Westinghouse

Hematite Decommissioning Project

NUMBER: **HDP-INST-FSS-LSA10-08**

TITLE: **Final Status Survey Plan and Instructions for Survey Area & Unit: LSA 10-08**
(Bladder Dam and New Berm Installation)

REVISION: **1**

EFFECTIVE DATE: **August 1, 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-10 **Description:** Burial Pits Open Land Area
Survey Unit: 08 **Description:** NE Corner of LSA10-02 (Berm)

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: 6
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	1.52E+00	7.00E-02	9.00E-01	NR	<=BKGD	<=BKGD
Maximum	6.76E+01	3.72E+00	9.90E+00	NR	4.00E-02	1.80E-01
Mean	2.33E+01	1.27E+00	5.29E+00	NR	<=BKGD	<=BKGD
Median	1.43E+01	7.60E-01	5.10E+00	NR	<=BKGD	<=BKGD
Standard Deviation	2.46E+01	1.36E+00	4.26E+00	NR	2.14E-01	1.54E-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:

This survey unit was developed to support the ~~total the~~ installation of a new berm in the NE corner of LSA10-02.
SEE ATTACHEMENT FOR DETAIL GMB 8/11/13

Classification: 1 Survey Unit Area (m^2): 110.5

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	20.4	7	14.5	5.8
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.

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} = 0.37

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} = 0.30 ☑

Background σ_{SOF} = 0.13 ☐

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.

$$\text{Relative Shift} = \frac{1 - \text{LBGR}}{\sigma_{SOF}}$$

Relative Shift = 2.11

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

- If "Yes", then continue to step 10f. 8 7/31/13
- 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 = NA

Adjusted Relative Shift = 2.11

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) = 10

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 (%) 4.28

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,

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

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 = 79.2 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 = 85.5 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}) = 11.1 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.

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

Area (m^2)	153375	10000	3000	1000	300	100	30	10	3	1
AF_{TotalU}	1.00	1.13	1.17	1.17	2.34	3.37	4.68	6.76	13.83	29.27

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}) = 6.6

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 = 525.21 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 = NA

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

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 = NA

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 ρCi/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}) = 8.91

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 = 16.93

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) = 10

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 = 3.57 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 reference 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 attach 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: 9289 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

Prepared by :	Michelle Bresnahan (Print Name)	(Signature)	7/31/13 (Date) 8/1/13
Peer Reviewed by :	Rock Veveau (Print Name)	(Signature)	8-1-13 (Date)
Approved by (RSO):	Joseph (Print Name)	(Signature)	8-1-13 (Date)

ATTACHMENT to FSS Survey Plan for LSA10-08
Berm Removal & Installation in NE Corner of LSA10-02

Appendix P-1 Section 3. Define the Survey Unit Classification

Survey Unit LSA10-08 was created to support the total remediation of LSA10-02 (portion of the north burial pit). The northeast portion of LSA10-02 which consists of bermed soils that divert the flow of the creek east of the burial pit will become its own survey unit, LSA10-08. In order to complete remediation, the existing berm must be excavated, characterized, and replaced as expeditiously as possible to prevent the creek from flowing into the remediated portions of the north burial pit.

The engineer planning the excavation and installation of the new berm estimates the footprint to be approximately 900-sq. ft (83.6-m2), with approximate length of 45-ft and approximate width of 20-ft. Based on experience performing excavations and remediation, Radiological Engineering added additional surface area around the estimated extent of excavation to accommodate for installation of a bladder dam, movement of heavy equipment, foot traffic of support personnel and heavy equipment, and the load-out/load-in of soils.

The total estimated surface area for LSA10-08 is 108.1-m2 (or1,164-ft2). It will be located in the northeast corner of the north burial pit and will be bordered by the current western edge of the creek. These locations are pre-excavation approximations – based on extensive walk downs with engineering, excavation supervisors, the Project Field Superintendent, subcontractor SMEs, and multiple GPS measurements. Radiological Engineering compiled this information to best determine what the final extent of excavations will be.

In order to accurately finalize the surface area of LSA10-08, additional GPS measurements will be performed immediately after the existing berm has been removed and prior to the installation of the new berm. Once this "extent-of-excavation" has been established and measured, FSS Technicians will enter the area to perform characterization using GWS, statistical analysis of the GWS measurements, and soil sampling (systematic & biased).

After this review, the soil samples will be sent off-site for analysis. To minimize the potential for impact from rain events to the north burial pit, the new berm will be installed after the on-site analysis by gamma spectroscopy and data review. While Tc-99 results will not be available, process knowledge the history of this area show very low potential for the presence of Tc-99.

This unit was created within a Class 1 area, and will also be a Class 1 survey unit.

Sample ID	U-234	U-235	U-238	U-238/U-235 Ratio	Enrichment
SS-BP-011-SF	6.88	0.38	1.43	3.76	4.00
SS-BP-012-DV	12.71	0.68	0.90	1.32	10.60
SS-BP-014-DV	35.48	1.95	9.90	5.08	3.00
SS-BP-024-DV	15.82	0.84	8.20	9.76	1.60
SS-BP-024-SV	67.59	3.72	9.30	2.50	5.90
NB-89-4.5-SL	1.52	0.07	2.00	28.57	0.60

Average 4.28

min	-0.23	-0.57	0.07	0.90	1.52	0.32
max	0.18	0.04	3.72	9.90	67.59	13.80
mean	-0.05	-0.25	1.27	5.29	23.33	3.48
median	-0.03	-0.24	0.76	5.10	14.27	1.02
st. dev	0.15	0.21	1.36	4.26	24.58	5.27

SEA	b	(burial pit)
Zone	U	
Infer Tc99	yes	

6

(Dataset with Background Adjustment)

SampleID	RA226	Th232	U235	U238	U-234	Tc-99
SS-BP-011-SF	-0.14	-0.57	0.38	1.43	6.88	0.78
SS-BP-012-DV	-0.03	-0.10	0.68	0.90	12.71	1.26
SS-BP-014-DV	-0.23	-0.25	1.95	9.90	35.48	0.41
SS-BP-024-DV	-0.02	0.04	0.84	8.20	15.82	4.29
SS-BP-024-SV	0.18	-0.23	3.72	9.30	67.59	13.80
NB-89-4.5-SL		-0.39	0.07	2.00	1.52	0.32

DCGLw

RA226	Th232	U235	U238	U234	Tc-99
1.9	2	5.8	168.8	195.4	25.1

stdev

RA226	Th232	U235	U238	U234	Tc99
0.15	0.21	1.36	4.26	24.58	5.27

Avg Conc

RA226	Th232	U235	U238	U-234	Tc-99
0.00	0.00	1.27	5.29	23.33	3.48

stdev / SOF

RA226	Th232	U235	U238	U234	Tc99
0.08	0.11	0.23	0.03	0.13	0.21

SOF

RA226	Th232	U235	U238	U234	Tc-99
0.00	0.00	0.22	0.03	0.12	0.14

LBGR
0.37

σ
0.30

Relative Shift
2.1070

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

Survey Area:	10	**Description:**	Burial Pits Open Land Area
Survey Unit:	08	**Description:**	NE Corner of LSA 10-02 (Berm)

Comments: REVISON 1: 8/1/2013

The survey unit is classified as MARSSIM Class 1 and is a small portion of what was formerly the northeast cover of LSA10-02. This is a new survey unit that arose from the need to complete the full remediation of LSA10-02 by removal of the earthen berm that diverts the creek running north-south along the eastern border of the north burial pits.

The engineer planning the excavation and installation of the new berm estimates the footprint to be approximately 900-sq. ft (83.6-m2), with approximate length of 45-ft and approximate width of 20-ft. Based on experience performing excavations and remediation, Radiological Engineering added additional surface area around the estimated extent of excavation to accommodate for installation of a bladder dam, movement of heavy equipment, foot traffic of support personnel and heavy equipment, and the load-out/load-in of soils.

The total estimated surface area for LSA10-08 was 108.1-m2 (or 1,164-ft2). After excavation, the final surface area is 112.7-m2. As previously stated, this survey unit will be located in the northeast corner of what is currently LSA10-02 and its western border will run along what is now the current western edge of the creek. These locations are pre-excavation approximations – based on extensive walk downs with engineering, excavation supervisors, the Project Field Superintendent, subcontractor SMEs, and multiple GPS measurements. Radiological Engineering compiled this information to best determine what the final extent of excavations will be.

In order to accurately finalize the surface area of LSA10-08, additional GPS measurements will be performed immediately after the existing berm has been removed and prior to the installation of the new berm. Once this "extent-of-excavation" has been established and measured, FSS Technicians will enter the area to perform characterization using GWS, statistical analysis of the GWS measurements, and soil sampling (systematic & biased).

After this review, the soil samples will be sent off-site for analysis. To minimize the potential for impact from rain events to LSA10-02, the new berm will be installed after the on-site analysis by gamma spectroscopy and data review. While Tc-99 results will not be available, process knowledge of the history of this area show very low potential for the presence of Tc-99.

END OF COMMENTS

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

Gamma Walkover Survey (GWS):	
Scan Coverage	100% accessible excavation floors and walls
Scan MDC	85.5 pCi/g Total Uranium (1,512 ncpm)
Investigation Action Level (IAL)	9,289 net cpm* * magnitude of IAL is due to small survey unit size, a more restrictive IAL of 4,000 ncpm will be used.

Systematic Sampling Locations:

Depth	Number of Sample	Comments
0 – 15 cm	0	These samples will be taken on a systematic grid that will be developed upon completion of the excavation of the current berm.
15 cm – 1.5 m	5	
> 1.5m	10	

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.

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

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 status 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 Radiological Engineering (or RSO) for resolution. All changes to the survey instructions shall be approved by Radiological Engineering (or RSO) before continuing work and be documented by the GWS Technician (or Radiological Engineer) in the FSS Field Log.
2. **This is a Class 1 Survey Unit.** Class 1 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 of random 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 predetermined sample locations with associated GPS coordinates will be generated after the extent of excavation for the current earthen berm has been completed and the GPS coordinates have been established. A copy of the sample map and survey locations will be attached to the survey instruction after the final extent of excavation has been established.
4. Verify that isolation controls established in accordance with HDP-PR-HP-602 are in place prior to the start of FSS.

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

5. Perform daily pre and post QC source checks in accordance with HDP-PR-HP-416.
6. Additional sampling may be required, based on results of the GWS, or as determined by Radiological Engineering.
7. **Sample locations will be established after the full extent of excavation has been completed.** At each systematic soil sampling location a composite soil sample will be collected from each location and depth as determined after the completion of excavation (and will be provided in Appendix P-4). The systematic sample locations will include 0 (zero) samples taken at a depth of 0 – 15 cm (surface) and 5 (five) samples collected at a depth of 15 cm – 1.5 m (root) and 10 (ten) samples collected at a depth of 1.5 m to 1.65 m (deep).
8. Biased soil sampling locations may be determined at the discretion of the HP Technician during the performance of the GWS. Biased soil sampling locations may also be determined at the discretion of Radiological Engineering based on statistical analysis of the survey/sampling data or process/historical knowledge of the area. Biased soil samples will be collected in a manner similar to systematic soil sampling locations. Radiological Engineer and/or the HP Technician will log the reason for collection of biased samples in the Survey Instruction log sheet and record the location of biased samples on Appendix P-4 of this survey instruction.

Specific Instructions:

Gamma Walkover Surveys (GWS)

1. Perform a gamma walkover of the survey unit holding the probe as close to the surface as possible, in accordance with HDP-PR-HP-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. Swing the survey probe in a serpentine pattern with a swing radius approximately "shoulder-to-shoulder" (i.e., approx. 9-in on either side of the centerline). 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 area background count rate and/or count rates that exceed 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 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).

   NOTE: If field conditions limit the ability to perform contact readings, collect readings as close as practical and log the issue for each location in the FSS Field Log and applicable survey forms. Contact Radiological Engineering (or RSO) regarding the issue for each location.

6. 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.

   Download the survey data at the end of each shift. To minimize data loss, periodically save the GWS data set

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

throughout the shift.

Sampling

1. Collect soil samples in accordance with HDP-PR-HP-711 at locations identified in LSA10-08 after the extent of excavation has been established and the GPS coordinates have been provided. Note that additional biased sampling locations may also be listed as determined by the GWS or as determined by Radiological Engineering.
2. Collect one duplicate sample for every 20 samples. A minimum of one duplicate sample is required for each survey unit.
3. Care should be exercised to ensure the entire sample is included from within the depths specified for sampling. When collecting the composite samples, vegetation and native debris/rocks with a diameter greater than 1 inch should be discarded.
4. Monitor the count rates observed at all accessible surfaces within close proximity (e.g., 2 meter diameter) of each biased sampling location, as practical. Note any accessibility issues and discuss compensatory measures with supervision.
   a. Contact and brief Radiological Engineering (or HP Supervision) on the results obtained from monitoring the locations of biased sampling to receive instructions for further investigation or the need for additional excavation.
5. Obtain and record the count rate on contact with features other than soil within the excavation. (e.g., native rock). Record the nature and extent of features other than soil found within the excavation in the FSS Survey Log and contact Radiological Engineering (or RSO) to determine additional characterization methods, if necessary.
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 radionuclide (Th-232, Am-241, etc.), and for Tc-99 by liquid scintillation counting or ICPMS.
7. Submit samples for analysis following sample chain of custody requirements contained in HDP-PR-QA-006.

Prepared by:	Michelle Bresnahan (Print Name)	(Signature)	8/1/13 (Date)
Peer Reviewed by:	Rock Nevem (Print Name)	(Signature)	8-1-13 (Date)
Approved by (RSO):	Joseph Guido (Print Name)	(Signature)	8-1-13 (Date)

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

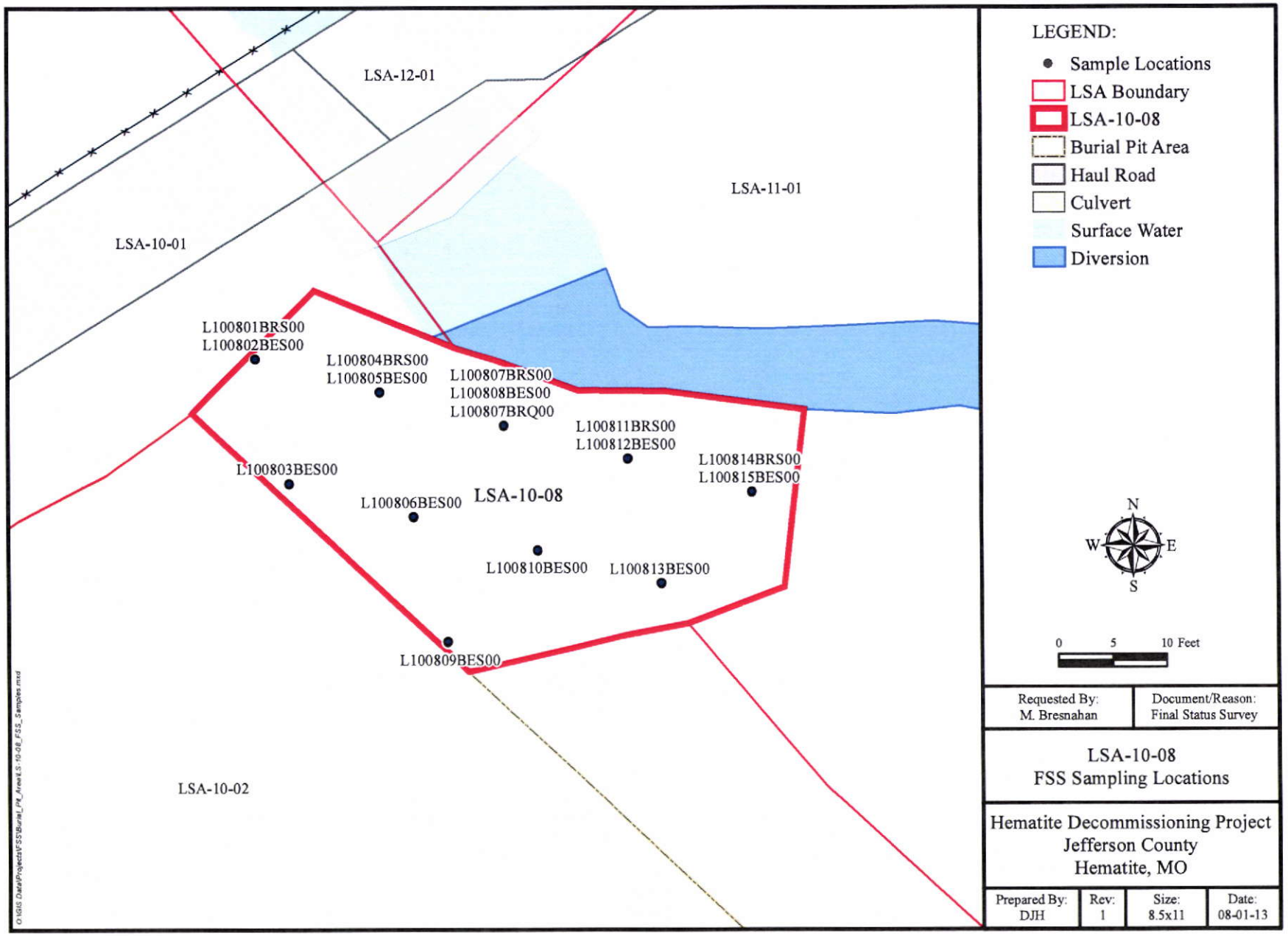
Survey Area: No. LSA 10 **Description:** Burial Pits Open Land Area

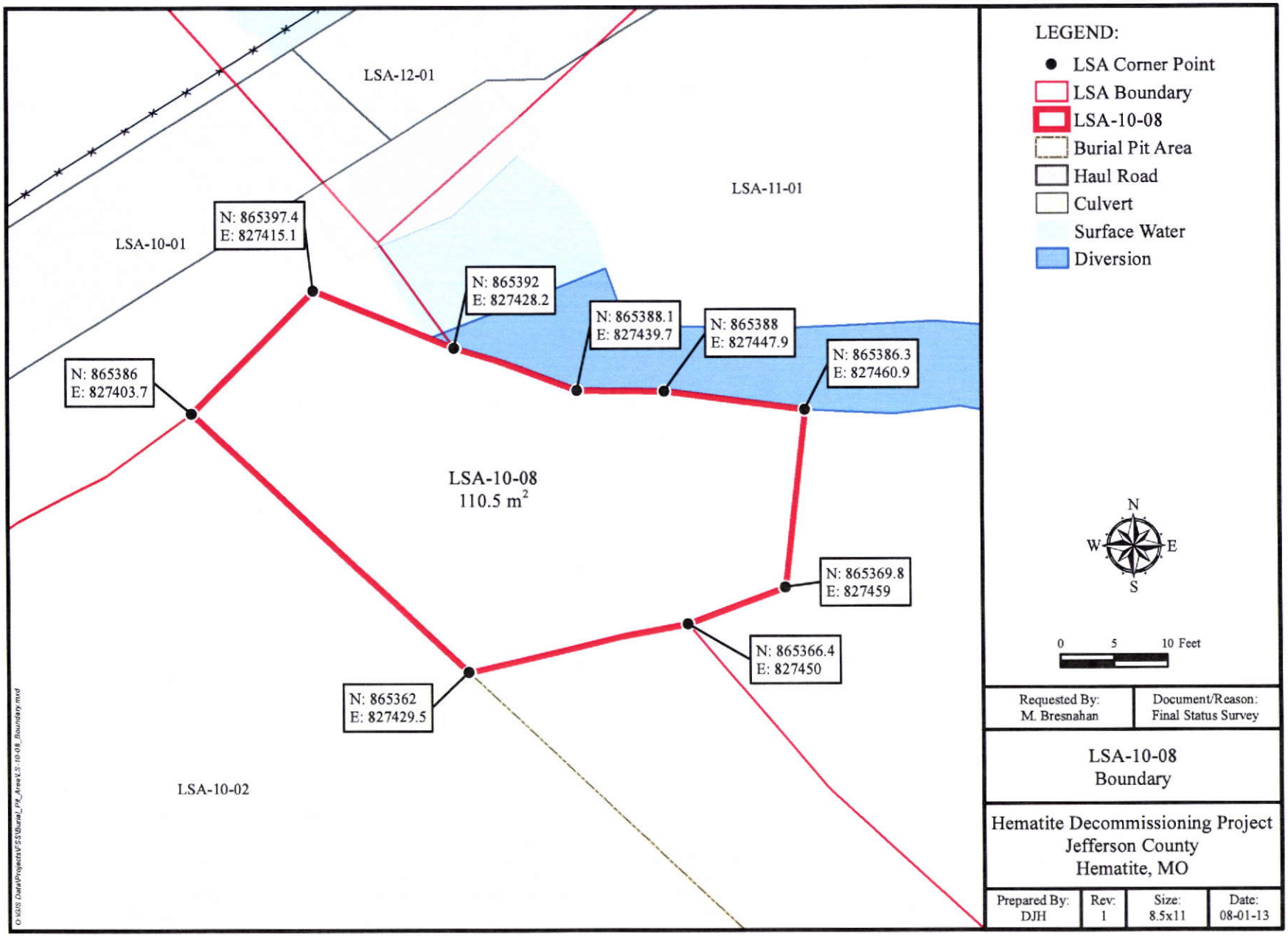
Survey Unit: No. 08 **Description:** NE Corner of LSA 10-02 (Berm)

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)*
L100801BRS00	Root	S	0	2.5	827409.7	865391.0
L100802BES00	Deep	S	2.5	3	827409.7	865391.0
L100803BES00	Deep	S	0	0.5	827412.8	865379.4
L100804BRS00	Root	S	0	1.5	827421.3	865387.9
L100805BES00	Deep	S	1.5	2	827421.3	865387.9
L100806BES00	Deep	S	0	0.5	827424.4	865376.3
L100807BRS00	Root	S	0	4.5	827432.9	865384.8
L100807BRQ00	Root	Q	0	4.5	827432.9	865384.8
L100808BES00	Deep	S	4.5	5	827432.9	865384.8
L100809BES00	Deep	S	0	0.5	827427.5	865364.7
L100810BES00	Deep	S	0	0.5	827436.0	865373.2
L100811BRS00	Root	S	0	3.5	827444.5	865381.7
L100812BES00	Deep	S	3.5	4	827444.5	865381.7
L100813BES00	Deep	S	0	0.5	827447.6	865370.1
L100814BRS00	Root	S	0	2.5	827456.1	865378.6
L100815BES00	Deep	S	2.5	3	827456.1	865378.6

* 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


LSA-12-01
LSA-11-01
LSA-10-01
L100801BRS00
L100802BES00
L100804BRS00
L100805BES00
L100807BRS00
L100808BES00
L100807BRQ00
L100811BRS00
L100812BES00
L100814BRS00
L100815BES00
L100803BES00
L100806BES00
LSA-10-08
L100810BES00
L100813BES00
L100809BES00
LSA-10-02
LEGEND:
Sample Locations
LSA Boundary
LSA-10-08
Burial Pit Area
Haul Road
Culvert
Surface Water
Diversion
N
W
E
S
0
5
10 Feet
Requested By:
M. Bresnahan
Document/Reason:
Final Status Survey
LSA-10-08
FSS Sampling Locations
Hematite Decommissioning Project
Jefferson County
Hematite, MO
Prepared By:
DJH
Rev:
1
Size:
8.5x11
Date:
08-01-13


LSA-12-01
LSA-11-01
LSA-10-01
LSA-10-02
N: 865397.4
E: 827415.1
N: 865392
E: 827428.2
N: 865388.1
E: 827439.7
N: 865388
E: 827447.9
N: 865386.3
E: 827460.9
N: 865386
E: 827403.7
LSA-10-08
110.5 m²
N: 865369.8
E: 827459
N: 865366.4
E: 827450
N: 865362
E: 827429.5
LEGEND:
LSA Corner Point
LSA Boundary
LSA-10-08
Burial Pit Area
Haul Road
Culvert
Surface Water
Diversion
N
W
E
S
0 5 10 Feet
Requested By: M. Bresnahan
Document/Reason: Final Status Survey
LSA-10-08 Boundary
Hematite Decommissioning Project
Jefferson County
Hematite, MO
Prepared By: DJH
Rev: 1
Size: 8.5x11
Date: 08-01-13
O:\GIS\Data\Projects\FSS\Burial_Pit_Area\LS-10-08_Boundary.mxd


Post
Area of Removal
07/03/2013 08:37