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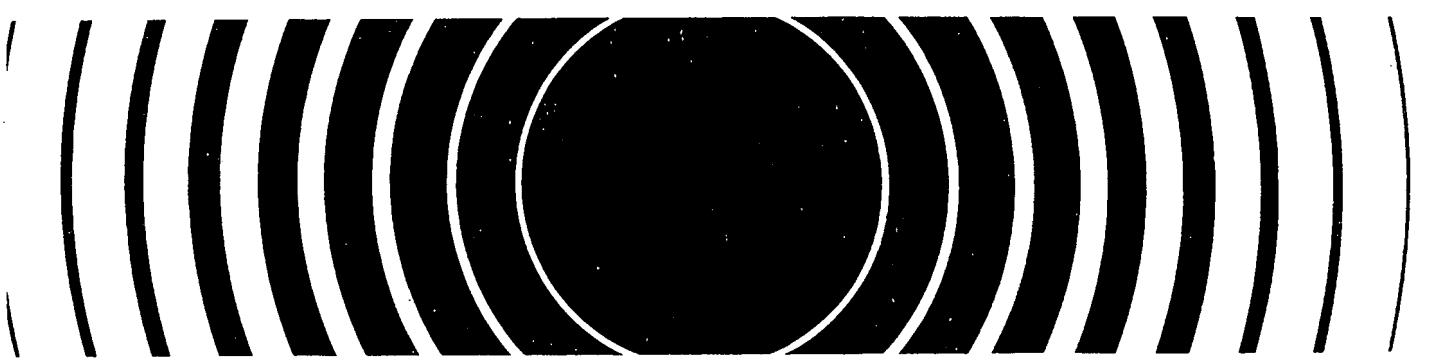
Annual Water Sampling and Analysis at the Salmon Test Site Area, Lamar County, Mississippi April 2002



Annual Water Sampling and Analysis at the Salmon Test Site Area

Lamar County, Mississippi
April 2002

by

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Prepared for the U.S. Department of Energy
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NOTICE

The information in this document has been funded wholly or in part by the United States Environmental Protection Agency (EPA) through Interagency Agreement (IAG) DE-AI 08-96NV11969 from the United States Department of Energy (DOE). It has been subjected to the Agency's peer and administrative reviews, and it has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

ABSTRACT

In 1964 and 1966, nuclear explosives were detonated approximately 2,700 feet (823 m) underground in the Salmon Test Site Area located in Lamar County, Mississippi. Drilling and clean-up activities have resulted in tritium contamination in close proximity to the surface ground zero. The Long-Term Hydrological Monitoring Program (LTHMP), directed by the EPA, conducts annual water sampling on and around the Salmon Test Site Area.

In this report, the 2002 annual water sampling at the Salmon Site is described, and the analytical results of the collected samples are given. The highest tritium concentration onsite was 2.09×10^4 pCi/L in water from one of the new wells (SA1-1h) added in 1997 (see Appendix B). No radioactivity attributable to the test site was found in any offsite water sample. The highest tritium concentration offsite was 14.6 ± 3.8 pCi/L at the Baxterville City Well.

All samples were analyzed for the presence of gamma-ray emitting radionuclides. None were detected above the minimum detectable concentration (MDC) (see Appendix B).

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FIGURES

ACRONYMS AND ABBREVIATIONS

DCG	Derived Concentration Guide
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
g	gram
HpGe	high purity germanium gamma detector
IAG	Interagency Agreement
keV	kilo electron volts = thousand electron volts
kg	kilogram, 1000 grams
kt	kiloton (TNT equivalent)
L	liter
LTHMP	Long Term Hydrological Monitoring Program
m	meter
MDC	minimum detectable concentration
MeV	one million electron volts
min	minute
mL	milliliter = one thousandth of a liter
ORIA	Office of Radiation and Indoor Air
pCi/L	picocuries per liter = 10^{-12} curies per liter = 1/1,000,000,000,000 curies per liter
PHS	U.S. Public Health Service
R&IE	Radiation and Indoor Environments National Laboratory
SGZ	surface ground zero
USGS	U.S. Geological Survey
^{3}H	Tritium
$^{3}H+$	Enriched Tritium
HM-L, HM-L2	Hydrological Monitoring Well - Local Aquifer
HM-S	Hydrological Monitoring Well - Surficial Aquifer
HM-1	Hydrological Monitoring Well - Aquifer 1
HM-2a	Hydrological Monitoring Well - Aquifer 2a
HM-2b	Hydrological Monitoring Well - Aquifer 2b
HM-3	Hydrological Monitoring Well - Aquifer 3
ITC	International Technology Corporation
REECo	Reynolds Electrical & Engineering Co
SA Wells	Source Area Wells

ACKNOWLEDGMENTS

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INTRODUCTION

Under an Interagency Agreement (IAG) with the DOE, the EPA's Radiation and Indoor Environments National Laboratory (R&IE) located in Las Vegas, NV, conducts sampling to measure radioactivity in water sources near the sites of underground nuclear explosions. The results provide assurance that radioactive materials from the tests have not migrated into drinking water supplies. This report presents the results for samples collected under EPA's LTHMP in April 2002, on and around the Salmon Test Site Area, Lamar County, Mississippi.

History

Project Dribble, consisting of two nuclear explosions, and Project Miracle Play, consisting of two non-nuclear gas explosions, were conducted in the Salmon Test Site Area, near Baxterville, Lamar County, Mississippi, between 1964 and 1970. The general area is depicted in Figure 1. The Salmon Test Site Area (Figure 2) contains approximately 1,470 acres located in Sections 11, 12, 13, and 14, Township 2 North, Range 16 West.

Test Date	Name	Type	Yield (kt)
10-22-64	Salmon	Nuclear	5.3
12-03-66	Sterling	Nuclear	0.38
02-02-69	Diode Tube	Gas	0.32
04-19-70	Humid Water	Gas	0.32

These tests were part of the Vela Uniform Program of the U.S. Atomic Energy Commission (a predecessor agency of the DOE). The purpose was to measure and evaluate the phenomena of seismic waves that are induced from the explosions as compared to those that occur naturally from earthquakes.

The first explosion, the Salmon Event, created a cavity in the salt dome underlying the test area. The top of the cavity is 1,160 feet (360 m) below the top of the salt dome which lies 1,500 feet (460 m) below the land surface (Figure 3). The Salmon detonation cavity was subsequently used to contain the next three explosions.

Following each detonation, the surrounding area was closely monitored by the U.S. Public Health Service (PHS). Radiological monitoring became the responsibility of the EPA at its inception in 1970, and after the second site cleanup operation in 1971-72, the LTHMP was instituted. In this program, all potable aquifers, several wells, public water supplies, and some surface waters in the vicinity of the Salmon Test Site are sampled and analyzed to determine the presence of tritium, gamma and other radioactive contaminants.

Historical Monitoring Results

The disposal of drilling mud and fluids near the surface ground zero (SGZ) is responsible for tritium (^3H) contamination of the soil zone and underlying shallow aquifer. These waters lie at depths of 4 to 10 feet (1.2 to 3 m) and 30 feet (9 m), respectively, and are not potable. Tritium contamination is also present in the potable water of the local aquifer which lies at about 200 feet (61 m). The observed ^3H concentration in the local aquifer is well below the 20,000 pCi/L guideline specified in the National Primary Drinking Water Regulations; Radionuclides; Final Rule (40CFR9/141/142), and is thought to be due to drilling activities at the site (Fenske and Humphrey, 1980; Fordham and Fenske, 1985).

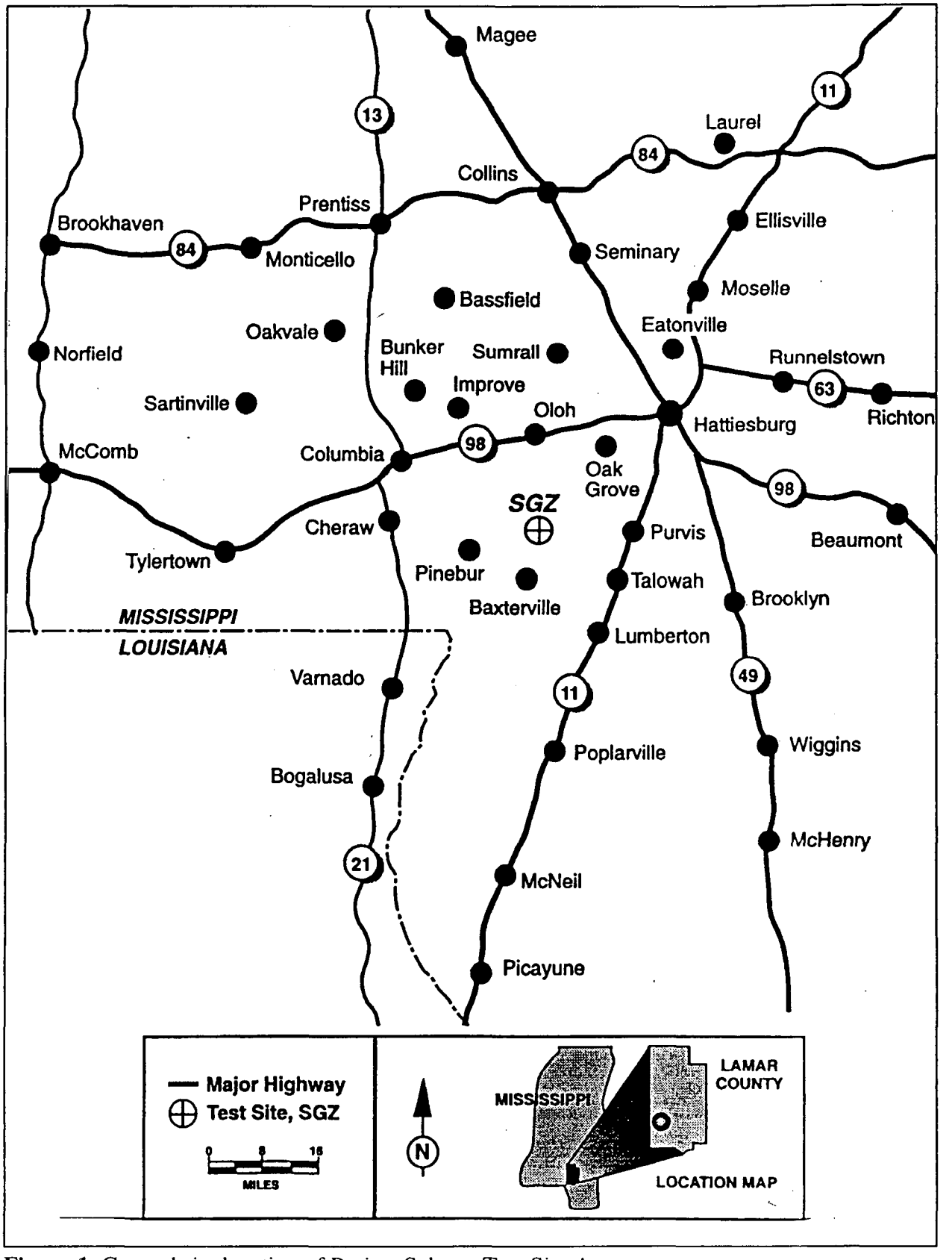

Figure 1 General site location of Project Salmon Test Site Area.

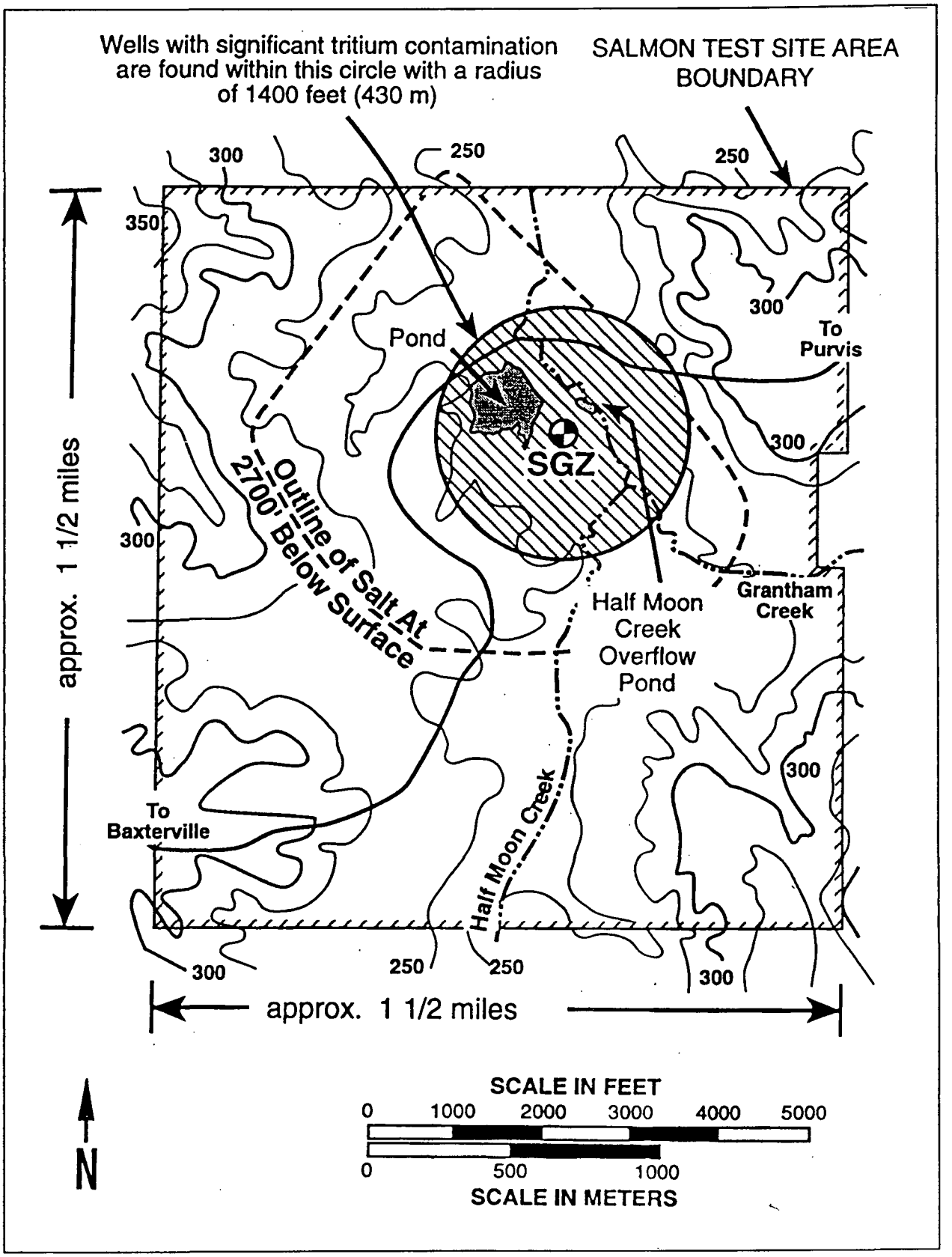

Figure 2 Topographic map of the Salmon Test Site Area showing the Surface Ground Zero and outline of Test Area at 2,700 feet below land surface.

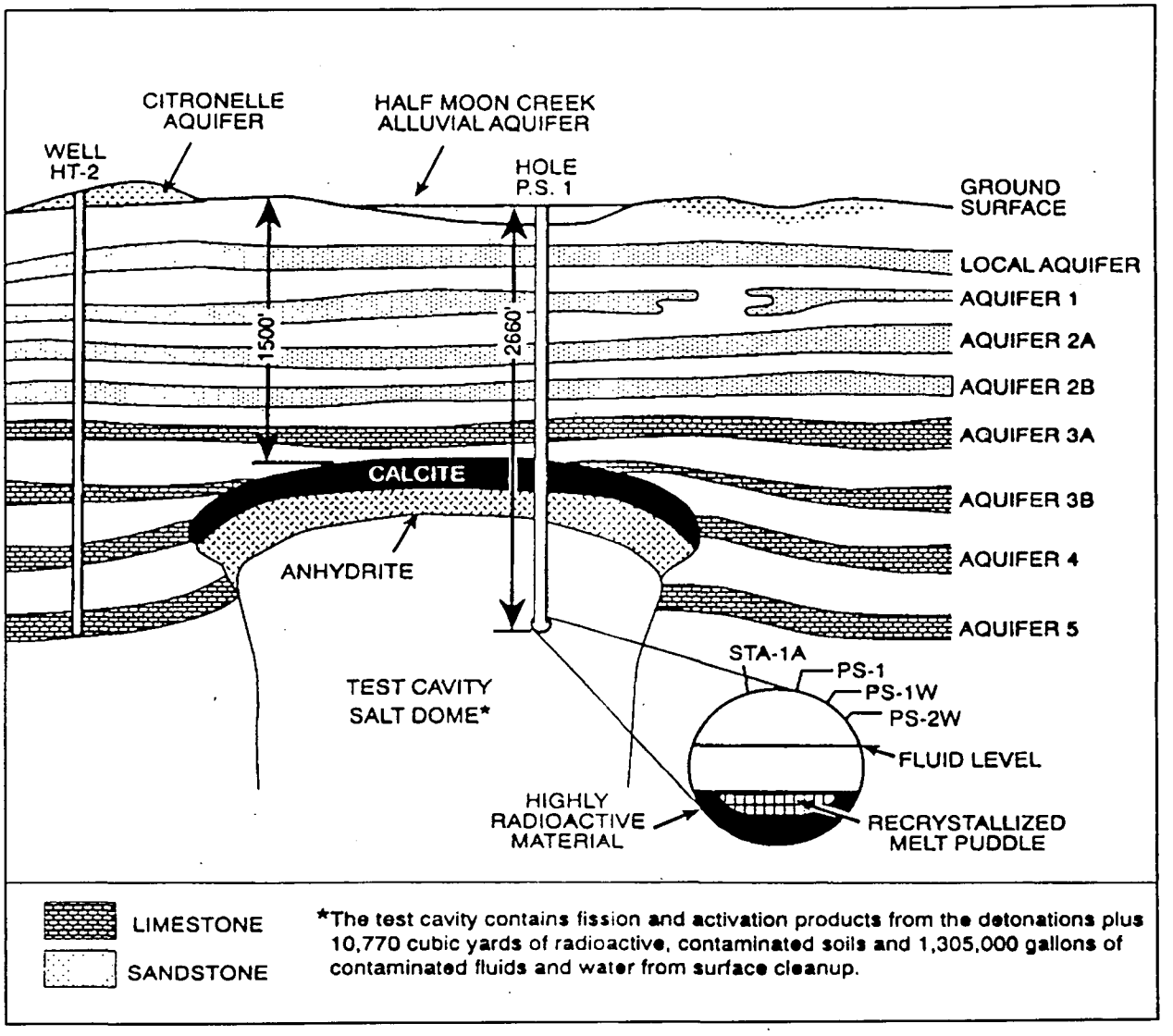

Figure 3 Test cavity and aquifers.

Of the 28 wells and 6 surface locations sampled on the Salmon Site, two regularly have tritium values above those expected in surface water. They are wells HM-S in the shallow aquifer, and HM-L in the underlying local aquifer. Plots of tritium concentration vs. time for these wells are shown in Figures 4 and 5. The solid line in the graph represents the normal radioactive decay of tritium. Surface water collected from the Half Moon Creek overflow pond adjacent to the SGZ area, has tritium values above background as does the REECo Pit drainage area which was used for the disposal of drilling mud.

Sample Collection

According to standard operating procedures agreed to by DOE (U.S. DOE 1981), the shallow wells are first sampled, pumped-down, and sampled on the following day. Wells HM-1, HM-2a, HM-2b, HM-3, and HM-L, which lie adjacent to SGZ, were first sampled and then pumped steadily while further samples were taken at 30 min intervals until the pH and conductivity of the water stabilized. A final sample was taken from each well 30 min after stability was reached. Water samples were

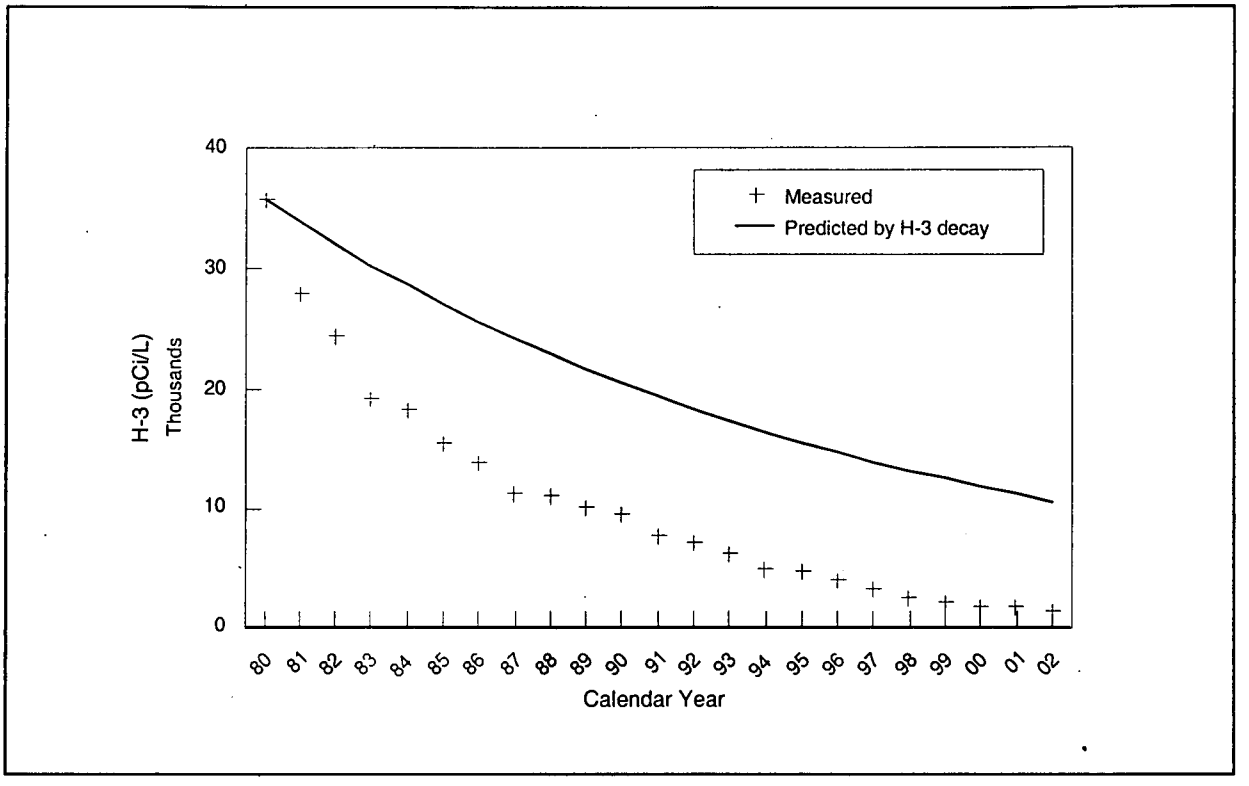

Figure 4 Tritium concentration vs. Sampling year for HM-S (depth = 30 ft).

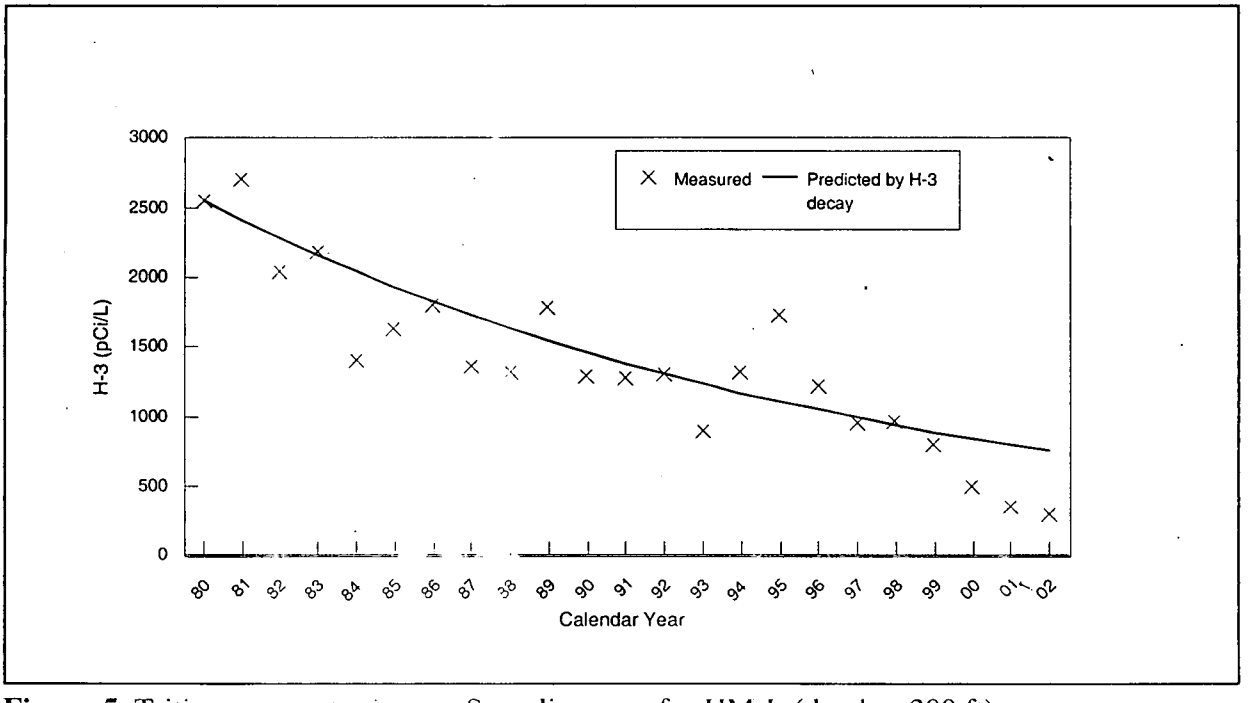

Figure 5 Tritium concentration vs. Sampling year for HM-L (depth = 200 ft).

taken from sources near the SGZ area (i.e., Half Moon Creek, Half Moon Creek Overflow, and the Pond west of SGZ) before and after the pumping operations to identify any resulting changes in tritium concentration from previous year. Well HM-L2 was first sampled and then pumped for one hour before a second sample is taken.

For wells with operating pumps, the samples were collected at the nearest convenient outlet. If the well had no pump, a truck-mounted or a submersible pump was used. To collect a sample with this truck mounted unit, it is possible to collect three-liter samples from wells as deep as 1800 meters (5,900 ft.). The pH, conductivity, water temperature, and sampling depth is measured and recorded as each sample was collected. Disposal of water from wells HM-3, SA-1-1H, and SA1-7H, were contained in a Frac Tank and then transported to the Columbia Waste Water Plant.

In November 2000, the U.S. DOE awarded a grant to Lamar County, Mississippi. The grant provided an extension of the current drinking water system around the Salmon Test Site (see letter in Appendix C). The water system eliminated the need to sample residential wells in the area, and around the site. However, the EPA and the State of Mississippi will continue monitoring wells and surface locations onsite and offsite annually. The offsite sampling sites will consist of city wells in Purvis, Baxterville, Columbia, and Lumberton, as well as some local ponds and streams.

From January to April 2002, the U.S. DOE plugged 33 wells on the Salmon Site. There are 28 wells remaining in the LTHMP that will be sampled annually onsite. If the reader would like more information on the plugged wells, they should contact the U.S. DOE in Las Vegas, Nevada.

The locations of all sampling sites are shown in Figures 6 and 7. The three sampling locations in Columbia, Mississippi, are not shown. The sampling results are discussed in the following sections.

Sample Analysis

Radiochemical laboratory procedures used to analyze the samples collected for this report are summarized in R&IE's SOPs (see Appendix A and D). These include standard methods to identify natural and man-made gamma-emitting radionuclides, tritium, plutonium, strontium, and uranium in water samples.

Two types of tritium analyses were performed: conventional and electrolytic enrichment. The enrichment method lowers the minimum detectable concentration (MDC) from approximately 300 pCi/L to about 5 pCi/L. An upper limit of activity of 700 - 800 pCi/L has been established for the tritium enrichment method because sample cross-contamination becomes a problem at higher levels.

In late 1995, it was decided that a maximum of 25 percent of all samples collected would be analyzed by the low-level enrichment method. This decision was based on the time required for analysis, budgetary constraints, and an assessment of past results. Under the current sampling and analysis protocol for the site, all samples are initially screened for tritium activity by the conventional method and selected samples enriched. At this time, only sampling locations that are in position to show migration are selected for enrichment.

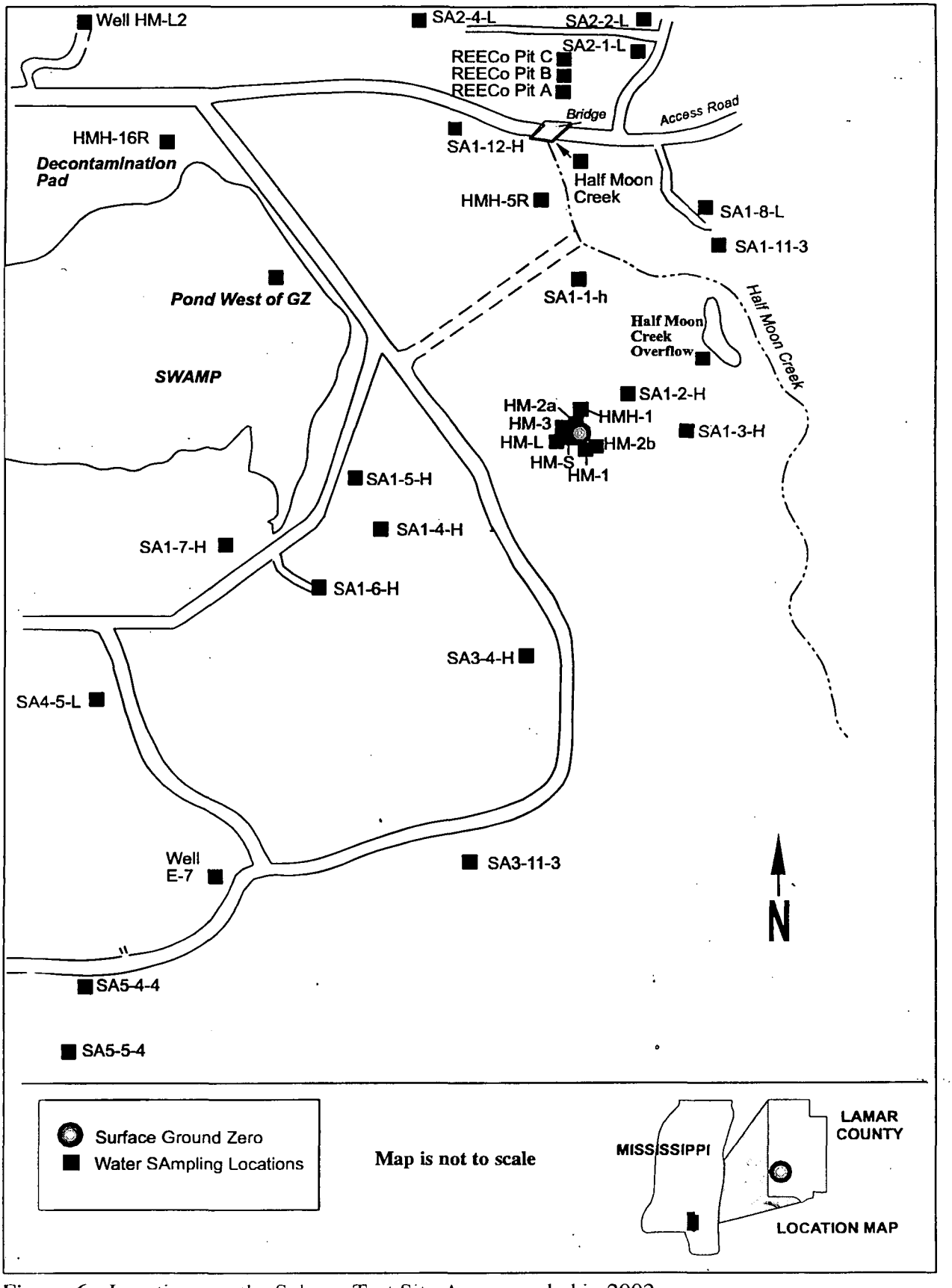

Figure 6 Locations on the Salmon Test Site Area sampled in 2002.

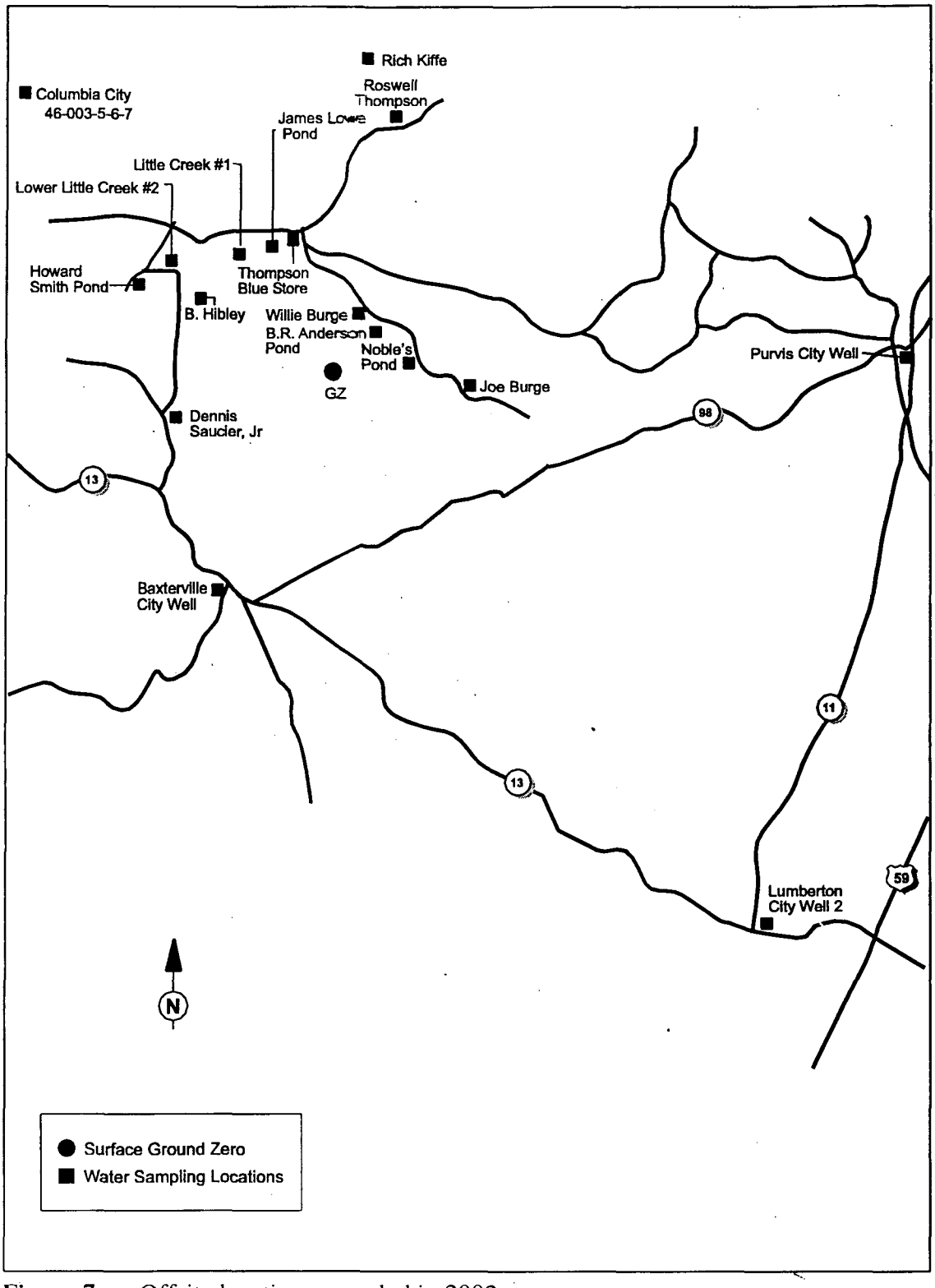

Figure 7 Offsite locations sampled in 2002.

Sufficient sample is collected from new sampling locations to perform all routine analyses and a full-suite of other radiochemical determinations including assays for strontium-90, plutonium, and uranium.

Water Analysis Results

Gamma-ray spectral analysis results indicated that no man-made gamma-emitting radionuclides were detected in any onsite or offsite samples. Tritium concentrations above normal background values were not detected in any offsite samples. Long-term decreasing trends in tritium concentrations are evident for onsite locations that have shown detectable tritium activity since monitoring began under the LTHMP (wells HM-S and HM-L, depicted in Figures 4 and 5).

Five wells were above the MDC in samples collected from the offsite locations. Tritium activity in the offsite samples ranged from less than the MDC to 14.6 pCi/L (~ 0.5 Bq/L), 0.073 percent of the DCG. These results do not exceed the natural tritium activity expected in rain water in this area.

Due to the high rainfall in the area, the sampling procedure for selected onsite wells was modified as follows: after collection of an initial sample, the well is purged, and a second sample is collected the following day after the well has recharged. The second sample is representative of water that has infiltrated through the soil zone, whereas the first sample may represent a mixture of direct rainwater influx at top of the well and infiltrated or soil zone water.

In April 2002, a total of 33 sampling locations onsite were not sampled. The wells were plugged reducing the number of locations onsite from 67 to 34. Of the 34 locations sampled onsite, 18 sites were sampled twice (pre-and post-sampling). 15 yielded tritium activities greater than the MDC in either the first or second sample. Of these, 11 yielded results higher than normal background (approximately 25 - 40 pCi/L [1 - 1.5 Bq/L]) as shown in Appendix B. The locations where the highest tritium activities were measured generally correspond to areas of known contamination.

No radioactive materials from the Salmon Test Site Area were detected in any water samples collected offsite. The tritium concentrations of water samples collected onsite and offsite are consistent with those of past studies at the Salmon Site. The highest tritium concentration found in water collected in the offsite area was 14.6 ± 3.8 pCi/L, which is typical of background tritium levels, and is 0.073 percent of the National Primary Drinking Water Regulations; Radionuclies; Final Rule (40CFR9/141/142).

The highest tritium concentration found onsite was 20,900 pCi/L. This was detected in a water sample collected from Well SA1-1H which is a shallow well (40') near SGZ. The water from this well is not available to the public, nor is it potable.

The tritium concentrations, except for Well SA1-1H, were all below the 20,000 pCi/L level defined in the National Primary Drinking Water Regulations; Radionuclies; Final Rule (40CFR9/141/142).

All samples were analyzed for presence of gamma-ray emitting radionuclides. None was detected above the MDC (see Appendix B on page 14).

REFERENCES

Final rule on Dec. 7, 2000. Code of Federal Regulations, Vol. 65, Title 40, Parts 9, 141, and 142, December 7, 2000, National Primary Drinking Water Regulations; Radionuclides; Final Rule.

A Guide for Environmental Radiological Surveillance at U.S. Dept. of Energy Installations, July 1981,Office of Operational Safety Report. Las Vegas, NV:
U.S. Department of Energy; DOE/EP-0023.

Fenske, P. R.; Humphrey, T. M., Jr. The Tatum Dome Project Lamar County, Mississippi. Las Vegas, NV: U.S. Department of Energy, Nevada Operations Office; NVO-225; 1980.

Fordham, J. W. Fenske, P. R. Tatum Dome Field Study Report and Monitoring Data Analysis, Las Vegas, NV: U.S. Department of Energy, Nevada Operations Office; DOE/NV/10384-03; 1985.

GLOSSARY OF TERMS

Background Radiation

The radiation in man's environment, including cosmic rays and radiation from naturally-occurring and man-made radioactive elements, both outside and inside the bodies of humans and animals. The usually quoted average individual exposure from background radiation is 125 millirem per year in mid-latitudes at sea level (Shein & Terplak, 1984).

Curie (Ci)

The basic unit used to describe the rate of radioactive disintegration. The curie is equal to 37 billion disintegrations per second, which is the equivalent of 1 gram of radium. Named for Marie and Pierre Curie who discovered radium in 1898. One microcurie (mCi) is one millionth of a Ci.

Isotope

Atoms of the same element with different numbers of neutrons in the nuclei. Thus ^{12}C, ^{13}C, and ^{14}C are isotopes of the element carbon, the numbers denoting the approximate atomic weights. Isotopes have very nearly the same chemical properties, but often different physical properties (for example ^{12}C and ^{13}C are stable, ^{14}C is radioactive).

Enrichment Method

A method of electrolytic concentration that increases the sensitivity of the analysis of tritium in water. This method is used by R&IE in selected samples if the tritium concentration is less than 700 pCi/L.

Minimum Detectable Concentration (MDC)

The smallest amount of radioactivity that can be reliably detected with a probability of Type I and Type II errors at 5 percent each (DOE 1981).

Offsite

Areas exclusive of the immediate Salmon Test Site Area.

Onsite

Refers to the immediate vicinity of the Salmon Test Site Area.

Shallow ground water

Water found near the soil surface, caused by precipitation infiltration of the soil. This shallow ground water is not an aquifer.

GLOSSARY OF TERMS
(Continued)

Surficial Aquifer

The ground water layer located closest to the surface, generally at a depth of approximately 30 feet at SGZ.

Tritium

A radioactive isotope of hydrogen that decays by beta emission. Its half-life is about 12.5 years.

Pre Sample

First sample taken from wells onsite (before pumping).

Post Sample

Last sample taken from wells onsite (after recharge).

Type I Error

The statistical error of accepting the presence of radioactivity when none is present. Sometimes called alpha error.

Type II Error

The statistical error of failing to recognize the presence of radioactivity when it is present. Sometimes called beta error.

APPENDIX A

Summary of Analytical Procedures

Type of Analysis	Analytical Equipment	Counting Period (Min)	Analytical Procedures	Sample Size	Approximate Detection Limit[a]
HpGe Gamma[b]	HpGe detector calibrated at 0.5 keV/ channel (0.04 to 2 MeV range). Individual detector efficiencies ranging from 15 to 35%.	150	Radionuclide concentration quantified from gamma spectral data by online computer program.	3.5L	Varies with radionuclides and detector used, normally counted to a MDC of approx. 5 pCi/L for Cs-137
^{3}H	Automatic liquid scintillation counter	300	Sample prepared by distillation.	5 to 10 mL	300 to 700 pCi/L
^{3}H+ Enrichment	Automatic liquid scintillation counter	300	Sample concentrated by electrolysis followed by distillation.	5 mL	5 pCi/L

[a] The detection limit is defined as the smallest amount of radioactivity that can be reliably detected, i.e., probability of Type I and Type II error at 5 percent each (DOE 1981).

[b] Gamma spectrometry using a high purity intrinsic germanium (HpGe) detector.

Typical MDA Values for Gamma Spectroscopy
(100 minute count time)

Geometry*	Marinelli	Model	430G
Matrix	Water	Density	1.0 g/ml
Volume	3.5 liter	Units	pCi/L
Isotope	MDA	Isotope	MDA
		Ru-106	4.76E+01
Be-7	4.56E+01	Sn-113	8.32E+00
K-40	4.92E+01	Sb-125	1.65E+01
Cr-51	5.88E+01	I-131	8.28E+00
Mn-54	4.55E+01	Ba-133	9.16E+00
Co-57	9.65E+00	Cs-134	6.12E+00
Co-58	4.71E+00	Cs-137	6.43E+00
Fe-59	1.07E+01	Ce-144	7.59E+01
Co-60	5.38E+00	Eu-152	2.86E+01
Zn-65	1.24E+01	Ra-226	1.58E+01
Nb-95	5.64E+00	U-235	1.01E+02
Zr-95	9.06E+00	Am-241	6.60E+01

Disclaimer

The MDA's provided are for background matrix samples presumed to contain no known analytes and no decay time. All MDA's provided here are for one specific *Germanium detector and the geometry of interest. The MDA's in no way should be used as a source of reference for determining MDA's for any other type of detector. All gamma spectroscopy MDA's will vary with different types of shielding, geometries, counting times, and decay time of sample.

APPENDIX B

Gamma/Tritium Results for Water Samples Collected in April 2002

Sample Location	Collection Date 2002	Enriched Tritium pCi/L ± 2 SD	(MDC)	Tritium pCi/L ± 2 SD	(MDC)	Comments	Gamma Spectrometry [b] (MDC)
Off-Site							
Baxterville Well City	4-16	14.6 ± 3.8	(5.8)				ND (4.6)
Lower Little Creek #2	4-16	13.6 ± 3.9	(6.1)				ND (4.8)
Burge, Willie & Grace	4-17	6.9 ± 3.4	(5.4)				ND (4.7)
Saucier, Dennis	4-15	12.4 ± 3.8	(5.9)				ND (5.0)
Anderson, Robert Lowell	4-15					City water (see Appendix C)	
Lumberton City Well 2	4-16	1.7 ± 3.6[a]	(5.9)				ND (4.7)
Anderson, Arlene	4-15					City water (see Appendix C)	
Purvis City Supply	4-15			39.8 ± 134[a]	(219)		ND (5.0)
O'Quinn, Jim & Cathy	4-15					City water (see Appendix C)	
City Well 46-003-5-6-7	4-16			-97.3 ± 131[a]	(219)		ND (5.0)
James Lowe Pond	4-16			88.4 ± 135[a]	(219)		ND (4.7)
Powell, Shannon	4-15					City water (see Appendix C)	
Smith, Howard Pond	4-16	12.9 ± 3.9	(6.1)				ND (5.0)
Thompson, Roswell	4-15			-30.9 ± 132[a]	(219)		ND (4.4)
Hibley, Billy	4-15			-79.6 ± 131[a]	(219)		ND (4.8)
Thompson, Mike	4-16					City water (see Appendix C)	
Kiffe, Richie & Patsy	4-15			0.0 ± 133[a]	(219)		ND (4.3)
Anderson, Billy Ray	4-15					City water (see Appendix C)	

[a] Indicates results are less than MDC

[b] No gamma radionuclides detected above MDC

ND Non-detected, represents ^{137}Cs (pCi/L)

APPENDIX B (Continued)

Gamma/Tritium Results for Water Samples Collected in April 2002

Sample Location		Collection Date 2002	Enriched Tritium pCi/L ± 2 SD	(MDC)	Tritium pCi/L ± 2 SD	(MDC)	Comments	Gamma Spectrometry [b] (MDC)	
Off-Site									
Thompson Blue Store		4/15	0.77 ± 3.6[a]	(5.9)			Background sample for HUB water	ND	(5.0)
Anderson, Rhonda		4-15					City water (see Appendix C)		
Lee, Perry T., Jr.		4-15					City water (see Appendix C)		
Napier, Denice		4-15					City water (see Appendix C)		
Burge, Joe		4-15			-4.4 ± 133[a]	(219)		ND	(4.7)
Noble, Evelyn		4-15					City water (see Appendix C)		
Nobles Pond		4-17			26.5 ± 134[a]	(219)		ND	(4.9)
Lower Little Creek #1		4-16			-13.3 ± 133[a]	(219)		ND	(1.5)
Anderson, Robert Lee, Jr.		4-15					City water (see Appendix C)		
Anderson Pond		4-16	11.0 ± 4.6	(7.2)				ND	(4.8)
On-Site									
Well HT-2c		4-18					Well Plugged, 2002		
Well HT-4		4-18					Well Plugged, 2002		
Well HT-5		4-18					Well Plugged, 2002		
Well E-7		4-17	4.5 ± 3.7[a]	(5.9)				ND	(4.9)
Half Moon Creek	Pre	4-15	13.6 ± 4.2	(6.5)				ND	(5.0)
	Post	4-16	13.7 ± 3.8	(5.9)				ND	(5.0)
Half Moon Creek Overflow	Pre	4-15			85.8 ± 130[a]	(227)		ND	(4.8)
	Post	4-16			92.9 ± 130[a]	(227)		ND	(4.7)
Well Ascot 2		4-17					Not sampled per DOE		

[a] Indicates results are less than MDC

[b] No gamma radionuclides detected above MDC

ND Non-detected, MDC for gamma represents ^{137}Cs (pCi/L)

APPENDIX B (Continued)
Gamma/Tritium Results for Water Samples Collected in April 2002

Sample Location		Collection Date 2002	Enriched Tritium pCi/L ± 2 SD (MDC)	Tritium pCi/L ± 2 SD (MDC)	Comments	Gamma Spectrometry [b] (MDC)
On-Site (cont.)						
Well HMH-1		4-16			Well Plugged, 2002	
Well HMH-2		4-16			Well Plugged, 2002	
Well HMH-3		4-16			Well Plugged, 2002	
Well HMH-4		4-16			Well Plugged, 2002	
Well HMH-5		4-16			Well Plugged, 2002	
Well HMH-5R		4-18		3920. ± 190 (220)		ND (1.6)
Well HMH-6		4-16			Well Plugged, 2002	
Well HMH-7		4-16			Well Plugged, 2002	
Well HMH-8		4-16			Well Plugged, 2002	
Well HMH-9		4-16			Well Plugged, 2002	
Well HMH-10		4-16			Well Plugged, 2002	
Well HMH-11		4-16			Well Plugged, 2002	
Well HMH-12		4-16			Well Plugged, 2002	
Well HMH-13		4-16			Well Plugged, 2002	
Well HMH-14		4-16			Well Plugged, 2002	
Well HMH-15		4-16			Well Plugged, 2002	
Well HMH-16		4-16			Well Plugged, 2002	
Well HMH-16R		4-18	52.7 ± 4.6 (6.2)			ND (1.8)
Well HM-S	Pre	4-15	1340. ± 13.0 (5.9)			ND (4.5)
	Post	4-16		1680. ± 164 (227)		ND (4.1)

[a] Indicates results are less than MDC
[b] No gamma radionuclides detected above MDC
ND Non-detected, MDC for gamma represents ^{137}Cs (pCi/L)

APPENDIX B (Continued)

Gamma/Tritium Results for Water Samples Collected in April 2002

Sample Location		Collection Date 2002	Enriched Tritium pCi/L ± 2 SD (MDC)	Tritium pCi/L ± 2 SD (MDC)	Comments	Gamma Spectrometry [b] (MDC)
On-Site (cont.)						
Well HM-1	Pre	4-15		32.2 ± 138[a] (227)		ND (5.0)
	1st 30 Min	4-15	0.16 ± 3.2[a] (5.2)			ND (4.9)
	2nd 30 Min	4-15	4.24 ± 3.6[a] (5.9)			ND (4.9)
	3rd 30 Min	4-15	3.6 ± 3.9[a] (6.4)			ND (5.0)
	Post	4-15	1.26 ± 5.0[a] (8.2)			ND (4.1)
Well HM-L	Pre	4-15	254.0 ± 6.7 (6.1)			ND (4.9)
	1st 30 Min	4-15	273.0 ± 6.6 (5.7)			ND (4.8)
	2nd 30 Min	4-15	276.0 ± 6.3 (5.2)			ND (4.8)
	3rd 30 Min	4-15	263.0 ± 6.9 (6.2)			ND (5.0)
	Post	4-15	303.0 ± 7.0 (5.8)			ND (5.0)
Well HM-2a	Pre	4-15		78.6 ± 139[a] (227)		ND (4.8)
	1st 30 Min	4-15		57.2 ± 139[a] (227)		ND (4.6)
	2nd 30 Min	4-15		111.0 ± 139[a] (227)		ND (4.8)
	3rd 30 Min	4-15		14.3 ± 138[a] (227)		ND (4.7)
	Post	4-15		31.1 ± 134[a] (220)		ND (5.0)
Well HM-2b	Pre	4-15		3.5 ± 134[a] (220)		ND (4.7)
	1st 30 Min	4-15		-38.0 ± 133[a] (220)		ND (4.5)
	Post	4-15		58.7 ± 135[a] (220)		ND (4.6)
Well HM-3	Pre	4-15		31.1 ± 134[a] (220)		ND (5.0)
	1st 30 Min	4-15		3.4 ± 134[a] (220)		ND (1.6)
	2nd 30 Min	4-15		69.0 ± 135[a] (220)		ND (4.2)
	3rd 30 Min	4-15		41.4 ± 134[a] (220)		ND (5.0)
	Post	4-15		41.4 ± 134[a] (220)		ND (5.0)
REECo Pit Drainage-A		4-17		110.0 ± 136[a] (220)		ND (4.4)
REECo Pit Drainage-B		4-17	54.4 ± 4.4 (5.8)			ND (4.2)
REECo Pit Drainage-C		4-17		51.8 ± 135[a] (220)		ND (5.0)
Well HM-L2	Pre	4-16		-96.6 ± 132[a] (220)		ND (4.7)
	Post	4-16		-89.7 ± 132[a] (220)		ND (4.5)
Pond West of GZ	Pre	4-15	4.7 ± 4.1[a] (6.6)			ND (5.0)
	Post	4-16	8.8 ± 4.5 (7.1)			ND (4.3)

[a] Indicates results are less than MDC

[b] No gamma radionuclides detected above MDC

ND Non-detected, MDC for gamma represents ^{137}Cs (pCi/L)

APPENDIX B (Continued)

Gamma/Tritium Results for Water Samples Collected in April 2002

Sample Location		Collection Date 2002	Enriched Tritium pCi/L ± 2 SD (MDC)	Tritium pCi/L ± 2 SD (MDC)	Comments	Gamma Spectrometry [b] (MDC)
On-Site (cont.)						
SA1-1h	Pre	4-15		20,900. ± 338 (220)		ND (4.9)
	Post	4-16		20,600. ± 336 (220)		ND (4.1)
SA1-2H	Pre	4-15	1950.0 ± 17 (5.9)			ND (1.9)
	Post	4-18	1480.0 ± 15 (5.9)			ND (4.9)
SA1-3H	Pre	4-15	589.0 ± 10 (6.6)			ND (4.8)
	Post	4-16	287.0 ± 7.4 (6.3)			ND (4.9)
SA1-4H	Pre	4-15		25.6 ± 130[a](213)		ND (4.5)
	Post	4-16		-45.0 ± 135[a](225)		ND (4.4)
SA1-5H	Pre	4-15	668.0 ± 11 (6.6)			ND (4.7)
	Post	4-16	734.0 ± 12 (7.3)			ND (4.3)
SA1-6H	Pre	4-15		146.0 ± 133 (213)		ND (4.9)
	Post	4-16		25.7 ± 130 (213)		ND (5.0)
SA1-7H	Pre	4-15		86.0 ± 131[a] (213)		ND (5.0)
	Post	4-16		-72.8 ± 128[a] (213)		ND (4.7)
SA1-8-L		4-17	4.0 ± 3.7[a](5.9)			ND (3.9)
SA1-9-2A		4-15			Well Plugged, 2002	
SA1-10-2B		4-15			Well Plugged, 2002	
SA1-11-3		4-18	0.56 ± 3.6[a](5.8)			ND (4.2)
SA1-12-H		4-18	9.9 ± 3.7 (5.8)			ND (1.7)
SA2-1-L		4-17		-8.6 ± 129[a](213)		ND (4.6)
SA2-2-L		4-18		81.3 ± 131[a](213)		ND (4.4)
SA2-3-L		4-15			Well Plugged, 2002	
SA2-4-L		4-18		42.8 ± 130[a](213)		ND (4.2)

[a] Indicates results are less than MDC

[b] No gamma radionuclides detected above MDC

ND Non-detected, MDC for gamma represents ^{137}Cs (pCi/L)

APPENDIX B (Continued)

Gamma/Tritium Results for Water Samples Collected in April 2002

Sample Location		Collection Date 2002	Enriched Tritium pCi/L ± 2 SD (MDC)	Tritium pCi/L ± 2 SD (MDC) Comments	Gamma Spectrometry [b] (MDC)
On-Site (cont.)					
SA2-5-L		4-15		Well Plugged, 2002	
SA3-1M		4-18		Well Plugged, 2002	
SA3-3M		4-18		Well Plugged, 2002	
SA3-4H	Pre	4-15	11.2 ± 4.6 (7.3)		ND (4.8)
	Post	4-16	12.8 ± 4.0 (6.2)		ND (5.0)
SA3-5-H		4-15		Well Plugged, 2002	
SA3-8-1		4-15		Well Plugged, 2002	
SA3-10-2B		4-15		Well Plugged, 2002	
SA3-11-3		4-15		38.5 ± 130[a](213)	ND (4.8)
SA4-1M		4-15		Well Plugged, 2002	
SA4-5-L		4-19	10.2 ± 3.7 (5.8)		ND (1.9)
SA5-1M		4-15		Well Plugged, 2002	
SA5-2M		4-15		Well Plugged, 2002	
SA5-3M		4-15		Well Plugged, 2002	
SA5-4-4		4-17		-38.5 ± 129[a](213)	ND (4.7)
SA5-5-4		4-18	5.6 ± 3.7[a] (6.0)		ND (4.8)
Rain Sample, Baxterville		4-16		-0.27 ± 136[a](225)	
Frac Tank		4-17		-128.0 ± 131[a](220)	ND (4.7)

[a] Indicates results are less than MDC
[b] No gamma radionuclides detected above MDC
ND Non -detected. MDC for gamma represents ^{137}Cs (pCi/L)

APPENDIX C

Letter from U.S.DOE "Water Sampling at Residences around the Salmon Site"

Department of Energy
National Nuclear Security Administration
Nevada Operations Office
P.O. Box 98518
Las Vegas, NV 89193-8518

April 15, 2002

NOTICE

WATER SAMPLING AT RESIDENCES AROUND THE SALMON SITE

For more than 20 years the Environmental Protection Agency and the State of Mississippi Division of Radiological Health have carried out the Long Term Hydrological Monitoring Program in support of the National Nuclear Security Administration Nevada Operations Office (NNSA/NV), formerly known as the Department of Energy Nevada Operations Office's management of the Salmon Site. As part of this program, water samples have been collected from various homes in the area around the Salmon Site including your residence. The years of sampling have clearly demonstrated that contamination has never moved off of the Salmon Site.

With the completion of the extension of the drinking water system into the area, the NNSA/NV has determined there is no longer a need to take water samples at each residence. Therefore, this will be the last year samples will be collected from residential locations around the Salmon Site. The NNSA/NV will continue to collect water samples at representative locations from each of the water franchises serving the homes in the vicinity of the Salmon Site. In addition, water samples will be collected from monitoring wells, ponds and streams located on the Salmon Site and from some of the streams and ponds around the site.

The NNSA/NV remains committed to the monitoring of the site, and should evidence ever suggest there is a potential for contamination to move off-site, NNSA/NV will take necessary additional actions to ensure protection of the public.

If you have any questions feel free to contact Peter A. Sanders at (702) 295-1037 or in writing at:

Peter A. Sanders
Environmental Restoration Division
National Nuclear Security Administration
Nevada Operations Office
P.O. Box 98518
Las Vegas, NV 89193-8518

APPENDIX D

Standard Operating Procedures for the Center for Radioanalysis & Quality Assurance

RQA-302	Standard Operating Procedures of Gamma-Ray Detector Systems
RQA-602	Tritium Enrichment Procedure
RQA-603	Standard Operating Procedure for 89Sr and 90Sr in Water, Air Filters and Milk
RQA-604	Standard Operating Procedure of Convention Tritium in Water
RQA-606	Analysis of Plutonium, Uranium and Thorium in Environmental Samples by Alpha Spectroscopy

Standard Operating Procedures for the Center for Environmental Restoration, Monitoring & Emergency Response

CER-203	Standard Operating Procedure for the Long-Term Hydrological Monitoring Program