NATURAL RESOURCES

1991 RADIATION MONITORING REPORT

SUMMARY OF RADIATION MONITORING DATA RELATED TO ST. LOUIS AREA RADIOACTIVE WASTE SITES

09/11/1991

RADMONIT

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INTRODUCTION

This report summarizes the laboratory results from samples taken by the Missouri Department of Natural Resources (MDNR) in relation to several low-level radioactive waste sites in the St. Louis area. These sites resulted from the processing of uranium ores and the handling of the resulting wastes in the 1940's through the 1970's. The primary radioactive contaminants are radium, thorium and uranium. The cleanup of these sites is the responsibility of the U.S. Department of Energy (DOE). Because these sites are on the Superfund's National Priority List (NPL) final cleanup decisions are the responsibility of the U.S. Environmental Protection Agency (EPA).

The monitoring done by the MDNR is in addition to that done by the DOE, the U.S. Geological Survey (USGS), the Missouri Department of Health (MDOH) and St. Charles County. Each of these agencies should be contacted directly for information on their monitoring data.

PUBLIC DRINKING WATER STANDARDS

The primary purpose of MDNR's testing is to ensure that public drinking water supplies are not adversely affected by these sites. The Environmental Protection Agency (EPA) and MDNR public drinking water standards for radionuclides in finished water (water that has been treated and is ready to be furnished to the customer) are:

Adjusted Gross Alpha	- 15 pCi/liter (excluding radon and uranium); This is a screening test for alpha emitters.
Combined Radium	- Ra-226 and Ra-228 cannot exceed a combined level of 5 pCi/liter (the EPA has proposed a new standard of 20 pCi/l for each radium isotope, i.e., the new combined level could be as much as 40 pCi/l).
Thorium	- There is no standard for thorium but the thorium levels in these water samples are very low due to the low solubility of thorium.
Uranium	- There is no standard at present but the EPA has proposed a standard of 20 micrograms/l which is based on uranium's chemical toxicity to the kidney (EPA assumes that this level is equivalent to 30 pCi/l in water). Uranium is relatively soluble in water and is the contaminant from these sites most likely to be found in water.
Gross Beta	- 4 mrem/yr exposure to an individual; a level of 50 pCi/l of Gross Beta activity would trigger a requirement for testing for individual radionuclides and calculating the total dose; this analysis is important as a screening test for man-made radionuclides, e.g., fission products from nuclear power plants, which are not found at these sites. However, Ra-228 and some other uranium and thorium decay products are beta emitters.

WELDON SPRING WELLFIELD GROUNDWATER

The St. Charles County public drinking water treatment plant draws its water from the Weldon Spring wellfield which is near the contaminated Weldon Spring quarry (see Appendix J-1). A comparison of the attached results to the public drinking water standards indicates that the finished water, the raw water (the combined flow of the production wells operating at the time of sampling), all individual production wells (PW-wells), the St. Charles County monitoring wells (RMW-wells), and the U.S. Department of Energy monitoring wells south of the Femme Osage Slough (MW-wells) in the Weldon Spring wellfield all meet the radiological standards for finished drinking water.

Based on over four years of monitoring of the Weldon Spring wellfield, MDNR found the raw (untreated) water to have 1.4 to 5.4 pCi/l (average: 3.6 pCi/l) of gross alpha activity and from less than 0.1 to 0.3 pCi/l of total uranium. Sampling of the individual production wells showed from 1.1 to 5.4 pCi/l (with an average of 3.4 pCi/l) of gross alpha and from less than 0.1 to 2.4 pCi/l of total uranium. The finished (treated) water has from less than 1.0 to 2.2 pCi/l of gross alpha activity and from less than <0.05 to 0.2 pCi/l of total uranium (see Appendix A).

However, MW-1011 is a Weldon Spring wellfield monitoring well (see Appendix J-2) that averages 13.8 pCi/l of gross alpha activity (the adjusted gross alpha would be 1.2 pCi/l) and 12.8 pCi/l of total uranium. These levels are above the levels in the production wells and are most likely above natural background levels (see discussion of background radioactivity on page 4). MW-1011 is a shallow well immediately adjacent to the contaminated water in the Femme Osage Slough. A deeper well at the same location (MW-1010) continues to show low levels of radionuclides (see Appendix C). It is not clear whether monitoring well MW-1011 is influenced by the contaminated slough water (see Appendix F) or the quarry. The DOE is planning a special study to determine the reason for the contamination in MW-1011. RMW-2 is another monitoring well that exhibits levels (7.7 pCi/l of gross alpha and 4.5 pCi/l of total uranium) which is above the average for the wellfield and may be above natural background (see Appendix B). However, over the five years covered by this data there is no indication of increasing levels in RMW-2. Also, there is no indication that the nearest drinking water production wells nearest to these two monitoring wells have been affected.

CONCLUSIONS ON WELDON SPRING WELLFIELD WATER

Based on these data and those of other agencies, the MDNR has concluded that the water from the St. Charles County water plant meets the state and federal standards for radionuclides for public drinking water. However, the MDNR has urged the DOE to remove the waste from the quarry and the wellfield area as soon as possible to eliminate even the risk of potential contamination. Treatment of the water in the quarry is scheduled to begin this year (1991); removal of the bulk wastes is scheduled to begin next year (1992). To ensure continued high quality public drinking water the MDNR will continue to monitor the wellfield area groundwater to determine whether any significant changes are taking place in the wellfield. Removal of the water and wastes from the quarry will reduce the chance of contamination in the wellfield.

BACKGROUND RADIOACTIVITY: MISSOURI RIVER ALLUVIAL GROUNDWATER

Sampling for background radioactivity is also being conducted in reference to the Weldon Spring Site for Missouri River alluvial groundwater. Alluvial groundwater samples were taken at the city of Columbia wellfield and at the Daniel Boone Gun Club well, which is in the Darst Bottoms upstream from the Weldon Spring wellfield.

The gross alpha and total uranium levels in the Weldon Spring wellfield are similar to the most comparable water supply, which is the City of Columbia's wellfield at McBaine in Boone County, Missouri. This well field is similar in size to the Weldon Spring wellfield and its wells also draw water from the Missouri River alluvial aquifer. In samples from Columbia raw water MDNR found 4.0 to 5.5 pCi/l (with an average of 4.6 pCi/l) for gross alpha and 0.4 pCi/l of uranium in the raw water and 1.2 to 1.5 pCi/l (with an average of 1.3 pCi/l) of gross alpha and 0.2 pCi/l of uranium in the treated water (see Appendix D). Based on a comparison to these samples, the Weldon Spring wastes have not had an impact on the drinking water production wells in the Weldon Spring wellfield.

Samples from the Daniel Boone Gun Club well showed from 7.7 to 10.9 pCi/l of gross alpha activity and from 5.3 to 6.6 pCi/l of uranium (see Appendix D). While the Daniel Boone Gun Club well is in the same alluvial aquifer (in the Darst Bottoms) as the Weldon Spring wellfield, it may not be an accurate well for background samples because it was not constructed as a monitoring well. It would be preferable to take background samples from properly constructed monitoring wells in the alluvial aquifer immediately upstream from the Weldon Spring wellfield. The U.S. Geological Survey (USGS) is planning such a study to determine the background water quality near Defiance in the Darst Bottoms, which is just upstream from the Weldon Spring wellfield. The USGS will install six new monitoring wells in the Darst Bottoms. This study should be underway in the fall of 1991.

WELDON SPRING AREA GROUNDWATER SUPPLIES

Several public drinking water supplies in the Weldon Spring area (generally to the northeast of the Weldon Spring site along Highway 40) obtain their water from bedrock aquifers (see Appendix E). Samples were taken from these wells and they were all within the drinking water standards for radionuclides.

In 1989 the Twin Island Lake Resort wells, were found to be contaminated with low levels of nitroaromatics, presumably the result of the U.S. Army's former TNT production facilities at the Weldon Spring Ordnance Works. At the state's request, the Army has provided a new water supply to the resort and these wells are no longer used for drinking water purposes.

As expected, some other wells showed somewhat higher levels of radioactivity which is common for deep groundwater supplies, particularly in certain areas of Missouri that pump water from the St. Peter Sandstone. There is no evidence of any impact of the Weldon Spring site on these wells.

WELDON SPRING SITE SURFACE WATER

As indicated in Appendix F, the water in some bodies of surface water, such as the Femme Osage Slough and the Southeast Drainage (valley 5300), is contaminated in excess of drinking water standards. These bodies of water are not currently drinking water sources but they are being studied as part of the DOE's Weldon Spring Site Remedial Action Project.

BACKGROUND RADIOACTIVITY: MISSOURI RIVER SURFACE WATER

To determine the background radioactivity of the Missouri River, surface water samples are being taken from the Missouri River at Jefferson City, the Weldon Spring Wildlife Area boat ramp, and at the St. Louis water treatment plants. Samples upstream at Jefferson City ranged from 3.3 to 10.5 pCi/l (average 6.1 pCi/l) of gross alpha activity. Total uranium levels ranged from 2.3 to 3.6 pCi/l (average 2.9 pCi/l). Samples at the Weldon Spring boat ramp ranged from 3.1 to 7.8 pCi/l (average 5.2 pCi/l) of gross alpha activity and from 1.6 to 3.7 pCi/l (average 2.4 pCi/l) of uranium (see Appendix G). The raw river water sampled at the St. Louis treatment plants is discussed in the next section.

Determining the exact background of the river is difficult because of natural variability due to seasonal changes, different river stages and varying amounts of sediment in the water. However, even the high end of this range of variability is below any current or proposed public drinking water standards for radionuclides in treated water. The USGS is currently conducting a study specifically designed to determine the background concentrations in the Missouri River in the wellfield area. This study will include sampling at varying river stages to assess the variability of certain naturally occurring radionuclides.

ST. LOUIS DRINKING WATER

MDNR has also been sampling downstream at the four St. Louis City and County water treatment plants on the Missouri and Mississippi Rivers. The Chain of Rocks water treatment plant is on the western bank of the Mississippi River immediately below the mouth of the Missouri River where the two rivers have not yet mixed. Therefore, this plant treats primarily Missouri River water downstream from the contaminated sites on Coldwater Creek (see the next section). MDNR found that the untreated river water contains from 2.2 to 8.0 pCi/l (average 4.8 pCi/l) of gross alpha and from less than 1.0 to 2.6 pCi/l of total uranium. The treated water contains from less than 1.0 to 3.4 pCi/l of gross alpha and from less than 0.1 to 1.9 pCi/l of total uranium. All four St. Louis water treatment plants are downstream of Weldon Spring but show only background levels of radioactivity (see Appendix H).

As stated above (page 2) the DOE is planning to treat the contaminated water in the Weldon Spring quarry. This water will be treated to essentially drinking water standards, stored in lined holding ponds until it is analyzed, and discharged to the Missouri River between sampling locations SW-1011 and SW-1012 (see Appendix J-4). The MDNR has issued a permit for this discharge and will sample selected batches of this treated water prior to its discharge to ensure that it does not impact the drinking water supplies in St. Louis that use Missouri River water.

THE FUSRAP SITES AND COLDWATER CREEK

There are also two radioactive waste sites on the banks of Coldwater Creek in north St. Louis County (the St. Louis Airport site and the Latty Avenue site). The DOE is investigating these sites as part of the Formerly Utilized Sites Remedial Action Program (FUSRAP). Consequently, samples are also being taken from Coldwater Creek.

Although there are elevated levels of radionuclides in the creek's sediments, there is no significant radiological impact on the water in the Coldwater Creek. For example, while the sediments in Coldwater Creek contain as much as 1400 pCi/g of Thorium 230, the water in the creek only contained 1 pCi/l or less of Thorium 230. This is probably due to the extremely low solubility of Thorium 230. Unfiltered gross alpha levels ranged from 2.5 to 5.5 pCi/l (average 4.0 pCi/l). Uranium levels ranged from 1.3 to 3.5 pCi/l and averaged 2.5 pCi/l (see Appendix I). The contaminated sediments in the creek will be studied as part of the DOE's FUSRAP activities at the St. Louis sites; decisions about cleaning up these sediments will be based on those studies.

As discussed in the previous section, samples of raw river water were also taken at the Chain of Rocks water treatment plant which is downstream from the Coldwater Creek sites (see Appendix H). There is no measurable impact of these sites on the water at the Chain of Rocks plant.

CONCLUSION

In conclusion, the St. Louis and St. Charles public drinking water supplies that were studied in this sampling program were well within the state and federal public drinking water standards for radionuclides. Also, this sampling found no measurable impact on public drinking water supplies by any of these radioactive waste sites in the St. Louis region.

As a precautionary measure, however, MDNR will continue sampling the Weldon Spring wellfield, Coldwater Creek, the Missouri River, and the finished water from the Missouri River and Mississippi River water treatment plants until these sites are cleaned up and for a period after cleanup to insure the effectiveness of the cleanups. In addition, other local, state, and federal agencies will be conducting monitoring programs in connection with these radioactive waste sites.

Despite any lack of demonstrated past or current impact on public drinking water supplies, the MDNR believes that these sites must be cleaned up to prevent problems that may arise in the future. Also, these sites may present risks by other chemicals or other routes of exposure (e.g., external (gamma) radiation, direct contact with or ingestion of soil, consumption of fish and wildlife, inhalation of radon or airborne particulates) and will be need to be cleaned up for this reason. This report has only addressed the issue of the radiological quality public drinking water supplies.

MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI RIVER BACKGROUND RADIATION MONITORING DATA
ALLUVIAL GROUNDWATER

09/09/91

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MISSOURI RIVER ALLUVIAL WELLS

Source	Date	Gross Alpha Unfil/fil	Radium Ra-226	Radium Ra-228	Thorium Th-230	Thorium Th-232	Total Uranium	Gross Beta Unfil/fil
Boone County (Columbia City Wells)								
CCW-1	10/88*	4.2	0.6	1.7	0.8	1.3	0.2	4.7
	10/88**	2.1	1.0	3.1			<1.0	5.1
	4/89**	3.2	0.7	2.0			<1.0	5.7
CCW-2	4/89**	3.5	0.6	1.6			<1.0	6.8
CCW-5	10/88*	6.3	0.6	1.6	0.7	0.8	0.3	9.0
	10/88**	3.3	0.8	4.4			<1.0	6.7
	4/89**	3.9	0.7	<1.0			<1.0	7.3
	8/90*	6.5	0.8	2.2	1.0	0.2	0.2	8.4
	8/90**	3.9	0.8	2.3			<1.0	7.1
CCW-6	10/88*	12.2	0.5	1.7	0.8	0.7	0.2	6.7
	10/88**	1.6	0.9	1.1			<1.0	5.4
	5/89*	5.1	0.6	1.7	0.6	0.9	0.2	7.0
	5/89**	2.4	0.6	1.3			<1.0	6.5
	8/90*	4.1	0.8	1.8	0.9	0.2	0.3	7.7
	8/90**	3.2	0.8	1.9			<1.0	6.1
CCW-8	10/88*	7.0	0.7	2.2	0.4	0.9	0.9	6.2
	10/88**	5.7	1.0	2.5			<1.0	6.2
	4/89**	4.0	0.8	1.9			<1.0	7.2
	8/90*	4.1	0.7	2.6	2.2	0.2	0.3	7.3
	8/90**	3.9	0.8	2.6			<1.0	6.1
COLUMBIA WELL A		4.5	0.7	2.0	0.9	0.7		6.7
Raw Water	4/89**	5.5	0.8	1.1			<1.0	6.3
	8/90*	4.0	0.7	1.7	0.7	0.2	0.4	7.0
	8/90**	4.2	0.9	1.9			<1.0	5.0
COLUMBIA RAW AV		4.6	0.8	1.6				6.1
Finished Water	4/89**	1.5	<0.1	<1.0			<1.0	3.2
	8/90*	1.3	0.2	<1.0	0.3	0.1	0.2	4.3
	8/90**	1.2	0.3	<1.0			<1.0	3.6
COL FINISHED AV		1.3						3.7

MISSOURI RIVER ALLUVIAL WELLS

Source	Date	Gross Alph Unfil/fil	Ra-226	Ra-228	Th-230	Th-232	Total Uranium	Gross Beta Unfil/fil
St.Charles County (Darst Bottoms)								
Daniel	11/88*	8.7	<0.1	0.7	<0.05	<0.05	5.3	6.5
Boone	11/88*	10.9	0.2	0.9	<0.05	<0.05	5.4	7.0
Gun Club Well	5/89*	10.4	0.4	1.2	0.2	2.4	6.6	6.6
MDOH	Average	10.0		0.9			5.8	6.7
	5/89**	7.7	0.3	1.4			6.0	6.2

All data in pCi/l; < = not detected;
* = analysis by MDOH; ** = analysis by SL Co. Health Dept.

MISSOURI DEPARTMENT OF NATURAL RESOURCES 09/09/91

WELDON SPRING SITE - MDNR MONITORING DATA WSGWSUPP
GROUNDWATER SUPPLIES IN WELDON SPRING AREA

Source	Date	Gross Alpha	Ra-226	Ra-228	Th-230	Th-232	Uranium	Gross Beta
Twin Isl. Lake Well #1	4/89*	<1.0	<0.1	<0.1	<0.05	<0.05	0.1	<1.0
	4/89**	1.6	0.2	<1.0			<1.0	<1.0
Twin Isl. Lake Well #3	4/89*	1.1	<0.1	0.3	0.2	0.3	0.1	<1.0
	4/89**	1.4	0.2	<1.0			<1.0	<1.0
Twin Isl. Lake Well #4	4/89*	<1.0	0.2	0.3	0.3	0.3	0.1	1.3
	4/89**	<1.0	0.2	<1.0			<1.0	1.2

Note: The Twin Island Lake Resort wells are no longer used for drinking water purposes.

PWSD #2 St. Ch Co. Well #2	4/89*	12.7	2.4	0.9	2.5	0.6	2.6	9.3
	4/89**	10.6	2.3	<1.0			<1.0	9.5
	7/91*	9.2	3.1	0.7	0.5	<0.1	1.2	7.8
PWSD #2 St. Ch Co. Well #3	7/91*	8.5	2.0	0.9	0.4	<0.1	1.4	8.5
PWSD #2 St. Ch Co. Well #4	4/89*	13.2	3.0	0.6	2.9	0.8	2.4	10.5
	4/89**	9.3	2.7	<1.0			<1.0	11.1
	7/91*	11.0	3.1	1.0	0.3	<0.1	0.9	8.1
PWSD #2 AVG		10.6	2.7		1.3			9.3
Martell Ridge Subdivision	4/89*	6.5	2.0	1.0	1.4	0.9	0.2	3.9
	4/89**	4.4	1.5	<1.0			<1.0	4.8
	7/91*	5.4	1.5	1.3	0.3	<0.1	0.2	5.6
Weldon Spring Heights	4/89*	6.8	1.2	1.8	1.5	1.0	0.6	9.7
	4/89**	4.0	1.3	<1.0			<1.0	9.0
	7/91*	6.2	1.6	2.0	0.4	<0.1	0.7	10.7

All data in pC/l; < = not detected;
* = analysis by MDOH; ** = analysis by SL Co. Health Department

MISSOURI DEPARTMENT OF NATURAL RESOURCES 08/22/91

WELDON SPRING SITE - MDNR MONITORING DATA
WELLFIELD AREA AND SOUTHEAST DRAINAGE - SURFACE WATER WSWFSURF

Source	Date	Gross Alpha Unfil/fil	Radium Ra-226	Radium Ra-228	Thorium Th-230	Thorium Th-232	Total Uranium	Gross Beta
Femme Osage Slough West	09/88*	60.6	0.9	0.8	41.2	6.9	48.6	30.3
Femme Osage Slough East	09/88*	28.4	0.7	0.7	12.6	7.8	17.3	18.5
SOUTHEAST DRAINAGE (Valley 5300)	10/90*	121.3	1.5	0.3	3.6	0.4	110.7	39.1
	04/91*	150.8	1.2	0.7	13.6	1.1	124.2	43.5
	04/91**	137.4					135.6	46.6
Valley 5300 AVG		136.5	1.4	0.5	8.6	0.8	123.5	43.1

Note: The Southeast Drainage (Valley 5300) flows southeast from the Weldon Spring Chemical Plant into the Missouri River downstream from sampling location SW-1012 and upstream from from sampling location SW-1013. (See Appendix F-1)

All data in pCi/l; < = Not detected
* = Analysis by MO DOH; ** = Analysis by SLCODOH

MISSOURI RIVER BACKGROUND RADIATION MONITORING DATA 08/22/91
MISSOURI RIVER SURFACE WATER (Raw Water) MORIVBK

MISSOURI RIVER AT WELDON SPRING AREA

Source	Date	Gross Alpha Unfil/fil		Radium Ra-226	Radium Ra-228	Thorium Th-230	Thorium Th-232	Total Uranium Unfil/fil		Gross Beta Unfil/fil	
SW-1011 (Weldon Spring boat ramp)	10/88*	7.8		0.2	0.7	0.2	0.2	2.7		9.7	
	4/89*	7.8		0.2	0.6	0.9	0.2	2.9		4.9	
	6/89*	5.5		0.2	0.5	0.1	0.1			9.7	
	10/89*	6.6		0.2	0.6	0.8	0.5	3.3		11.0	
	11/89*	6.6		0.2	0.9	0.6	0.4	2.2		9.5	
	02/90*	4.4		<0.1	0.2	<0.1	<0.1	2.0		6.3	
	10/90*	5.5		0.2	0.5	0.3	<0.1	2.1		10.2	
	11/90*	5.7		<0.1	0.2	1.1	<0.1	2.2		9.6	
	03/91*	3.8		0.3	1.0			2.7		6.8	
	04/91*	3.3	2.8	0.3	0.6	<0.1	<0.1	2.7		7.5	6.7
	08/91*	5.3	3.0					3.7	3.0	7.1	6.4
MDOH	AVERAGE	5.7	2.9		0.6			2.7		8.4	6.6
SW-1011 (Weldon Spring boat ramp)	4/89**	3.1		0.2	<1.0			2.7		7.3	
	6/89**	4.7		0.2	<1.0			2.5		9.3	
	11/89**	4.4		0.2	<1.0			2.1		7.6	
	02/90**	3.2		0.2	<1.0			1.6		5.5	
	03/91**	5.6		0.3	<1.0			2.0		6.5	
	04/91**	4.8						2.4		7.0	
SLCODOH	AVERAGE	4.3		0.2	<1.0			2.2		7.2	
SW-1011	AVERAGE	5.2						2.4		8.2	
SW-1012	10/90*	6.5		0.3	0.3	<0.1	1.0	2.5		9.0	
	04/91*	7.0	3.8	0.3	0.6	0.3	<0.1	3.8		11.4	7.4
	04/91**	3.7						1.9		6.6	
SW-1012	AVERAGE	5.7						2.7		9.0	
SW-1013	10/90*	6.7		0.2	0.4	0.3	<0.1	2.5		10.5	
	04/91*	9.2	3.3	0.4	0.6	<0.1	<0.1	3.3		10.9	7.4
	04/91**	3.3						2.1		6.1	
SW-1013	AVERAGE	6.4						2.6		9.2	

MISSOURI RIVER AT JEFFERSON CITY BOAT RAMP

Source	Date	Gross Alpha Unfil/fil		Radium Ra-226	Radium Ra-228	Thorium Th-230	Thorium Th-232	Total Uranium		Gross Beta Unfil/fil	
JC Boat Ramp	10/88*	10.5		0.2	<0.05	0.2	<0.05	2.7		12.8	
	11/89*	5.4		0.2	0.3	0.5	0.3	2.3		7.3	
	10/90*	7.7		0.2	0.5	<0.1	<0.1	3.2		10.0	
	08/91*	5.5	2.6					3.6	3.2	9.9	7.1
MDOH	Average	7.3		0.2				3.0		10.0	
JC Boat Ramp	10/88**	4.2		0.3	<1.0			2.9		10.7	
	11/89**	3.3		0.3	<1.0			2.9		6.0	
SLCODOH	Average	3.8						2.9		8.4	
JCB Ramp AVERAGE		6.1						2.9		9.5	
MO RIVER AVERAGE		5.6	3.1	<1.0	<1.0			2.6		8.5	7.0

All data in pCi/l; < = not detected;
* = analysis by MDOH; ** = analysis by SL Co. Health Dept.

MISSOURI DEPARTMENT OF NATURAL RESOURCES 09/09/91
MISSOURI AND MISSISSIPPI RIVERS BACKGROUND RADIATION MONITORING DATA
ST. LOUIS COUNTY & CITY; SURFACE WATER AND FINISHED WATER MO-MISS

MISSOURI RIVER: ST. LOUIS COUNTY

Source	Date	Gross Alpha Unfil/fil		Radium 226	Radium 228	Thorium 230	Thorium 232	Total Uranium Unfil/fil	Gross Beta Unfil/fil	
Missouri	04/90*	4.7		0.1	0.4	0.6	<0.1	1.4	8.0	
River	10/90*	6.0		0.2	0.4	<0.1	<0.1	2.6	10.6	
Howard	05/91*	5.0	3.0	0.4	0.5	0.2	<0.1	2.4	6.6	5.5
Bend	04/90**	3.2		0.1	<1.0			<1.0	5.6	
Raw	10/90**	4.7		0.2	1.8			1.5	7.1	
Water	11/90**							1.8	6.7	
	05/91**	4.5						1.3	7.1	
	AVERAGE	4.7		0.2					7.4	
Missouri	04/90*	<1.0		<0.05	0.3	<0.1	<0.1	0.4	3.8	
River	10/90*	1.9		<0.1	<0.1	<0.1	<0.1	0.4	4.6	
Howard	05/91*	2.9	1.4	<0.1	0.2	<0.1	<0.1	1.3	6.1	4.0
Bend Pl	04/90**	<1.0		<0.1	<1.0			<1.0	4.7	
Finished	10/90**	<1.0		0.1	1.5			<1.0	5.1	
Water	11/90**							1.6	5.0	
	05/91**	1.8						<1.0	4.0	
	AVERAGE								4.8	
Missouri	04/90*	3.6		0.2	0.2	<0.1	<0.1	1.8	7.9	
River	10/90*	4.3		0.2	0.2	<0.1	<0.1	1.9	10.7	
Central	05/91*	6.0	1.8	0.5	0.5	0.3	<0.1	1.6	7.4	6.7
Plant	04/90**	4.1		0.1	<1.0			<1.0	5.5	
Raw	10/90**	4.0		0.3	<1.0			1.7	6.3	
Water	05/91**	5.9						1.3	8.1	
	AVERAGE	4.7		0.3					7.7	
Missouri	04/90*	2.4		<0.05	0.2	<0.1	<0.1	1.7	4.3	
River	10/90*	<1.0		<0.1	0.3	<0.1	<0.1	1.4	5.8	
Central	05/91*	2.0	1.8	<0.1	<0.1	<0.1	<0.1	1.2	4.6	4.3
Plant	04/90**	2.9		<0.1	<1.0			<1.0	5.0	
Finished	10/90**	1.7		0.1	<1.0			1.2	4.8	
Water	05/91**	3.4						<1.0	4.6	
	AVERAGE								4.9	

Missouri	04/90*	4.8		0.2	0.2	<0.1	<0.1	1.1	6.6	
River	10/90*	6.8		<0.1	0.4	2.4	<0.1	2.5	9.9	
North	05/91*	6.1	2.5	0.4	0.5	0.4	<0.1	1.6	7.8	
Plant	04/90**	2.2		0.2	<1.0			<1.0	5.7	6.0
Raw	10/90**	3.0		0.2	<1.0			1.7	7.5	
Water	05/91**	6.7						1.4	8.1	
		4.9							7.9	
Missouri	04/90*	2.0		<0.05	0.2	<0.1	<0.1	0.9	4.0	
River	10/90*	2.7		<0.1	0.4	<0.1	<0.1	1.8	6.1	
North	05/91*	2.4	1.8	<0.1	<0.1	<0.1	<0.1	1.5	4.6	3.4
Plant	04/90**	1.5		<0.1	<1.0			<1.0	4.2	
Finished	10/90**	1.8		0.2	<1.0			1.1	5.5	
Water	05/91**	1.7						<1.0	5.4	
	AVERAGE	2.0							5.0	

MISSISSIPPI RIVER: ST. LOUIS CITY

Miss.	04/90*	4.4		0.1	0.2	0.2	<0.1	1.3	8.2	
River	10/90*	8.0		<0.1	0.2	<0.1	<0.1	2.3	11.0	
Chain of	05/91*	4.6	1.9	<0.1	0.3	<0.1	<0.1	2.4	7.4	4.0
Rocks Pl	04/90**	3.6		0.3	<1.0			<1.0	9.1	
Raw	10/90**	4.2		0.2	1.6			<1.0	5.1	
Water	05/91**	4.5						1.8	7.1	
		4.9							8.0	
Miss.	04/90*	2.4		<0.05	0.2	<0.1	<0.1	1.3	4.4	
River	10/90*	2.1		<0.1	<1.0	<0.1	<0.1	1.9	5.0	
Chain of	05/91*	1.4	1.2	<0.1	0.5	<0.1	<0.1	1.3	5.0	3.5
Rocks Pl	04/90**	<1.0		<0.1	<1.0			<1.0	9.1	
Finished	10/90**	1.9		0.1	<1.0			<1.0	5.3	
Water	05/91**	2.2						<1.0	4.4	
									5.5	
RAW WATER AVERAGE		4.8	2.3						7.7	5.6
FINISHED WATER AVG			1.6						5.0	3.8

All data in pCi/l; < = not detected
* = analysis by MDOH Laboratory; ** = Analysis by St. Louis Co. DOH Lab

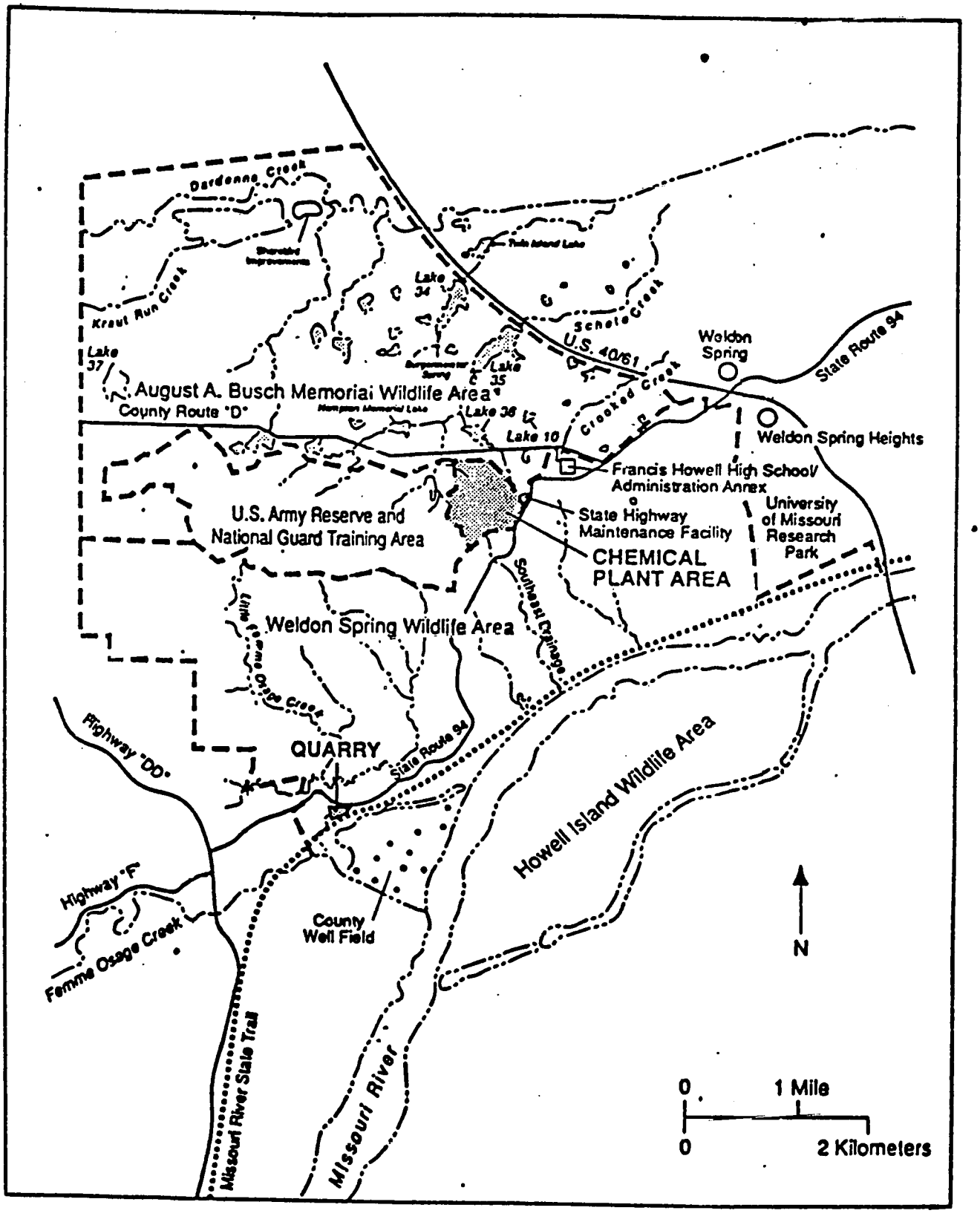
MISSOURI DEPARTMENT OF NATURAL RESOURCES 07/11/91.

COLDWATER CREEK RADIATION MONITORING DATA
SURFACE WATER COLDWACR

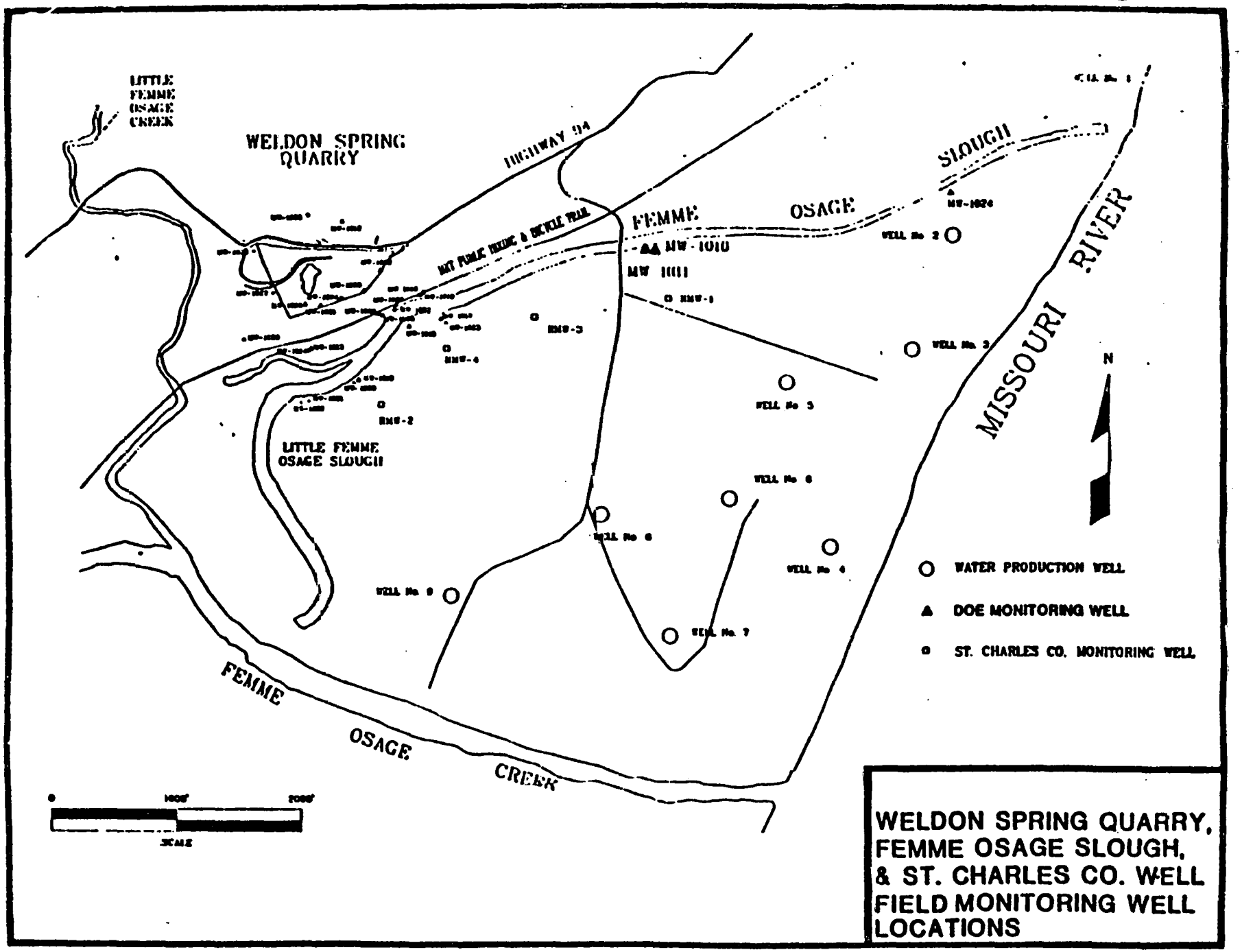
SURFACE WATER (Raw Water)

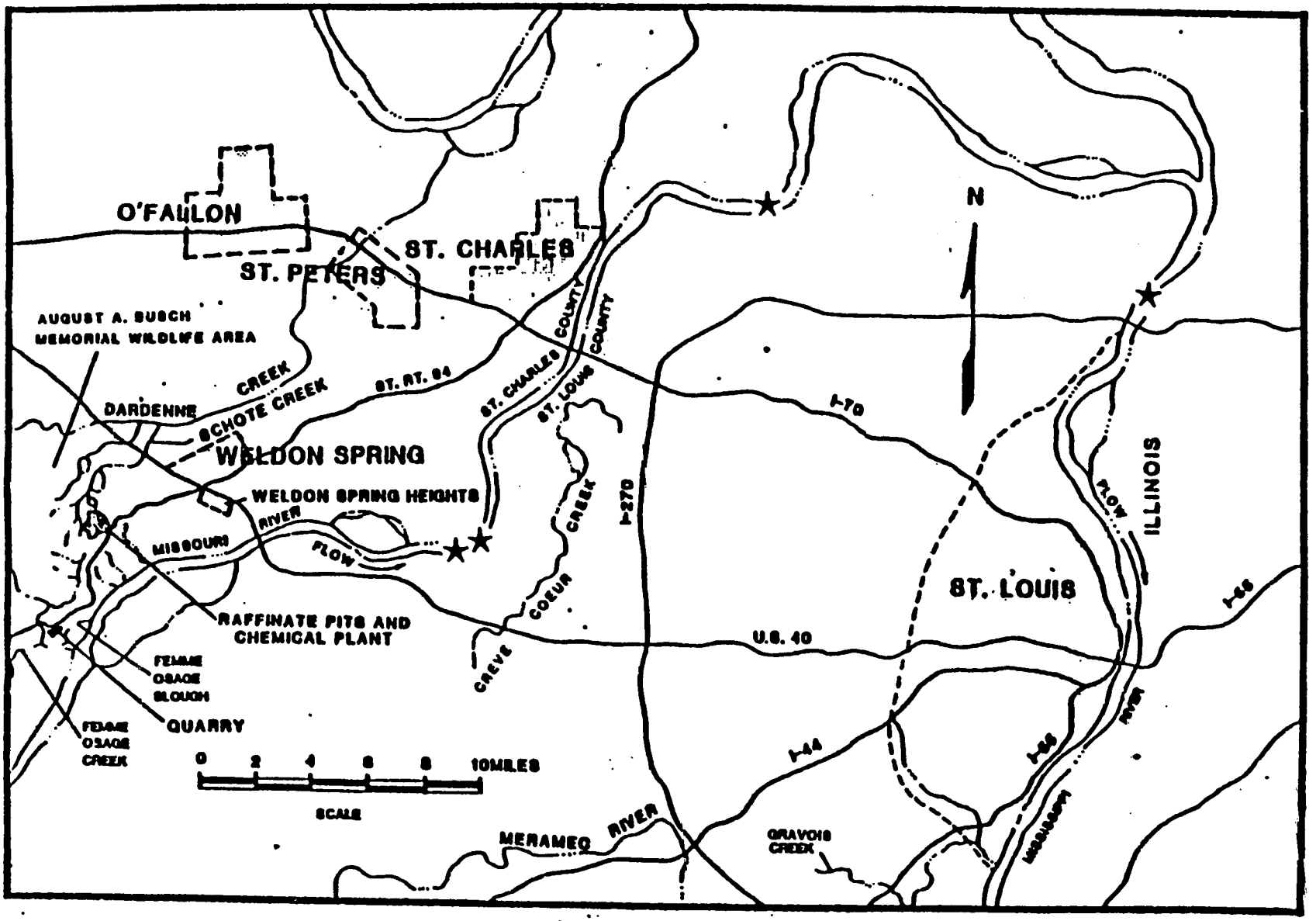
Source	Date	Gross Alph Unfil/fil	Radium Ra-226	Radium Ra-228	Thorium Th-230	Thorium Th-232	Uranium Total	Gross Beta Unfil/fil	
McDonnell Blvd. Bridge at SLAPS	03/90*	5.2	<0.1	0.4	0.8	<0.1	3.5	7.0	
	10/90*	4.0	<0.1	0.4	0.3	<0.1	3.5	7.8	
	05/91*	2.9 2.6	0.2	0.3	0.2	<0.1	3.5	7.3	5.8
AVERAGE		4.0			0.4		3.5	7.4	
Ballfield Ditch	03/90*	4.3	0.2	0.2	0.6	<0.1	3.0	7.1	
	10/90*	4.7	<0.1	<0.1	0.3	<0.1	3.0	8.0	
AVERAGE		4.5			0.5		3.0	7.6	
St. Cin Park	03/90*	3.6	<0.1	0.3	0.8	<0.1	1.6	5.4	
	10/90*	5.5	<0.1	0.4	<0.1	0.2	2.6	7.0	
	05/91*	2.6 2.3	0.3	0.2	<0.1	<0.1	1.6	4.5	4.0
AVERAGE		3.9					1.9	5.6	
Ferdinand Park	03/90*	4.0	<0.1	0.3	1.0	<0.1	1.7	6.0	
	10/90*	5.0	<0.1	1.0	<0.1	<0.1	2.6	7.5	
	05/91*	2.5 1.5	<0.1	0.4	<0.1	<0.1	1.3	4.7	4.6
AVERAGE		3.8					1.9	6.1	
COLDWATER CR AVG		4.0 2.1		0.4			2.5	6.6	4.8

All data in pCi/l; < = not detected
* = analysis by MDOH Laboratory



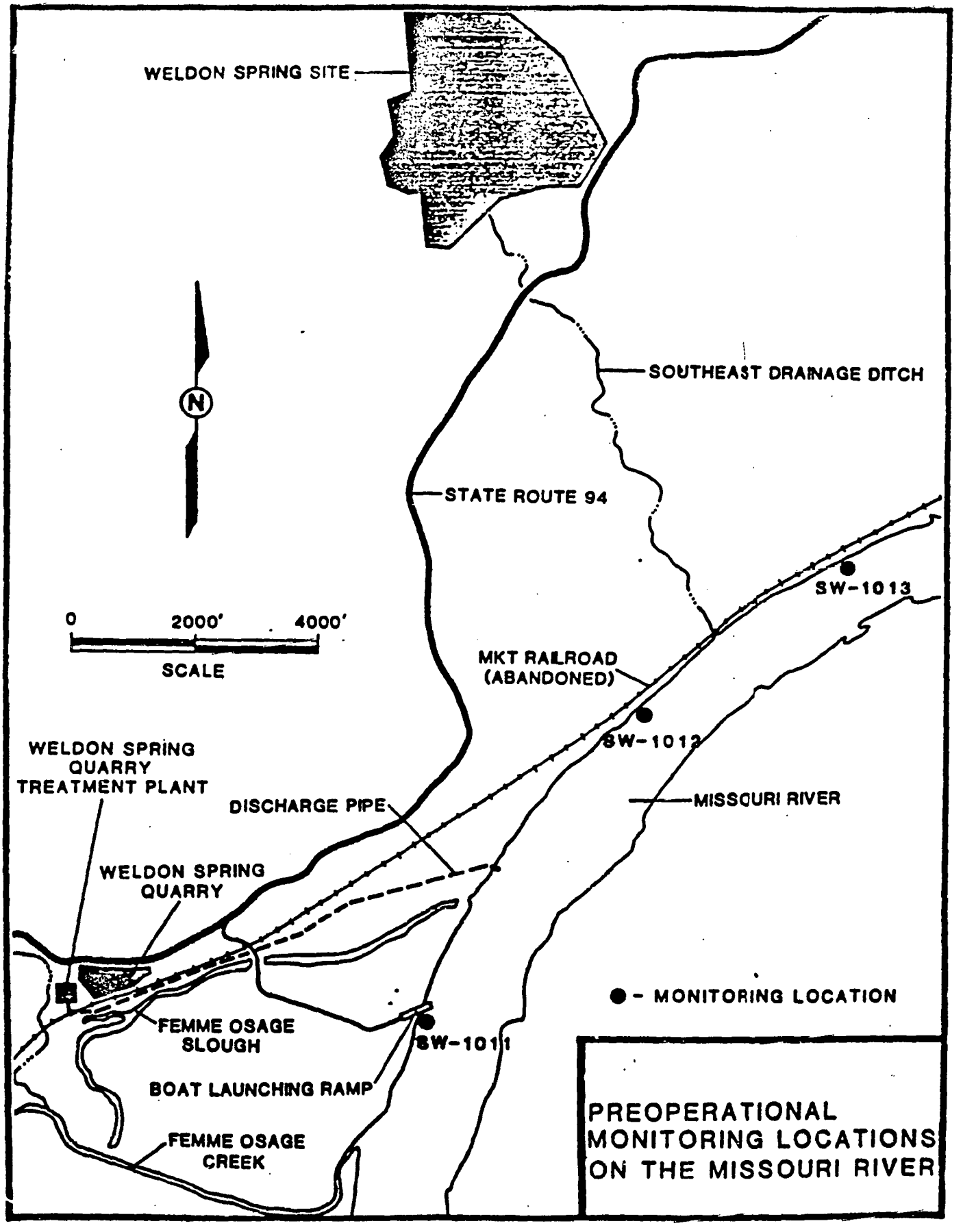
Surface Features near the Weldon Spring Site

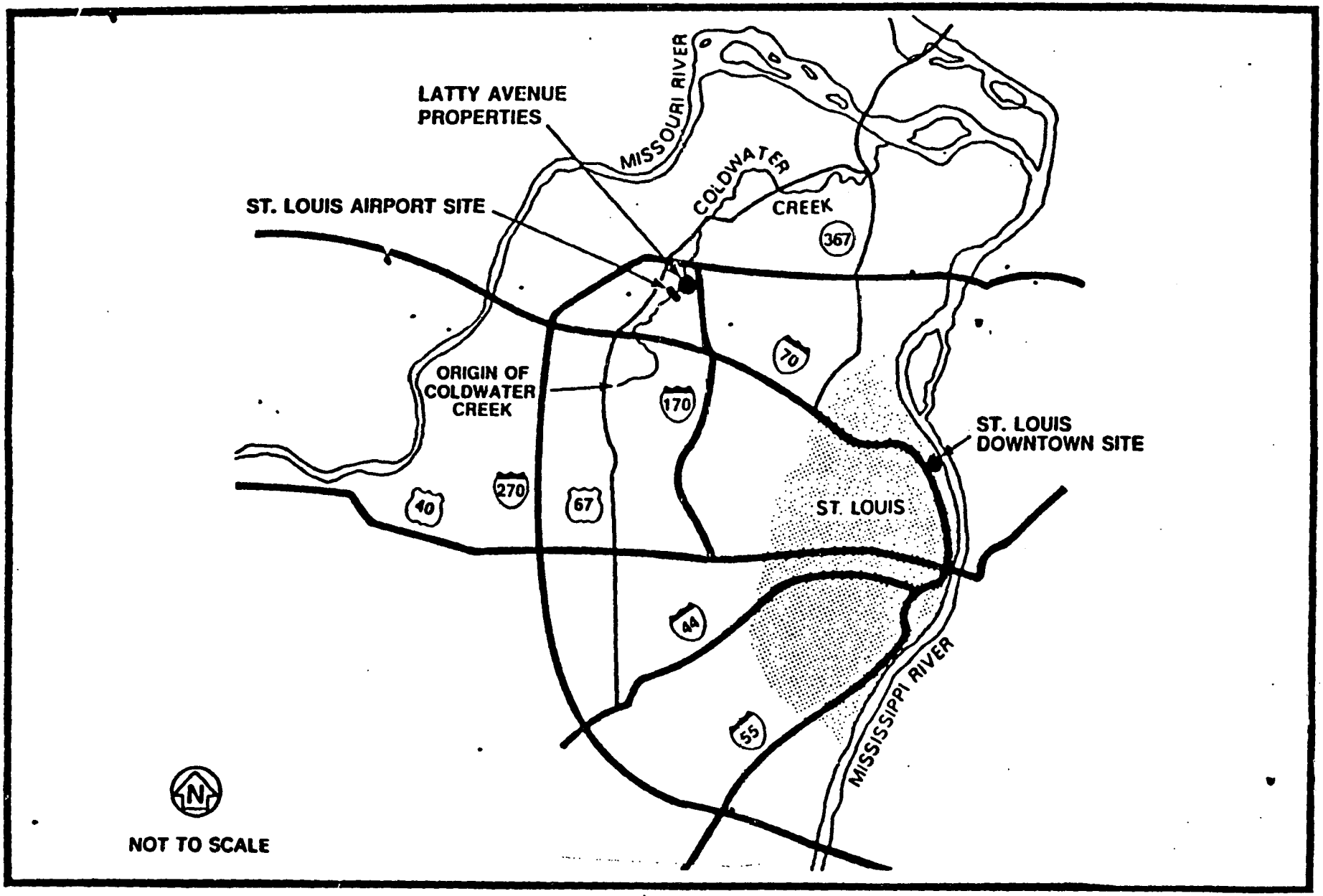

LITTLE FEMME OSAGE CREEK
WELDON SPRING QUARRY
HIGHWAY 94
SLOUGH
FEMME OSAGE
MW-1010
MW 1011
MISSOURI RIVER
BMW-1
BMW-2
BMW-3
BMW-4
WELL No 2
WELL No 3
WELL No 5
WELL No 6
WELL No 7
WELL No 8
WELL No 9
LITTLE FEMME OSAGE SLOUGH
FEMME OSAGE CREEK
N
WATER PRODUCTION WELL
DOE MONITORING WELL
ST. CHARLES CO. MONITORING WELL
WELDON SPRING QUARRY, FEMME OSAGE SLOUGH, & ST. CHARLES CO. WELL FIELD MONITORING WELL LOCATIONS



Area and Vicinity Map of the Weldon Spring Site, Weldon Spring, Missouri

★ Drinking Water Intakes


WELDON SPRING SITE
SOUTHEAST DRAINAGE DITCH
N
STATE ROUTE 94
SW-1013
0
2000'
4000'
SCALE
MKT RAILROAD
(ABANDONED)
SW-1012
WELDON SPRING
QUARRY
TREATMENT PLANT
DISCHARGE PIPE
MISSOURI RIVER
WELDON SPRING
QUARRY
● - MONITORING LOCATION
FEMME OSAGE
SLOUGH
SW-1011
BOAT LAUNCHING RAMP
FEMME OSAGE
CREEK
PREOPERATIONAL
MONITORING LOCATIONS
ON THE MISSOURI RIVER



LOCATIONS OF FUSRAP PROPERTIES IN THE ST. LOUIS, MISSOURI, AREA

081180

STATE OF MISSOURI
OFFICE INFORMATION MEMO

DATE	TIME ☐ AM ☐ PM
9/12/91	

TO	DEPARTMENT OR DIVISION
Dave Adler	
FROM	**DEPARTMENT**
David Bedan	DNR/DEQ/Administration

RE: Radiation Monitoring Report

- ☐ TAKE NECESSARY ACTION
- ☐ FOR YOUR APPROVAL
- ☐ REPLY
- ☐ FOR YOUR COMMENTS
- ☒ FOR YOUR INFORMATION
- ☐ PER YOUR REQUEST
- ☐ RETURN
- ☐ FILE
- ☐ FOR YOUR SIGNATURE
- ☐ PREPARE FOR MY SIGNATURE

Attached for your use is a copy of MDNR's updated report on radiation monitoring related to the St. Louis area radioactive waste sites.

If you have any questions or comments, please give me a call at (314) 751-4533.

MO 999-0033 (9-87)