Westinghouse

Hematite Decommissioning Project

NUMBER: **HDP-INST-FSS-LSA05-01**

TITLE: **Final Status Survey Plan and Instructions for Survey Area & Unit: LSA 05-01**

REVISION: **3**

EFFECTIVE DATE: **August 15, 2013**

Approvals:

Author: Michelle E. Bresnahan

Owner: Joseph S. Guido

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

Survey Area: LSA-05 **Description:** Barns and Cistern Open Land Area
Survey Unit: 01 **Description:** Red Room Roof / Limestone Fill / Cistern Burn Pit Area

1. Verify Survey Unit Isolation & Control

a. Survey Unit properly isolated and/or controlled (indicated by outlining the area with green rope and posting the appropriate signage) as required by HDP-PR-HP-602, *Data Package Development and Isolation and Control Measures to Support Final Status Survey*? Yes☑ No☐
(If "No", discontinue survey design until area turnover requirements have been met.)

2. Evaluate Final Remedial Action Support Survey (RASS) Data

a. Number of RASS Samples: 19
b. Record analytical results and summary statistics for each RASS sample

	U-234 (ρCi/g)	U-235 (ρCi/g)	U-238 (ρCi/g)	Tc-99 (ρCi/g)	Th-232 (ρCi/g)	Ra-226 (ρCi/g)
Minimum	< MDA	< MDA	< MDA	-1.40E-01	-3.70E-01	-3.94E-02
Maximum	1.19E+01	6.37E-01	2.47E+00	9.96E+00	2.77E-01	5.15E-01
Mean	4.63E+00	1.64E-01	2.24E-01	4.65E+00	-5.54E-02	1.80E-01
Median	3.95E+00	1.22E-01	< MDA	4.24E+00	-4.46E-02	1.92E-01
Standard Deviation	3.79E+00	1.60E-01	6.81E-01	2.66E+00	2.11E-01	1.52E-01

c. Are all RASS results less, or equal to the appropriate DCGLw? Yes☑ No☐

d. If "No", have remaining locations of elevated concentration been evaluated? N/A☑ Yes☐ No☐
(If "No", discontinue survey design until investigation is complete.)

e. Have elevated areas identified by gamma walkover surveys been investigated? Yes☑ No☐
(If "No", then terminate survey design and perform additional investigation and repeat the planning process)

f. Are the Initial Characterization and RASS data sufficient to support FSS Design? Yes☑ No☐
(If "No", terminate survey design, perform additional characterization or remediation and repeat the planning process.)

3. Define the Survey Unit Classification

Write a short description of the survey unit based on historical use and remedial activities:

LSA 05-01 consists of Limestone Fill Area #1, the Cistern Burn Pit and the Red Room Roof Burial Pit. Please see Appendix P-3 for further information on the historical use and remedial activities for this area.

Classification: 1 Survey Unit Area (m^2): 1781.0

a. Has the Classification changed from the Initial Classification as indicated in DP Ch. 14? Yes☐ No☑
(If "Yes", then include a copy of Appendix P-5, *Survey Unit Classification Change Form.*)

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

b. Is the Survey Unit area less than the maximum size for the Classification? Yes☑ No☐
(If "No", then terminate survey design and evaluate dividing the survey unit into multiple survey units.)

4. Define the Surrogate Evaluation Area (SEA)

a. Select the appropriate SEA as input to calculating scan sensitivity and variability in the RASS SOF.
Plant Soils SEA ☐ Tc-99 SEA ☑ Burial Pit SEA ☐

5. Define Final Survey Unit Conditions

☐ No Excavations, Paved/Partially Paved or Excavated but not Backfilled

☑ Excavated and to be Backfilled

☐ Excavated and Backfilled

Note: If a portion of a Survey Unit is paved, then Surface Soil strata begins at the bottom of the paved surface and extends 15 cm from that point below grade. The lower depth of the Root Strata remains at 1.5 m below grade. The pavement is then treated as a separate structural Survey Unit within the Survey Area.

6. Define the Type of FSS Samples and Measurements

a. Select the appropriate types of samples and measurements for FSS of this Survey Unit that corresponds to the final condition and survey classification of the Survey Unit.

Not Excavated, Paved/Partially Paved or Excavated but not Backfilled:

☐ Surface Soil (<15cm) Samples.

☐ Root Strata Soil Samples composited from 15cm to 1.5m.

Note: If the SOF of the Root Strata sample exceeds 0.5, a composite sample is collect from 1.5 meters to an appropriate depth (deep stratum)

Excavated and to be Backfilled:

☑ Surface Soil Samples taken from any remaining surface soil strata and Root Strata Soil Samples taken at the same locations as Surface Samples, composited over the entire root strata.

☑ Root Strata Soil Samples composited from exposed grade to 1.5m and Deep Strata Soil Samples taken at the same locations as Root Samples of the top 15cm of the deep strata

☑ Deep Strata Soil Samples of the top 15 cm of the exposed Deep Strata.

Excavated and Backfilled

☐ Core through backfill layer to the lowest point where remediation occurred and composite a sample from a coring that extends one meter deeper than the lowest point where remediation occurred.

Scan Measurements:

☑ 100% Scan Coverage of Exposed Soil.

☐ _____% Scan Coverage of Exposed Soil.

☐ Other _____

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

7. Define Derived Concentration Guideline Levels (DCGL)

a. Select the appropriate DCGL for each Radionuclide of Concern (ROC) based on the corresponding SEA and the Uniform Conceptual Site Model (CSM).
- If Tc-99 was measured during the characterization/RASS survey, then the "Measure Tc-99" DCGLs will be used from Appendix A of HDP-PR-FSS-701.
- If Tc-99 was not measured in the characterization/RASS survey, then the modified U-235 DCGL ("Infer Tc-99") will be used from Appendix A HDP-PR-FSS-701.

	Surface Strata (pCi/g)	Root Strata (pCi/g)	Deep Strata [1] (pCi/g)	Uniform (pCi/g)
U-234	508.5	235.6	872.4	195.4
U-235	3.2	1.4	3.3	1.2
U-238	297.6	183.3	551.1	168.8
Tc-99	151	30.1	74	25.1
Th-232 + C	4.7	2	5.2	2
Ra-226 + C	5	2.1	5.4	1.9

1. The Deep Strata DCGLs correspond to the Excavation Scenario DCGL from Appendix A of HDP-PR-FSS-701.

NOTE: The Uniform DCGL will be used to calculated the number of samples in the statistical survey population.

8. Calculate the Number of Samples in the Statistical Survey Population

NOTE: The Statistical Survey Population is routinely derived based on the Uniform DCGL.
- Alternatively, if the Survey Unit excavation extends into multiple CSMs (e.g. surface, root & deep), then the DCGL(s) from the most limiting strata can be used with the equations below; OR
- If the excavation significantly extends into the deep strata, then the alternate approach presented in section 8.2.5 of HDP-PR-FSS-701 may be used for determining the mean SOF and weighted standard deviation that accounts for the reduced dose from the deeper surface, i.e., by weighting the Root stratum and Excavation $DCGL_w$ values.
- The values used in the following equations (SOF_{mean} and σ_{SOF}) can be found in the tables from Section 2b and Section 7a.

a. Calculate a mean SOF for the characterization/RASS survey data set.

$$SOF_{Mean} = \frac{Conc_{U-234}}{DCGL_{U-234}} + \frac{Conc_{U-235}}{DCGL_{U-235}} + \frac{Conc_{U-238}}{DCGL_{U-238}} + \frac{Conc_{Tc-99}}{DCGL_{Tc-99}} + \frac{Conc_{Th-232}}{DCGL_{Th-232}} + \frac{Conc_{Ra-226}}{DCGL_{Ra-226}}$$

Lower Bound of the Grey Region (LBGR) = $SOF_{Mean} = 0.26$

b. Calculate the mean and standard deviation in the SOF for the characterization/RASS survey data set.

NOTE: For the calculation of SOF_{Mean} and σ_{SOF}, include the concentration for Tc-99 if it was measured. If Tc-99 was not measured, include the modified U-235 DCGL and omit Tc-99 concentration term.

$$\sigma_{SOF} = \sqrt{\left(\left(\frac{\sigma_{U-234}}{DCGL_{U-234}}\right)^2 + \left(\frac{\sigma_{U-235}}{DCGL_{U-235}}\right)^2 + \left(\frac{\sigma_{U-238}}{DCGL_{U-238}}\right)^2 + \left(\frac{\sigma_{Tc-99}}{DCGL_{Tc-99}}\right)^2 + \left(\frac{\sigma_{Th-232}}{DCGL_{Th-232}}\right)^2 + \left(\frac{\sigma_{Ra-226}}{DCGL_{Ra-226}}\right)^2\right)}$$

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

		✓ *Used in worksheet survey design*
Survey Unit σ_{SOF} =	0.19	☐
Background σ_{SOF}=	0.22	☑

c. Define the Decision Errors.
Type I Error = 0.05 Type II Error = 0.10
NOTE: The Type II Error is set at 0.10 initially but it may be adjusted with RSO concurrence.

d. Calculate the Relative Shift.

$$\text{Relative Shift} = \frac{\text{I - LBGR}}{\sigma_{SOF}}$$

Relative Shift = 3.33

e. Is the Relative Shift between 1 and 3? Yes☐ No☑

- If "Yes", then continue to step 10f.
- If "No", then adjust the LBGR as necessary to achieve a relative shift between 1 and 3. In order to accomplish this, the LBGR may be set as low as the MDC for the analytical technique.

Adjusted LBGR = 0.43

Adjusted Relative Shift = 3.00

f. Determine the Number of Samples (N for the Sign test or N/2 for the WRS test) required corresponding to the Type I error, Type II Error and the Relative Shift.
- If the Sign Test has been chosen as the statistical test, then use Appendix E of HDP-PR-FSS-701 to determine N.
- If the WRS Test has been chosen as the statistical test, then use Appendix F of HDP-PR-FSS-701 to determine N/2.

No. of Samples (N or N/2) = 8

9. Calculate the Scan MDC for Total Uranium
- When U-235 is reported as negative or zero and U-238 is reported as positive, set the sample enrichment to 0.71% (natural uranium).
- When U-235 is reported as positive and U-238 is reported as negative or zero, set the sample enrichment to 100% (highly enriched).Note: When both U-235 and U-238 data are reported as positive, calculate the U-238/U-235 ratio for each sample and use Appendix G of HDP-PR-FSS-701, to determine the uranium enrichment that corresponds to the mean U-238:U-235 ratio.

a. Calculate and record the average Uranium enrichment for the survey unit using the enrichment calculated for each individual sample.

Average Enrichment (%) 2.73

NOTE: The Activity Fractions (f) for each radionuclide that corresponds to the mean enrichment in the following calculations is obtained from Appendix G of HDP-PR-FSS-701.
If the Uniform DCGL is not used, and the excavation extends into multiple CSMs (e.g. surface,

root & deep), then the most conservative DCGLs should be used in the following calculation.

b. Calculate a $DCGL_w$ for Total Uranium

$$DCGL_{wTotU} = \frac{1}{\frac{f_{U-234}}{DCGL_{U-234}} + \frac{f_{U-235}}{DCGL_{U-235}} + \frac{f_{U-238}}{DCGL_{U-238}}}$$

$DCGL_{wTotU}$ for Total Uranium = 25.9 pCi/g

c. Identify the Radiological Instrument that will be used for scanning.

☑ 2"x 2" NaI Detector ☐ FIDLER NaI Detector ☐ Other_____

d. Calculate the Scan MDC for the selected instrument

NOTE: 2x2 Sodium Iodide (with surveyor efficiency factor of 0.5 and a background count rate of 10,000 cpm).
If the instrument is not a 2"x 2" NaI detector, or if the background count rate exceeds 10,000 cpm, the MDC_{scan} can be determined in accordance with DP Ch. 14, section 14.4.4.2.9 (Reference 5.1) of HDP-PR-FSS-701.

$$ScanMDC = \frac{1}{\frac{f_{U-234}}{7383\,pCi/g} + \frac{f_{U-235}}{4.9\,pCi/g} + \frac{f_{U-238}}{62.8\,pCi/g}}$$

MDC_{scan} for Total Uranium = 74.7 pCi/g

10. Calculate the Scan MDC for Th-232 and Ra-226

a. Select the appropriate $DCGL_w$ for Th-232 and Ra-226 corresponding to the soil strata that will be exposed at the time of FSS and the SEA where the survey unit is located.

Th-232 $DCGL_w$ = 2 pCi/g Ra-226 $DCGL_w$ = 1.9 pCi/g

NOTE: If the Uniform DCGL is not used, and the excavation extends into multiple CSMs (e.g. surface, root & deep), then the most conservative DCGL for the strata should be used. With RSO concurrence, the alternate approach as presented in DP Ch. 14, section 14.4.3.1.10 (Reference 5.1) of HDP-PR-FSS-701 may be used in lieu of using the most conservative.

b. Identify the Radiological Instrument that will be used for scanning.

☑ 2"x 2" NaI Detector ☐ FIDLER NaI Detector ☐ Other_____

c. Calculate the Scan MDC for the selected instrument

Note: Table 6.4 of NUREG-1507 (Reference 5.8) of HDP-PR-FSS-701 has calculated an MDC_{scan} of 1.8 pCi/g for Th-232 and 2.8 pCi/g for Ra-226 when using a 2"x 2" NaI detector.

Note: If the selected instrument is not a 2"x 2" NaI detector, then the MDC_{scan} can be determined in accordance with DP Ch. 14, section 14.4.4.2.9 (Reference 5.1) of HDP-PR-FSS-701.

MDC_{scan} for Th-232 = 1.8 pCi/g MDC_{scan} for Ra-226 = 2.8 pCi/g

NOTE: If a value is not applicable, mark as N/A.

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

11. Adjust the Statistical Sample Population Size (N or N/2) for Scan MDC

a. If the survey unit is either Class 2 or 3, then proceed to step 12.

b. Divide the total area of the survey unit by the Number of Samples (N or N/2) calculated in step 8f to calculate the area bounded by the statistical sample population.
Area Bounded by the Statistical Sample Population (A_{su}) = 222.6 m^2

URANIUM

c. Is the Scan MDC for the selected instrument less than the $DCGL_w$ that was calculated for Total Uranium? (compare values from step 9b and 9d) Yes☐ No☑
(If yes proceed to step 11k)

d. Using the Area Factors in Appendix H of HDP-PR-FSS-701, calculate a Total Uranium AF for each listed area using the Activity Fractions (*f*) for each radionuclide that corresponds to the mean enrichment from Appendix G of HDP-PR-FSS-701.

$$AF_{TotU} = \frac{1}{DCGL_{w,TotU} \times \left(\frac{f_{U\text{-}234}}{AF_{U\text{-}234} \times DCGL_{w,U\text{-}234}} + \frac{f_{U\text{-}235}}{AF_{U\text{-}235} \times DCGL_{w,U\text{-}235}} + \frac{f_{U\text{-}238}}{AF_{U\text{-}238} \times DCGL_{w,U\text{-}238}} \right)}$$

Area (m^2)	153375	10000	3000	1000	300	100	30	10	3	1
AF_{TotalU}	1.00	1.11	1.12	1.12	2.02	2.72	3.64	5.20	10.62	22.64

NOTE: The AFs for the Uniform strata will generally be used. The RSO may approve use of AFs from the Surface, Root or Deep CSMs, or the Excavation Scenario.

e. Find the Area Factor (AF_{TotalU}) calculated in the previous step that corresponds to the area bounded by the Statistical Sample Population (A_{su}).
AF_{TotU} for the Bounded Area (A_{su}) = 2.3

f. Multiply the $DCGL_w$ calculated for Total Uranium by the Area Factor (AF_{TotU}) to derive a $DCGL_{EMC}$ for Total Uranium.
$DCGL_{EMC}$ for Total Uranium = 58.81 pCi/g

g. Is the MDC_{scan} for the selected instrument less than the $DCGL_{EMC}$ that was calculated for Total Uranium? NA☐ Yes☐ No☑
(If "Yes" then proceed to step 11k.)

h. Calculate a new AF (AF_{EMC}) corresponding to the MDC_{scan} for the selected instrument by dividing the MDC_{scan} by the DCGLw.
AF_{EMC} for Utotal = 2.9

i. Find the Area (A') that corresponds to the Area Factor (AF_{EMC}).
A' for Utotal = 80.9

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

j. Calculate an Adjusted Number of Samples (N_{EMC}) for the Statistical Sample Population size that corresponds to the bounded A_{EMC}.

$$N_{EMC} = \frac{A_{SU}}{A'}$$

N_{EMC} corresponding to A' for Utotal = 23.0

THORIUM-232

k. Is the MDC_{Scan} for Th-232 less than the $DCGL_W$? Yes☑ No☐
(If "Yes" then proceed to step 11r)

l. Find the Area Factor (AF) in Appendix H that corresponds to the area bounded by the Statistical Sample Population (A_{SU}).

AF_{Th-232} for the Bounded Area (A_{SU}) = NA

m. Multiply the $DCGL_W$ for Th-232 by the Area Factor (AF) to derive a $DCGL_{EMC}$ for Th-232
$DCGL_{EMC}$ for Th-232 = NA pCi/g

n. Is the MDC_{scan} for Th-232 less than the $DCGL_{EMC}$ that was calculated for Th-232?
NA☑ Yes☐ No☐
(If "Yes" then proceed to step 11r)

o. Calculate a new AF (AF_{EMC}) corresponding to the MDC_{scan} for the selected instrument by dividing the MDC_{scan} by the $DCGL_W$.
AF_{EMC} for Th-232 = NA

p. Find the Area (A') that corresponds to the Area Factor (AF_{EMC}).
A' for Th-232 = NA

NOTE: The Area Factors for Th-232 can be found in Appendix H of HDP-PR-FSS-701.

q. Calculate an Adjusted Number of Samples (N_{EMC}) for the Statistical Sample Population size that corresponds to the bounded A_{EMC}.

$$N_{EMC} = \frac{A_{SU}}{A'}$$

N_{EMC} corresponding to A' for Th-232 = NA

RADIUM-226

r. Is the MDC_{Scan} for Ra-226 less than the $DCGL_W$? Yes☐ No☑
(If "Yes" then proceed to step 12)

s. Find the Area Factor (AF) in Appendix H that corresponds to the area bounded by the Statistical Sample Population (A_{SU}).
AF_{Ra-226} for the Bounded Area (A_{SU}) = 3.03

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

t. Multiply the $DCGL_w$ for Ra-226 by the Area Factor (AF) to derive a $DCGL_{EMC}$ for Ra-226
$DCGL_{EMC}$ for Ra-226 = 5.75

u. Is the MDC_{scan} for Ra-226 less than the $DCGL_{EMC}$ that was calculated for Ra-226?
NA☐ Yes☑ No☐

(If "Yes" then proceed to step 12)

v. Calculate a new AF (AF_{EMC}) corresponding to the MDC_{scan} for the selected instrument by dividing the MDC_{scan} by the $DCGL_w$
AF_{EMC} for Ra-226 = NA

w. Find the Area (A') that corresponds to the Area Factor (AF_{EMC}).
A' for Ra-226 = NA

x. Calculate an Adjusted Number of Samples (N_{EMC}) for the Statistical Sample Population size that corresponds to the bounded A_{EMC}.

$$N_{EMC} = \frac{A_{SU}}{A'}$$

N_{EMC} corresponding to A' for Ra-226 = NA

12. Calculate the Grid Spacing

a. Larger of N from step 8f and the maximum value of N_{EMC} from 11j, 11q or 11x.
(N_{EMC}[max] or N) = 23

b. Is the Survey Unit a Class 3 Survey Unit? Yes☐ No☑
(If "Yes", then continue to step 13)

c. Calculate Grid Spacing (L).

☑ Triangular Grid $L = \sqrt{\frac{Area}{.866(N \text{ or } N/2)}}$ ☐ Square Grid $L = \sqrt{\frac{Area}{(N \text{ or } N/2)}}$

Grid Spacing (L) for Survey Unit = 9.46 m

13. Generate a Survey Map

a. Assign a unique identification number to each sample in the Statistical Sample Population using the guidance and direction provided in Appendix M of HDP-PR-FSS-701.
b. Generate a graphic representation of the Survey Unit with dimensions and boundaries corresponding to the established referenee coordinate system in accordance with step 8.2.10 of HDP-PR-FSS-701.
c. Using the reference coordinate system, ascertain coordinates for each sample location.
d. Designate sample locations, and location coordinates on Appendix P-4, *FSS Sample & Measurement Locations & Coordinates* and attacb a copy of that form to this FSSP.
e. Attach a copy of the developed Survey Map with sample locations to this FSSP.

14. QC & Biased Samples

a. Randomly choose 5% of the Statistical Sample Population as QC Samples in accordance with

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

HDP-PR-FSS-703, *Final Status Survey Quality Control* (Reference 5.9) of HDP-PR-FSS-701.

b. Designate QC sample locations, and location coordinates on attached Appendix P-4, *FSS Sample & Measurement Locations & Coordinates.*
c. Designate if any biased samples will be taken at the discretion of the survey designer and the basis for taking them. Necessary biased samples will be explained on Appendix P-3, *FSS Sample Instructions.*
d. Using the reference coordinate system, determine coordinates for each biased sample location.
e. Designate biased sample locations, and location coordinates on attached Appendix P-4, *FSS Sample & Measurement Locations & Coordinates.*

15. Scan Coverage

a. The Survey Unit is: ☑ Class 1 ☐ Class 2 ☐ Class 3

b. Based on the Survey Unit Classification, the scan coverage in this Survey Unit is;
☑ 100% Scan Coverage of exposed soil ☐ _____% Scan Coverage of exposed soil

c. Designate any specific scan locations as determined necessary, on Appendix P-3, *FSS Sample Instructions* and attach a copy of that form to this FSSP.

16. Investigation Levels

a. The Survey Unit is: ☐ Class 3

1) Scan Investigation Levels are set at: NA cpm

Sample Investigation Levels are set at 50% of the $DCGL_w$ when expressed as the SOF.

b. The Survey Unit is: ☐ Class 2

2) Scan Investigation Levels are set at: NA cpm

Sample Investigation Levels are set at the $DCGL_w$ when expressed as the SOF.

c. The Survey Unit is: ☑ Class 1

3) Scan Investigation Levels are set at: 1352 cpm

Sample Investigation Levels are set at the $DCGL_w$ when expressed as the SOF.

17. Survey Instructions and Sample Measurement Locations and Coordinates FSSP Approval

Attach a copy of completed forms as appropriate:

☑ Appendix P-3, *FSS Survey Sample Instructions,*
☑ Appendix P-4, *FSS Sample Measurement Locations & Coordinates*
☐ Appendix P-5, *FSS Unit Classification Change Form*
☑ Appendix P-6, *FSS Field Log*
☑ Survey Unit Figure
☐ Other:

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

18. FSSP Approval

	(Print Name)	(Signature)	(Date)
Prepared by :	Michelle Bresnahan		8/15/13
Peer Reviewed by :	Rock Nevem		8-15-13
Approved by (RSO):	Joseph Guim		8-15-13

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-3
FSS SAMPLE INSTRUCTIONS

Survey Area: 05 **Description:** Barns and Cistern Open Land Area
Survey Unit: 01 **Description:** Limestone Slope Area (portion of LSA 05-01, including Spring Pipe Section #2)

Comments: REVISION 3: 8/15/2013

The Limestone Fill Area #1 is an open land area located southwest of Building 101 (also referred to as the Tile Barn). The surface grade within this open land area was raised by placing fill composed of limestone that had been previously used in the ventilation exhaust scrubber system.

During remediation activities in LSA 05-01 it was found limestone had been used to fill a sloped area near State HWY P, which runs adjacent to the survey unit. This area was not immediately remediated due to concerns with removing the material might affect HWY P's support structure. The Missouri Department of Transportation (MoDOT) was notified of this issue, and stated the sloped area near HWY P could be remediated to a 1:1 slope and backfilled with material to a minimum 2:1 slope.

While the slope is being remediated (and until the backfill operation is complete) HDP would be responsible for closing down the left lane (closest to LSA 05-01) of HWY P and provide traffic control.

HDP will conduct excavation activities of the sloped area of LSA 05-01 to remove the limestone fill present to a 1:1 slope. While the area is excavated and before backfill operations begin, HDP will conduct FSS of the sloped area of LSA 05-01. The following instructions explain how FSS of the sloped area of LSA 05-01, including the footprint of Spring Pipe Section #2 will be conducted.

Please note the following instructions cover the portion of systematic and biased FSS samples and FSS scans that fall within the sloped area boundary of LSA 05-01. Further instruction is provided for taking the rest of the systematic and biased FSS samples and FSS scans that cover the LSA 05-01 survey unit.

The survey unit is classified as MARSSIM Class 1.

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-3
FSS SAMPLE INSTRUCTIONS

Gamma Walkover Survey (GWS):	
Scan Coverage	100% of Accessible Excavation Floor and Wall Surfaces
Scan MDC	74.7 pCi/g Total Uranium (unsaturated soil) 97.6 pCi/g Total Uranium (saturated soil) [1]
Investigation Action Level (IAL)	1,352 Net CPM* *After GWS is performed, the data will be examined to confirm areas exceeding the calculated IAL and statistical analysis will determine significance.

Systematic Sampling Locations:		
Depth	Number of Samples	Comments: Water intrusion has caused less than five percent (<5%) of the floor surfaces adjacent to the toe of the slope (within the footprint of Spring Pipe Section #2) to be underwater and not accessible for scan survey. See the "Specific Instructions" section for compensatory measures that will be used to characterize areas not immediately accessible for scan surveys.
0 – 15 cm	4	
15 cm – 1.5 m	15	
> 1.5m	12	

Biased Survey/Sampling Locations:

Biased samples may be collected during Gamma Walkover Surveys (at the discretion of the HP Technician), after statistical analysis of the survey data, or at the direction of Radiological Engineering.

Inaccessible (Underwater) Sample Locations:

Samples will be collected at three stations located within areas that will be underwater. Two samples will be collected from each location (for a total of 6 samples). See Appendix P-4 for detail regarding the depth and location of these samples.

Limestone Slope Area: **NOTE:** The purpose of the following biased samples on the slope are to determine the extent of limestone that extends beyond a 1:1 slope, therefore the following samples may be taken prior to isolation and control or any time prior to backfill.

Both vertical and horizontal cores will be used to collect samples from the sloped area containing limestone.

- **VERTICAL SAMPLES:** Samples will be collected by coring vertically down into the sloped limestone area from 9 stations located on the sloped surface leading up to State Road P. Two samples will be collected from each station for a total of 18 samples.
- **HORIZONTAL SAMPLES:** Samples will be collected by coring horizontally into the sloped limestone area from 5 stations located on the sloped surface near State Road P. Two samples will be collected from each station for a total of 10 coring locations. The first sample will be collected to determine the extent of limestone remaining on the hillside. The second sample will collect the remaining 6-inches of soil past the depth of remaining limestone.

If no limestone is present, sample the first 6-inches of soil; then sample the next 6-inches of soil. See details from the instructions and the maps provided in subsequent sections of this survey instruction.

(For additional detail, see "Biased Sampling - Slope Near Highway P" section attached)

Instrumentation	
Ludlum 2221 with 44-10 (2x2 NaI) detector	Used for gamma walkover survey and to obtain static count rates at biased measurement locations.

1. Reference 1, Attachment 1.

General Instructions:

1. Summarize daily work activities on the log sheets provided in Appendix P-6. Provide a description of site conditions (including the condition of isolation controls), samples collected and the progress of gamma walkover surveys for every shift that involves work in this survey unit.
2. In accordance with HDP-PF-FSS-701, Final Status Survey Plan Development (Sec. 8.4.2), documentation of activities performed, equipment used, and potential safety hazards that may be encountered during the performance of characterization activities (along with associated controls) will be documented using the FSS Daily Task Briefing log sheet.

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-3
FSS SAMPLE INSTRUCTIONS

3. A gamma walkover survey (GWS) will be performed using a 2"x2" NaI(Tl) detector held at a distance as close as possible to the surface being surveyed. The meter will be moved in a serpentine pattern at a speed of approximately 1-foot per second or less. The GWS will cover the percentage of the accessible surface areas within the area of interest as indicated above. Notify Radiological Engineering of any areas, conditions or constraints (outside of the anticipated issues addressed in this survey instruction) where surveying/sampling may not be possible. Document the conditions and any resolutions in the FSS Field Log.
4. A GPS system and data logger should be interfaced with the meter. The downloaded information will then be used to prepare maps, illustrating relative count rates and to perform statistical analysis of the data. If a GPS data logging system is not available, contact Radiological Engineering to determine specific instructions for performing and documenting gamma walkover surveys.
5. Class 1 Open Land Survey Units are gridded to identify the systematic sampling locations. Each sample location will have associated GPS coordinates specified. In the case of inaccessible sampling locations, the sample location will be relocated within a radial distance of 2 feet of the original location. A map of the survey unit showing the systematic sample locations with associated GPS coordinates is attached.
6. Verify that isolation controls are established in accordance with HDP-PR-HP-602 prior to the start of FSS.
7. Perform daily pre- and post-QC source checks in accordance with HDP-PR-HP-416.
8. A map of the survey unit showing any biased sample locations with associated GPS coordinates is attached. If biased samples are taken during or as a result of the GWS, their locations will be added to the map.
9. Biased soil sampling will be performed as indicated in these instructions. Biased sample locations will be selected by the HP Technician during the performance of GWS or as determined by Radiological Engineering after a review of the GWS data. Biased soil samples will be collected in a manner similar to systematic soil sampling locations. Record the location of any biased samples collected not already listed on Appendix P-4 of HDP-PR-FSS-701 on the Field Log (Appendix P-6 of HDP-PR-FSS-701).
10. At each soil sampling location a composite soil sample will be collected from each location and depth listed on Appendix P-4 of HDP-PR-FSS-701.

Specific Instructions:

Before Beginning Work

1. Rad. Engineer/HP Technician: Verify and document (each shift) that isolation controls established in accordance with HDP-PR-HP-602 are in place prior to the start of FSS using the Daily Task Briefing log sheet.
2. Rad. Engineer/HP Technician: Perform a daily task-specific briefing: documenting the attendants, planned work activities, anticipated hazards, and controls on FSS Daily Task Briefing log sheet. Retain all completed daily briefing log sheets in the Field Log section of this package.

   NOTE: If soil sampling to a depth greater than one-foot is required, ensure HDP Safety & Health are aware of the activity, underground utilities have been identified, and (if deemed necessary) an Excavation Permit (Form HDP-PR-EHS-021-1) has been performed for the work area.

Gamma Walkover Surveys (GWS)

1. Establish a general area background, in accordance with HDP-PR-FSS-711.
2. Perform a gamma walkover of the survey unit holding the probe as close to the surface as possible, in accordance with HDP-PR-FSS-711.
   a. Look and/or listen for locations that exhibit anomalous readings (e.g., count rates in excess of the area background count rate and/or count rates that exceed the IAL for this unit).
   b. Mark the location(s) exhibiting anomalous readings to facilitate possible future investigations (for example, use a flag, stake, or other marking resistant to anticipated environmental conditions).
3. At each location where anomalous readings occur, perform a more detailed point survey of the area. Pause and place the survey probe as close as possible to the surface to define and record the total count rate associated with the area of interest on the Field Log.

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-3
FSS SAMPLE INSTRUCTIONS

NOTE: If field conditions limit the ability to perform contact readings, collect readings as close as practical. Contact HP Supervisor (or Radiological Engineering) regarding the issue for each location. The HP Technician, HP Supervisor and/or Radiological Engineer will log the issue (and resolution) for each location in the FSS Field Log and on applicable HDP survey forms.

4. **GPS (and associated data logger) is the preferred method for performing GWS.**

When a GPS and data logger is used, down load and provide the survey data to a GIS Specialist.

a. **GIS Specialist**: Provide colorimetric maps indicating survey coverage and measurements exceeding the IAL and send the survey data to Radiological Engineering.

b. **Radiological Engineering**: Provide statistical analysis to determine population characteristics of the survey data set and identify any areas requiring additional surveys or sampling. Contact HP Technician to mark additional locations requiring survey or sampling as described above in Step 5 of these Specific Instructions.

If a GPS and data logger cannot be used to perform GWS in any portion of this survey unit, the HP Technician will contact Radiological Engineering to determine compensatory survey methods. Radiological Engineering will log the compensatory methods in the FSS Survey Log.

Areas Submerged Underwater

1. If a portion of the survey unit is underwater, direct the excavation of soil within the area covered by water to a depth of at least 6 – 12 inches.
   a. Place the excavated soil onto geotextile fabric to define the depth of material removed.
   b. Spread to a depth of approximately 6 inches to prepare the excavated soil for GWS survey..
2. Perform a GWS of 100% of surface of the excavated soil in accordance with HDP-PR-FSS-711.
   a. Move at a speed of 1-foot per second or less. Swing the survey probe in a serpentine pattern with a swing radius approximately "shoulder-to-shoulder" (e.g., approx. 9-in on either side of the centerline.)
   b. If a count rate in excess of the IAL is identified, notify Radiological Engineering for further instruction.

Sampling

1. Collect soil samples in accordance with HDP-PR-FSS-711at locations identified on Appendix P-4 of HDP-PR-FSS-701. Note: If a sample location is under water, the sample may be obtained using a hand auger.

   NOTE: The sample depths have been determined based on the limestone slope being excavated to a 1:1 slope. After excavation of the slope is complete, if the depth of excavation does not reach a 1:1 slope, the sample depths will be reviewed and, if necessary, recalculated to ensure the samples are taken at the appropriate depth.
2. Collect one duplicate sample for every 20 systematic samples. A minimum of one duplicate sample is required for each survey unit.
3. If directed by Radiological Engineering, collect a soil sample at locations that were marked/flagged during the GWS.
4. Document all samples collected on the Field Log (Appendix P-6).
5. Care should be exercised to ensure the entire sample is included from within the depths specified for sampling. When collecting composite samples, vegetation and native debris/rocks with a diameter greater than 1 inch may be discarded.
6. All samples collected as part of this survey will be analyzed at an off-site laboratory by gamma spectroscopy for uranium and gamma emitting radionuclides (Th-232, Am-241, etc.), and for Tc-99 by liquid scintillation counting or ICPMS.
7. Submit all samples for analysis following sample chain of custody requirements contained in HDP-PR-QA-006.

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-3
FSS SAMPLE INSTRUCTIONS

Biased Sampling: Slope Near Highway P

Eight investigation samples were previously collected from three core sampling locations following the initial excavation on the slope adjacent to Highway P.

- Three samples were collected from the first core sampling location (located closest to LSA 05-02) at depths 0.5'-1.0', 1.5'-2.0' and 3.0'-3.5'.
- Three samples were collected from the second core sampling location (center) at depths 1.5'-2.0', 4.0'-4.5' and 5.0'-5.5'.
- Two samples collected from the third sample location (located closest the tree stump) at depths 1.5'-2.0' and 2.5'-3.0' (refusal at 3.0').

Based on these sample results (documented on Appendix G-2 of HDP-PR-FSS-721, attached), further sampling is necessary following excavation to adequately show the survey unit is acceptable for unrestricted release.

Nine additional vertical core sampling locations have been defined to adequately bound the area of elevated activity identified by the initial investigation samples, and to provide a defined area for applying the elevated measurement comparison (EMC) evaluation.

Instructions:

1. Locate the 9 vertical core sampling locations on the slope near Highway P located in LSA 05-01as indicated on the attached map.
2. Samples will be taken vertically into the slope (perpendicular to level ground).
3. At each of the 9 locations, 2 samples will be collected (which will result in a total of 18 samples).
    a. The first (top) sample will be a composite sample through the depth of the limestone material remaining on the slope after excavation. Note, if no limestone material remains, a sample will be taken to a depth of 6 inches.
    b. The second (bottom) sample will be taken of top 6 inches of soil beneath the limestone or directly below the top 6 inch sample.
4. Locate the 5 horizontal core sampling locations. Collect horizontal core samples through the thickness of limestone material remaining on the slope (approximately parallel to surface grade of the survey unit).

    NOTE: These horizontal core sample locations will be defined following the removal of the slope containing the limestone to the extent possible, and placed at locations where visual inspection identifies that limestone remains within the slope.
5. Collect the 5 horizontal core samples in the same manner as the 9 vertical core samples.
    a) The first sample will be a composite sample through the extent of limestone material remaining.
    b) The second sample will be taken of the following 6 inches of material beyond the limestone.
6. Document the depth and location (coordinates) of the horizontal core samples on the Field Log (Appendix P-6).

Prepared by:	Michelle Bremaker (Print Name)	(Signature)	8/15/13 (Date)
Peer Reviewed by:	Rock Nevcan (Print Name)	(Signature)	8-15-13 (Date)
Approved by (RSO):	Joseph Guzzo (Print Name)	(Signature)	8-15-13 (Date)

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-3
FSS SAMPLE INSTRUCTIONS

ATTACHMENT 1

The following compensatory measures are in response to the inability to conduct an in-situ scan survey in portions of the survey unit that are underwater or may become submerged under water during the work associated with remediation of this survey unit. These measures have been implemented within portion of the survey unit; and will be implemented within the balance of the survey unit following NRC concurrence.

- **Ex-situ Scan Surveys:** These measurements serve to confirm the absence of gamma-emitting radionuclides in excavated soil at concentrations that exceed the IAL. Based on these measurements, it can be reasonably inferred that any residual concentrations remaining within the excavation would also not result in a scan survey result that exceeds the IAL. A scan MDC was calculated for saturated soils excavated from portions of a survey unit that are underwater. The scan MDC for saturated soil conditions is greater than the calculated scan MDC, and therefore the IAL remains unchanged. The MDC for these measurements is diminished slightly (approximately 10 percent of the efficiency value) due to the extremely saturated condition of the soil. (See subsequent sections in this attachment)
- **Excavation Depth:** Extensive sampling was conducted during the RASS to identify the location and depth of Tc-99 contamination in limestone and in underlying soil. The sampling was conducted by making three core borings with samples obtained at the bottom of each boring. Two of the three locations (4525-RA-130304-05-12 and 4424-RA-130219-09-05) showed the depth of contamination to extend to less than two feet below the excavation surface at that time. The third boring (4441-RA-130220-09-06) showed residual Tc-99 at a concentration that was approximately two times the DCGL at a depth of one foot below the surface of the excavation at that time.

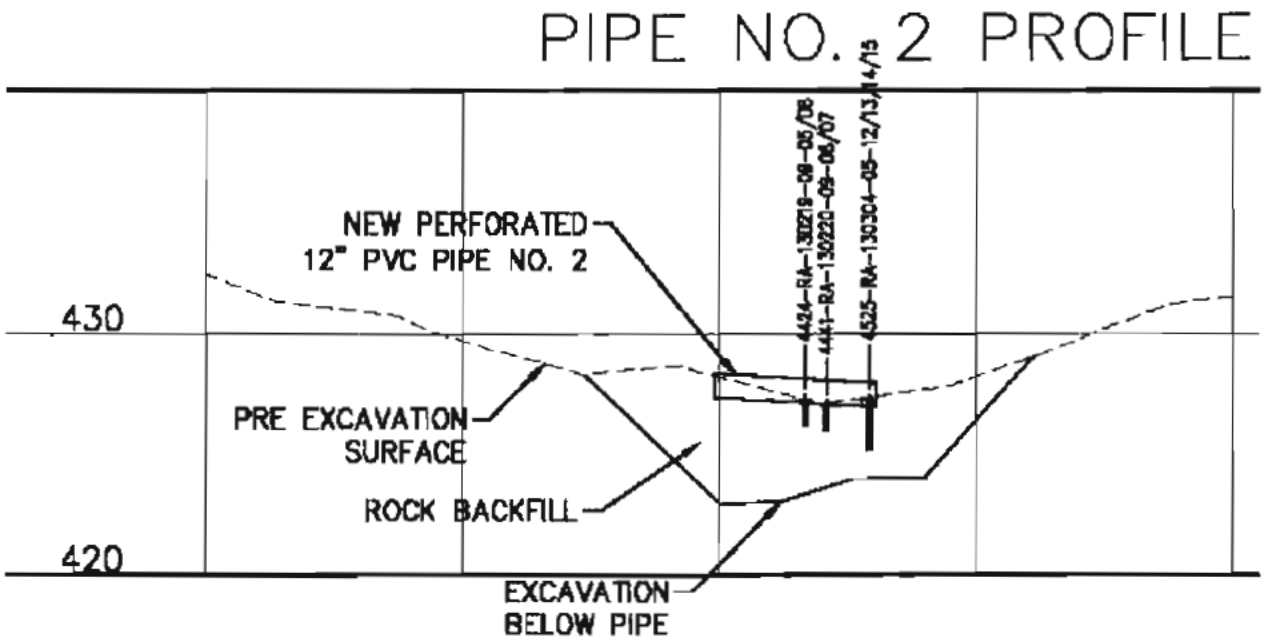
  As a part of the design for the piping installation, this information was considered to ensure that the excavation for placement of the piping exceeded the known depth of the contamination. The excavation was completed approximately one foot below the deepest coring, and slightly more than two feet below the sample showing residual Tc-99 at approximately two times the DCGL.
- **Biased Sampling:** In the absence of scan survey data, the basis for selecting the biased sampling locations considers the submerged portions of the survey unit (and therefore cannot be directly scanned) and the locations that will be inaccessible for excavation following piping installation. in the event that residual radioactivity exceeds the expected concentrations. In the event that residual radioactivity exceeds the expected concentrations the amount of analytical data obtained from the biased sampling locations is expected to provide adequate information to support the derivation of an average concentration.
- **Excavation Depth:** The following table includes the data summary of the samples obtained from core boring, and the subsequent figure illustrates the depth of contamination relative to the final depth of the excavation.

The core boring (4441-RA-130220-09-06) showed residual Tc-99 at a concentration that was approximately two times the DCGL at a depth of one foot below the surface of the excavation at that time, however with the removal of an additional two feet of soil, it is reasonable to expect that residual radioactivity, if any, will not exceed the DCGL. This assumption is consistent with reduction in concentration with increasing depth exhibited by the sample results contained in the section entitled RASS Data and Figures in the LSA-05-01 survey instruction package.

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-3
FSS SAMPLE INSTRUCTIONS

RASS Samples collected in the location of Spring Pipe No. 2

Station	X	Y	Ra-226	Th-232	U-235	U-238	U-234	Tc-99	Depth Top	Depth Bottom
4525-RA-130304-05-12	826543.6	864563.6	-0.11	-0.38	0.00	0.00	0.00	51.50	0.0	0.5
4525-RA-130304-05-13	826543.6	864563.6	-0.04	-0.26	0.18	0.00	5.96	58.40	0.5	1.0
4525-RA-130304-05-14	826543.6	864563.6	-0.09	-0.52	0.11	0.00	3.50	51.20	1.0	1.5
4525-RA-130304-05-15	826543.6	864563.6	-0.21	-0.55	0.00	0.00	0.00	19.30	1.5	2.0
4441-RA-130220-09-06	826544.5	864568.6	0.05	-1.00	0.24	0.00	7.80	51.80	0.0	0.5
4441-RA-130220-09-07	826544.5	864568.6	-0.12	-1.00	0.10	0.00	3.13	67.80	0.5	1.0
4424-RA-130219-09-05	826544.2	864571.4	0.09	-1.00	0.22	0.00	7.18	60.30	0.0	0.5
4424-RA-130219-09-06	826544.2	864571.4	0.05	-0.70	0.21	0.00	6.79	23.10	0.5	1.0



Scan Sensitivity: The following graph represents a comparison of the scan MDC for saturated and unsaturated soil, and the corresponding MicroShield reports include the results for each of the uranium isotopes. As shown in the graph, the scan MDC is approximately 20% higher for saturated soils.

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-4
FSS SAMPLE & MEASUREMENT LOCATIONS & COORDINATES

Survey Area: No. 05 **Description:** Barns and Cistern Open Land Area

Survey Unit: No. 01 **Description:** Limestone Slope Area (Portion of LSA 05-01)

Survey Type: Soil Sampling **Classification:** 1

Measurement or Sample ID	Surface or CSM	Type	Start Depth (feet)	End Depth (feet)	Easting (X Axis)*	Northing (Y Axis)*
L050119TSS00	Surface	S	0	0.5	826499.8	864485.5
L050119TSQ00	Surface	Q	0	0.5	826499.8	864485.5
L050120TRS00	Root	S	0.5	5	826499.8	864485.5
L050121TS500	Surface	S	0	0.5	826526.0	864478.5
L050122TR500	Root	S	0.5	5	826526.0	864478.5
L050125TRS00	Root	S	0	3	826519.0	864504.7
L050126TES00	Deep	S	3	3.5	826519.0	864504.7
L050127TRS00	Root	S	0	4	826545.2	864497.7
L050128TES00	Deep	S	4	4.5	826545.2	864497.7
L050131TR500	Root	S	0	2.5	826512.0	864530.9
L050132TES00	Deep	S	2.5	3	826512.0	864530.9
L050133TRS00	Root	S	0	4	826538.2	864523.9
L050134TES00	Deep	S	4	4.5	826538.2	864523.9
L050139TES00	Deep	S	0	0.5	826531.2	864550.1
L050139TEQ00	Deep	Q	0	0.5	826531.2	864550.1
L050140TR500	Root	S	0	2	826557.4	864543.1
L050141TES00	Deep	S	2	2.5	826557.4	864543.1
L050146TS500	Surface	S	0	0.5	826524.1	864576.4
L050147TR500	Root	S	0.5	5	826524.1	864576.4
L050148TR500	Root	S	0	2	826550.4	864569.3
L050149TES00	Deep	S	2	2.5	826550.4	864569.3
L050154TRS00	Root	S	0	0.5	826543.3	864595.6
L050155TES00	Deep	S	0.5	1	826543.3	864595.6
L050156TRS00	Root	S	0	1	826569.6	864588.6
L050157TES00	Deep	S	1	1.5	826569.6	864588.6
L050162TRS00	Root	S	0	4.5	826562.6	864614.8
L050163TE500	Deep	S	4.5	5	826562.6	864614.8
L050164TRS00	Root	S	0	0.5	826588.8	864607.8
L050165TE500	Deep	S	0.5	1	826588.8	864607.8
L050169TSS00	Surface	S	0	0.5	826555.5	864641.0
L050170TRS00	Root	S	0.5	5	826555.5	864641.0
L050171TRS00	Root	S	0	2.5	826581.8	864634.0
L050172TES00	Deep	S	2.5	3	826581.8	864634.0
L050101TUB00	Uniform	B	0	Limestone Extent	826530.5	864559.6
L050102TUB00	Uniform	B	Limestone Extent	0.5	826530.5	864559.6
L050103TUB00	Uniform	B	0	Limestone Extent	826543.5	864567.1
L050104TUB00	Uniform	B	Limestone Extent	0.5	826543.5	864567.1
L050105TUB00	Uniform	B	0	Limestone Extent	826530.5	864574.6
L050106TUB00	Uniform	B	Limestone Extent	0.5	826530.5	864574.6

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-4
FSS SAMPLE & MEASUREMENT LOCATIONS & COORDINATES

L050107TUB00	Uniform	B	0	Limestone Extent	826543.5	864582.1
L050108TUB00	Uniform	B	Limestone Extent	0.5	826543.5	864582.1
L050109TUB00	Uniform	B	0	Limestone Extent	826530.5	864589.6
L050110TUB00	Uniform	B	Limestone Extent	0.5	826530.5	864589.6
L050111TUB00	Uniform	B	0	Limestone Extent	826543.5	864597.1
L050112TUB00	Uniform	B	Limestone Extent	0.5	826543.5	864597.1
L050113TUB00	Uniform	B	0	Limestone Extent	826543.5	864612.1
L050114TUB00	Uniform	B	Limestone Extent	0.5	826543.5	864612.1
L050115TUB00	Uniform	B	0	Limestone Extent	826556.5	864619.6
L050116TUB00	Uniform	B	Limestone Extent	0.5	826556.5	864619.6
L050117TUB00	Uniform	B	0	Limestone Extent	826556.5	864634.6
L050118TUB00	Uniform	B	Limestone Extent	0.5	826556.5	864634.6
L050190TUB00	Uniform	B	0	0.5	826552.8	867580.6
L050191TUB00	Uniform	B	0.5	1	826552.8	867580.6
L050192TUB00	Uniform	B	0	0.5	826550.7	864568.5
L050193TUB00	Uniform	B	0.5	1	826550.7	864568.5
L050194TUB00	Uniform	B	0	0.5	826546.4	864557.3
L050195TUB00	Uniform	B	0.5	1	826546.4	864557.3

* Distance in feet from southwest corner of the surface.
Surface: Floor = F, Wall = W, Ceiling = C, Roof = R
CSM: Surface, Roof, Deep or Uniform
Type: Systematic = S, QC = Q, Biased = B, Investigation = I

Note: If no visible limestone is left in the area where the biased samples are to be taken, the start and end depths of the biased samples will change to the top 6 inches and bottom 6 inches of the soil left after excavation. (e.g. Sample L050101TUB00 will have a start depth of 0 and an end depth of 0.5.)

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-3
FSS SAMPLE INSTRUCTIONS

Survey Area:	05	**Description:**	Barns and Cistern Open Land Area
Survey Unit:	01	**Description:**	Spring House Foundation (portion of LSA 05-01)

The Limestone Fill Area #1 is an open land area located southwest of Building 101 (also referred to as the Tile Barn). The surface grade within this open land area was raised by placing fill composed of limestone that had been previously used in the ventilation exhaust scrubber system.

During remediation, a concrete foundation was found imbedded in the sloped portion of LSA 05-01. The foundation consists of 3 different sections, a flat (floor) portion that is approximately 8 feet wide, a concrete piece that is perpendicular on one end to the flat portion (left wall) and a third concrete piece perpendicular to the other end of the flat portion (right wall). The foundation will be sampled and surveyed in accordance with the instructions in the section below titled Survey and Sampling of Concrete Foundation.

The surveys will be performed in accordance with HDP-PR-HP-311 and will be compared to the limits found in document *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material.*

END OF COMMENTS

Meters B, I or D (Ludlum 2360 w/ 43-89) will be selected to perform the following surveys. See attached sheets (Minimum Detectable Concentration (MDC) Worksheet) for scan MDC and IAL calculations.

Surface Contamination Survey (SCS):	
Scan Coverage	100% exposed surfaces
Meter B: Alpha Scan MDC	82 dpm/100cm^2
Meter B: Beta Scan MDC	2,057 dpm/100cm^2
Meter B: Alpha Investigation Action Level (IAL)	15 Net CPM
Meter B: Beta Investigation Action Level (IAL)	218 Net CPM
Meter I: Alpha Scan MDC	110 dpm/100cm^2
Meter I: Beta Scan MDC	2,725 dpm/100cm^2
Meter I: Alpha Investigation Action Level (IAL)	19 Net CPM
Meter I: Beta Investigation Action Level (IAL)	252 Net CPM
Meter D: Alpha Scan MDC	169 dpm/100cm^2
Meter D: Beta Scan MDC	2,023 dpm/100cm^2
Meter D: Alpha Investigation Action Level (IAL)	27 Net CPM
Meter D: Beta Investigation Action Level (IAL)	217 Net CPM

Systematic Surface Contamination Measurements:
Number of Locations
A measurement will be performed on the surface of the foundation approximately every linear meter. A minimum of one measurement will be performed.

Biased Surface Contamination Measurements:
If the scan result is greater than either the alpha or beta IAL listed above, take a static measurement and a removable activity smear. Collect 3 volumetric samples from 0" to 0.25" depth at locations with the highest static measurements. Volumetric samples will be sent to an offsite laboratory for analysis by gamma spectroscopy and liquid scintillation or ICPMS for Tc-99.

Instrumentation	
Ludlum 2360 w/ 43-89	Used for direct alpha and beta measurements and surface contamination scan surveys.

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-3
FSS SAMPLE INSTRUCTIONS

General Instructions:

1. Summarize daily work activities on Appendix P-6. Provide a description of site conditions (including the condition of isolation controls), samples collected and the progress of surveys.
2. Verify isolation and controls are established in accordance with HDP-PR-HP-602 prior to beginning FSS.

Survey and Sampling of Concrete Foundation

1. Perform daily pre QC source check on the instrument used in accordance with HDP-PR-HP-411. Perform a post QC source check in the same manner you would perform a pre QC source check. Note in the comment section of Form HDP-PR-HP-411-4 when post QC check is performed.
2. Perform 3 background measurements in alpha mode and 3 background measurements in beta mode in the general location of the area to be surveyed. The average of the 3 measurements for alpha and the 3 measurements for beta will be the field background used.
3. Perform a surface contamination scan survey over 100% of the exposed concrete surfaces in accordance with HDP-PR-HP-311. Hold the detector as close as possible to the surface being surveyed. Move the meter at a speed of approximately 3 inches per second.
4. Perform static surface contamination measurements at systematic locations defined in the above table in accordance with HDP-PR-HP-311. At each measurement location a 1 minute static count will be performed.
5. If results in excess of the IAL are found, follow the instructions listed above under Biased Surface Contamination Measurements.
6. In the locations where a static surface contamination measurement is taken, collect a removable activity smear survey in accordance with HDP-PR-HP-311.
7. Document all surveys performed on items found in the survey unit on Form HDP-PR-HP-311-1.

Prepared by:	Michelle Bresnahan (Print Name)	(Signature)	8/14/13 (Date)
Peer Reviewed by:	Rock Nevem (Print Name)	(Signature)	8-14-13 (Date)
Approved by (RSO):	Joseph Gurley (Print Name)	(Signature)	8-15-13 (Date)

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-3
FSS SAMPLE INSTRUCTIONS

Survey Area:	05	**Description:**	Barns and Cistern Open Land Area
Survey Unit:	01	**Description:**	Red Room Roof / Limestone Fill / Cistern Burn Pit Area

Comments: The Cistern Burn Pit open land area is located southwest of Building 101. This feature was created during the agricultural use of this property to collect water for livestock consumption. Circa 1960 – 1974, this was the location where wooden pallets and other combustible wastes that may have contained radioactive material were incinerated. Note that the following two portions of the site are included in the portion of the site designated as the Cistern Burn Pit Area.

The Limestone Fill Area #1 is an open land area located southwest of Building 101 (also referred to as the Tile Barn). The surface grade within this open land area was raised by placing fill composed of limestone that had been previously used in the ventilation exhaust scrubber system. During excavation of the limestone, a 14 inch diameter perforated PVC pipe was exposed that ran through the center track of the survey unit. This pipe was installed during the timeframe the limestone was being placed as fill. The purpose of the pipe was to divert the natural spring water that runs through the survey unit to the Site Pond. After this pipe was exposed, it was apparent it was not sufficient to manage the amount of water flowing from the spring into the Unit and therefore the Unit was often flooded. Also, results from samples taken where the pipe was located indicated limestone was placed below where the pipe was installed. A new 12 inch diameter perforated PVC pipe was installed to the right of where the original pipe was placed for water management purposes. The original pipe was removed and properly disposed in order to excavate the limestone that remained below the original pipe.

The Red Room Roof Burial Pit is an open land area located immediately south of Building 101. The portion of Building 240-1 referred to as the "Red Room" was used for UF6 conversion of highly enriched uranium. The roof of the Red Room was removed and buried in this open land area.

The survey unit is classified as MARSSIM Class 1.

Gamma Walkover Survey (GWS):	
Scan Coverage	100% of Accessible Excavation Floor and Walls
Scan MDC	74.7 pCi/g Total Uranium
Investigation Action Level (IAL)	1,352 Net CPM* *After GWS is performed, the data will be examined to confirm areas exceeding the calculated IAL and statistical analysis will determine significance.

Systematic Sampling Locations:

Depth	Number of Samples	Comments
0 – 15 cm	4	None
15 cm – 1.5 m	13	
> 1.5m	11	

Biased Survey/Sampling Locations:

Biased samples may be collected during Gamma Walkover Surveys (at the discretion of the HP Technician), after statistical analysis of the survey data, or at the direction of Radiological Engineering.

2 samples will be collected from 1 location in the trench left from excavation activities to remove the old spring pipe. Samples are listed on Appendix P-4.

Instrumentation	
Ludlum 2221 with 44-10 (2x2 NaI) detector	Used for gamma walkover survey and to obtain static count rates at biased measurement locations.

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-3
FSS SAMPLE INSTRUCTIONS

General Instructions:

1. Summarize daily work activities on the log sheets provided in Appendix P-6. Provide a description of site conditions (including the condition of isolation controls), samples collected and the progress of gamma walkover surveys for every shift that involves work in this survey unit. In the event that a situation arises where the survey instructions cannot be followed as written, stop work and contact the RSO or Radiological Engineering for resolution. All changes to the survey instructions shall be approved by the RSO or Radiological Engineering before continuing work and be documented in the FSS Field Log.
2. Class 1 Open Land Survey Units are gridded to identify the systematic sampling locations. Each sample location will have associated GPS coordinates specified. In the case of inaccessible sampling locations additional pairs sample coordinates may be generated with the RSO or his designee's approval in order to identify an acceptable sampling location.
3. A map of the survey unit showing the systematic sample locations with associated GPS coordinates is attached.
4. A map of the survey unit showing any biased sample locations with associated GPS coordinates is attached. If biased samples are taken during or as a result of the GWS, their locations will be added to the map.
5. Verify that isolation controls established in accordance with HDP-PR-HP-602 are in place prior to the start of FSS.
6. Biased soil sampling will be performed as indicated in these instructions, as well as at the discretion of the HP Technician based on field conditions. Biased soil samples will be collected in a manner similar to systematic soil sampling locations. Record the location of any biased samples collected not already listed on Appendix P-4 of HDP-PR-FSS-701 on the Field Log (Appendix P-6 of HDP-PR-FSS-701). At each soil sampling location a composite soil sample will be collected from each location and depth listed on Appendix P-4 of HDP-PR-FSS-701. 4, 0 – 15 cm (surface), 13, 15 cm – 1.5 m (root) and 11, > 1.5 m (deep) samples will be collected.

Specific Instructions:

Gamma Walkover Surveys (GWS)

1. Perform a gamma walkover survey of the survey unit holding the probe as close to the surface as possible, in accordance with HDP-PR-FSS-711. A GPS system and data logging should be interfaced with the meter whenever possible. If a GPS system is not available, contact Radiological Engineering.
2. Move at a speed of 1-foot per second or less. Move the survey probe in a serpentine pattern with a swing radius approximately "shoulder-to-shoulder". The GWS will cover all accessible surface areas with the survey unit or a specific region of interest (ROI).
3. Look and/or listen for locations that exhibit anomalous readings (e.g., count rates in excess of the IAL for this unit).
4. Mark the location(s) exhibiting anomalous readings and ensure the location is logged to facilitate future investigations (for example, use a flag, stake, or other marking resistant to anticipated environmental conditions). Paint may be used to temporarily mark the area in lieu of immediately placing a flag/stake/etc.
5. At each location where the anomalous readings occur, perform a more detailed point survey of the area. Pause and place the survey probe as close as possible to the surface to define and record the total count rate associated with the area of interest on the Field Log (Appendix P-6).
6. If a portion of the survey unit is underwater, direct the excavation of soil within the area covered by water to a depth of at least 6 inches (determined using a leveling survey rod) and place the excavated soil on a dry geotextile covered surface within the survey unit and spread to a depth of approximately 6 inches (verify using a dowel or measuring rod).
7. Perform a GWS of 100% of surface of the excavated soil in accordance with HDP-PR-FSS-711.
8. Move at a speed of 1-foot per second or less. Swing the survey probe in a serpentine pattern with a swing radius approximately "shoulder-to-shoulder" (e.g., approx. 9-in on either side of the centerline.)
9. If a count rate in excess of the IAL is identified, notify Radiological Engineering for further instruction.

Sampling

1. Collect soil samples in accordance with HDP-PR-FSS-711 at locations identified on Appendix P-4 of HDP-PR-FSS-701. Note: If a sample location is under water, the sample may be obtained using a hand auger.
2. Collect one duplicate sample for every 20 systematic samples. A minimum of one duplicate sample is required for each survey unit.

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-3
FSS SAMPLE INSTRUCTIONS

3. If directed by Radiological Engineering, collect a soil sample at locations that were marked/flagged during the GWS.
4. Document all samples collected on the Field Log (Appendix P-6).
5. Care should be exercised to ensure the entire sample is included from within the depths specified for sampling. When collecting composite samples, vegetation and native debris/rocks with a diameter greater than 1 inch may be discarded.
6. All samples collected as part of this survey will be analyzed at an off-site laboratory by gamma spectroscopy for uranium and gamma emitting radionuclides (Th-232, Am-241, etc.), and for Tc-99 by liquid scintillation counting or ICPMS.
7. Submit all samples for analysis following sample chain of custody requirements contained in HDP-PR-QA-006.

Prepared by:	Michelle Bresnahan (Print Name)	(Signature)	8/14/13 (Date)
Peer Reviewed by:	Rock Nevear (Print Name)	(Signature)	8-14-13 (Date)
Approved by (RSO):	Joseph Quiroz (Print Name)	(Signature)	8-15-13 (Date)

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-4
FSS SAMPLE & MEASUREMENT LOCATIONS & COORDINATES

Survey Area: No. 05 **Description:** Barns and Cistern Open Land Area

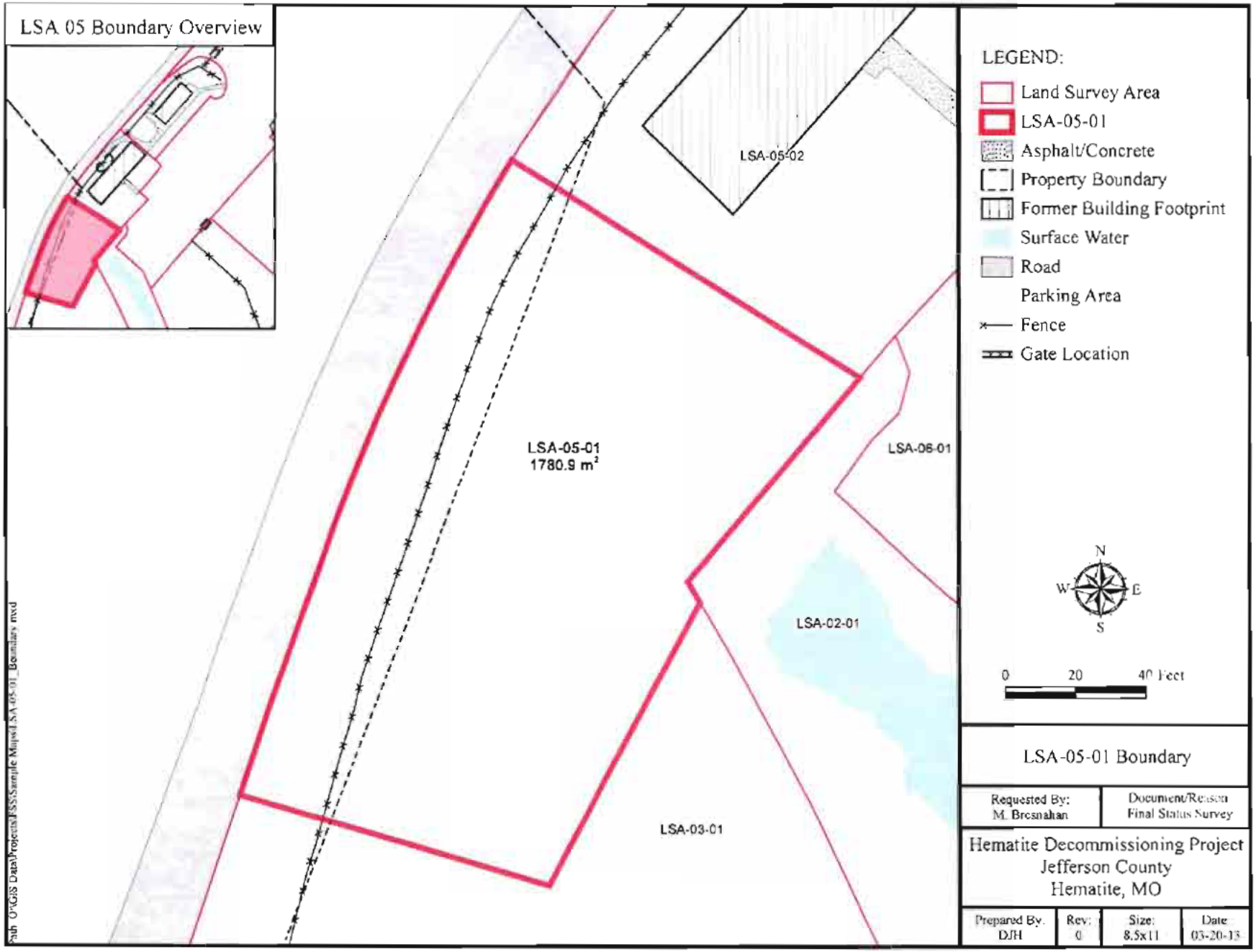
Survey Unit: No. 01 **Description:** Red Room Roof / Limestone Fill / Cistern Burn Pit Area

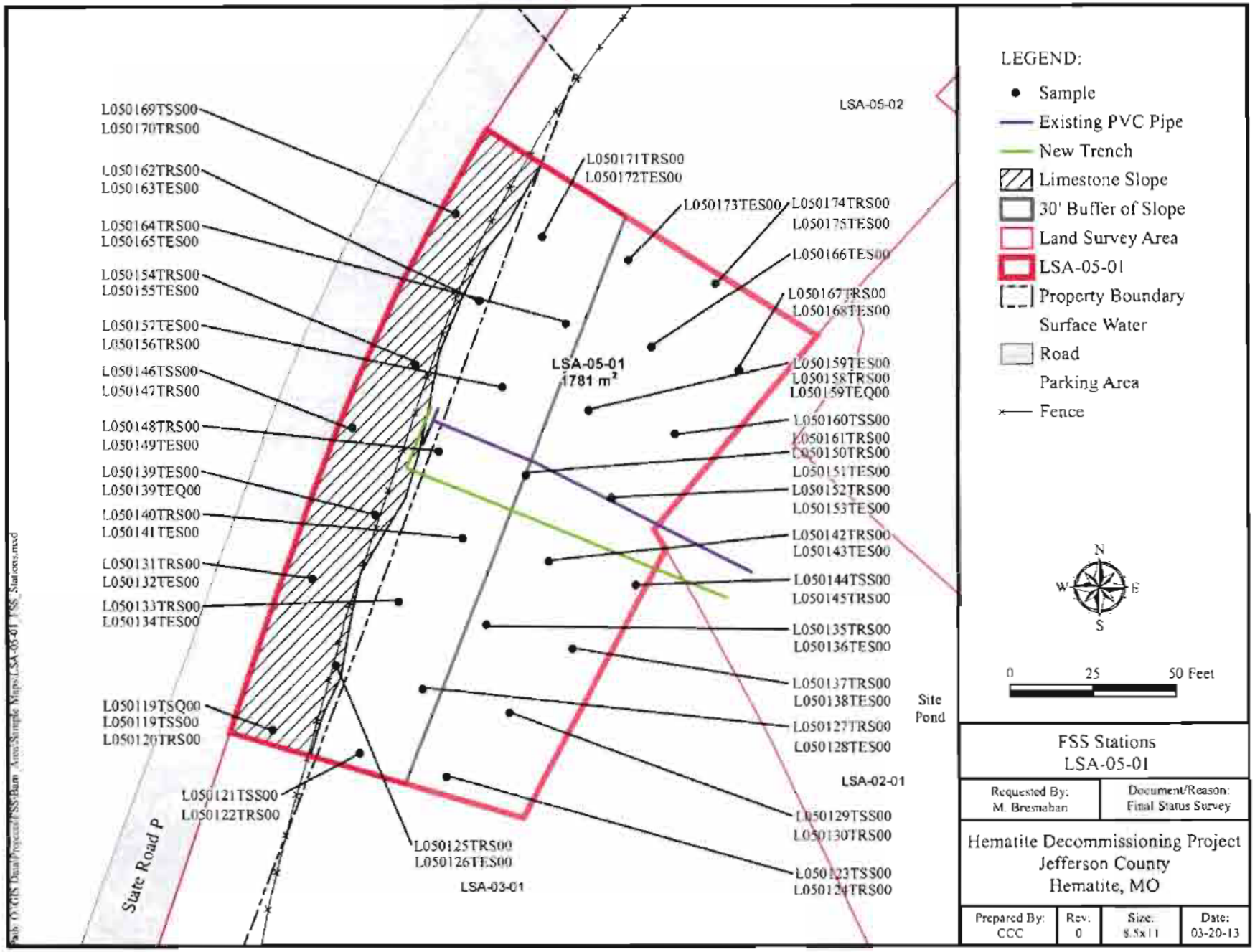
Survey Type: Soil Sampling **Classification:** 1

Measurement or Sample ID	Surface or CSM	Type	Start Depth (feet)	End Depth (feet)	Easting (X Axis)*	Northing (Y Axis)*
L050123TSS00	Surface	S	0	0.5	826552.3	864471.4
L050124TRS00	Root	S	0.5	5	826552.3	864471.4
L050129TSS00	Surface	S	0	0.5	826571.5	864490.6
L050130TRS00	Root	S	0.5	5	826571.5	864490.6
L050135TRS00	Root	S	0	4	826564.4	864516.9
L050136TES00	Deep	S	4	4.5	826564.4	864516.9
L050137TRS00	Root	S	0	4.5	826590.7	864509.8
L050138TES00	Deep	S	4.5	5	826590.7	864509.8
L050142TRS00	Root	S	0	3	826583.6	864536.1
L050143TES00	Deep	S	3	3.5	826583.6	864536.1
L050144TSS00	Surface	S	0	0.5	826609.9	864529.1
L050145TR500	Root	S	0.5	5	826609.9	864529.1
L050150TRS00	Root	S	0	2	826576.6	864562.3
L050151TES00	Deep	S	2	2.5	826576.6	864562.3
L050152TRS00	Root	S	0	3	826602.8	864555.3
L050153TES00	Deep	S	3	3.5	826602.8	864555.3
L050158TRS00	Root	S	0	3	826595.8	864581.5
L050159TES00	Deep	S	3	3.5	826595.8	864581.5
L050159TEQ00	Deep	Q	3	3.5	826595.8	864581.5
L050160TSS00	Surface	S	0	0.5	826622.1	864574.5
L050161TRS00	Root	S	0.5	5	826622.1	864574.5
L050164TRS00	Root	S	0	0.5	826588.8	864607.8
L050165TES00	Deep	S	0.5	1	826588.8	864607.8
L050166TES00	Deep	S	0	0.5	826615.0	864600.7
L050167TRS00	Root	S	0	2.5	826641.3	864593.7
L050168TES00	Deep	S	2.5	3	826641.3	864593.7
L050173TES00	Deep	S	0	0.5	826608.0	864627.0
L050174TRS00	Root	S	0	0.5	826634.2	864619.9
L050175TES00	Deep	S	0.5	1	826634.2	864619.9
L050184TUB00	Uniform	B	0	0.5	826581.3	864565.0
L050185TUB00	Uniform	B	0.5	1	826581.3	864565.0

* Distance in feet from southwest corner of the surface.
Surface: Floor = F, Wall = W, Ceiling = C, Roof = R
CSM: Surface, Root, Deep or Uniform
Type: Systematic = S, QC = Q, Biased = B, Investigation = I

NOTE: Systematic samples listed above are designed based on proposed excavation activities left to carry out in LSA 05-01. Sample start depth and end depth are subject to change if it is determined further excavation is necessary in this area.


LSA 05 Boundary Overview
LSA-05-02
LSA-05-01
1780.9 m²
LSA-06-01
LSA-02-01
LSA-03-01
LEGEND:
Land Survey Area
LSA-05-01
Asphalt/Concrete
Property Boundary
Former Building Footprint
Surface Water
Road
Parking Area
Fence
Gate Location
N
W
E
S
0
20
40 Feet
LSA-05-01 Boundary
Requested By:
M. Bresnahan
Document/Reason
Final Status Survey
Hematite Decommissioning Project
Jefferson County
Hematite, MO
Prepared By:
DJH
Rev:
0
Size:
8.5x11
Date
03-20-13
Sub 0\GIS Data\Projects\FSS\Sample Maps\LSA-05-01_Boundary.mxd



Path: O:\GIS Data\Projects\FSS\Barn Area\Simple Maps\LSA-05-01 FSS_Stations.mxd

FSS Stations
LSA-05-01

Requested By:	Document/Reason:
M. Bresnahan	Final Status Survey

Hematite Decommissioning Project
Jefferson County
Hematite, MO

Prepared By:	Rev:	Size:	Date:
CCC	0	8.5x11	03-20-13