

Hill, Carol

From: Hammond, Michelle
Sent: Wednesday, April 20, 2016 12:12 PM
To: Hill, Carol
Cc: Campbell, Vivian
Subject: FW: UAF LARS Site Characterization Survey
Attachments: NRC LARS cover letter.pdf; LARS status survey.pdf; LARS Survey Maps.pdf; Soil and water analysis raw data.pdf; Summary of 3H tissue data.pdf; Summary of 14C tissue data.pdf

Please set up this amendment with attachments. We will be drafting a memo to transfer this action to Decommission Branch, as discussed.

Thanks.
Michelle M. Hammond

From: Tracey Martinson [mailto:tamartinson@alaska.edu]
Sent: Tuesday, April 12, 2016 7:51 PM
To: Hammond, Michelle <Michelle.Hammond@nrc.gov>
Subject: [External_Sender] UAF LARS Site Characterization Survey

PUBLIC

☐ Immediate Release
☒ Normal Release

NON-PUBLIC

☐ A.3 Sensitive-Security Related
☐ A.7 Sensitive Internal
☐ Other: _____

Reviewer: mt

Date: 4/22/16

Dear Ms. Hammond,

Please find attached a site characterization survey for the University of Alaska Fairbanks' Large Animal Research Station (LARS), along with supporting documentation.

Sincerely,
Tracey Martinson, RSO

On Fri, Feb 20, 2015 at 1:58 PM, Tracey Martinson <tamartinson@alaska.edu> wrote:

Dear Ms. Hammond,

Per our phone conversation this morning, please find attached a letter outlining our response to your February 6th email.

Sincerely,

Tracey Martinson, RSO

Tracey Martinson, Ph.D., C-OHC
Industrial Hygienist/Radiation Safety Officer
Environmental Health, Safety, & Risk Management
University of Alaska Fairbanks
1855 Marika Road
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April 12, 2016

Michelle Hammond
Nuclear Materials Licensing Section
U.S. Nuclear Regulatory Commission, Region IV
1600 E. Lamar Blvd.
Arlington, TX 76011-4511

Dear Ms. Hammond,

In response to your request dated February 6, 2015, please find attached a Site Characterization Survey for the Large Animal Research Station at the University of Alaska Fairbanks. Our license number is 50-02430-07, the docket number is 030-01179, and the control number is 585635.

Sincerely,

A handwritten signature in black ink that reads 'Tracey A. Martinson'.

Tracey A. Martinson, Ph.D.
Radiation Safety Officer
(907) 474-6771

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590694

LARS Site Characterization Survey

Executive Summary

The University of Alaska Fairbanks (UAF) has conducted studies on the physiology of reindeer, caribou, and muskoxen using radioisotopes since 1980. At this time, UAF has ceased the use of radioisotopes at the Large Animal Research Station (LARS) and is decommissioning the facility. UAF would like to consolidate their large animal operations by moving animal herds from other sites to LARS. At the conclusion of research studies, the UAF administration would like to have the option of selling some animals for human consumption.

From 1980-2012, a total of 128 mCi of ^{14}C and a total of 1.877 Ci of ^3H have been released at the site. In addition, 12 mCi of short-lived radioisotopes (^{51}Cr , ^{75}Se , ^{103}Ru , ^{125}I , ^{35}S , ^{141}Ce , and ^{46}Sc) were released in the early 1980s. All of the short-lived isotopes have decayed through at least 10 half-lives. Thus, the radioisotopes of concern are ^{14}C and ^3H . The derived concentration guideline levels (DCGL) were set at 30 pCi per gram for ^{14}C , and at 100 pCi per gram for ^3H . The null hypotheses were that the residual ^{14}C and ^3H activity exceeded the DCGLs. For decommissioning, water, soil, and tissue samples were analyzed for ^{14}C and ^3H .

Two water samples were collected from a seasonal melt water pond at LARS and compared with two water samples taken from another seasonal melt water pond located ~1.5 miles from LARS. The melt water pond is the only source of surface water at LARS. The null hypothesis was rejected ($\alpha = 0.001$) for both ^3H and ^{14}C . All of the samples were below the detection limit for the analytical method.

A total of 90 soil samples were collected in 11 survey units and analyzed for ^{14}C and ^3H . Results were analyzed using the Wilcoxon Rank Sum test. The null hypotheses were rejected for 9 of the 11 survey units for ^{14}C ($\alpha = 0.001$ -0.01), and for all 11 of the survey units for ^3H ($\alpha = 0.001$). Two of the survey units had two sample locations that exceeded the DGCL for ^{14}C , but none of these were in excess of the DCGL_{EMC} ($\text{DCGL} + 2\sigma$).

To address the potential for an increased dose to humans due to consumption of animals raised at LARS, we collected and analyzed a total of 80 tissue samples from animals that had been living at LARS for 3 months to 8 years. These included muscle, liver, kidney, heart, fat, and bone/marrow. The null hypotheses were rejected for all tissues for both ^{14}C ($\alpha = 0.001$) and ^3H ($\alpha = 0.001$ -0.05). We concluded that the animals grazing at LARS are not accumulating ^{14}C or ^3H from foraging at LARS, and that there would be no increased dose to humans due to consumption of these animals.

UAF respectfully requests that the LARS site be released for unrestricted use based on this site characterization survey.

Site Characterization Survey

Site Operating History

The University of Alaska Fairbanks (UAF) byproduct license NRC 50-02430-07 allows for the use of radiotracers at the Large Animal Research Station (LARS). The specific applications have included radiotracer methodologies for evaluating body composition, body water turnover, milk production and metabolism. These methods used tritiated water as the radiotracer, while other applications utilized ^{14}C -labeled nutrients for determining the metabolism of those nutrients. The experimental animals were reindeer/caribou (*Rangifer tarandus*) and muskoxen (*Ovibos moschatus*). These animals were and are permanent experimental animals that are owned by UAF.

In 1980, the site was the location of one land burial of radioisotopes. This burial included materials containing ^3H , ^{14}C , ^{75}Se , ^{51}Cr , ^{103}Ru , ^{125}I , ^{35}S , ^{141}Ce , and ^{46}Sc . The burial occurred in an ice lens located on the southwest edge of the property, in an area that is not currently used for animals. These materials and their activities are summarized in Table 1 (see below).

Radioisotope use at LARS ceased in 2012. At this time, no further use of radioisotopes is planned for the site. UAF would like to consolidate its animal facilities and move all large research animals to LARS. This would entail moving the current reindeer herd from the UAF Experimental Farm to LARS. These reindeer are used for husbandry studies and for research on meat production. Such research includes taste tests by panels. UAF would also like the ability to sell the reindeer meat to the general public at the conclusion of a given study.

Radionuclides of concern

The historical usage of radioisotopes (both experimental releases and burials) is summarized in Table 1. The two long-lived isotopes were ^{14}C and ^3H , while the short-lived isotopes included ^{75}Se , ^{51}Cr , ^{103}Ru , ^{125}I , ^{35}S , ^{141}Ce , and ^{46}Sc .

Table 1. Summary of radioisotopes used at LARS from 1980-2012.

Isotope	Experiments (μCi)	Burials (μCi)	Total (μCi)	Adjusted for decay (μCi)
^{14}C	118,146	10,000	128,146	N/A
^3H	1,846,712	30,000	1,876,712	399,470
^{75}Se		100	100	3.07×10^{-31}
^{51}Cr	4,500	50	4,550	6.84×10^{-124}
^{103}Ru	5,600	50	5,650	1.24×10^{-86}
^{125}I		100	100	2.79×10^{-64}
^{35}S		500	500	1.57×10^{-42}
^{141}Ce	500		500	5.59×10^{-109}
^{46}Sc	600		600	5.51×10^{-41}

Table 1 shows that all of the short-lived isotopes have passed through at least 10 half-lives and should therefore be essentially non-existent in the soils. Thus, the two radionuclides of concern are ^3H and ^{14}C .

Residual Radioactivity Limits (DCGLs)

The derived concentration guideline levels used in this Site Characterization/Final Status Survey were obtained from 10 CFR 20 Appendix B. For ^{14}C , the target concentration is $3 \times 10^{-5} \mu\text{Ci}$ (30 pCi) per gram of soil or milliliter of water (Appendix B, Table 2, Column 2). For ^3H , the target concentration is $1 \times 10^{-3} \mu\text{Ci}$ (100 pCi) per g of soil or milliliter of water (Appendix B, Table 2, Column 2). Since some areas could be expected to exceed the DCGL (especially for ^{14}C), a DGCL_{EMC} was established at the mean plus two standard deviations.

Classification of areas

LARS encompasses a total area of approximately 151 acres (61 hectares). A site map of LARS is provided in Figure 1.

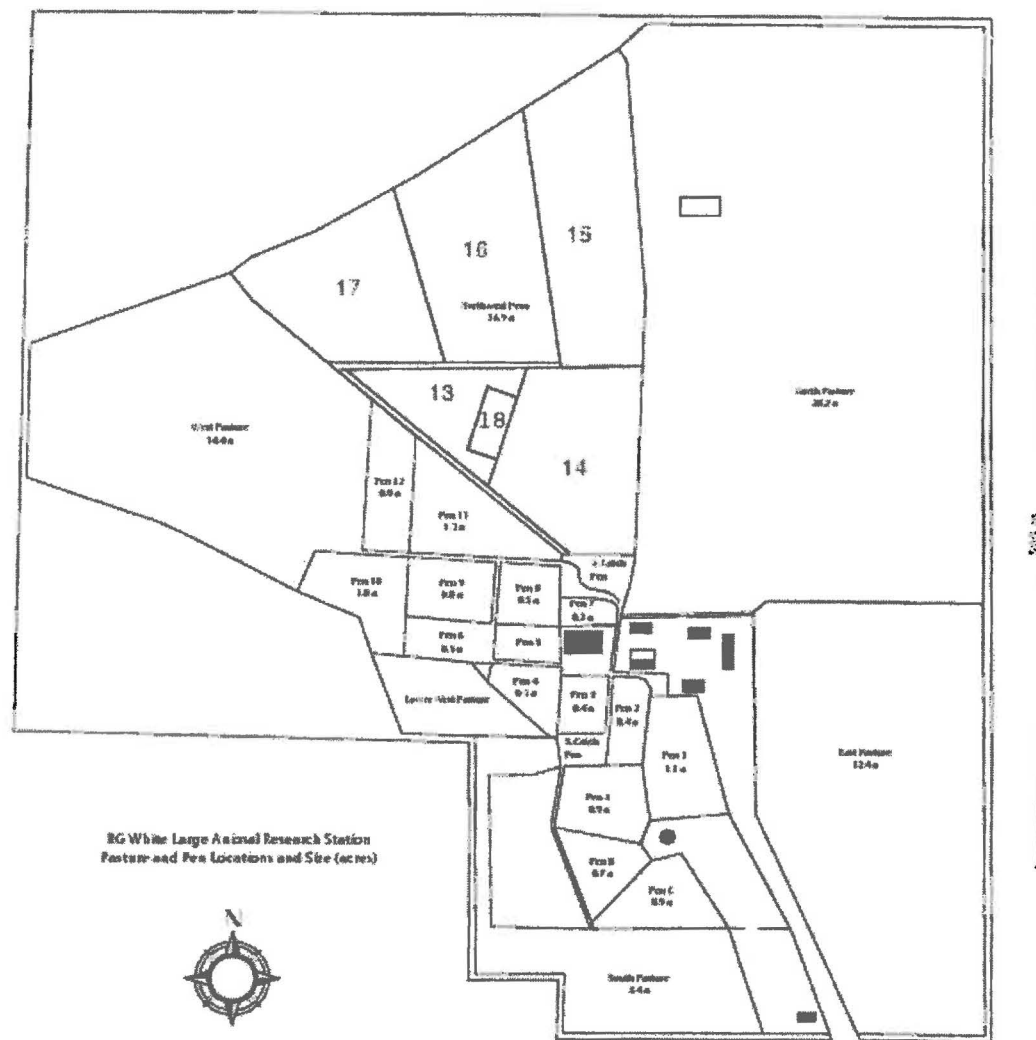


Figure 1. Site map of LARS.

Based on historical use records, animals were dosed in the barns (large dark rectangle and black/white rectangle on map) and held for 24-48 hours outside in the adjacent areas. After the initial sample collection period, they were released to pens 1 through 9, depending on availability and suitability of the pen. Ultimately, they may have been moved to a more distant pen, such as 15, 16, or 17. Based on this information, the areas immediately surrounding the barns were identified as class 1 areas, as they were the most likely to show any residual contamination. Pens 1-9 were also initially classified as class 1 areas, while Pens 15-17 were identified as class 2 areas.

Survey units

For soil sampling efforts, areas surrounding the barns were chosen, as well as two representative pens near the barns (Pen 3 and Pen 5). In addition, Pens 15-17 were sampled. Water samples were taken from the only source of surface water on the site: a seasonal melt pond that forms in the late spring at the southeast corner of the property (in the East Pasture). This location was considered to be a Class 2 area.

Summary of methods used for screening for ^{14}C and ^3H contamination at LARS

For soil samples, a core of 6-12" was taken. In areas where the surface was primarily loose gravel and soil (areas surrounding the barns), soil was collected by digging 4-6". Rocks and gravel were sifted out by hand. Clean Nalgene bottles were used to collect surface water from the meltwater pond and from the reference meltwater pond. Samples were refrigerated until sent to the Oak Ridge Associated Universities laboratory for analysis.

Select representative reference areas

Since both ^{14}C and ^3H are present in background, reference areas were chosen from which to collect samples. For soil, four reference areas were chosen, all just outside the confines of the LARS site. One was taken at the northeast corner of the property, and a second one was taken half-way down the eastern fence line. A third one was taken from the southeast corner of the fence, and a fourth was taken along the southern fence line, about midway between the eastern and western ends. For water, two water samples were collected from a seasonal meltwater pond at a location approximately 1.5 miles away from the LARS site.

Survey design

Since no soil concentration data were available at the time of sampling, sampling locations were chosen by examining the elevation and general topography of the pen or area. An estimate was made of the number of samples that would adequately cover the area and then sampling locations were distributed over the area at random. The number of samples needed were confirmed later using the Wilcoxon Rank Sum test (see Summary of Screening Results, below). A brief description of the sampling strategy for each pen/area is provided here. Maps of each pen are provided in Appendix A, and the locations of soil samples are indicated on each map.

Pen 5 (Sheet 1)

This pen is 96' x 159' 9" in size, and at the time of sampling, had nine smaller fence sections distributed in it (see Sheet 1 of the maps; Appendix A). Samples 1-4 were located in areas where feed and water troughs had historically been sited. The rationale was that the

animals would spend a fair amount of time here, and could release residual 14C and/or 3H in those locations. Additional samples were taken in random locations over the remainder of the pen.

Barn pad (Sheet 2)

The barn pad is located on the south side of the main barn, and is approximately 88' long and 33' wide. The surface is covered with rocks and gravel, with some fine soil mixed in. The entire area slopes down toward the south, and the barn has a steeply pitched roof. All precipitation pours off the roof and runs down to the bottom of the pad. Thus, sampling locations were selected along the southern fence line (fence shared with Pen 3).

West barn site (Sheet 3)

The pad on the west side of the main barn is irregularly shaped, and is approximately 80' long and from 16' to 30' wide. The surface is dirt and gravel and flat. Sample locations were distributed over the area with an emphasis on where animals would be most likely to spend time.

Pen 3 (Sheet 4)

Pen 3 is located immediately south of the Barn pad (Sheet 2), and is 130' long by 88' wide. The field had been plowed a few weeks prior to sampling, and the area slopes downward to the south. Samples were collected in 6 locations, beginning across the lower end of the pen (samples 1-3) and then from 3 locations distributed across the middle of the field.

Behind barn, North East side (Sheet 5)

The area behind the barn (the easternmost pen on the north side of the barn) is approximately 18' 9" wide by 38' 6" long. There are five tether points on the northern wall of the enclosure. Samples were collected near the tether points, as these are the locations where dosed animals would have been tethered for sample collection. The ground cover here consists of soil and rocks, and is level.

Behind barn, North West side (Sheet 6)

The area behind the barn (the westernmost pen on the north side of the barn) is approximately 16' 10" wide and 17' 9" long. There are three tether points along the north wall. Samples were collected near the tether points, as these are the locations where dosed animals would have been standing during the early stages of sample collection. The ground cover consists of soil and rocks, and is level.

Behind barn, West side (Sheet 7)

The area immediately to the west of the barn is irregular in shape, but is approximately 8' 6" wide and approximately 19' long at its widest point. There are two tethers on the north wall. Samples were collected near these tether points. The ground cover consists of soil and rocks, and is level.

Pen 17 (Sheet 8)

Pen 17 is located in the northwest corner of the LARS site and is partially wooded. It is uphill from the main buildings on the farm. It is irregular in shape, but is approximately 477' by 294' in size. The general tendency is for the land to slope to the south. Samples were collected

primarily in the open, grassy areas where animals usually congregate. The soils were relatively free of rocks.

Small barn site (Sheet 9)

The pen behind the small barn was historically used for some dosing studies. It is 80' 4" long and between 21' 5" and 40' 5" wide. There are a total of six tethers on the north side of the pen, and three on the west side. The ground cover consisted of rocky soil. Samples were collected in the vicinity of the tethers, and at one location near the entrance to the barn.

Pen 16 (Sheet 10)

Pen 16 is located uphill from the main buildings on the LARS site and is approximately 222' wide and about 527' long. Trees cover about two-thirds of the pen and the remainder is grassy. The underlying soil is relatively free of rocks. Samples were collected across the grassy areas in a grid pattern beginning at the southern fence line. Some samples were taken in the treed area as there is evidence that animals occasionally enter that area to seek shade.

Pen 15 (Sheet 11)

Pen 15 is located uphill from the main buildings at LARS and ranges from about 186' to 253' wide. It ranges from about 694' to 823' in length. About two-thirds of the pen are tree-covered, and the remainder is grassy. The underlying soil is relatively free of rocks. Samples were collected in a grid across the pen, with an emphasis on the grassy areas where the animals could be expected to congregate the most.

Summary of screening results

Results of soil analysis

Soil samples were sent to the Oak Ridge Associated Universities laboratory for analysis of ^3H and ^{14}C by liquid scintillation counting. Results were analyzed using the Wilcoxon Rank Sum test. The null hypotheses were that the residual ^3H and ^{14}C in the survey area exceeded the derived concentration guideline (DCGL). For ^3H , the DCGL was set at 100 pCi per gram. For ^{14}C , the DCGL was set at 30 pCi per gram. Results are shown in Table 2.

Table 2. Wilcoxon Rank Sum Test results for soils.

Survey area	Isotope	# samples	# reference samples	W_r	Critical value	Alpha	Reject H_0 ?
Pen 5	^3H	9	4	46	46	0.001	Yes
	^{14}C	9	4	43	42	0.01	Yes
Barn Pad	^3H	5	4	30	30	0.001	Yes
	^{14}C	5	4	22	25	0.1	No
West barn	^3H	5	4	30	30	0.001	Yes
	^{14}C	5	4	30	30	0.001	Yes
Pen 3	^3H	6	4	34	34	0.001	Yes
	^{14}C	6	4	28	28	0.1	No
Behind barn, NE side	^3H	5	4	30	30	0.001	Yes
	^{14}C	5	4	30	30	0.001	Yes
NW Barn Pen	^3H	3	4	22	22	0.001	Yes
	^{14}C	3	4	22	22	0.001	Yes
Behind barn, W side	^3H	5	4	30	30	0.001	Yes
	^{14}C	5	4	30	30	0.001	Yes
Pen 17	^3H	8	4	42	42	0.001	Yes
	^{14}C	8	4	42	42	0.001	Yes
Small Barn	^3H	11	4	54	53	0.001	Yes
	^{14}C	11	4	50	49	0.01	Yes
Pen 16	^3H	12	4	58	57	0.001	Yes
	^{14}C	12	4	58	57	0.001	Yes
Pen 15	^3H	21	4	94	86	0.001	Yes
	^{14}C	21	4	94	86	0.001	Yes

In all but two survey areas, the W_r values exceeded the critical value, thus allowing us to reject the null hypothesis at alpha levels ranging from 0.001 to 0.01, for both ^{14}C and ^3H . The two survey areas that did not meet the criteria for ^{14}C were Pen 3 and the Barn pad. This was due to isolated areas with ^{14}C concentrations that were higher than the DCGL. However, the four samples with elevated concentrations did not exceed the DGCL_{EMC} ($\text{DCGL} + 2\sigma$). These results are summarized in Table 3.

Table 3. Comparison of soil ^{14}C values with the DCGL_{EMC} .

Survey unit	Sample #	^{14}C (pCi/gram)	Exceed DCGL (30 pCi/gram)?	Mean ^{14}C (pCi/gram)	Standard deviation (pCi/gram)	DCGL_{EMC} (pCi/gram)	Exceed DGCL_{EMC} ?
Pen 3	1	25.4	No	28.42	19.92	69.84	No
	2	66.4	Yes				No
	3	30.4	Yes				No
	4	22.6	No				No
	5	10.6	No				No
	6	15.1	No				No
Barn Pad	1	41.7	Yes	28.72	18.23	65.18	No
	2	25.8	No				No
	3	49.2	Yes				No
	4	1.9	No				No
	5	25	No				No

Verification of sample size needed for survey areas

Since no data were available prior to soil sampling, verification of the necessary sample size had to be done after the soil samples were analyzed and an estimate of the variability was available. The results are summarized in Table 4.

Table 4. Determination of sample sizes needed for analysis.

Site classification	Parameter	³ H	¹⁴ C
Class 1	Average (pCi/gram)	7.72	13.62
	Standard deviation, σ (pCi/gram)	7.94	14.45
	DCGL _w (pCi/gram)	100	30
	LBGR (pCi/gram)	50	15
	Delta (pCi/gram)	50	15
	Relative shift (Delta/ σ)	6.29	1.04
	N/2 (from MARSSIM Table 5.3)	9	32
	# samples collected, including reference samples (N)	49	49
Class 2	Average (pCi/gram)	2.92	0.17
	Standard deviation, σ (pCi/gram)	2.69	3.7
	DCGL _w (pCi/gram)	100	30
	LBGR (pCi/gram)	50	15
	Delta (pCi/gram)	50	15
	Relative shift (Delta/ σ)	18.56	4.06
	N/2 (from MARSSIM Table 5.3)	9	9
	# samples collected, including reference samples (N)	45	45

These data show that there were sufficient numbers of soil samples collected from the representative survey areas.

Results of water analysis

Water samples were sent to the Oak Ridge Associated Universities laboratory for analysis of ³H and ¹⁴C by liquid scintillation counting. Results were analyzed using the Wilcoxon Rank Sum test. The null hypotheses were that the residual ³H and ¹⁴C in the water exceeded the derived concentration guideline (DCGL). For ³H, the DCGL was set at 100 pCi per gram. For ¹⁴C, the DCGL was set at 30 pCi per gram. Results are shown in Table 5.

Table 5. Wilcoxon Rank Sum test results for water samples.

Survey area	Isotope	# samples	# reference samples	W _r	Critical value	Alpha	Reject H ₀ ?
Melt pond in SE corner	³ H	2	2	7	7	0.001	Yes
	¹⁴ C	2	2	7	7	0.001	Yes

An estimate was made of the required sample size for water samples. The results are shown in Table 6.

Table 6. Sample size determination for the Wilcoxon Rank Sum test for water samples.

Site classification	Parameter	^3H	^{14}C
Class 2	Average (pCi/gram)	-80.5	6
	Standard deviation, σ (pCi/gram)	30.4	1.4
	DCGL _w (pCi/gram)	100	30
	LBGR (pCi/gram)	50	15
	Delta (pCi/gram)	50	15
	Relative shift (Delta/ σ)	1.64	10.6
	N/2 (from MARSSIM Table 5.3)	16	9
	# samples collected, including reference samples (N)	4	4

These results indicate that the number of water samples analyzed were not sufficient for the test. There were no additional sources of surface water on the site, however.

Additional analyses

Given the small sample size for the water samples, and the isolated areas of elevated ^{14}C soil concentrations in Pen 3 and the Barn Pad, we looked for other ways to assess the probability of increased exposure to humans due to consumption of animals raised at LARS. This is currently not permitted by the conditions of our license, however, the UAF administration would like to consolidate all of their large animal operations to LARS and to be able to sell some for human consumption. Therefore, we opted to assess tissue concentrations of tritium and ^{14}C for animals that had been living and grazing at LARS.

Animal tissue analyses

Animal tissues were collected from LARS animals who were culled for various reasons. These animals had been living at LARS for 3 months to nearly 8 years, depending on the age of the animals. During their time at LARS, they had been rotated through a variety of pens and barn areas. All types of tissue that could reasonably be expected to be consumed by a human were collected. These included muscle, liver, kidney, heart, fat, and bone/bone marrow.

Tissues were digested using Solvable (Perkin Elmer) according to standard protocols published by Perkin Elmer. These protocols were also used for tissues that did not have a published analytical protocol (e.g., fat, bone marrow). Samples with excessive amounts of color (i.e., liver) were decolorized using 35% hydrogen peroxide. Samples were analyzed by liquid scintillation counting here at the University of Alaska Fairbanks. The results were analyzed using the Wilcoxon Rank Sum test. The null hypotheses were that the residual ^3H and ^{14}C in the tissues exceeded the derived concentration guideline (DCGL). For ^3H , the DCGL was set at 100 pCi per gram. For ^{14}C , the DCGL was set at 30 pCi per gram. Results are shown in Table 7.

Table 7. Wilcoxon Rank Sum test for tissues harvested from animals at LARS.

Tissue type	Isotope	# samples	# reference samples	W _r	Critical value	Alpha	Reject H ₀ ?
Muscle	³ H	12	4	55	54	0.005	Yes
	¹⁴ C	12	4	58	57	0.001	Yes
Liver	³ H	12	3	36	36	0.05	Yes
	¹⁴ C	12	3	42	42	0.001	Yes
Kidney	³ H	12	3	41	40	0.005	Yes
	¹⁴ C	12	3	42	42	0.001	Yes
Heart	³ H	12	4	58	57	0.001	Yes
	¹⁴ C	12	4	58	57	0.001	Yes
Fat	³ H	20	2	42	42	0.025	Yes
	¹⁴ C	20	2	43	43	0.001	Yes
Bone marrow	³ H	12	2	26	25	0.025	Yes
	¹⁴ C	12	2	27	27	0.001	Yes

Verification of sample size needed for tissue analysis

For tissue analysis, the DCGL was set at 30 pCi/gram for ¹⁴C and 100 pCi/gram for ³H. The LBGR values were set at half of the DCGL, and therefore the values of delta were 15 pCi per gram and 50 pCi per gram, for ¹⁴C and ³H, respectively. The results are summarized in Table 8.

Table 8. Determination of sample size required for Wilcoxon Rank Sum test for animal tissues.

Isotope	Tissue	Average (pCi/g)	Std deviation (pCi/g)	LBGR (pCi/g)	Delta (pCi/g)	Relative shift	N/2 (from MARSSIM Table 5.3)	N
³ H	Muscle	56.4	34.5	50	50	1.5	18	16
	Liver	79.1	67.7	50	50	0.74	61	15
	Kidney	34.6	30.1	50	50	1.7	15	15
	Heart	33.7	22.3	50	50	2.2	11	16
	Fat	25.6	27.0	50	50	1.85	14	22
	Bone/marrow	52.3	31.3	50	50	1.6	16	14
	All tissues	44.1	17.7	50	50	2.8	10	96
¹⁴ C	Muscle	1.5	1.9	15	15	7.8	9	16
	Liver	1.2	6.7	15	15	2.2	11	15
	Kidney	0.53	4.1	15	15	3.6	9	15
	Heart	0.45	3.0	15	15	5.0	9	16
	Fat	2.2	4.6	15	15	3.24	10	22
	Bone/marrow	0.6	5.1	15	15	2.9	10	14
	All tissues	0.65	2.8	15	15	5.3	9	96

These data show that there were sufficient numbers of tissue samples analyzed for ¹⁴C, which is the isotope of primary concern because of three areas of elevated soil ¹⁴C measurements in Pen 3 and the Barn Pad (Table 2). The results for tritium were more variable due to interferences from sample color and/or chemiluminescence. None of the tissue samples were over the DCGL of 100 pCi per gram, however, the variability in sample measurements increased the number of required samples above that which we were able to obtain and/or analyze thus far. When all types of tissue are assessed together, the analyses indicate that 32 samples are needed for ³H and nine for ¹⁴C. Altogether, a total of 96 tissue samples were analyzed from a total of 12 LARS animals and five controls (two wild caribou, a non-LARS reindeer, locally-raised pork, and commercially-available chicken).

Given that the soil tritium concentrations were not elevated above the DCGL_w, we do not feel that there is a risk that animals grazing at LARS would ingest forage containing tritium in excess of the DCGL_w, and therefore there is no risk of excess radiation exposure to humans from the consumption of meat or other organs from animals raised at LARS.

Summary of quality assurance program

Quality assurance of the Radiation Safety Program at UAF is provided by the RSO. The organization of the Radiation Safety Program at UAF is shown in Figure 2.

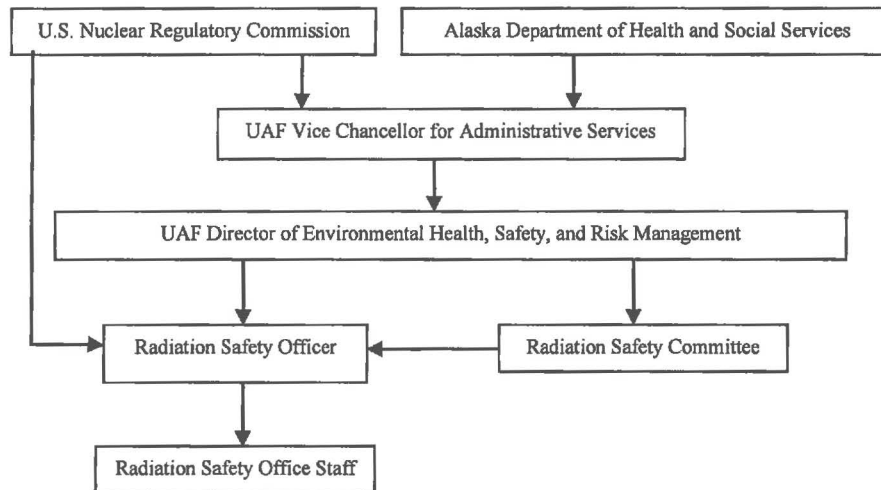


Fig. 2. Organizational chart of the Radiation Safety Program at UAF.

The U.S. NRC and Alaska Department of Health and Social Services are the regulatory agencies directly involved in radiation safety at UAF. As a non-agreement state, the role of the Alaska Department of Health and Social Services at UAF primarily involves registration of x-ray sources. The Director of UAF Environmental Health, Safety, and Risk Management (EHSRM) is responsible for appointing and evaluating the RSO, appoints members of the Radiation Safety Committee, and serves as chair of the Radiation Safety Committee. The Director of EHSRM reports directly to the Vice Chancellor for Administrative Services. The RSO is responsible for the day-to-day management of the radiation safety program at UAF and is responsible for communicating directly to the NRC. The RSO is assisted by the Radiation Safety Office staff, which currently consists of an Environmental Compliance Officer. For purposes of this decommissioning work, the RSO was responsible for collection of all soil and water samples, and analysis of tissue samples. Tissue samples were collected by UAF Animal Resources Center staff and analyzed by the RSO.

Equipment used for measurement

Soil and water analyses were performed by the Oak Ridge Associated University and analyzed by liquid scintillation counting. Per ORAU, all quality control requirements were met, except for one duplicate ¹⁴C sample (Batch CB0085). The results indicated that the sample was

not completely homogeneous, and therefore it was re-analyzed for both ^{14}C and tritium. This batch included soil samples from Pen 3, Northwest Barn Pen, West Barn, and Barn Pad.

Tissue samples were analyzed at the University of Alaska Fairbanks using a Beckman LS6500 liquid scintillation counter (SN: 458898). For the purposes of this decommissioning work, the instrument was calibrated on 18 February 2015 and on 25 March 2016. Samples were counted for 5 minutes in triplicate on both tritium and ^{14}C channels. Tritium activity in decays per minute was determined by the instrument using an internal ^{137}Cs source. ^{14}C activity in decays per minute was estimated from counts per minute data using a counting efficiency of 96%.

Release criteria for unrestricted use

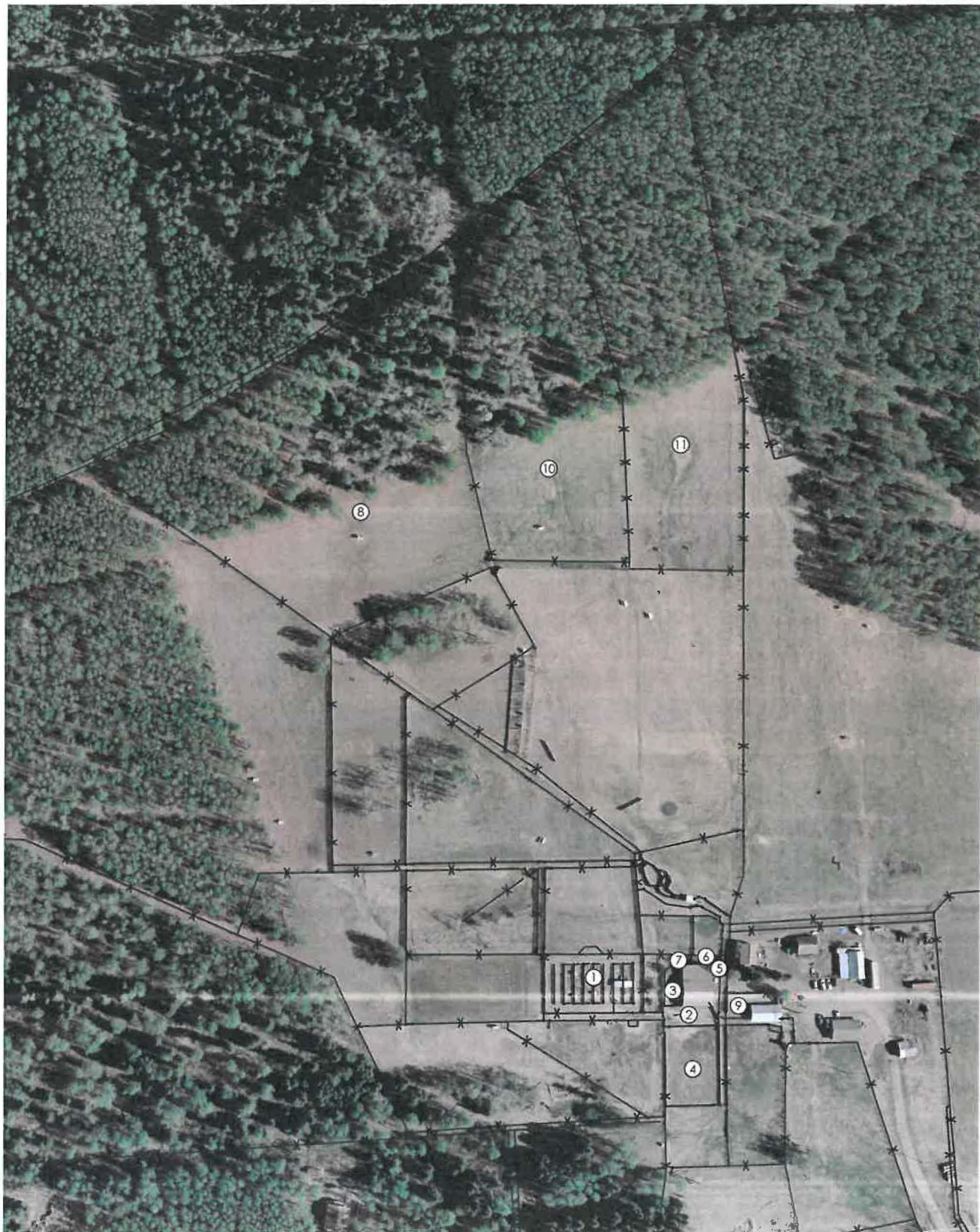
The release criteria for unrestricted use are 100 pCi per gram for tritium, and 30 pCi per gram for ^{14}C . Soil and water concentrations for ^3H meet the criteria for unrestricted release. The majority of the soil and water concentrations for ^{14}C meet the criteria for unrestricted release, with the exception of three soil samples. Analysis of ^3H and ^{14}C concentrations in the tissues of animals raised at LARS, however, shows that the animals are not ingesting and concentrating either ^3H or ^{14}C from forage to any detectable extent.

Radioactive waste management program

There are no radioactive wastes associated with decommissioning activities at the LARS site. In the past, any radioactive wastes generated by experiments involving ^{14}C and ^3H were either incinerated or disposed to the sanitary sewer in accordance with the provisions of our materials license.

Appendices

- A. LARS survey maps
- B. Soil and water analysis raw data
- C. Summary of ^3H tissue data
- D. Summary of ^{14}C tissue data



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LARGE ANIMAL RESEARCH STATION SITE MAP - AREAS SAMPLED
SCALE: NTS



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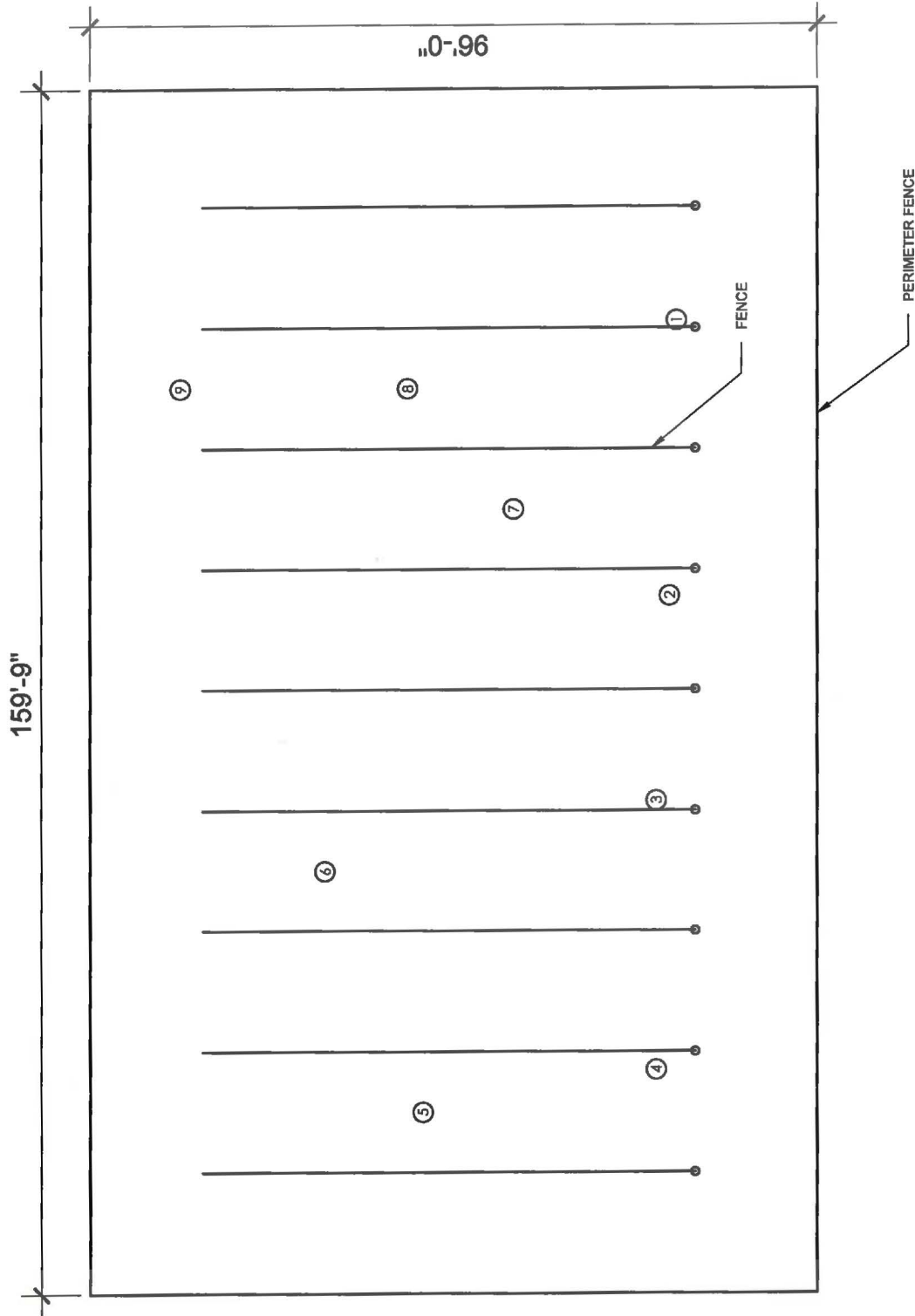
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Project Title:

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STATION SOIL SAMPLING**

Sheet Contents:
**LARGE ANIMAL RESEARCH
STATION SITE MAP -
AREAS SAMPLED**

DRAWN AMK
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DATE NOV, 2015
SCALE AS DISPLAYED
Project Number:

SHEET NO.
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1 OF 12



LEGEND

○ SAMPLES
● POSTS

PEN 5 SITE MAP
SCALE: 3/64" = 1'-0" @ 8.5X11

0 8 16 32 48 64 FEET

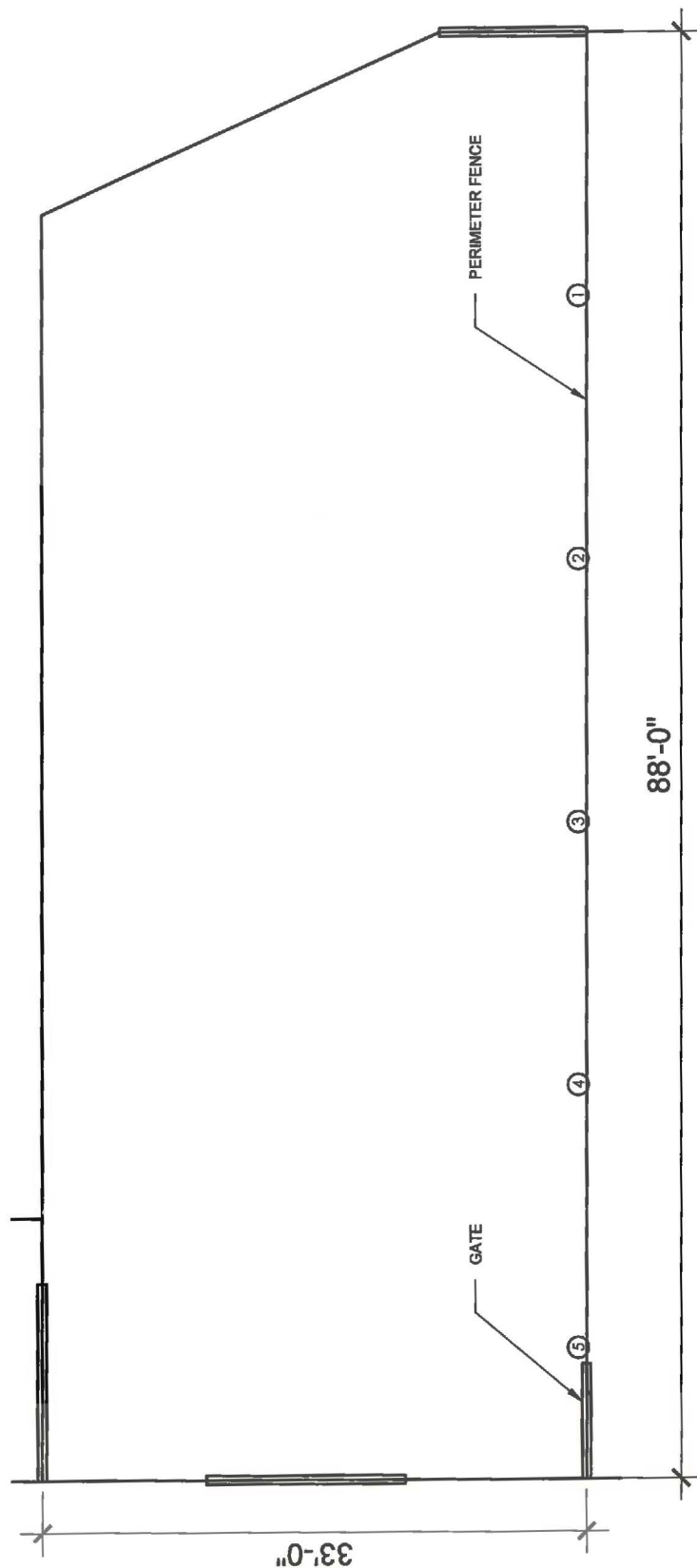


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Sheet Contents:
PEN 5 SITE MAP

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LEGEND

- ① SAMPLES
- GATE

BARN PAD SITE MAP

SCALE: 3/32" = 1'-0" @ 8.5X11



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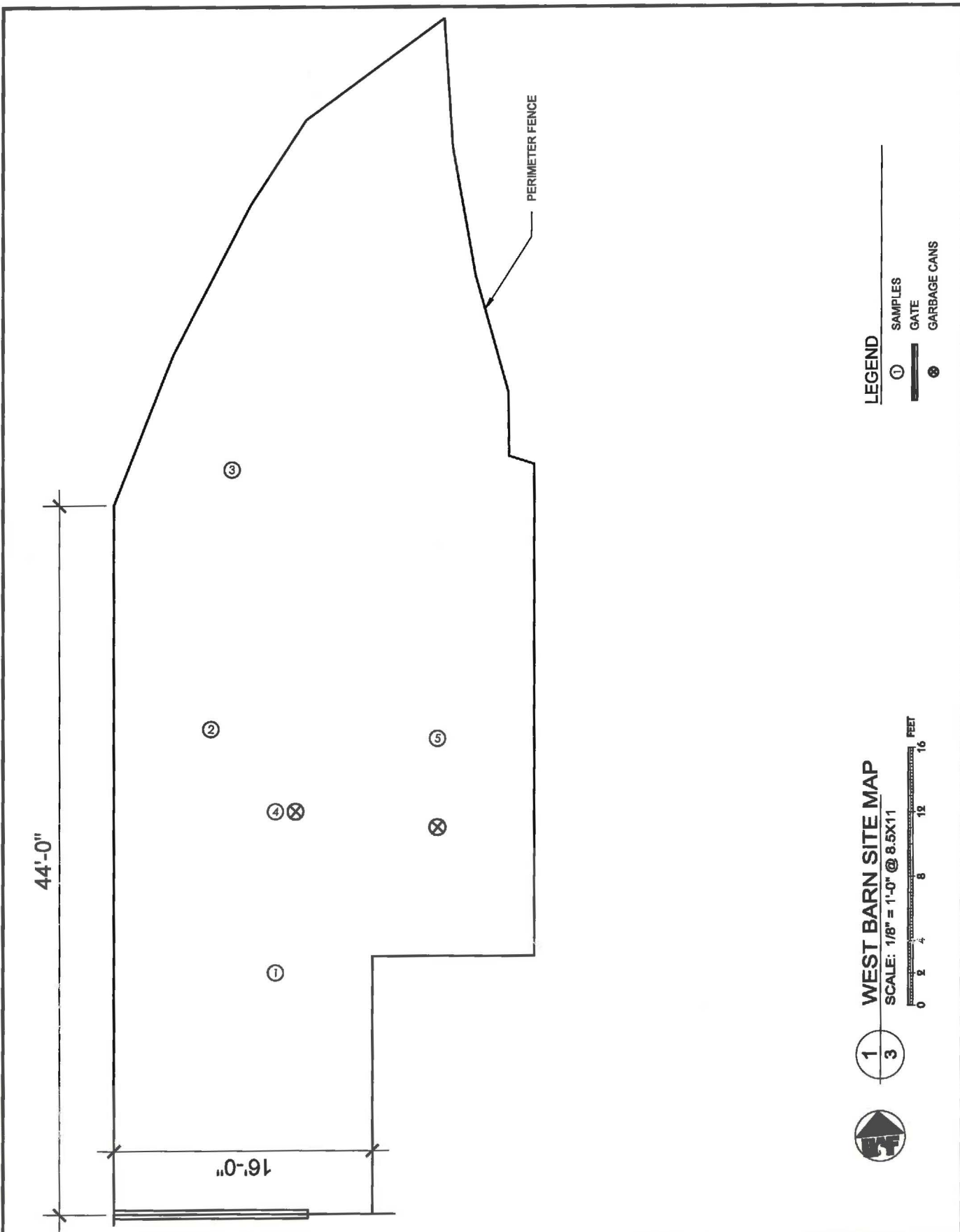
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BARN PAD SITE MAP

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 3 OF 12



WEST BARN SITE MAP

SCALE: 1/8" = 1'-0" @ 8.5X11



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 Project Title:

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 STATION SOIL SAMPLING**

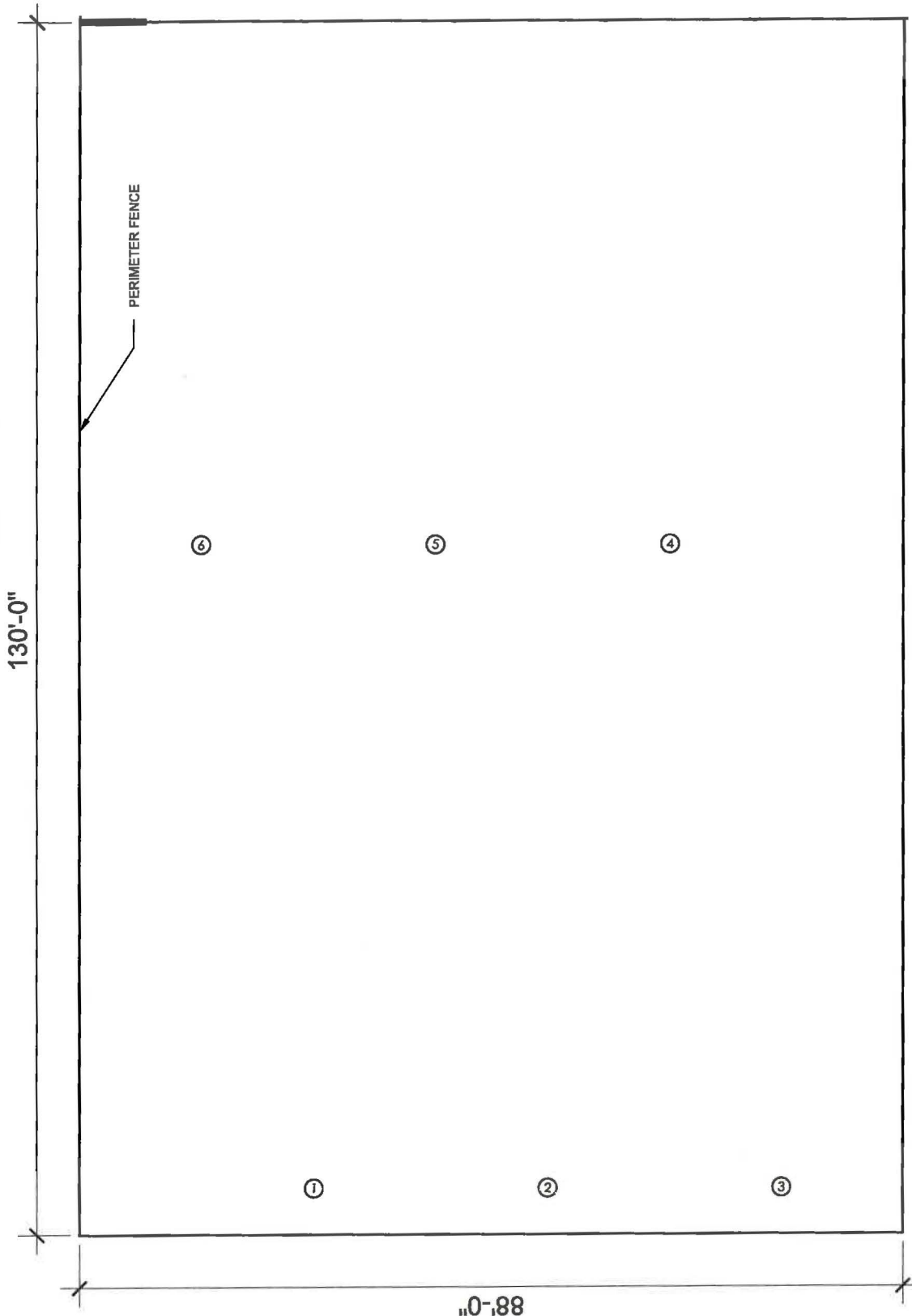
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WEST BARN SITE MAP

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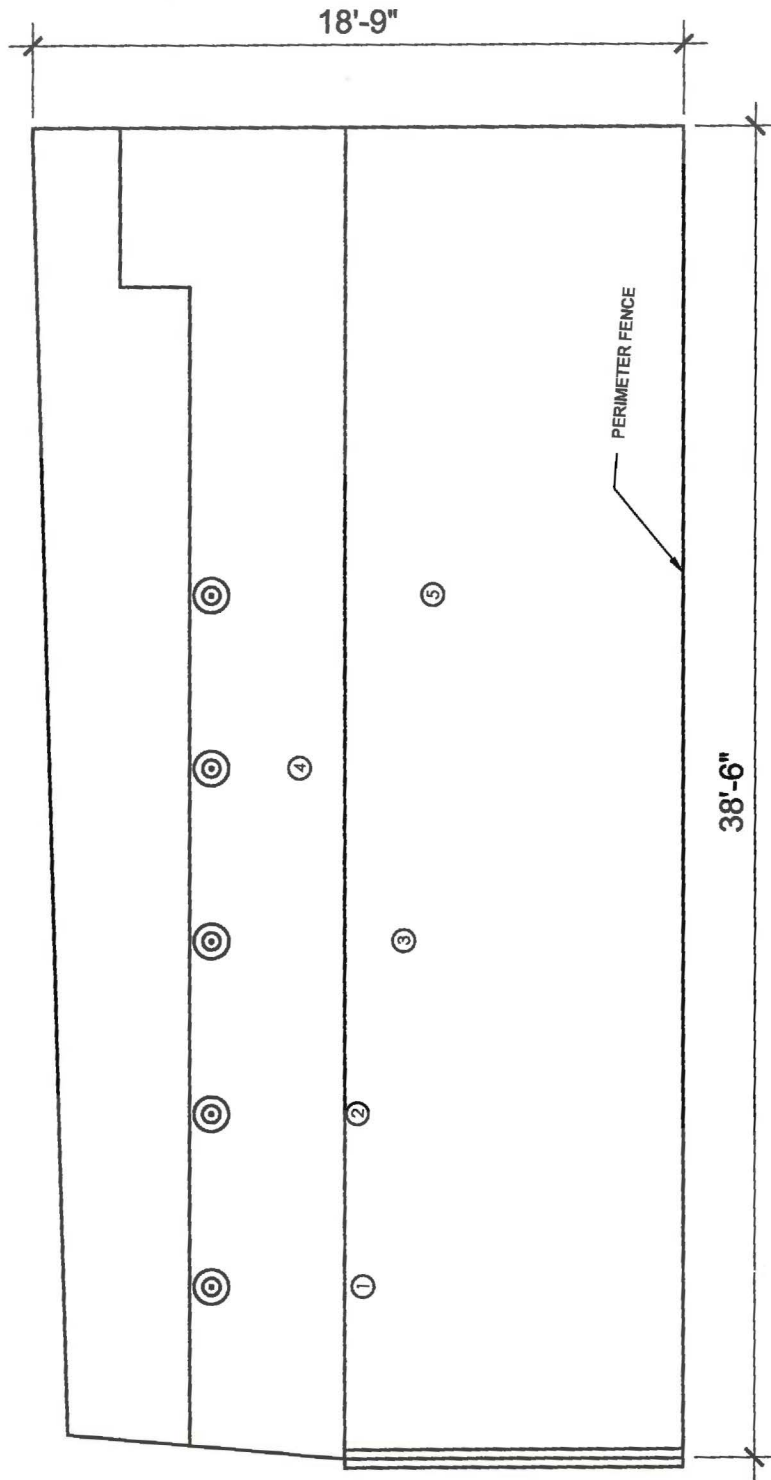
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STATION SOIL SAMPLING**

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PEN 3 SITE MAP

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5 OF 12	

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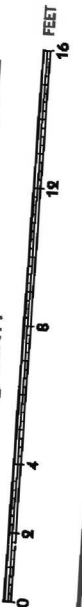
S:\PROJECTS\LARS\LARS Soil Sampling_forEHSRMI\Drawings\LARS_Figures.dwg Sheet-5_BehindBarnNEside



LEGEND

- 1 SAMPLES
- GATE
- TETHERING RINGS

BEHIND BARN - NE SIDE SITE MAP
SCALE: 3/16" = 1'-0" @ 8.5X11



1 5



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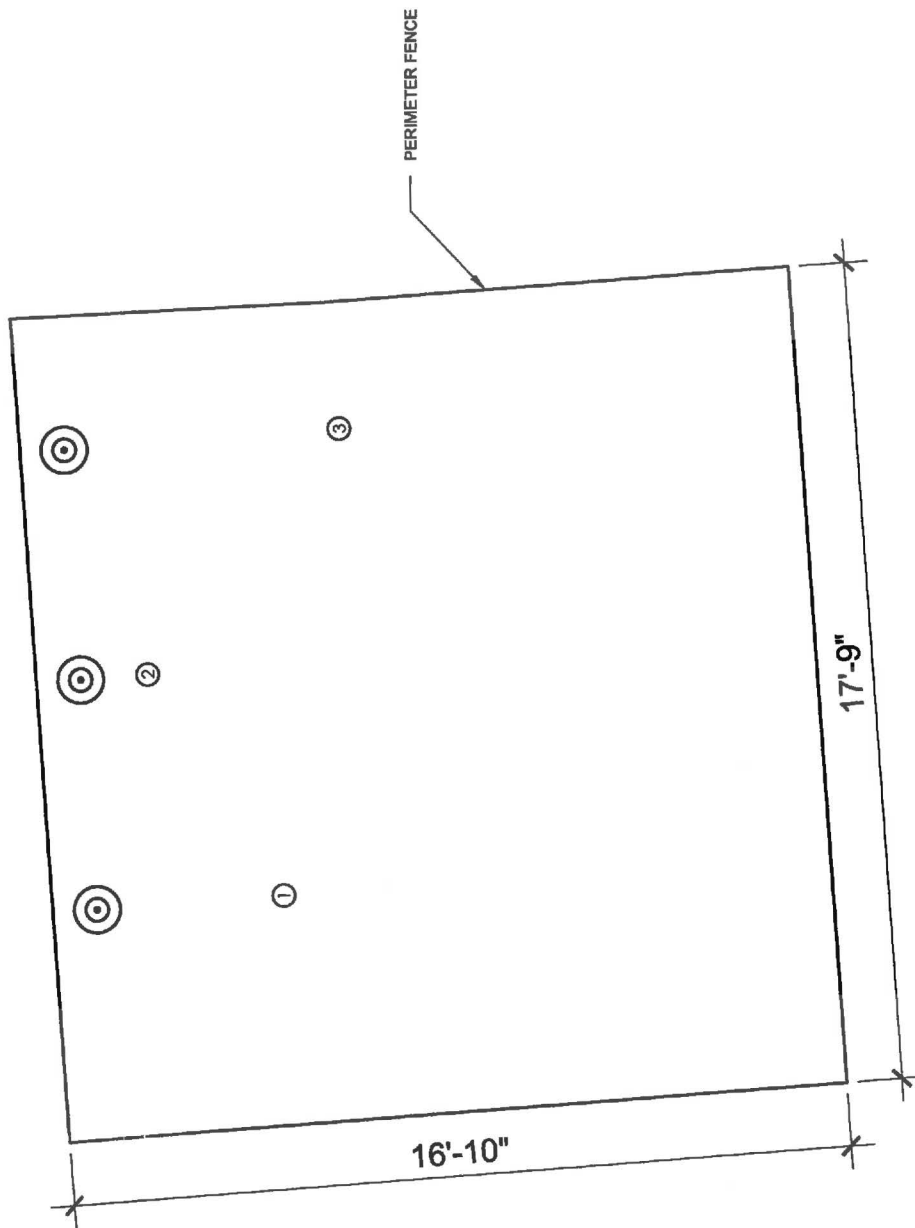
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BEHIND BARN - NE SIDE
SITE MAP

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LEGEND

① SAMPLES

② TETHERING RINGS

BEHIND BARN - NW SIDE SITE MAP

SCALE: 1/4" = 1'-0" @ 8.5X11



1 6



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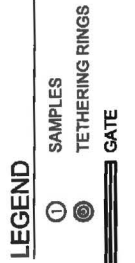
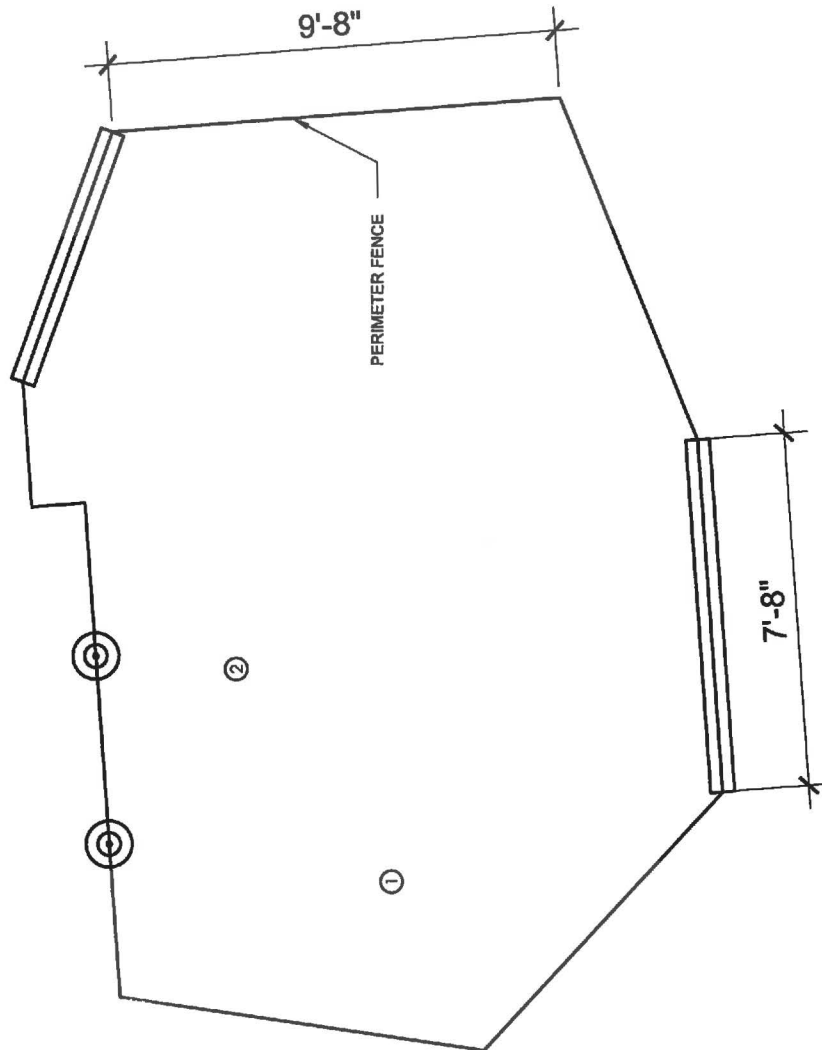
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 BEHIND BARN - NW SIDE
 SITE MAP

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BEHIND BARN - W SIDE SITE MAP

SCALE: 1/4" = 1'-0" @ 8.5X11



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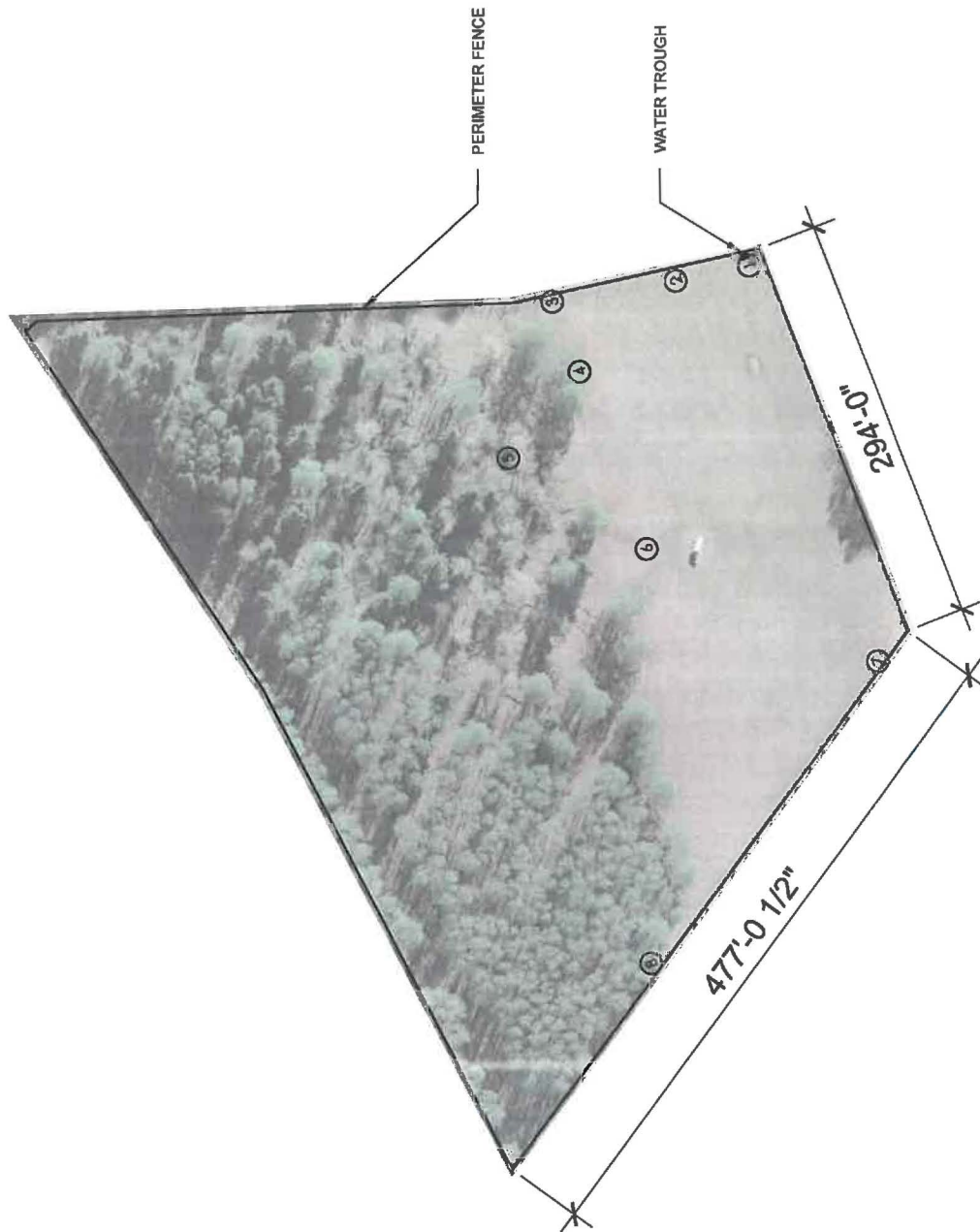
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 BEHIND BARN - W SIDE SITE
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LEGEND

① SAMPLES

— GATE

PEN 17 SITE MAP

SCALE: 1/128" = 1'-0" @ 8.5X11

0 32 64 128 192 256 FEET

1 8



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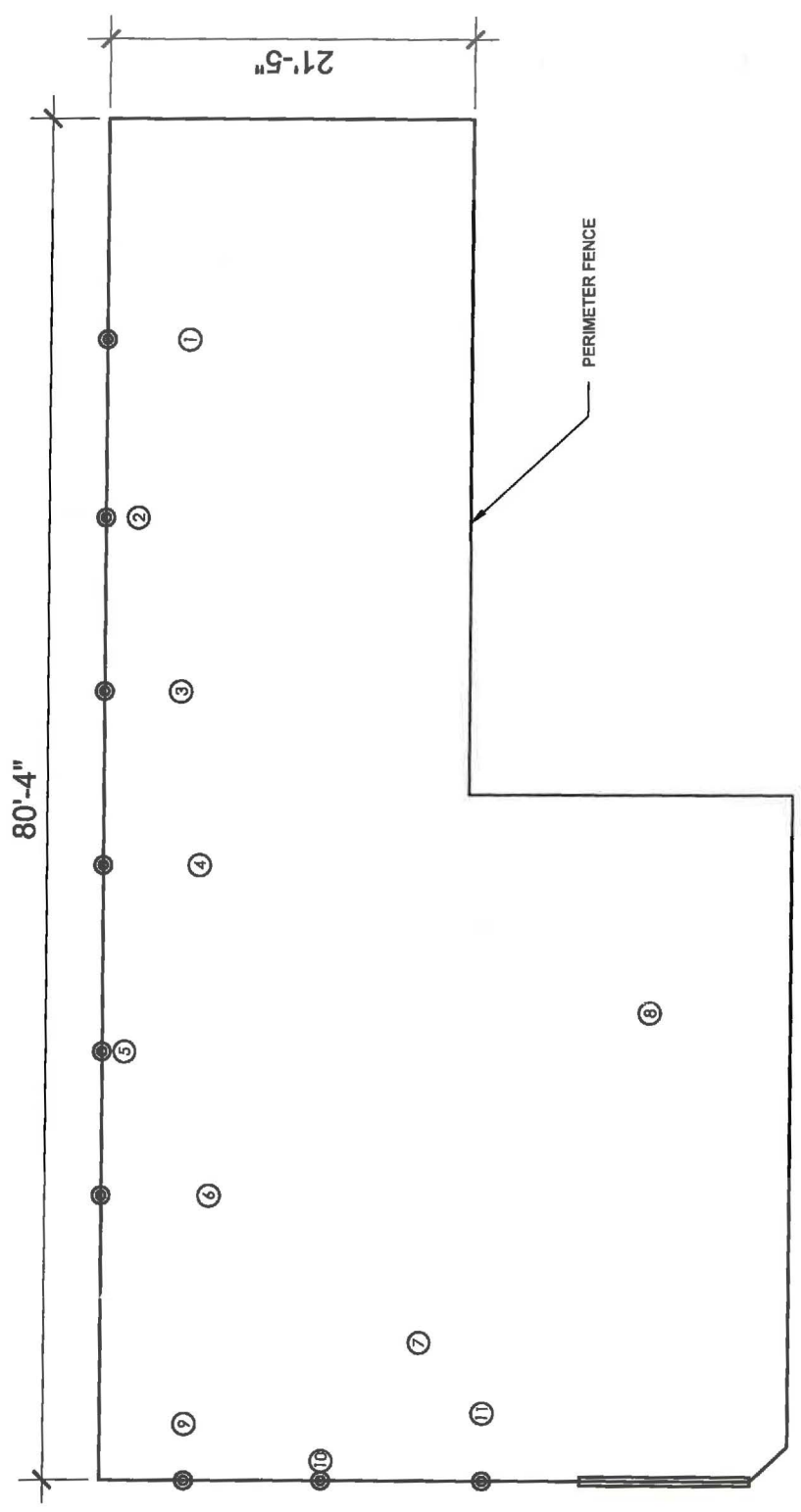
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 STATION SOIL SAMPLING**

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 PEN 17 SITE MAP

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LEGEND

① SAMPLES
② TETHERING RINGS
[Symbol] GATE

SMALL BARN SITE MAP
SCALE: 3/32" = 1'-0" @ 8.5X11

0 4 8 16 24 32 FEET

1 9



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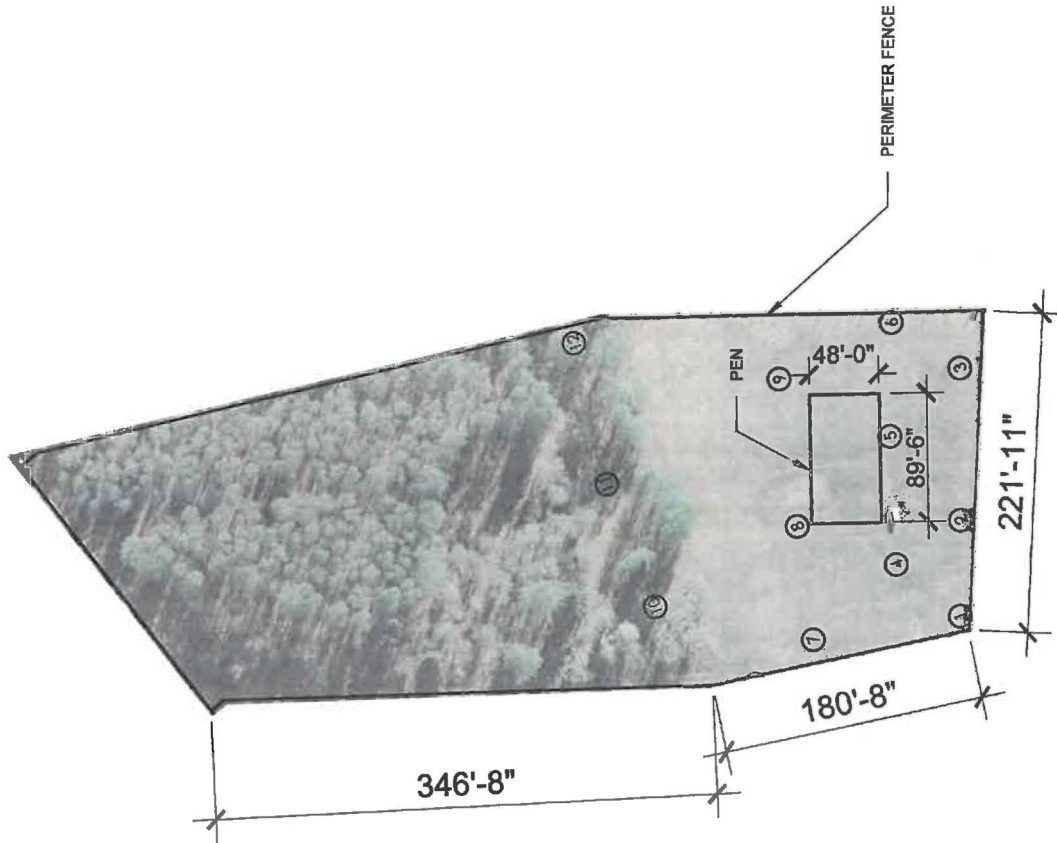
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Sheet Contents:
SMALL BARN SITE MAP

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LEGEND

① SAMPLES

PERIMETER FENCE

PEN 16 SITE MAP

SCALE: 1/128" = 1'-0" @ 8.5X11

0 32 64 128 192 256 FEET



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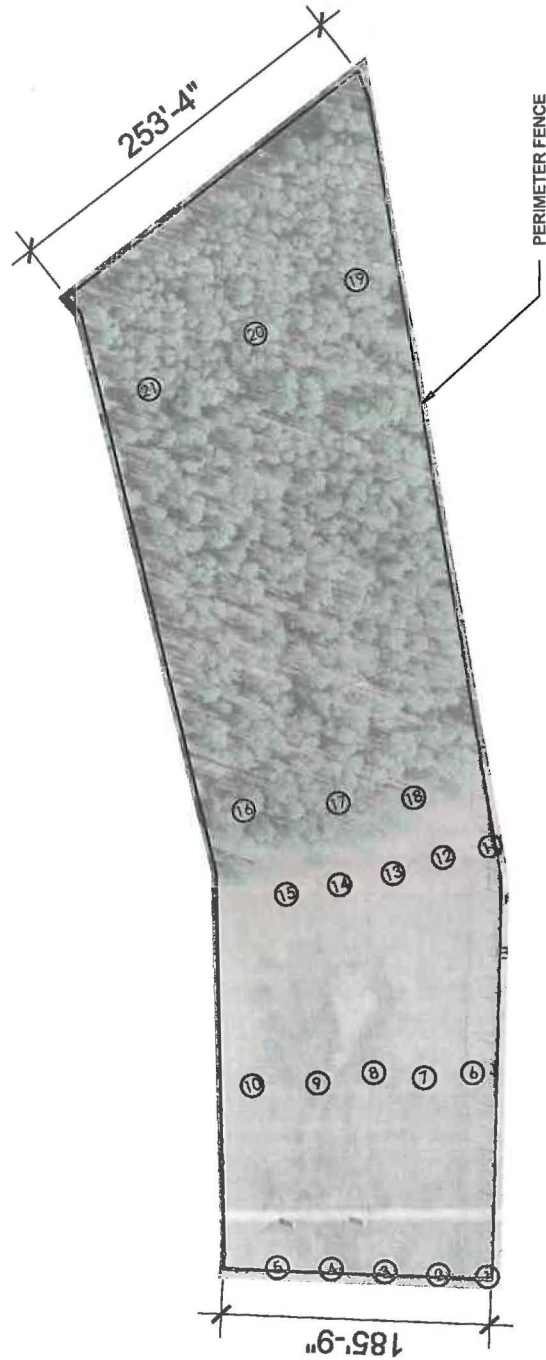
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STATION SOIL SAMPLING**

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PEN 16 SITE MAP

No 590694

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LEGEND

① SAMPLES

== GATE

PEN 15 SITE MAP

SCALE: 1/128" = 1'-0" @ 8.5X11

0 32 64 128 192 256 FEET



11



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PEN 15 SITE MAP

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11
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August 4, 2015

Dr. Tracey Martinson
Environmental Health, Safety, & Risk Management
University of Alaska Fairbanks
P.O. Box 758145
Fairbanks, AK 99775-8145

**SUBJECT: LETTER REPORT FOR ANALYTICAL RESULTS FOR NINETY FOUR SOIL
AND FOUR WATER SAMPLES FROM THE UNIVERSITY OF ALASKA
FAIRBANKS IN FAIRBANKS, ALASKA
DCN: 5268-LR-01-0**

Dear Dr. Martinson:

Oak Ridge Associated Universities (ORAU) received ninety four soil and four water samples on July 7, 2015 from the University of Alaska Fairbanks in Fairbanks, Alaska. The samples were received in good condition. The chain of custody form that arrived with the samples only included the number of samples per sample location. ORAU added sequential numbers for each sample from common locations to distinguish individual samples. For example, sample location "Pen 3" had six samples associated with it. ORAU added "#1, #2" etc. after "Pen 3" on the data reports. Per the letter proposal agreement, the samples were analyzed for tritium (H-3) and carbon-14 (C-14) by liquid scintillation counting. The analytical data and other pertinent information are presented in the attached reports.

ORAU's quality control (QC) requirements were met for these analyses with the exception of the sample duplicate for C-14 batch #CB0085. The duplicate error ratio (DER) was greater than 3, suggesting the samples are not completely homogeneous. The DER, also known as the normalized absolute difference, is a calculation using the sample result and one sigma uncertainty along with the duplicate sample result and uncertainty to evaluate if the results are statistically equivalent. A $DER \leq 3$ indicates that, at a 99+% confidence interval, the duplicate sample results do not differ significantly when compared to their respective one standard deviation (sigma) uncertainty. However, it is important to note that DER analysis of analytical results below or near the minimum detectable concentration (MDC) are less useful. To further demonstrate potential sample inhomogeneity, samples 10336S0001-10336S0019 were reanalyzed for both H-3 and C-14 and some of the data has DER values greater than 3. The reanalysis data for these samples are the data presented in the data tables. The QC files are available for your review upon request.

My contact information is listed below. You may also contact Forrest Smith at 865.574.9802 with any questions or comments.

Sincerely,

Wade Ivey, Laboratory Manager
ORAU
WPI:WFS:km

Enclosures

Electronic: S. Roberts, ORAU T. Vitkus, ORAU File 10336

Distribution approval and concurrence:		Initials
Quality Review		PB
Technical Review		ENB

Liquid Scintillation Analysis Summary Results by Analyte



Analyte: C-14
Project Name: University of Alaska

SOPs (Rev. #): AP6 (20)
AP9 (6)
CP4 (5)
SDG #: 201210336-1

Report Date: 8/4/2015

Project #: 201210336

Client Sample ID	Lab Sample ID	Result	TPU(2s)	MDC	Units	Qualifier Flag	Batch #
Pen 3 #1	10336S0001	25.4	7.1	10.0	pCi/g		CB0085
Pen 3 #2	10336S0002	66.4	9.9	9.9	pCi/g		CB0085
Pen 3 #3	10336S0003	30.4	7.5	10.0	pCi/g		CB0085
Pen 3 #4	10336S0004	22.6	6.9	9.8	pCi/g		CB0085
Pen 3 #5	10336S0005	10.6	6.1	9.7	pCi/g		CB0085
Pen 3 #6	10336S0006	15.1	6.4	9.8	pCi/g		CB0085
Northwest barn pen #1	10336S0007	4.6	6.0	10.0	pCi/g	U	CB0085
Northwest barn pen #2	10336S0008	1.3	5.6	9.8	pCi/g	U	CB0085
Northwest barn pen #3	10336S0009	8.1	6.1	10.0	pCi/g	U	CB0085
West barn #1	10336S0010	14.7	6.6	10.1	pCi/g		CB0085
West barn #2	10336S0011	11.3	6.2	9.9	pCi/g		CB0085
West barn #3	10336S0012	13.1	6.5	10.1	pCi/g		CB0085
West barn #4	10336S0013	6.7	6.0	10.0	pCi/g	U	CB0085
West barn #5	10336S0014	10.2	6.2	10.0	pCi/g		CB0085
Barn pad #1	10336S0015	41.7	8.3	10.1	pCi/g		CB0085
Barn pad #2	10336S0016	25.8	7.2	10.1	pCi/g		CB0085
Barn pad #3	10336S0017	49.2	8.6	9.8	pCi/g		CB0085
Barn pad #4	10336S0018	1.9	5.6	9.6	pCi/g	U	CB0085
Barn pad #5	10336S0019	25.0	7.1	9.9	pCi/g		CB0085
Small barn yard #1	10336S0020	3.3	5.4	9.1	pCi/g	U	CB0063
Small barn yard #2	10336S0021	5.9	5.7	9.4	pCi/g	U	CB0063
Small barn yard #3	10336S0022	4.1	5.4	9.1	pCi/g	U	CB0063
Small barn yard #4	10336S0023	3.6	5.5	9.3	pCi/g	U	CB0063
Small barn yard #5	10336S0024	39.2	7.4	8.8	pCi/g		CB0063
Small barn yard #6	10336S0025	2.1	5.3	9.1	pCi/g	U	CB0063
Small barn yard #7	10336S0026	1.8	5.4	9.3	pCi/g	U	CB0063
Small barn yard #8	10336S0027	0.4	5.2	9.2	pCi/g	U	CB0063
Small barn yard #9	10336S0028	2.3	5.3	9.2	pCi/g	U	CB0063
Small barn yard #10	10336S0029	1.8	5.3	9.1	pCi/g	U	CB0063
Small barn yard #11	10336S0030	-0.4	5.1	9.0	pCi/g	U	CB0063
Behind barn West #1	10336S0031	5.8	5.5	9.2	pCi/g	U	CB0063
Behind barn West #2	10336S0032	3.1	5.1	8.8	pCi/g	U	CB0063
East barn pen #1	10336S0033	0.7	5.3	9.3	pCi/g	U	CB0063
East barn pen #2	10336S0034	4.2	5.2	8.8	pCi/g	U	CB0063
East barn pen #3	10336S0035	9.0	5.7	9.1	pCi/g	U	CB0063
East barn pen #4	10336S0036	5.8	5.3	8.7	pCi/g	U	CB0063
East barn pen #5	10336S0037	0.2	5.1	8.9	pCi/g	U	CB0063
Pen 5 #1	10336S0038	21.9	6.4	9.0	pCi/g		CB0065
Pen 5 #2	10336S0039	12.1	5.5	8.4	pCi/g		CB0065
Pen 5 #3	10336S0040	8.9	5.7	9.1	pCi/g	U	CB0065
Pen 5 #4	10336S0041	31.0	7.0	9.0	pCi/g		CB0065
Pen 5 #5	10336S0042	11.2	5.6	8.7	pCi/g		CB0065
Pen 5 #6	10336S0043	9.9	5.7	9.1	pCi/g		CB0085
Pen 5 #7	10336S0044	27.8	6.7	8.8	pCi/g		CB0065
Pen 5 #8	10336S0045	7.3	5.5	9.0	pCi/g	U	CB0065
Pen 5 #9	10336S0046	19.4	6.3	9.0	pCi/g		CB0065
Pen 17 #1	10336S0047	12.7	5.8	8.8	pCi/g		CB0065
Pen 17 #2	10336S0048	-3.0	4.8	8.7	pCi/g	U	CB0065
Pen 17 #3	10336S0049	2.3	5.3	9.1	pCi/g	U	CB0065
Pen 17 #4	10336S0050	6.2	5.5	9.1	pCi/g	U	CB0065

Client Sample ID	Lab Sample ID	Result	TPU(2s)	MDC	Units	Qualifier Flag	Batch #
Pen 17 #5	10336S0051	7.3	5.6	9.1	pCi/g	U	CB0065
Pen 17 #6	10336S0052	5.8	5.4	9.0	pCi/g	U	CB0065
Pen 17 #7	10336S0053	5.0	5.0	8.3	pCi/g	U	CB0065
Pen 17 #8	10336S0054	4.7	5.3	8.9	pCi/g	U	CB0065
North Pasture #1	10336S0055	5.1	5.4	9.0	pCi/g	U	CB0065
North Pasture #2	10336S0056	8.8	5.5	8.8	pCi/g	U	CB0065
North Pasture #3	10336S0057	12.9	5.8	9.0	pCi/g		CB0065
Pen 16 #1	10336S0058	2.2	5.3	9.1	pCi/g	U	CB0079
Pen 16 #2	10336S0059	0.8	5.4	9.4	pCi/g	U	CB0079
Pen 16 #3	10336S0060	1.6	5.3	9.2	pCi/g	U	CB0079
Pen 16 #4	10336S0061	-3.6	4.9	8.9	pCi/g	U	CB0079
Pen 16 #5	10336S0062	-4.3	4.8	8.8	pCi/g	U	CB0079
Pen 16 #6	10336S0063	1.9	5.2	9.1	pCi/g	U	CB0079
Pen 16 #7	10336S0064	0.6	5.1	8.9	pCi/g	U	CB0079
Pen 16 #8	10336S0065	1.2	5.4	9.4	pCi/g	U	CB0079
Pen 16 #9	10336S0066	2.6	5.5	9.4	pCi/g	U	CB0079
Pen 16 #10	10336S0067	1.6	5.3	9.2	pCi/g	U	CB0079
Pen 16 #11	10336S0068	-0.2	5.3	9.4	pCi/g	U	CB0079
Pen 16 #12	10336S0069	-5.5	5.0	9.3	pCi/g	U	CB0079
Pen 15 #1	10336S0070	1.0	5.4	9.5	pCi/g	U	CB0079
Pen 15 #2	10336S0071	-3.7	4.9	8.9	pCi/g	U	CB0079
Pen 15 #3	10336S0072	-1.7	5.1	9.1	pCi/g	U	CB0079
Pen 15 #4	10336S0073	-2.2	5.2	9.3	pCi/g	U	CB0079
Pen 15 #5	10336S0074	-1.1	5.3	9.4	pCi/g	U	CB0079
Pen 15 #6	10336S0075	-2.5	5.1	9.2	pCi/g	U	CB0079
Pen 15 #7	10336S0076	1.6	5.3	9.2	pCi/g	U	CB0081
Pen 15 #8	10336S0077	-1.3	5.1	9.0	pCi/g	U	CB0081
Pen 15 #9	10336S0078	-1.6	5.1	9.2	pCi/g	U	CB0081
Pen 15 #10	10336S0079	1.4	5.4	9.4	pCi/g	U	CB0081
Pen 15 #11	10336S0080	-3.0	5.3	9.5	pCi/g	U	CB0081
Pen 15 #12	10336S0081	-2.6	5.3	9.6	pCi/g	U	CB0081
Pen 15 #13	10336S0082	-2.0	5.1	9.2	pCi/g	U	CB0081
Pen 15 #14	10336S0083	-1.6	5.2	9.4	pCi/g	U	CB0081
Pen 15 #15	10336S0084	-5.0	5.1	9.4	pCi/g	U	CB0081
Pen 15 #16	10336S0085	-0.1	5.2	9.2	pCi/g	U	CB0081
Pen 15 #17	10336S0086	0.0	5.3	9.4	pCi/g	U	CB0081
Pen 15 #18	10336S0087	-1.2	5.4	9.5	pCi/g	U	CB0081
Pen 15 #19	10336S0088	-2.5	5.0	9.1	pCi/g	U	CB0081
Pen 15 #20	10336S0089	0.0	5.4	9.6	pCi/g	U	CB0081
Pen 15 #21	10336S0090	-4.7	5.1	9.3	pCi/g	U	CB0081
Reference areas #1	10336S0091	1.1	5.3	9.2	pCi/g	U	CB0081
Reference areas #2	10336S0092	2.4	5.6	9.6	pCi/g	U	CB0081
Reference areas #3	10336S0093	-1.7	5.2	9.4	pCi/g	U	CB0081
Reference areas #4	10336S0094	-0.5	5.4	9.5	pCi/g	U	CB0081
LARS water #1	10336W0001	7	13	22	pCi/L	U	CD0083
LARS water #2	10336W0002	5	13	22	pCi/L	U	CD0083
Reference water #1	10336W0003	1	13	22	pCi/L	U	CD0083
Reference water #2	10336W0004	14	13	22	pCi/L	U	CD0083

Signed By: Wade Ivey

Date: 8/3/2015

Qualifier Flags:

U= Analyte not detected (<MDC)

TPU= Total Propagated Uncertainty

MDC= Minimum Detectable Concentration

Liquid Scintillation Analysis Summary Results by Analyte



Analyte: H-3
 Project Name: University of Alaska
 Project #: 201210336

SOP (Rev. #): AP6 (20)
 AP2 (20)
 CP4 (5)
 SDG #: 201210336-1

Report Date: 8/4/2015

Client Sample ID	Lab Sample ID	Result	TPU(2s)	MDC	Units	Qualifier Flag	Batch #
Pen 3 #1	10336S0001	14.6	7.1	10.6	pCi/g		HB0086
Pen 3 #2	10336S0002	17.7	7.3	10.5	pCi/g		HB0086
Pen 3 #3	10336S0003	12.3	6.9	10.6	pCi/g		HB0086
Pen 3 #4	10336S0004	23.5	7.7	10.4	pCi/g		HB0086
Pen 3 #5	10336S0005	9.7	6.6	10.3	pCi/g	U	HB0086
Pen 3 #6	10336S0006	8.1	6.4	10.4	pCi/g	U	HB0086
Northwest barn pen #1	10336S0007	4.9	6.3	10.7	pCi/g	U	HB0086
Northwest barn pen #2	10336S0008	-1.7	5.5	10.4	pCi/g	U	HB0086
Northwest barn pen #3	10336S0009	8.3	6.6	10.7	pCi/g	U	HB0086
West barn #1	10336S0010	15.5	7.3	10.7	pCi/g		HB0086
West barn #2	10336S0011	11.7	6.8	10.5	pCi/g		HB0086
West barn #3	10336S0012	13.2	7.0	10.7	pCi/g		HB0086
West barn #4	10336S0013	13.1	7.0	10.6	pCi/g		HB0086
West barn #5	10336S0014	14.6	7.1	10.6	pCi/g		HB0086
Barn pad #1	10336S0015	21.6	7.7	10.7	pCi/g		HB0086
Barn pad #2	10336S0016	20.8	7.7	10.7	pCi/g		HB0086
Barn pad #3	10336S0017	13.5	6.9	10.4	pCi/g		HB0086
Barn pad #4	10336S0018	4.8	6.0	10.2	pCi/g	U	HB0086
Barn pad #5	10336S0019	16.4	7.2	10.6	pCi/g		HB0086
Small barn yard #1	10336S0020	3.7	6.8	11.8	pCi/g	U	HB0064
Small barn yard #2	10336S0021	-3.3	6.4	12.2	pCi/g	U	HB0064
Small barn yard #3	10336S0022	1.5	6.6	11.8	pCi/g	U	HB0064
Small barn yard #4	10336S0023	-3.4	6.4	12.1	pCi/g	U	HB0064
Small barn yard #5	10336S0024	0.2	6.3	11.4	pCi/g	U	HB0064
Small barn yard #6	10336S0025	4.5	6.9	11.8	pCi/g	U	HB0064
Small barn yard #7	10336S0026	2.1	6.8	12.0	pCi/g	U	HB0064
Small barn yard #8	10336S0027	0.6	6.6	11.9	pCi/g	U	HB0064
Small barn yard #9	10336S0028	-1.9	6.4	11.8	pCi/g	U	HB0064
Small barn yard #10	10336S0029	1.4	6.6	11.7	pCi/g	U	HB0064
Small barn yard #11	10336S0030	0.8	6.5	11.7	pCi/g	U	HB0064
Behind barn West #1	10336S0031	9.6	7.3	11.8	pCi/g	U	HB0064
Behind barn West #2	10336S0032	-1.9	6.1	11.3	pCi/g	U	HB0064
East barn pen #1	10336S0033	0.9	6.7	12.1	pCi/g	U	HB0064
East barn pen #2	10336S0034	-0.6	6.3	11.4	pCi/g	U	HB0064
East barn pen #3	10336S0035	-1.5	6.3	11.7	pCi/g	U	HB0064
East barn pen #4	10336S0036	4.6	6.6	11.3	pCi/g	U	HB0064
East barn pen #5	10336S0037	1.2	6.4	11.5	pCi/g	U	HB0064
Pen 5 #1	10336S0038	33.3	8.9	11.6	pCi/g	U	HB0066
Pen 5 #2	10336S0039	9.7	6.8	10.8	pCi/g	U	HB0066
Pen 5 #3	10336S0040	8.5	7.2	11.7	pCi/g	U	HB0066
Pen 5 #4	10336S0041	5.7	6.8	11.5	pCi/g	U	HB0066
Pen 5 #5	10336S0042	9.6	7.0	11.2	pCi/g	U	HB0066
Pen 5 #6	10336S0043	7.4	7.0	11.7	pCi/g	U	HB0066
Pen 5 #7	10336S0044	8.2	6.9	11.3	pCi/g	U	HB0066
Pen 5 #8	10336S0045	4.3	6.7	11.5	pCi/g	U	HB0066
Pen 5 #9	10336S0046	7.2	7.0	11.6	pCi/g	U	HB0066
Pen 17 #1	10336S0047	-1.4	6.2	11.4	pCi/g	U	HB0066
Pen 17 #2	10336S0048	4.0	6.5	11.2	pCi/g	U	HB0066
Pen 17 #3	10336S0049	1.9	6.6	11.7	pCi/g	U	HB0066
Pen 17 #4	10336S0050	2.6	6.7	11.7	pCi/g	U	HB0066

Client Sample ID	Lab Sample ID	Result	TPU(2s)	MDC	Units	Qualifier Flag	Batch #
Pen 17 #5	10336S0051	3.1	6.8	11.8	pCi/g	U	HB0066
Pen 17 #6	10336S0052	1.1	6.5	11.6	pCi/g	U	HB0066
Pen 17 #7	10336S0053	1.7	6.0	10.7	pCi/g	U	HB0066
Pen 17 #8	10336S0054	0.1	6.3	11.5	pCi/g	U	HB0066
North Pasture #1	10336S0055	1.4	6.5	11.6	pCi/g	U	HB0066
North Pasture #2	10336S0056	1.8	6.4	11.3	pCi/g	U	HB0066
North Pasture #3	10336S0057	3.3	6.6	11.5	pCi/g	U	HB0066
Pen 16 #1	10336S0058	5.3	6.1	10.2	pCi/g	U	HB0080
Pen 16 #2	10336S0059	3.9	6.1	10.5	pCi/g	U	HB0080
Pen 16 #3	10336S0060	5.5	6.1	10.3	pCi/g	U	HB0080
Pen 16 #4	10336S0061	3.3	5.7	9.9	pCi/g	U	HB0080
Pen 16 #5	10336S0062	4.9	5.8	9.8	pCi/g	U	HB0080
Pen 16 #6	10336S0063	5.3	6.0	10.1	pCi/g	U	HB0080
Pen 16 #7	10336S0064	8.0	6.2	9.9	pCi/g	U	HB0080
Pen 16 #8	10336S0065	0.9	5.8	10.4	pCi/g	U	HB0080
Pen 16 #9	10336S0066	4.6	6.2	10.5	pCi/g	U	HB0080
Pen 16 #10	10336S0067	4.6	6.0	10.2	pCi/g	U	HB0080
Pen 16 #11	10336S0068	2.9	6.0	10.4	pCi/g	U	HB0080
Pen 16 #12	10336S0069	2.6	5.9	10.3	pCi/g	U	HB0080
Pen 15 #1	10336S0070	5.0	6.2	10.6	pCi/g	U	HB0080
Pen 15 #2	10336S0071	5.7	6.0	9.9	pCi/g	U	HB0080
Pen 15 #3	10336S0072	7.6	6.3	10.2	pCi/g	U	HB0080
Pen 15 #4	10336S0073	6.7	6.3	10.3	pCi/g	U	HB0080
Pen 15 #5	10336S0074	1.2	5.8	10.4	pCi/g	U	HB0080
Pen 15 #6	10336S0075	2.0	5.8	10.2	pCi/g	U	HB0080
Pen 15 #7	10336S0076	9.7	7.2	11.6	pCi/g	U	HB0082
Pen 15 #8	10336S0077	5.3	6.7	11.4	pCi/g	U	HB0082
Pen 15 #9	10336S0078	3.4	6.7	11.6	pCi/g	U	HB0082
Pen 15 #10	10336S0079	2.6	6.7	11.8	pCi/g	U	HB0082
Pen 15 #11	10336S0080	-1.5	6.5	12.0	pCi/g	U	HB0082
Pen 15 #12	10336S0081	2.1	6.9	12.1	pCi/g	U	HB0082
Pen 15 #13	10336S0082	-1.3	6.3	11.6	pCi/g	U	HB0082
Pen 15 #14	10336S0083	1.1	6.6	11.8	pCi/g	U	HB0082
Pen 15 #15	10336S0084	2.6	6.8	11.9	pCi/g	U	HB0082
Pen 15 #16	10336S0085	-1.4	6.3	11.6	pCi/g	U	HB0082
Pen 15 #17	10336S0086	3.4	6.8	11.8	pCi/g	U	HB0082
Pen 15 #18	10336S0087	0.3	6.7	12.0	pCi/g	U	HB0082
Pen 15 #19	10336S0088	-0.7	6.2	11.4	pCi/g	U	HB0082
Pen 15 #20	10336S0089	-0.5	6.6	12.1	pCi/g	U	HB0082
Pen 15 #21	10336S0090	1.5	6.6	11.8	pCi/g	U	HB0082
Reference areas #1	10336S0091	1.1	6.5	11.7	pCi/g	U	HB0082
Reference areas #2	10336S0092	-2.8	6.5	12.2	pCi/g	U	HB0082
Reference areas #3	10336S0093	4.6	6.9	11.8	pCi/g	U	HB0082
Reference areas #4	10336S0094	-3.3	6.3	12.0	pCi/g	U	HB0082
LARS water #1	10336W0001	-59	146	260	pCi/L	U	HD0084
LARS water #2	10336W0002	-102	144	260	pCi/L	U	HD0084
Reference water #1	10336W0003	-72	145	260	pCi/L	U	HD0084
Reference water #2	10336W0004	2	149	260	pCi/L	U	HD0084

Signed By: Wade Ivey

Date: 8/3/2015

Qualifier Flags:

U= Analyte not detected (<MDC)

TPU= Total Propagated Uncertainty

MDC= Minimum Detectable Concentration

Summary of Tritium tissue data															
values are in µCi per gram; samples were analyzed in triplicate															
Animal	Muscle	Liver	Kidney	Heart	Gluteal Fat	Stomach fat	Bone	Average of all tissues/organs	Std Dev	DCGL	LBGR	Shift (delta)	Delta/ sigma	Animal	Combined fat
N14-174	3.42E-05	6.70E-06	1.88E-05	2.95E-05	-1.15E-09	-1.78E-06	6.76E-05	2.22E-05	2.44E-05	1.00E-04	5.00E-05	5.00E-05	2.0	N14-174	-1.15E-09
N14-173	3.85E-05	5.11E-05	3.73E-05	1.71E-05	-1.11E-06		8.24E-05	3.75E-05	2.87E-05	1.00E-04	5.00E-05	5.00E-05	1.7	N14-173	-1.11E-06
N14-222	3.97E-05	8.60E-05	3.26E-05	1.55E-05	8.02E-06	6.41E-05	9.67E-06	3.65E-05	2.94E-05	1.00E-04	5.00E-05	5.00E-05	1.7	N14-222	8.02E-06
N14-230	5.71E-05	5.71E-05	6.25E-05	2.18E-05		3.84E-05	3.26E-05	4.49E-05	1.64E-05	1.00E-04	5.00E-05	5.00E-05	3.1	N14-243	2.64E-05
N14-243	9.48E-05	6.60E-05	-2.47E-05	5.34E-05	2.642E-05	1.77E-05	1.15E-04	4.98E-05	4.77E-05	1.00E-04	5.00E-05	5.00E-05	1.0	N15-017	2.80E-05
N14-244	7.95E-05	7.07E-05	2.97E-05	5.78E-05			7.39E-05	6.23E-05	1.99E-05	1.00E-04	5.00E-05	5.00E-05	2.5	N15-018	1.56E-05
N15-017	4.37E-05	7.54E-05	9.70E-05	3.21E-05	2.802E-05	3.07E-05	8.51E-05	5.60E-05	2.90E-05	1.00E-04	5.00E-05	5.00E-05	1.7	N15-021	1.05E-05
N15-018	3.56E-05	5.71E-05	1.47E-05	3.32E-05	1.56E-05	3.67E-05	7.00E-05	3.76E-05	2.03E-05	1.00E-04	5.00E-05	5.00E-05	2.5	N15-040	8.42E-06
N15-021	7.82E-05	5.98E-05	7.67E-05	5.31E-05	1.05E-05	8.28E-06	4.63E-05	4.76E-05	2.85E-05	1.00E-04	5.00E-05	5.00E-05	1.8	N16-039	4.99E-06
N15-040	6.03E-05	-4.05E-06	4.55E-05	4.01E-05	8.42E-06	1.11E-05	2.18E-05	2.62E-05	2.31E-05	1.00E-04	5.00E-05	5.00E-05	2.2	N16-040	6.32E-05
N16-039	1.10E-04	2.51E-04	2.58E-05	5.48E-05	4.99E-06	1.46E-05	2.34E-05	6.93E-05	8.76E-05	1.00E-04	5.00E-05	5.00E-05	0.6	Chicken	7.18E-05
N16-040	1.19E-04	2.09E-04	5.01E-05	3.23E-05	6.32E-05	9.93E-05	2.65E-05	8.56E-05	6.40E-05	1.00E-04	5.00E-05	5.00E-05	0.8	Pork	7.69E-06
Control caribou	2.36E-05	2.40E-05	2.77E-05	4.84E-05				3.09E-05	1.18E-05	1.00E-04	5.00E-05	5.00E-05	4.2	N14-174	-1.78E-06
Control chicken	-1.33E-05	8.83E-05	-4.38E-06	4.56E-05	7.18E-05			3.76E-05	4.52E-05	1.00E-04	5.00E-05	5.00E-05	1.1	N14-222	6.41E-05
Control pork	2.98E-05				7.69E-06		1.87E-05	1.87E-05	1.10E-05	1.00E-04	5.00E-05	5.00E-05	4.5	N14-230	3.84E-05
Control reindeer	7.12E-05	8.81E-05	2.94E-05	-2.98E-05			5.92E-05	4.36E-05	4.63E-05	1.00E-04	5.00E-05	5.00E-05	1.1	N14-243	1.77E-05
Control caribou				2.67E-05										N15-017	3.07E-05
					see combined fat									N15-018	3.67E-05
								Average for all tissues, all animals						N15-021	8.28E-06
Average (µCi/g)	5.64E-05	7.91E-05	3.46E-05	3.32E-05	2.03E-05	3.19E-05	5.23E-05	4.41E-05						N15-040	1.11E-05
Std Dev	3.45E-05	6.77E-05	3.01E-05	2.17E-05	2.39E-05	3.03E-05	3.13E-05	1.77E-05						N16-039	1.46E-05
DCGL	1.00E-04	1.00E-04	1.00E-04	1.00E-04	1.00E-04	1.00E-04	1.00E-04	1.00E-04						N16-040	9.93E-05
LBGR	5.00E-05	5.00E-05	5.00E-05	5.00E-05	5.00E-05	5.00E-05	5.00E-05	5.00E-05							
Shift (delta)	5.00E-05	5.00E-05	5.00E-05	5.00E-05	5.00E-05	5.00E-05	5.00E-05	5.00E-05						Average	2.56E-05
Delta/sigma (tissue)	1.4	0.74	1.7	2.3	2.1	1.6	1.6	2.83						Std dev	2.70E-05
Value for N/2 (Table 5.3)	19	61	15	11	13	16	16	10						DCGL	1.00E-04
α	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05						LBGR	5.00E-05
β	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05						Delta/sigma	1.85
														N/2	14

Summary of ¹⁴C tissue data

All values are in µCi/gram; samples were analyzed in triplicate

Animal	Muscle	Liver	Kidney	Heart	Gluteal Fat	Stomach fat	Bone	Average of all tissues/organs	Std Dev	DCGL	LBGR	Delta (DCGL-LBGR)	Delta/sigma	14C	Combined fat
N14-174	2.23E-06	3.07E-06	2.68E-06	4.71E-06	-2.66E-06	-8.29E-06	-1.30E-05	-1.60E-06	6.71E-06	3.00E-05	1.50E-05	1.50E-05	2.2	N14-174	-2.66E-06
N14-173	4.57E-07	-2.40E-06	-3.32E-06	-2.08E-06	-4.58E-06		-5.11E-06	-2.84E-06	2.00E-06	3.00E-05	1.50E-05	1.50E-05	7.5	N14-173	-4.58E-06
N14-222	-7.51E-07	-1.07E-06	1.84E-06	3.32E-07	7.13E-06	-1.54E-06	4.00E-08	8.54E-07	2.98E-06	3.00E-05	1.50E-05	1.50E-05	5.0	N14-222	7.13E-06
N14-230	-1.66E-06	-8.31E-06	-3.20E-06	-3.31E-06		-2.17E-07	-1.94E-06	-3.11E-06	2.79E-06	3.00E-05	1.50E-05	1.50E-05	5.4	N14-243	8.72E-06
N14-243	4.47E-06	1.33E-05	6.19E-06	2.40E-06	8.72E-06	7.28E-06	4.36E-06	6.67E-06	3.58E-06	3.00E-05	1.50E-05	1.50E-05	4.2	N15-017	5.60E-06
N14-244	2.78E-06	7.42E-07	5.73E-06	3.48E-06			7.07E-06	3.96E-06	2.49E-06	3.00E-05	1.50E-05	1.50E-05	6.0	N15-018	7.92E-06
N15-017	3.68E-06	3.50E-06	3.57E-06	1.68E-06	5.60E-06	6.23E-06	6.62E-06	4.41E-06	1.79E-06	3.00E-05	1.50E-05	1.50E-05	8.4	N15-021	2.46E-06
N15-018	3.87E-06	5.59E-09	3.02E-06	4.82E-06	7.92E-06	9.22E-06	3.91E-06	4.68E-06	3.08E-06	3.00E-05	1.50E-05	1.50E-05	4.9	N15-040	3.10E-06
N15-021	3.46E-07	1.35E-05	3.05E-06	2.36E-06	2.46E-06	4.71E-06	3.08E-06	4.22E-06	4.31E-06	3.00E-05	1.50E-05	1.50E-05	3.5	N16-039	1.50E-06
N15-040	1.83E-06	5.24E-06	-2.51E-06	-1.65E-06	3.10E-06	3.85E-06	1.24E-07	1.43E-06	2.89E-06	3.00E-05	1.50E-05	1.50E-05	5.2	N16-040	3.31E-07
N16-039	1.91E-06	1.92E-06	-1.38E-06	1.85E-06	1.50E-06	-1.01E-06	2.73E-06	1.07E-06	1.60E-06	3.00E-05	1.50E-05	1.50E-05	9.4	Pork	-9.41E-07
N16-040	4.06E-06	2.79E-06	4.37E-06	1.09E-06	3.31E-07	1.81E-06	1.73E-06	2.31E-06	1.50E-06	3.00E-05	1.50E-05	1.50E-05	10.0	N14-174	-8.29E-06
Control caribou	-5.61E-07	-8.55E-07	-3.09E-06	-3.98E-06				-2.12E-06	1.68E-06	3.00E-05	1.50E-05	1.50E-05	8.9	N14-222	-1.54E-06
Control chicken	1.14E-06	-1.22E-05	-8.56E-06	-3.66E-06		-1.42E-06		-4.94E-06	5.40E-06	3.00E-05	1.50E-05	1.50E-05	2.8	N14-230	-2.17E-07
Control caribou				-3.28E-06				-3.28E-06		3.00E-05	1.50E-05	1.50E-05		N14-243	7.28E-06
Control pork	-7.21E-07				-9.41E-07		2.59E-07	-4.68E-07	6.39E-07	3.00E-05	1.50E-05	1.50E-05	23.5	N15-017	6.23E-06
Control reindeer	7.90E-07	-1.84E-06	-4.04E-07	2.39E-06			-1.54E-06	-1.20E-07	1.75E-06	3.00E-05	1.50E-05	1.50E-05	8.6	N15-018	9.22E-06
														N15-021	4.71E-06
Average	1.49E-06	1.16E-06	5.32E-07	4.46E-07	2.60E-06	1.87E-06	5.97E-07	6.54E-07						N15-040	3.85E-06
Std Dev	1.92E-06	6.70E-06	4.14E-06	3.02E-06	4.40E-06	5.02E-06	5.14E-06	3.37E-06						N16-039	-1.01E-06
DCGL	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05						N16-040	1.81E-06
LBGR (=delta)	1.50E-05	1.50E-05	1.50E-05	1.50E-05	1.50E-05	1.50E-05	1.50E-05	1.50E-05						Chicken	-1.42E-06
Delta/sigma	7.80	2.24	3.62	4.96	3.41	2.99	2.92	4.45							
N/2 (MARSSIM Tab)	9	11	9	9	10	10	10	9						ave	2.24E-06
α	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05						stnd dev	4.62E-06
R	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05						DCGL	3.00E-05
														LBGR (delt	1.50E-05
														Delta/sigm	3.24
														N/2	10



DATE
04/20/2016

NAME AND ADDRESS OF APPLICANT AND/OR LICENSEE

Tracey A. Martinson, Ph.D., Radiation Safety Officer
University of Alaska Fairbanks
P.O. Box 758145
Fairbanks, AK 99775-8145

LICENSE NUMBER

50-02430-07

MAIL CONTROL NUMBER

590694

LICENSING AND/OR TECHNICAL REVIEWER

CH

This is to acknowledge the receipt of your:

☒ LETTER and/or ☐ APPLICATION DATED: 04/12/2016

The initial processing, which included an administrative review, has been performed.

☒ AMENDMENT ☐ TERMINATION ☐ NEW LICENSE ☐ RENEWAL

- ☐ There were no administrative omissions identified during our initial review.
- ☐ This is to acknowledge receipt of your application for renewal of the material(s) license identified above. Your application is deemed timely filed, and accordingly, the license will not expire until final action has been taken by this office.
- ☐ Your application for a new NRC license did not include your taxpayer identification number. Please fill out NRC Form 531, located at the following link:

<http://www.nrc.gov/reading-rm/doc-collections/forms/nrc531.pdf>

Send the completed NRC Form 531, by facsimile, to the following number: (301) 415-5387

A copy of your action has been emailed to our License Fee and Accounts Receivable Branch, in our Headquarters office in Rockville, MD. You will be contacted separately if there is a fee issue involved.

Your application has been assigned the above listed **MAIL CONTROL NUMBER**. When calling to inquire about this action, please refer to this control number. Your application has been forwarded to a technical reviewer. Please note that the technical review, which is normally completed within 180 days for a renewal application (90 days for all other requests), may identify additional omissions or require additional information. If you have any questions concerning the processing of your application, our contact information is listed below:

Region IV
U. S. Nuclear Regulatory Commission
DNMS/NMSB - B
1600 E. Lamar Boulevard
Arlington, TX 76011-4511
(817) 200-1140

✓4/20

BETWEEN:

Accounts Receivable/Payable
and
Regional Licensing Branches

[FOR ARPB USE]
INFORMATION FROM WBL

Program Code: 04620
Status Code: Pending Amendment
Fee Category: 3L(1) 3P 4A
Exp. Date:
Fee Comments:
Decom Fin Assur Req'd: Y

License Fee Worksheet - License Fee Transmittal

A. REGION

1. APPLICATION ATTACHED

Applicant/Licensee: ALASKA, UNIV OF FAIRBANKS
Received Date: 04/20/2016
Docket Number: 3001179
Mail Control Number: 590694
License Number: 50-02430-07
Action Type: Amendment

2. FEE ATTACHED

Amount: _____

Check No.: _____

3. COMMENTS

Signed: _____

Date: _____

B. LICENSE FEE MANAGEMENT BRANCH (Check when milestone 03 is entered / /)

1. Fee Category and Amount: _____

2. Correct Fee Paid. Application may be processed for:

Amendment: _____

Renewal: _____

License: _____

3. OTHER _____

Signed: _____

Date: _____