MISSISSIPPI STATE DEPARTMENT OF HEALTH

Preliminary Sample Analysis Results

Sampling for Tritium in Trees at the Salmon Test Site Lamar County, Mississippi

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1.0 Background

The State of Mississippi is acquiring surface ownership of the Atomic Energy Commission's (AEC) Salmon Test Site (STS), formerly the Tatum Salt Dome Test Site, located in Lamar County, Mississippi. The U.S. Department of Energy (DOE), as successor agency to AEC, will carry out the transfer of ownership under the authority of the 1997 National Defense Authorization Act, Public Law 104-201-Sept. 23, 1996, Section 2851, Land Conveyance, Tatum Salt Dome Test Site, Mississippi. The surface site will be named the Jamie Whitten Forest Management Area. The State of Mississippi intends to harvest trees from the site for commercial sale as part of the forest management plan for the site.

2.0 Purpose

The Mississippi Forestry Commission (MFC) has conducted extensive sampling for tritium in trees at the STS in preparation for the upcoming transfer of site ownership from DOE to the State of Mississippi. The Mississippi Forestry Commission sampled approximately 400 trees, including off site locations. This report presents the results of that sampling and analysis of tree cores. The analyte is total tritium in the wood. Discussion is provided to establish a perspective from which to judge the sample analysis results. This perspective includes understanding the reasons that some amount of tritium exists in the natural environment and therefore may be detected by the sample analyses.

3.0 Tritium in the Environment

Tritium is a radioactive isotope of hydrogen; it has the same chemical properties as hydrogen and has a half-life of 12.3 years. Tritium in the natural environment comes from two primary sources: (1) ongoing interactions of cosmic radiation with the earth's atmosphere, and (2) fallout from above-ground nuclear testing. The tritium is brought to the earth's surface by precipitation in the form of tritiated water. Atmospheric tritium concentration from radioactive fallout peaked in the early 1960s, and has since decayed off to much lower levels. However, it is still present in the atmosphere, and therefore brought to earth by precipitation along with the tritium formed by cosmic radiation interacting with the earth's atmosphere.

4.0 Sampling

The sampling was conducted in the last two weeks of March 2010. The MFC acquired approximately 360 samples from the site for analysis plus background samples from nearby offsite plots. The plan was to sample a random selection of trees for a statistical analysis of the tritium levels on the STS. The Mississippi Forestry Commission provided latitude and longitude coordinates, determined by a global positioning system (GPS), for each sampled tree. The Mississippi Forestry Commission also placed a blaze-orange number on each sampled tree. A

supplemental sampling was done on June 29, 2010 due to samples being consumed in an analysis run that failed its quality control.

5.0 Laboratory Analysis Methods

Sample analyses were conducted by the Plant & Soil Sciences Laboratory at Mississippi State University (MSU) in Starkville, MS. The analysis method analyzes the tritium content of the water contained in the wood sample, and the organically bound tritium contained in the wood pulp as a single analysis, but each core must be broken down into sections of less than 0.75 g. Therefore, for each sampled tree there are several reported analyses results; however, a summary report is generated that averages the results for each core.

The tritium analysis entailed oxidizing the chilled tree core, collecting the oxidation products, and then counting radioactive decay events in the collected oxidation products in a liquid scintillation counter for 30 minutes. These analysis results are reported in picocuries per gram (pCi/g) in Table 1.

6.0 Sample Analysis Results

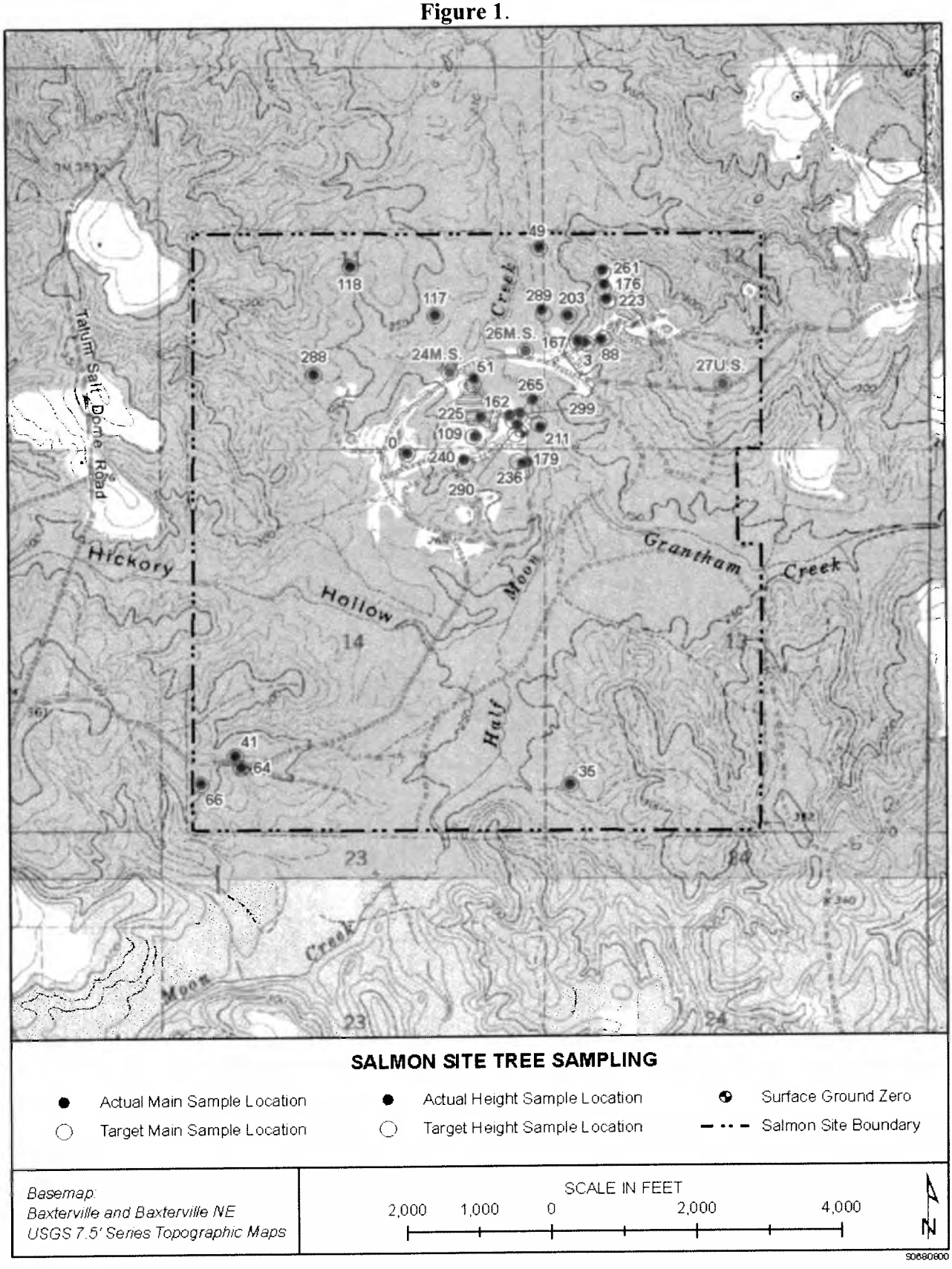
Sample analysis results are listed in Table 1 for samples analyzed through the end of June 2010. These samples include 18 trees that were considered priority samples, due to their being in areas that have been recorded as having contamination at some point in the past. It is believed that if any trees showed contamination, it would be one of these. See Figure 1 for locations.

The table lists the average of the core results from bark to center. Each sample run was bracketed by control cores of the same species, when possible, from offsite, and these were used as a background correction. The background is also a factor in the uncertainty and minimum detectable concentration (MDC). Additional control cores were spiked to ensure the quality of the data. The results of these spikes and their recovery are included in Table 1.

The reported concentrations for the analyses for all but one core section were very low, and were flagged with the laboratory qualifier "U" meaning the results were below the MDC. The MDC represents the concentration that the measurement system is expected to be capable of detecting, given the characteristics and capabilities of the measurement system components. The single result above the MDC was 5.91 ± 3.25 pCi/g on tree 290, Section 5 (of 6). That tree is right at ground zero and the result is still below any level of concern (the drinking water standard converts to roughly 20 pCi/g).

DOE has also performed a confirmatory sampling of the trees, consisting of approximately 10% of the trees sampled by the MFC. Several of those were the same as the priority trees. All DOE sample analysis results were below the MDC.

Figure 1.


SALMON SITE TREE SAMPLING
Actual Main Sample Location
Target Main Sample Location
Actual Height Sample Location
Target Height Sample Location
Surface Ground Zero
Salmon Site Boundary
Basemap:
Baxterville and Baxterville NE
USGS 7.5' Series Topographic Maps
SCALE IN FEET
2,000 1,000 0 2,000 4,000
N
Tatum Salt Dome Road
Hickory Hollow
Moon Creek
Grantham Creek
Half Moon Creek
26M.S.
24M.S.
27U.S.
49
118
117
289
203
261
176
223
167
3
88
288
51
265
162
225
299
109
211
0
240
179
236
290
41
64
66
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23
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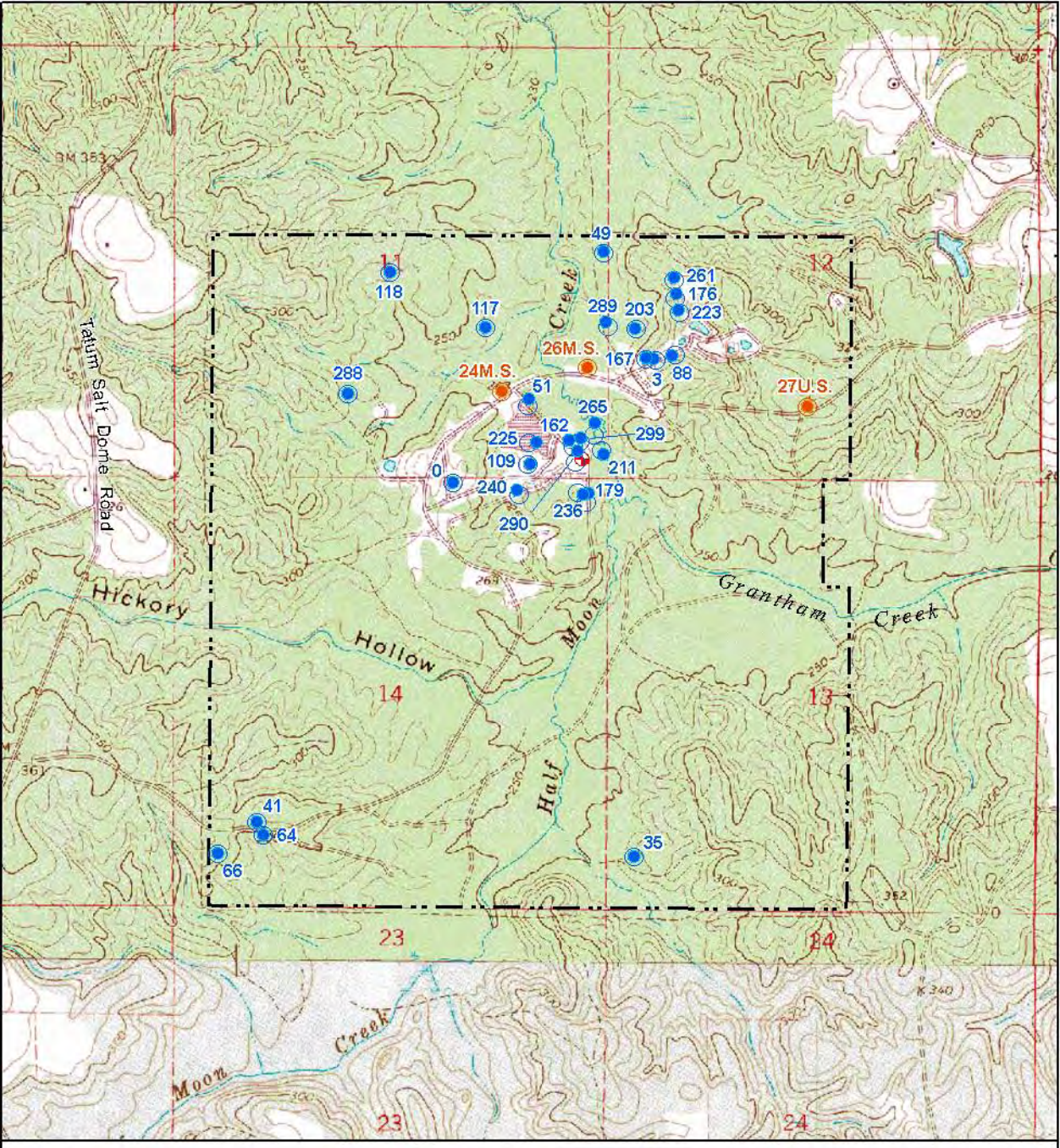

SALMON SITE TREE SAMPLING

- Actual Main Sample Location
- Target Main Sample Location
- Actual Height Sample Location
- Target Height Sample Location
- Surface Ground Zero
- Salmon Site Boundary

Basemap:
Baxterville and Baxterville NE
USGS 7.5' Series Topographic Maps

SCALE IN FEET
2,000 1,000 0 2,000 4,000

N

S0680800

7.0 Qualifiers

The quench curve used by the liquid scintillation counter was not generated using a NIST traceable source in the same cocktail being used in the capture of the oxidation products. However, recovery has been good over a range of quenches on the spikes, so it is believed that the data is good for most results; the exception being the mid stem sample from tree 26 (26 M.S.). The quench on three of the sections from this sample was clearly out of range of the current calibration, and therefore the average for that sample is only from four of the seven sections. It is the intent of MSU to acquire a NIST traceable quench calibration set and retroactively apply the new quench curve to samples already run.

8.0 Conclusions

As discussed in Section 3.0, tritium is present everywhere in precipitation in the natural environment. Additionally, at the Salmon Test Site, tritium has been detected in shallow groundwater and surface water near surface ground zero, as a result of drilling back into the cavity left by the Salmon and Sterling detonations. Consequently it was anticipated that tritium may be elevated above background in trees at the Salmon Test Site.

As part of the due diligence for the upcoming transfer of site ownership from DOE to the State of Mississippi, Mississippi State University developed a statistically based sampling plan to test for tritium in the trees at the site. The Mississippi Forestry Commission sampled approximately 400 trees for tritium, including off site locations. In support of the Mississippi Forestry Commission efforts, DOE conducted confirmatory sampling of approximately 10 percent of the trees sampled by the Mississippi Forestry Commission. At this time, analysis results from all the tree sampling conducted by the Mississippi Forestry Commission are not yet available. However, the sample analysis results to date are very encouraging. Tritium concentrations in the sampled trees at the Salmon site were too low to be quantified once averaged over the life of the tree (i.e. the core from bark to tree center).

It is the opinion of the Division of Radiological Health that the vast majority, if not all, of the trees at the STS are eligible for harvesting and marketing subject to the provisions of the letter (attached) from the Mississippi Radiation Advisory Council.

Table 1. Sample Analysis Results

Field ID[1]	Sample Type	Sampling Date	Analyte	Average Activity		2-sigma Average	MDC[3]	Units	Data Qualifiers[2]
C-60-3	High Spike	3/24/10	H-3	131.86	±	22.50	5.34	pCi/g	Recovery=99.6%
3	Sample	3/23/10	H-3	0.96	±	2.43	5.93	pCi/g	U
24 M.S.	Sample	3/23/10	H-3	0.54	±	2.83	7.07	pCi/g	U
27 U.S.	Sample	3/23/10	H-3	0.15	±	2.77	6.85	pCi/g	U
C-60-5	Low Spike	3/24/10	H-3	73.16	±	12.84	5.45	pCi/g	Recovery=103%
C-63-2	High Spike	3/24/10	H-3	167.40	±	28.47	7.13	pCi/g	Recovery=83.6%
49	Sample	3/23/10	H-3	0.60	±	2.23	4.36	pCi/g	U
167	Sample	3/23/10	H-3	-0.61	±	2.37	5.48	pCi/g	U
223	Sample	3/23/10	H-3	-0.46	±	2.43	5.92	pCi/g	U
C-63-4	Low Spike	3/24/10	H-3	50.40	±	9.13	4.71	pCi/g	Recovery=90%
C-62-2	High Spike	3/24/10	H-3	126.39	±	21.60	5.73	pCi/g	Recovery=94.6%
26 M.S.*	Sample	3/24/10	H-3	1.06	±	2.39	3.24	pCi/g	U
203	Sample	3/23/10	H-3	-0.87	±	2.27	5.98	pCi/g	U
289	Sample	3/23/10	H-3	-1.37	±	2.32	5.42	pCi/g	U
C-62-4	Low Spike	3/24/10	H-3	41.51	±	7.68	4.43	pCi/g	Recovery=92.1%
C-04-2	High Spike	3/24/10	H-3	203.03	±	34.38	7.02	pCi/g	Recovery=82.5%
C-04-3	High Spike	3/24/10	H-3	234.21	±	39.57	6.82	pCi/g	Recovery=95.9%
0	Sample	3/19/10	H-3	-1.06	±	2.49	7.87	pCi/g	U
C-04-5	Low Spike	3/24/10	H-3	95.57	±	16.50	5.51	pCi/g	Recovery=108.1%
C-04-6	Low Spike	3/24/10	H-3	90.47	±	15.67	5.59	pCi/g	Recovery=102.4%
C-57-6	High Spike	3/24/10	H-3	231.74	±	39.16	6.51	pCi/g	Recovery=100.4%
109	Sample	3/23/10	H-3	-1.66	±	2.93	7.19	pCi/g	U
162	Sample	3/23/10	H-3	-0.48	±	3.07	6.95	pCi/g	U
240	Sample	3/23/10	H-3	-1.71	±	3.20	8.37	pCi/g	U
C-64-2	Low Spike	3/24/10	H-3	90.18	±	15.64	5.82	pCi/g	Recovery=100%
C-46-2	High Spike	3/24/10	H-3	173.43	±	29.40	5.61	pCi/g	Recovery=88.6%

Field ID[1]	Sample Type	Sampling Date	Analyte	Average Activity		2-sigma	MDC[3]	Units	Data Qualifiers[2]
C-22-2	High Spike	3/24/10	H-3	228.66	±	38.65	6.79	pCi/g	Recovery=91.1%
64	Sample	3/17/10	H-3	-0.50	±	3.12	9.61	pCi/g	U
66	Sample	3/17/10	H-3	0.66	±	2.96	5.94	pCi/g	U
88	Sample	3/23/10	H-3	0.45	±	3.36	7.79	pCi/g	U
C-22-4	Low Spike	3/24/10	H-3	105.41	±	18.16	6.19	pCi/g	Recovery=102.4%
C-29-2	High Spike	3/24/10	H-3	176.17	±	29.83	4.87	pCi/g	Recovery=101.2%
179	Sample	3/23/10	H-3	1.04	±	3.26	7.93	pCi/g	U
179	Sample	3/23/10	H-3	1.10	±	3.21	10.35	pCi/g	U
265	Sample	3/23/10	H-3	1.16	±	3.27	8.17	pCi/g	U
C-29-4	Low Spike	3/24/10	H-3	123.68	±	21.19	7.17	pCi/g	Recovery=106.5%
C-23-2	High Spike	3/24/10	H-3	285.91	±	48.24	8.13	pCi/g	Recovery=91.5%
41	Sample	3/17/10	H-3	0.40	±	2.81	5.41	pCi/g	U
41	Sample	3/17/10	H-3	2.50	±	2.97	5.44	pCi/g	U
261	Sample	3/23/10	H-3	1.91	±	3.04	6.69	pCi/g	U
C-23-4	Low Spike	3/24/10	H-3	168.10	±	28.63	8.68	pCi/g	Recovery=109.8%
C-16-5	High Spike	3/24/10	H-3	217.60	±	36.79	6.51	pCi/g	Recovery=95.1%
51	Sample	3/23/10	H-3	-0.85	±	3.26	10.29	pCi/g	U
225	Sample	3/23/10	H-3	2.70	±	3.22	9.23	pCi/g	U
290	Sample	3/23/10	H-3	2.14	±	3.02	7.14	pCi/g	U
C-16-7	Low Spike	3/24/10	H-3	115.25	±	19.81	6.98	pCi/g	Recovery=105.7%
C-31-7	High Spike	3/24/10	H-3	130.93	±	22.27	4.24	pCi/g	Recovery=96.3%
35	Sample	3/24/10	H-3	0.14	±	3.20	7.34	pCi/g	U
118	Sample	3/19/10	H-3	-1.32	±	3.08	7.25	pCi/g	U
288	Sample	3/19/10	H-3	0.80	±	3.53	8.89	pCi/g	U
C-20-4	Low Spike	3/24/10	H-3	72.02	±	12.85	8.76	pCi/g	Recovery=138.1%

Field ID[1]	Sample Type	Sampling Date	Analyte	Average Activity		2-sigma	MDC[3]	Units	Data Qualifiers[2]
C-74-2	High Spike	3/24/10	H-3	158.02	±	26.79	4.62	pCi/g	Recovery=98%
109	Sample	6/29/10	H-3	0.60	±	3.41	9.31	pCi/g	U
236	Sample	6/29/10	H-3	2.77	±	3.13	6.89	pCi/g	U
299	Sample	6/29/10	H-3	-2.31	±	2.80	6.43	pCi/g	U
C-74-4	Low Spike	3/24/10	H-3	94.11	±	16.23	5.07	pCi/g	Recovery=117.1%
C-31-2	High Spike	3/24/10	H-3	195.74	±	33.12	5.49	pCi/g	Recovery=92.7%
117	Sample	6/29/10	H-3	-0.20	±	3.04	6.08	pCi/g	U
176	Sample	6/29/10	H-3	-0.60	±	2.88	5.75	pCi/g	U
211	Sample	6/29/10	H-3	-0.03	±	3.08	6.11	pCi/g	U
C-31-4	Low Spike	3/24/10	H-3	105.98	±	18.25	6.13	pCi/g	Recovery=100.8%

*3 of 7 sections not used due to the quench being out of range.

[1]Sample location identifier assigned by the MSU forestry department and the MFC.

[2]Result flag. U means the analytical result was below the MDC.

[3]Minimum detectable concentration. The concentration that the measurement system employed by the lab would be expected to detect based on the characteristics and capabilities of all components and aspects of the measurement system combined. Because the sections of the core were of different weights this is the maximum MDC of the individual sections.