Annual Water Sampling and Analysis at the Salmon Test Site Area

Lamar County, Mississippi
April 1998

by

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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 and monitors radiological sampling equipment on the site throughout the year.

In this report the 1998 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 2.99×10^4 pCi/L in water from one of the new wells added in 1997, see Appendix B, Page 16. No radioactivity attributable to the test site was found in any offsite water samples. The highest tritium concentration offsite was 24 ± 3.4 pCi/L at the Ascot Well #2. The lower levels of activity were determined using a tritium enrichment analytical method.

All samples, with the exception of HMH-1 through HMH-16, HM-S and the 15 wells that were added in 1997, plus the addition of 14 Wells that were added in 1998 (see Appendix B), were analyzed for presence of gamma-ray emitting radionuclides. None were detected above the minimum detectable concentration (MDC).

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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	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
HMH	Hydrological Monitoring Hole (1-16)
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
HT-2c	Hydrological Test Hole
HT-4	Hydrological Test Hole
HT-5	Hydrological Test Hole
SA Wells	Source Area Wells

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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 a LTHMP to measure radioactivity concentrations in water sources near the sites of underground nuclear explosions. The results of the LTHMP provide assurance that radioactive materials from the tests have not migrated into drinking water supplies. This report presents the results for the samples collected in April 1998, on and around the Salmon Test Site Area, in 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 Salmon Test Site Area that was used for the following three explosions. 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).

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 and other radioactive contaminants.

Historical Monitoring Results

The disposal of drilling mud and fluids near the surface ground zero (SGZ) is possibly responsible for tritium (^3H) contamination of the soil zone and underlying shallow aquifer. These waters lie at depths of 4 to 10 feet (1.3 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 (62 m). The observed concentration of ^3H at that depth is well below the concentration specified in the National Interim Primary Drinking Water Regulations (40CFR141), which places the maximum level of tritium in drinking water at 20,000 pCi/L, and is thought to be due to

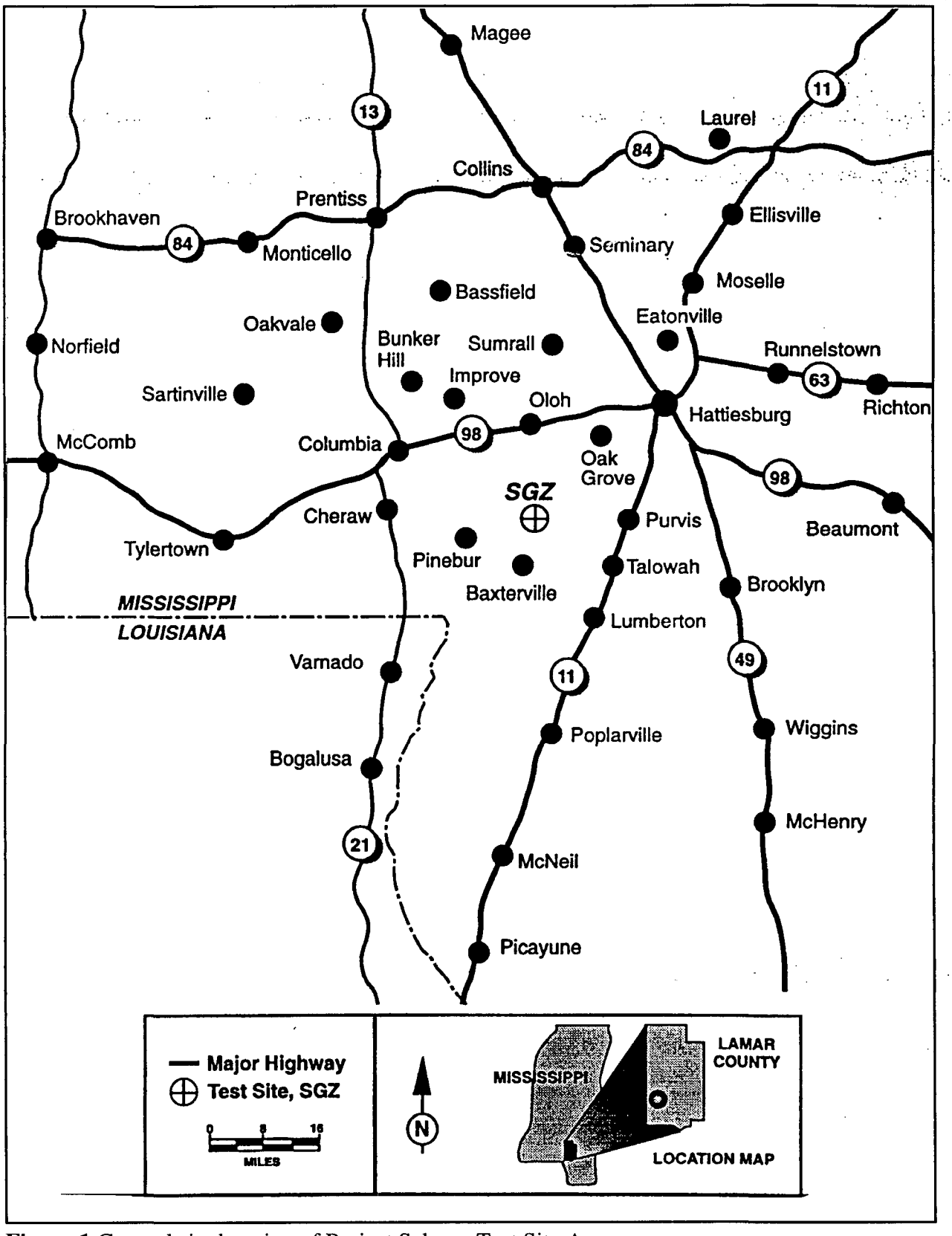

Figure 1 General site location of Project Salmon Test Site Area.

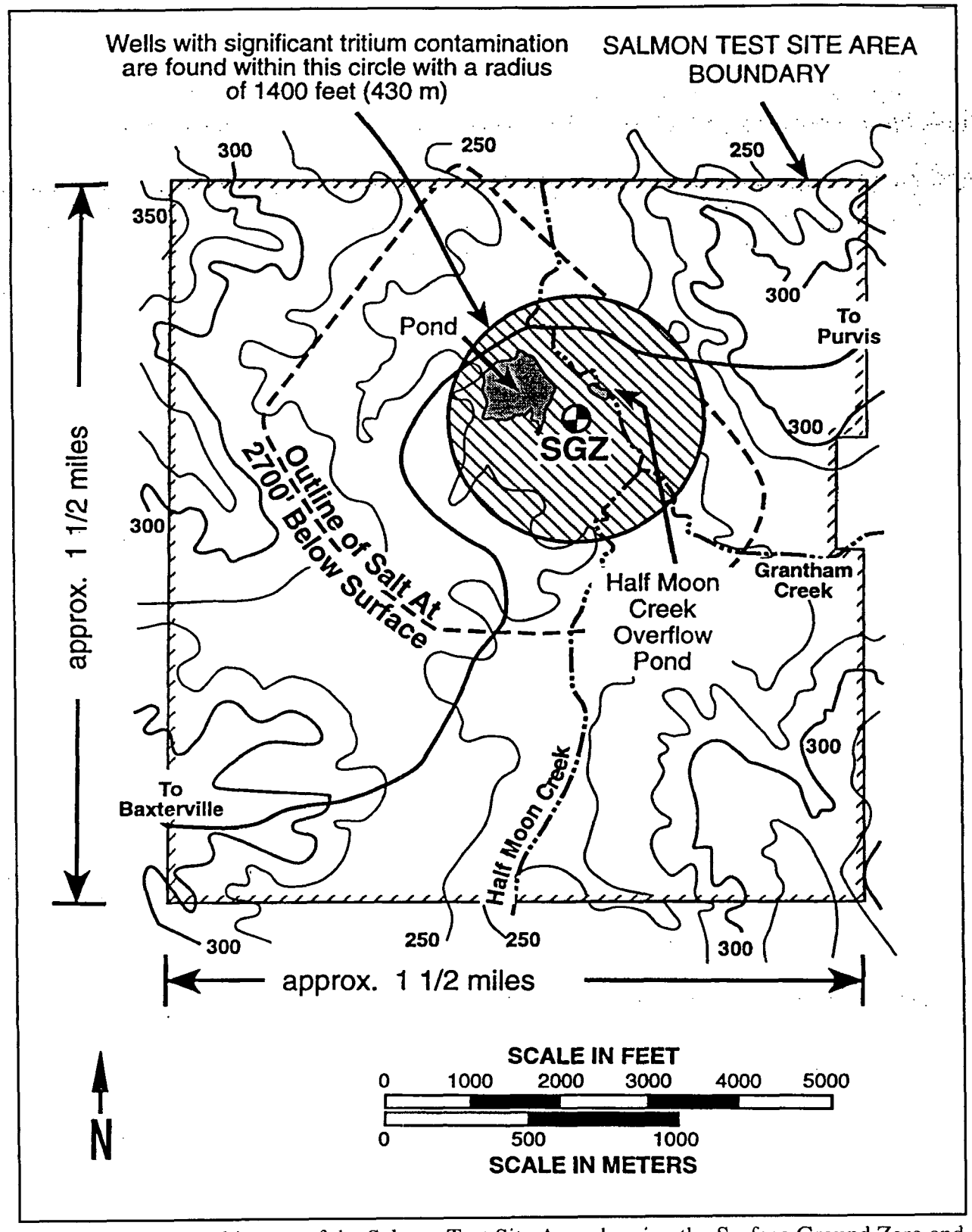

Figure 2 Topographic map of the Salmon Test Site Area showing the Surface Ground Zero and outline of Test Area at 2,700 feet below land surface.

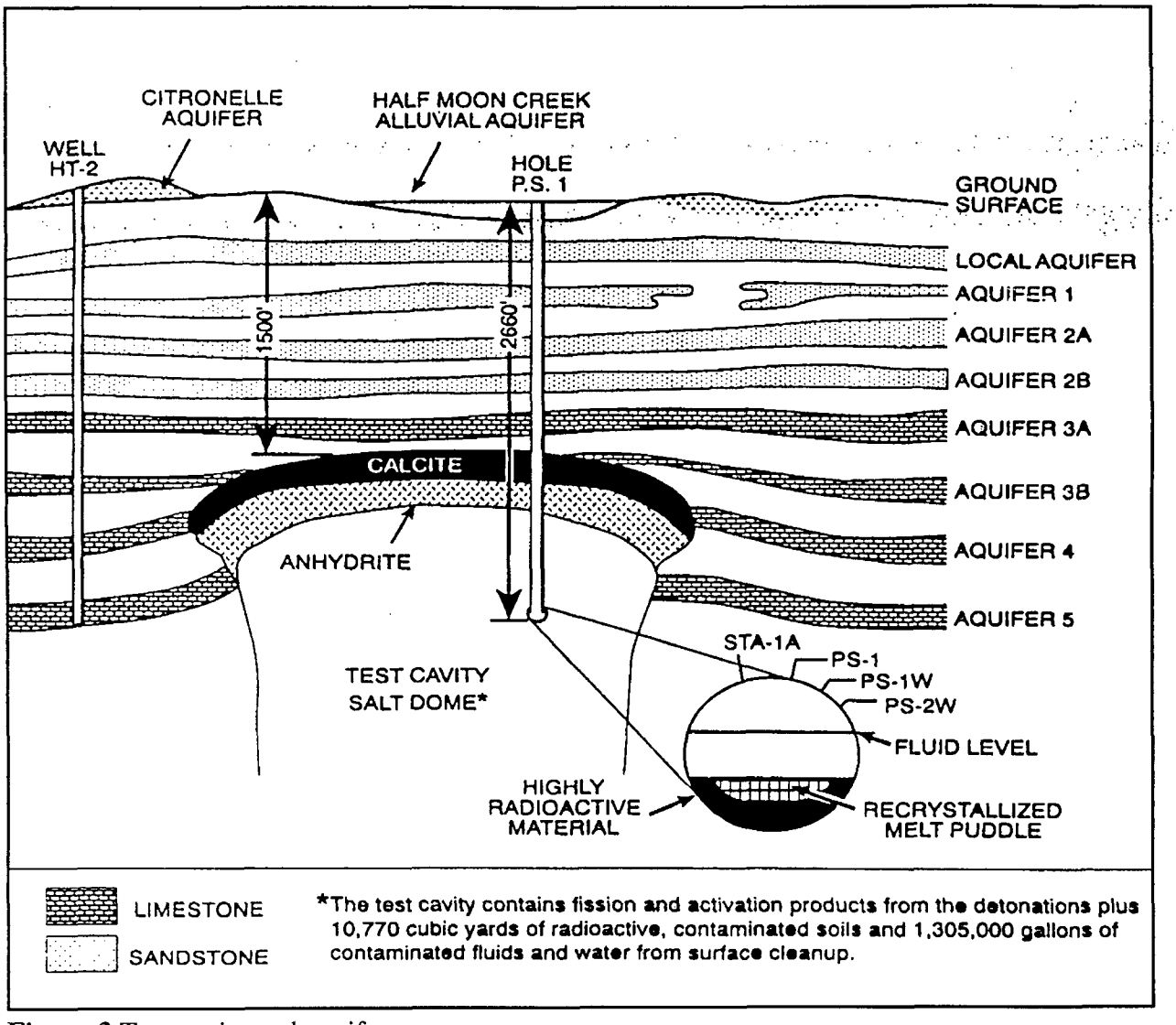

Figure 3 Test cavity and aquifers.

drilling activities at the site (Fenske and Humphrey, 1980; Fordham and Fenske, 1985).

Of the 55 wells that are sampled on the Salmon Site, five regularly have tritium values above those expected in surface water values. These include surface ground water wells HMH-1, HMH-2, HMH-5, Local Aquifer well HM-L, and Surficial Aquifer Well HM-S. Plots of tritium concentration vs. time for these wells are shown in Figure 4 to 8. The solid line in the graph represents the normal radioactive decay of tritium. Surface water collected from the Half Moon Creek overflow pond, which lies adjacent to the SGZ area, has tritium values above background. Also, the REECo Pit drainage area, used for the disposal of drilling mud, occasionally shows elevated levels of tritium.

Sampling Collection

According to standard operating procedures agreed to by DOE (U.S. DOE 1981), the HMH

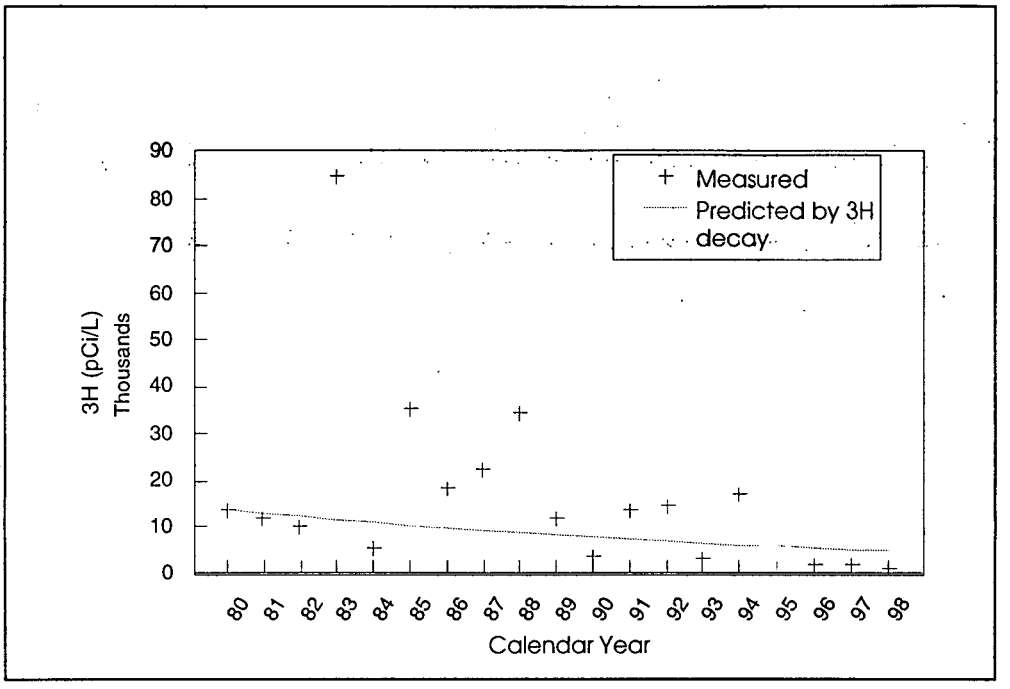

Figure 4 Tritium concentration vs. sampling year for HMH-1 (depth = 10ft).

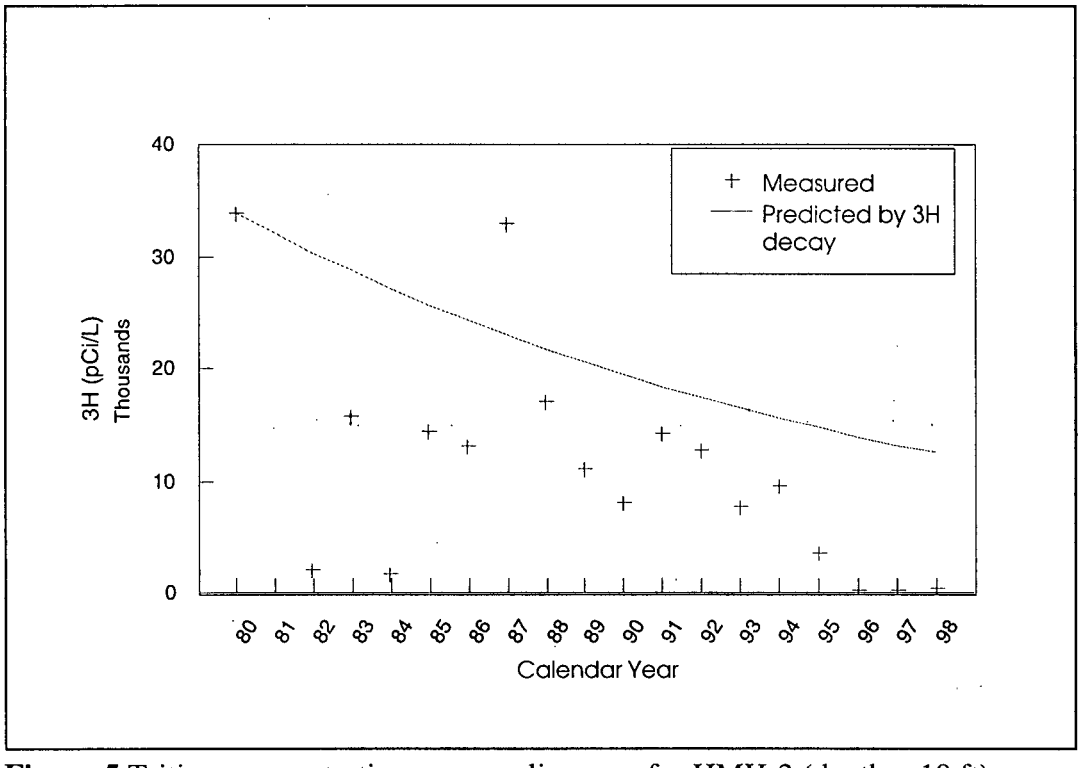

Figure 5 Tritium concentration vs. sampling year for HMH-2 (depth = 10 ft).

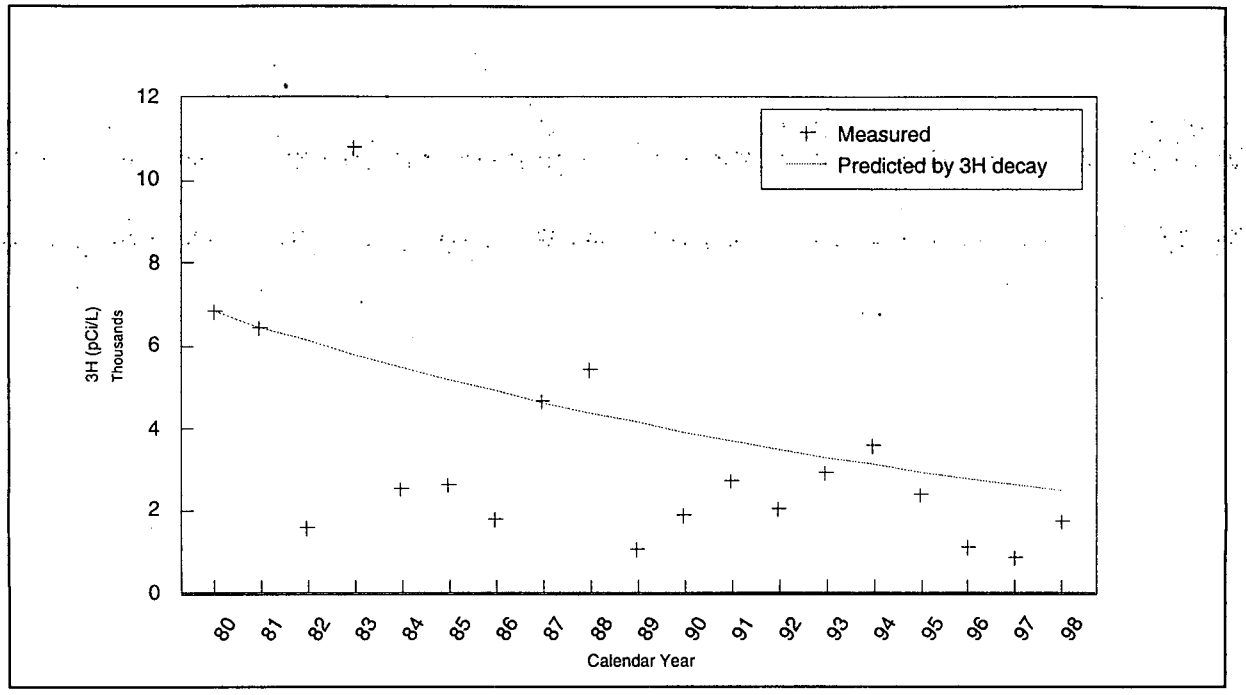

Figure 6 Tritium concentration vs. sampling year for HMH-5 (depth = 10 ft).

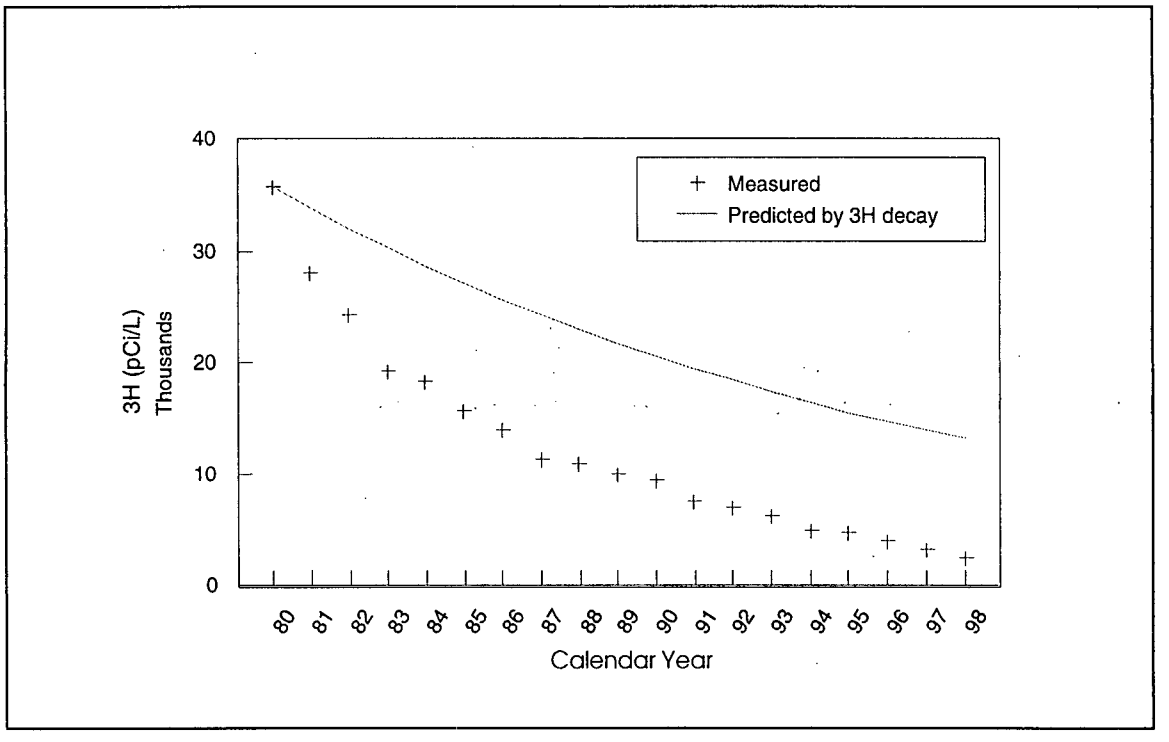

Figure 7 Tritium concentration vs. sampling year for HM-S (depth = 30 ft).

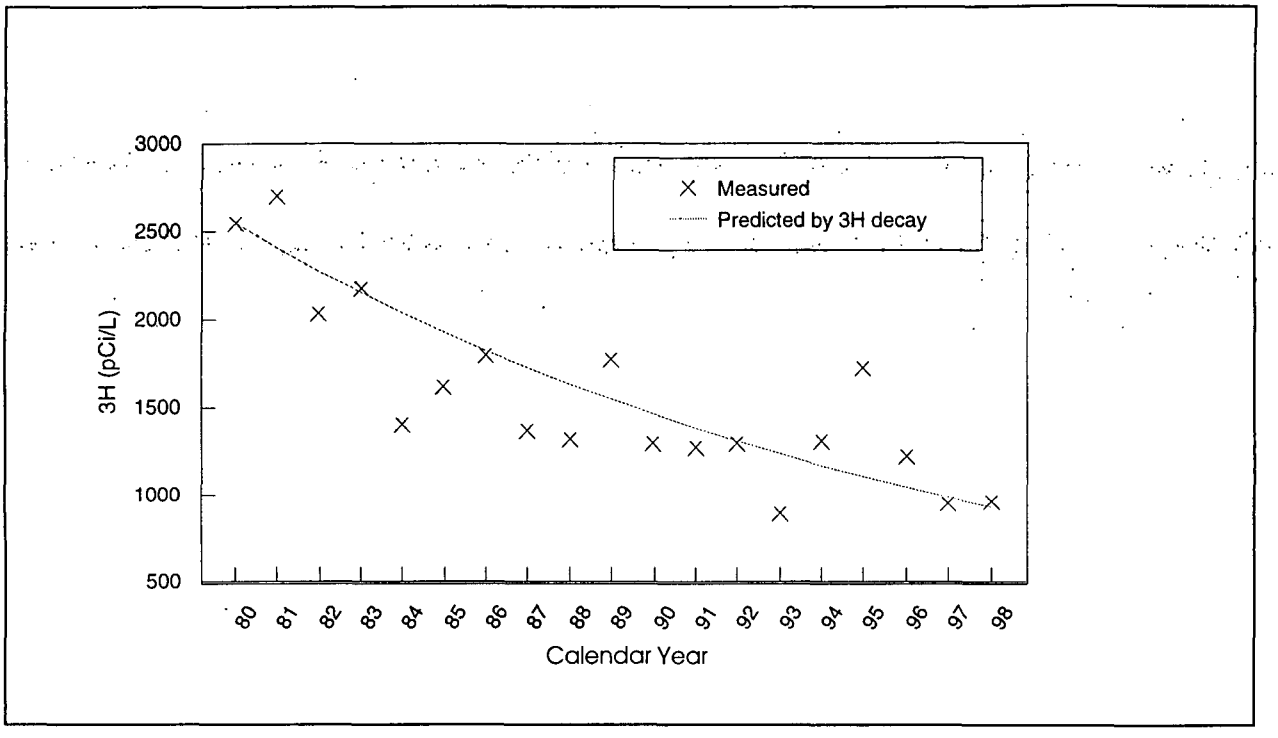

Figure 8 Tritium concentration vs. sampling year for HM-L (depth = 200 ft).

wells on the test site were first sampled, pumped-dry, and sampled on the following day as were the 15 new wells added in 1997. The 14 new wells added in 1998 were purged three volumes of water and then sampled. 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 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. Well HM-L2 was first sampled and then pumped for one hour before a second sample was taken. All other water supplies of this study were sampled only once.

The locations of all sampling sites are shown in Figures 9 - 10. Sampling also included three locations in Columbia, Mississippi (not shown). The sampling results are discussed in the following sections.

For wells with operating pumps, the samples are collected at the nearest convenient outlet. If the well has no pump, a truck-mounted sampling unit is used. With this unit it is possible to collect three-liter samples from wells as deep as 1800 meters (5,900 ft.). At the sample collection sites, the pH, conductivity, water temperature, and sampling depth are measured and recorded when the sample is collected.

Sample Analysis Procedures

The procedures for the analysis of samples collected for this report were described by Johns et al. (1979) and are summarized in

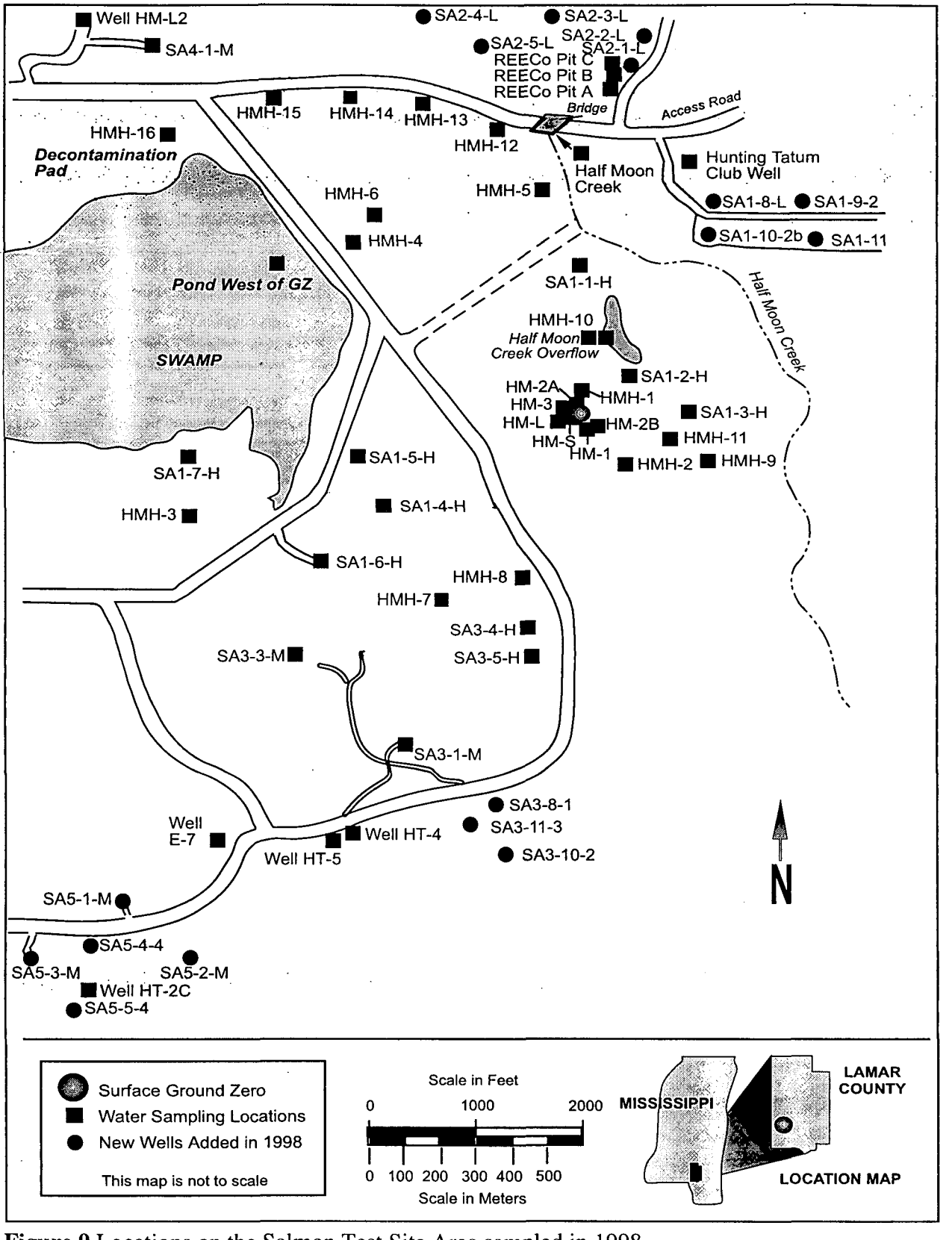

Figure 9 Locations on the Salmon Test Site Area sampled in 1998.

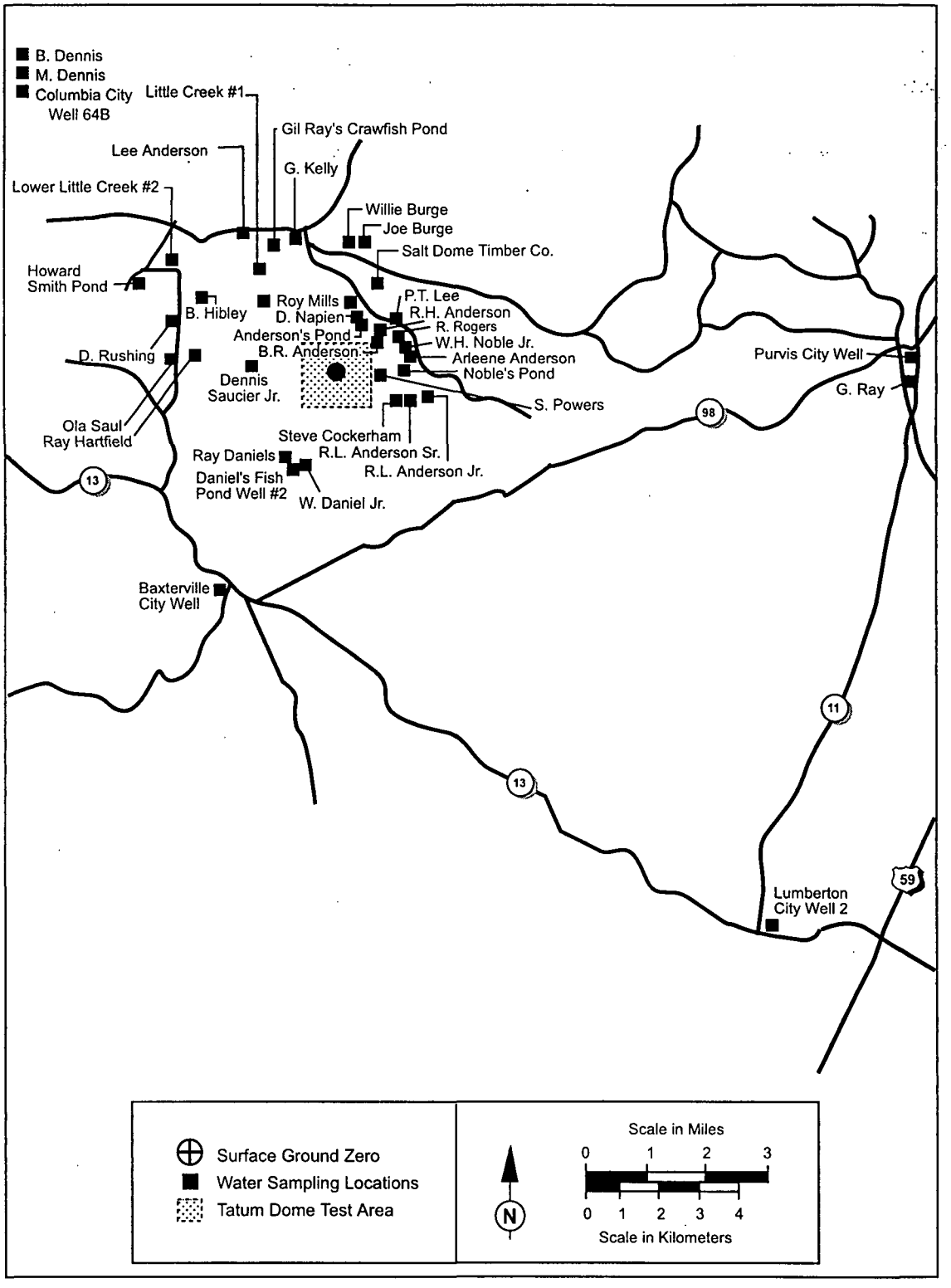

Figure 10 Offsite locations sampled in 1998.

Appendix A. These include gamma spectral analysis and radiochemical analysis of tritium.

The procedures are based on standard methodology for given analytical procedures. Two methods for tritium analysis are performed: conventional and electrolytic enrichment. The samples are initially analyzed by the conventional method. If the tritium result is less than 700 pCi/L, the selected sample is then analyzed by the electrolytic enrichment method which lowers the minimum detectable concentration (MDC) from approximately 300 pCi/L to about 5 pCi/L. The upper level of 700 pCi/L has been established for the tritium enrichment method as sample cross contamination becomes a problem at higher ranges. In late 1995, it was decided that only 25% of all tritium samples collected would be analyzed by the enrichment method, due to budget constraints and the time required to do the analysis as well as past results indicating low levels of tritium. All samples are screened to determine which ones may be analyzed by the enrichment method. Sample results are corrected for the background radioactivity in the laboratory. The first time samples are collected from a well, $^{89,90}Sr$, $^{238, 239+240}Pu$, and uranium isotopes are determined by radiochemistry. At least one of the cubitainers from each site is analyzed by gamma spectrometry. At this time, only sampling locations that are in position to show migration are selected for enrichment.

Water Analysis Results

Gamma-ray spectral analysis results indicated that no man-made gamma-emitting radionuclides were present in any onsite or offsite samples above the MDC. Long-term decreasing trends in tritium concentrations are evident for those locations that had detectable tritium activity at the beginning of the LTHMP, such as in the samples from the Baxterville City Well depicted in Figure 10 and Well HM-S shown in Figure 7. Due to the high rainfall in the area, the normal sampling procedure is modified for some of the onsite wells as stated below. The second samples may be representative of formation water, whereas the first samples may be more indicative of recent rainfall. Of the 55 locations sampled onsite, 34 sites sampled twice (pre-and post-pumping), 25 yielded tritium activities greater than the MDC in either the first or second sample. Of these, 16 yielded results higher than normal background (approximately 60 pCi/L [2.2 Bq/L]) as shown in Appendix B. The locations where the highest tritium activities were measured generally correspond to areas of known contamination. Decreasing trends are evident for the wells where high tritium activities have been found, such as Well HM-S depicted in Figure 7. No tritium concentrations above normal background values were detected in any offsite samples.

In 1998 an additional 14 shallow wells were added to the annual sampling, which range in depth of 195' to 2100', increasing the total wells sampled onsite to 55. Five of the previous locations regularly have tritium values above those expected in surface water samples; of the 14 new wells, tritium values were all below the MDC. The water in these wells is not accessible to the public, nor suitable for drinking due to its brackishness. Only five wells were above the MDC in the samples collected from the offsite sampling locations, tritium activity ranged from less than the MDC to 24 ± 3.4 pCi/L at the Ascot Well in Baxterville, 0.14 percent of the DCG.

These results do not exceed the natural tritium activity expected in rain water in this area.

Conclusions

No radioactive materials from the Salmon Test Site Area were detected in any water samples collected offsite. The highest tritium concentration found in water collected in the offsite area was 21 ± 3.4 pCi/L, which is typical of background tritium levels, and is 0.12 percent of the National Interim Primary Drinking Water Regulations (40CFR141).

The highest tritium concentration found onsite was 29,900 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 well below the 20,000 pCi/L level defined in the EPA Drinking Water Regulations (40CFR141).

Tritium concentrations of water samples collected onsite and offsite are consistent with those of past studies at the Salmon Site.

All samples were analyzed for presence of gamma-ray emitting radionuclides with the exception of HMH-1 though HMH-16 and the 15 shallow wells that were added to the LTHMP program in 1997. None were detected above the MDC (see Appendix B on page 16).

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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.

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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 (μCi) 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 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	Sn-113	8.32E+00
Be-7	4.56E+01	Sb-125	1.65E+01
K-40	4.92E+01	I-131	8.28E+00
Cr-51	5.88E+01	Ba-133	9.16E+00
Mn-54	4.55E+01	Cs-134	6.12E+00
Co-57	9.65E+00	Cs-137	6.43E+00
Co-58	4.71E+00	Ce-144	7.59E+01
Fe-59	1.07E+01	Eu-152	2.86E+01
Co-60	5.38E+00	Ra-226	1.58E+01
Zn-65	1.24E+01	U-235	1.01E+02
Nb-95	5.64E+00	Am-241	6.60E+01
Zr-95	9.06E+00		

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
TRITIUM RESULTS FOR WATER SAMPLES COLLECTED IN APRIL, 1998

Sample Location		Collection Date 1998	Enriched Tritium pCi/L ± 2 SD	(MDC)	Tritium pCi/L ± 2 SD	(MDC)	Comments	Gamma Spectrometry [b] (MDC)
Baxterville, MS								
Anderson, Billy Ray		4-22	11 ± 3.2	(4.9)				ND (5.0)
Anderson Pond		4-20	12 ± 3.3	(5.1)				ND (4.9)
Steve Cockerham		4-22				No sample - house empty		
Anderson, Robert Harvey		4-22			-38± 137[a]	(227)		ND (4.7)
O'Quinn, Jim		4-20			-76 ± 137[a]	(227)		ND (5.0)
Anderson, Robert Lowell, Jr.		4-22			-76 ± 137[a]	(227)		ND (4.8)
Anderson, Robert Lee		4-22			-76 ± 137[a]	(227)		ND (5.0)
Anderson, Tony		4-21			191 ± 141[a]	(227)		ND (4.7)
Burge, Joe		4-22			-76 ± 137[a]	(227)		ND (4.3)
Daniels, Webster, Jr.		4-21				No sample HUB water		
Daniels - Well #2 Fish Pond		4-21				No sample - pump inoperative		
Thompson, Mike		4-21	Hub water		-76 ± 137	(227)		ND (4.9)
Half Moon Creek	Pre	4-20	14 ± 3.6	(5.4)				ND (4.8)
	Post	4-21	15 ± 3.1	(4.7)				ND (4.8)
Half Moon Creek	Pre	4-20			115 ± 168[a]	(276)		ND (4.7)
Overflow	Post	4-21			87 ± 168[a]	(276)		ND (5.0)
Hibley, Billy		4-20			-76 ± 137[a]	(227)		ND (4.9)
Napier, Denice		4-20			38 ± 139[a]	(227)		ND (4.9)
Lee, Perry T., Jr.		4-20			-76 ± 137[a]	(227)		ND (4.8)

[a] Indicates results are less than MDC.

[b] No gamma radionuclides detected above MDC.

ND Non-detected. Value in parenthesis represents ^{137}Cs MDC (pCi/L).

APPENDIX B (Continued)
TRITIUM RESULTS FOR WATER SAMPLES COLLECTED IN APRIL, 1998

Sample Location	Collection Date 1998	Enriched Tritium pCi/L ± 2 SD (MDC)	Tritium pCi/L ± 2 SD (MDC)	Comments	Gamma Spectrometry [b] (MDC)
Baxterville, MS (Cont)					
Lower Little Creek #1	4-20		-38 ± 137[a] (227)		ND (5.0)
Lower Little Creek #2	4-20		38 ± 139[a] (227)		ND (5.0)
Mills, Roy	4-20		-153 ± 135[a] (227)		ND (4.8)
Nobles Pond	4-22		38 ± 139[a] (227)		ND (4.8)
Noble, Evelyn	4-22		-38 ± 137[a] (227)		ND (4.6)
Pond West of GZ Pre	4-20	13 ± 3.5 (5.4)			ND (4.7)
Post	4-21	12 ± 4.0 (6.2)			ND (4.6)
REECo Pit Drainage-A	4-21	11 ± 3.5 (5.3)			
REECo Pit Drainage-B	4-21	72 ± 4.1 (4.8)			
REECo Pit Drainage-C	4-21	70 ± 4.2 (4.9)			
REECo Pit Drainage-C Dup	4-21	344 ± 7.7 (6.2)			
Salt Dome Hunting Club	4-20			No Sample - moved	
Salt Dome Timber Co.	4-20			No Sample - business closed	
Saucier, Dennis	4-20		0.00 ± 138[a] (227)		ND (4.7)
Well Ascot 2	4-21	24 ± 3.4 (4.9)			ND (5.0)
Baxterville Well City	4-21	16 ± 3.7 (5.5)			ND (4.5)
Well E-7	4-21	-1.2 ± 2.8 [a] (4.7)			ND (4.7)
Well HM-1 Pre	4-20		-1.36 ± 166[a] (276)		ND (4.6)
1st 30 Min	4-20		-65 ± 167[a] (276)		ND (5.0)
2nd 30 Min	4-20		-76 ± 166[a] (276)		ND (4.9)
Post	4-20		57 ± 168[a] (276)		ND (5.0)

[a] Indicates results are less than MDC.

[b] No gamma radionuclides detected above MDC.

ND Non-detected. Value in parenthesis represents ^{137}Cs MDC (pCi/L).

APPENDIX B (Continued)
TRITIUM RESULTS FOR WATER SAMPLES COLLECTED IN APRIL, 1998

Sample Location		Collection Date 1998	Enriched Tritium pCi/L ± 2 SD (MDC)	Tritium pCi/L ± 2 SD (MDC)	Comments	Gamma Spectrometry [b] (MDC)
Baxterville, MS (cont.)						
Well HM-2A	Pre	4-20		-1.01 ± 166[a] (276)		ND (5.0)
	1st 30 Min	4-20		-46 ± 167[a] (276)		ND (5.0)
	2nd 30 Min	4-20		16 ± 167[a] (276)		ND (5.0)
	Post	4-20		-22 ± 167[a] (276)		ND (4.9)
Well HM-2B	Pre	4-20		35 ± 168[a] (276)		ND (4.7)
	1st 30 Min	4-20		-27 ± 167[a] (276)		ND (4.8)
	Post	4-20		-65 ± 167[a] (276)		ND (5.0)
Well HM-3	Pre	4-20	1.2 ± 2.9 [a] (4.7)			ND (5.0)
	1st 30 Min	4-20		-1.34 ± 141[a] (276)		ND (4.8)
	2nd 30 Min	4-20		-183 ± 165[a] (276)		ND (4.5)
	3rd 30 Min	4-20		-65 ± 167[a] (276)		ND (4.9)
	Post	4-20		-85 ± 166 [a] (276)		ND (4.9)
Well HM-L	Pre	4-20		966 ± 177 (276)		ND (5.0)
	1st 30 Min	4-20		617 ± 174 (276)		ND (4.9)
	2nd 30 Min	4-20		619 ± 174 (276)		ND (5.0)
	3rd 30 Min	4-20		772 ± 175 (276)		ND (5.0)
	4th 30 Min	4-20		649 ± 174 (276)		ND (4.4)
	Post	4-20		745 ± 175 (276)		ND (4.3)
Well HM-L2	Pre	4-21		-134 ± 166[a] (276)		ND (4.5)
	Post	4-21		-98 ± 166[a] (276)		ND (4.8)
Well HM-S	Pre	4-19		2450 ± 192 (276)		ND (4.8)
	Post	4-20		2530 ± 215 (317)		
Well HMH-1	Pre	4-19			Sample Lost in Lab	
	Post	4-20		892 ± 177 (276)		
Well HMH-2	Pre	4-19		-38 ± 137[a] (276)		
	Post	4-20		420 ± 172 (276)		
Well HMH-3	Pre	4-19		-38 ± 137[a] (227)		
	Post	4-20	22 ± 3.8 (5.5)			

[a] Indicates results are less than MDC.

[b] No gamma radionuclides detected above MDC.

ND Non-detected. Value in parenthesis represents ^{137}Cs MDC (pCi/L).

APPENDIX B (Continued)
TRITIUM RESULTS FOR WATER SAMPLES COLLECTED IN APRIL, 1998

Sample Location		Collection Date 1998	Enriched Tritium pCi/L ± 2 SD	(MDC)	Tritium pCi/L ± 2 SD	(MDC)	Comments	Gamma Spectrometry [b] (MDC)
Baxterville, MS (cont.)								
Well HMH-4	Pre	4-19	9.8 ± 3.0	(4.7)				
	Post	4-20					No Sample - well dry	
Well HMH-5	Pre	4-19			130 ± 160[a]	(227)		
	Post	4-20			1741 ± 185	(276)		
Well HMH-6	Pre	4-19	59 ± 4.3	(5.3)				
	Post	4-20						
Well HMH-7	Pre	4-20					No Sample:	
	Post	4-21					Well Underwater	
Well HMH-8	Pre	4-20					No Sample:	
	Post	4-21					Well Underwater	
Well HMH-9	Pre	4-20	29 ± 4.3	(6.1)				
	Post	4-21			57 ± 168[a]	(276)		
Well HMH-10	Pre	4-19			649 ± 149	(227)		
	Post	4-20			352 ± 171	(276)		
Well HMH-11	Pre	4-19			76 ± 139[a]	(227)		
	Post	4-20			-71 ± 166[a]	(276)		
Well HMH-12	Pre	4-19			-153 ± 135[a]	(227)		
	Post	4-20			-41 ± 167[a]	(276)		
Well HMH-13	Pre	4-19					Sample Lost in Lab	
	Post	4-20			-19 ± 167[a]	(276)		
Well HMH-14	Pre	4-19					No sample - well dry	
	Post	4-20					No sample - well dry	
Well HMH-15	Pre	4-19			-76 ± 137[a]	(227)		
	Post	4-20			-153 ± 166[a]	(276)		

[a] Indicates results are less than MDC.

[b] No gamma radionuclides detected above MDC.

ND Non-detected. Value in parenthesis represents ^{137}Cs MDC (pCi/L).

APPENDIX B (Continued)
TRITIUM RESULTS FOR WATER SAMPLES COLLECTED IN APRIL, 1998

Sample Location		Collection Date 1998	Enriched Tritium pCi/L ± 2 SD	(MDC)	Tritium pCi/L ± 2 SD	(MDC)	Comments	Gamma Spectrometry [b] (MDC)
Baxterville, MS (cont.)								
Well HMH-16	Pre	4-19	57 ± 4.3	(5.3)				
	Post	4-20	67 ± 4.3	(5.1)				
SA1-1H	Pre	4-19			29900 ± 447	(276)		
	Post	4-20			27500 ± 399	(227)		
SA1-2H	Pre	4-19			3820 ± 205	(276)		
	Post	4-20			3950 ± 206	(276)		
SA1-3H	Pre	4-19			1170 ± 180	(276)		
	Post	4-20			939 ± 177	(276)		
SA1-4H	Pre	4-19			267 ± 170[a]	(276)		
	Post	4-20			196 ± 169[a]	(276)		
SA1-5H	Pre	4-19			701 ± 175	(276)		
	Post	4-20			712 ± 175	(276)		
SA1-6H	Pre	4-19			41 ± 168[a]	(276)		
	Post	4-20			-68 ± 166[a]	(276)		
SA1-7H	Pre	4-19	33 ± 3.9	(5.4)				
	Post	4-20	30 ± 3.5	(4.8)				
SA1-8-L		4-22	1.6 ± 2.9[a]	(4.8)				ND (5.0)
SA1-9-2A		4-23	.09 ± 2.8[a]	(4.7)				ND (4.9)
SA1-10-2B		4-22	-2.4 ± 3.2[a]	(5.4)				ND (5.0)
SA1-11-3		4-22	-1.8 ± 3.0[a]	(5.0)				ND (5.0)
SA2-1-L		4-22	1.4 ± 3.0[a]	(4.9)				ND (4.8)
SA2-2-L		4-22	1.7 ± 3.2[a]	(5.1)				ND (5.0)

[a] Indicates results are less than MDC.

[b] No gamma radionuclides detected above MDC.

ND Non-detected. Value in parenthesis represents ^{137}Cs MDC (pCi/L).

APPENDIX B (Continued)
TRITIUM RESULTS FOR WATER SAMPLES COLLECTED IN APRIL, 1998

Sample Location		Collection Date 1998	Enriched Tritium pCi/L ± 2 SD	(MDC)	Tritium pCi/L ± 2 SD	(MDC)	Comments	Gamma Spectrometry [b] (MDC)	
Baxterville, MS (cont.)									
SA2-3-L		4-22	0.38 ± 3.0[a]	(4.9)				ND	(4.8)
SA2-4-L		4-22	0.09 ± 3.1[a]	(5.1)				ND	(5.1)
SA2-5-L		4-23	-1.3 ± 5.8[a]	(5.3)				ND	(4.8)
SA3-1M	Pre	4-19	10 ± 3.1	(4.7)					
	Post	4-20	7.4 ± 3.3	(5.2)					
SA3-3M	Pre	4-19	11 ± 3.0	(4.7)					
	Post	4-20	16 ± 3.1	(4.7)					
SA3-4H	Pre	4-19	20 ± 3.3	(4.7)					
	Post	4-20	21 ± 3.4	(4.9)					
SA3-8-1		4-23	-0.10 ± 3.2[a]	(5.3)				ND	(5.0)
SA3-10-2		4-22	-1.2 ± 3.5[a]	(5.9)				ND	(4.5)
SA3-11-3		4-23	0.43 ± 3.4[a]	(5.6)				ND	(4.9)
SA4-1M	Pre	4-19	1.7 ± 3.0[a]	(4.9)					
	Post	4-20	1.7 ± 3.0[a]	(4.9)					
SA5-1M	Pre	4-19	12 ± 3.1[a]	(4.6)					
	Post	4-20	9.9 ± 3.0	(4.7)					
SA5-2M	Pre	4-19	14 ± 3.5	(5.3)					
	Post	4-20	19 ± 3.3	(4.9)					
SA5-3M	Pre	4-19	7.2 ± 3.0	(4.7)					
	Post	4-20			65	± 167[a]	(276)		

[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)
TRITIUM RESULTS FOR WATER SAMPLES COLLECTED IN APRIL, 1998

Sample Location	Collection Date 1998	Enriched Tritium pCi/L ± 2 SD	(MDC)	Tritium pCi/L ± 2 SD	(MDC)	Comments	Gamma Spectrometry [b] (MDC)
Baxterville, MS (cont.)							
SA5-4-4	4-22	-0.54 ± 2.9 [a]	(4.7)				ND (5.0)
SA5-5-4	4-22	2.3 ± 2.9[a]	(4.7)				ND (4.7)
Well HT-2C	4-21	2.2 ± 2.9 [a]	(4.6)				ND (5.0)
Well HT-4	4-21	-0.81 ± 3.2 [a]	(5.3)				ND (4.6)
Well HT-5	4-24			-41 ± 167[a]	(276)		ND (5.0)
Columbia, MS							
Dennis, Buddy	4-21					No sample; HUB Water System*	
Dennis, Marvin	4-21					Did not want to participate	
Well 64B City	4-21			-38 ± 137 [a]	(6.3)		ND (5.0)
Lumberton, MS							
Anderson, Arleene	4-22			0.00 ± 138[a]	(227)		ND (4.8)
Anderson, Lee L.	4-20			114 ± 140[a]	(227)		ND (5.0)
Ron Boren	4-20			-38 ± 139[a]	(227)		ND (4.9)
Ron Boren Crawfish Pond	4-20			38 ± 139[a]	(227)		ND (5.0)
Hartfield, Ray	4-20			-38 ± 139[a]	(227)		ND (5.0)
Powell, Shannon	4-20			0.00 ± 122[a]	(202)		ND (4.2)
Ladner, Debra Rushing,	4-20					No sample; HUB Water System*	
Saul O/A	4-20					No sample; HUB Water System*	

[a] Indicates results are less than MDC.
[b] No gamma radionuclides detected above MDC.
ND Non-detected. Value in parenthesis represents ^{137}Cs MDC (pCi/L).
* Several of the old sampling locations are now on a community water system (HUB).

APPENDIX B (Continued)
TRITIUM RESULTS FOR WATER SAMPLES COLLECTED IN APRIL, 1998

Sample Location	Collection Date 1998	Enriched Tritium pCi/L ± 2 SD (MDC)	Tritium pCi/L ± 2 SD (MDC)	Comments	Gamma Spectrometry [b] (MDC)
Lumberton, MS (cont.)					
Smith, Howard Pond	4-20		38 ± 139[a] (227)		ND (4.9)
Thompson, Roswell	4-20		76 ± 139[a] (227)		ND (4.8)
Well 2 City	4-21		38 ± 139[a] (227)		ND (5.0)
Burge, Willie	4-22		38 ± 139[a] (227)		ND (5.0)
City Supply Purvis	4-21	-0.72 ± 2.8[a] (4.7)			ND (4.4)
Rain Sample IT Compound	4-22			No sample	

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