Hematite Decommissioning Project

NUMBER:	**HDP-INST-FSS-LSA10-09**
TITLE:	**Final Status Survey Plan and Instructions for Survey Area & Unit: LSA 10-09** ("VOC Pit" in LSA 10-06)
REVISION:	**1**
EFFECTIVE DATE:	**October 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-10 **Description:** Burial Pits Open Land Area
Survey Unit: 9 **Description:** VOC Pit in LSA 10-06

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: 5
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	NR	-1.43E-01	9.91E-02
Maximum	5.75E+00	1.77E-01	2.27E+00	NR	1.12E-01	4.62E-01
Mean	3.55E+00	1.23E-01	8.41E-01	NR	-4.41E-02	2.32E-01
Median	4.15E+00	1.45E-01	< MDA	NR	-1.15E-01	2.07E-01
Standard Deviation	2.19E+00	7.13E-02	1.16E+00	NR	1.19E-01	1.36E-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 10-09 is a small pit contaminated with VOCs within the footprint of LSA 10-06. Remediation of this area was performed to an acceptable extent (groundwater was reached) before discontinuing.

Classification: 1 Survey Unit Area (m^2): 216

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.

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) = $SOF_{Mean} = 0.17$

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} = 0.09 ☐

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 = 6.25

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 = 0.3

Adjusted Relative Shift = 5.38

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) = 7

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 (%) 77.88

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 = 93.5 ρCi/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 = 142.5 ρCi/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 ρCi/g Ra-226 $DCGL_w$ = 1.9 ρCi/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 ρCi/g for Th-232 and 2.8 ρCi/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 ρCi/g MDC_{scan} for Ra-226 = 2.8 ρCi/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}) = 30.9 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	1.14	1.18	1.18	2.51	3.78	5.36	7.82	15.98	33.66

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}) = 5.3

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 = 499.33 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}) = 6.07

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 = 11.53

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) = 7

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 = 5.97 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: 5297 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		10/15/13
Peer Reviewed by :	Rock Nevenu		10-15-13
Approved by (RSO):	Joseph Gimo		10/15/13

HDP-PR-FSS-701
Appendix P-1
Data for Enrichment Calc.

Sample ID	U-234	U-235	U-238	U-238/U-235 Ratio	Enrichment
6461-SS-130906-05-01-ON	4.15	0.13	0.00	0.00	HEU
6461-SS-130906-05-02-ON	3.15	0.17	1.93	11.69	1.40
6461-SS-130906-05-03-ON	0.00	0.00	2.27	0.00	HEU
6461-SS-130906-05-04-ON	5.75	0.18	0.00	0.00	HEU
6461-SS-130906-05-05-ON	4.70	0.14	0.00	0.00	HEU

Average 77.88

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:	09	**Description:**	VOC Pit in LSA 10-06

Comments:

Revision 1: 10/15/2013

The survey unit is classified as MARSSIM Class 1. LSA 10-09 is a new survey unit created out of a need to backfill this "low point" in LSA 10-06 to prevent ground water infiltration. LSA 10-09 is a small excavated pit within the footprint of LSA 10-06. The foot print of LSA 10-09 covers a small area that was necessary to excavate due to the presence of VOC contamination. There were no radiological concerns related to the excavation.

FSS was conducted under Revision 0 of this instruction set. During chemical confirmation sampling, Environmental Personnel informed Radiological Engineering of some plastic and gravel material in the unit. The origin of the plastic and gravel material was discussed with the Environmental Manager and ECC Personnel. It was determine the material was left behind from the excavation of Test Pits that were dug to investigate the location and depth of VOC contamination. The Test Pits were lined with geo-fabric and backfilled for safety reasons. The Test Pit area was later excavated down to the phreatic surface in accordance with the SAP, however, the elevation of the Test Pits was below the phreatic surface. FSS and confirmation sampling was stopped in this area and excavation activities began in order to remove the gravel and plastic material as well as excavate the material that was used to backfill the Test Pits. Civil survey of the pit was performed to provide evidence that the excavation efforts removed any backfill left in the unit.

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	142.5 pCi/g Total Uranium (1,512 ncpm)
Investigation Action Level (IAL)	5,297 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	3	These samples will be taken on a systematic grid.
15 cm – 1.5 m	6	
> 1.5m	4	

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 for resolution. All changes to the survey instructions shall be approved by the RSO before continuing work and be documented in the FSS Field Log.
2. In accordance with HDP-PR-FSS-701, *Final Status Survey Plan Development (Sec. 8.4.2),* documentation of activities performed, equipment used, 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.
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 gamma walkover survey will cover the percentage of the accessible surface areas within the area of interest as indicated in the table above. Notify Radiological Engineering of any areas, conditions or constraints where surveying (or subsequent sampling) may not be possible. Document the conditions and any resolutions in the FSS Field Log.

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

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. This is a Class 1 Survey Unit. Each sample location will be selected systematically and have associated GPS coordinates specified. In the case of inaccessible sampling locations additional pairs of random sample coordinates may be generated with the Radiological Engineering's approval in order to identify an acceptable sampling location.
6. A map of the survey unit showing predetermined sample locations with associated GPS coordinates will be generated. A copy of the sample map and survey locations will be attached to the survey instruction.
7. Verify that isolation controls established in accordance with HDP-PR-HP-602 are in place prior to the start of FSS. Ensure isolation controls include, as necessary, the use of "waddles", a berm, or trenching to minimize the potential for contaminated soils and water from surrounding areas to cross the boundary of this unit.
8. Perform daily pre and post QC source checks in accordance with HDP-PR-HP-416.
9. 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 3 (three) samples taken at a depth of 0 – 15 cm (surface) and 6 (six) samples collected at a depth of 15 cm – 1.5 m (root) and 4 (four) samples collected at a depth of 1.5 m to 1.65 m (deep).
10. 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 Field Log sheet and record the location of biased samples on Appendix P-4 of this survey instruction.

    NOTE: If trash, waste, or other non-native materials are observed during sample collection, stop sampling activities and notify HP Supervision (or Radiological Engineering) before collecting samples at any sample location in the unit.
11. 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 and for Tc-99 by liquid scintillation counting or ICPMS.

Specific Instructions:

NOTE: Unless otherwise indicated, the performance of these specific instructions is the responsibility of the HP Technician.

Before Beginning Work

1. **Rad. Engineer/HP Technician:** Verify 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. LSA 10-09 is bordered on all sides by LSA 10-06. LSA 10-09 is a low point within LSA 10-06 and therefore a physical barrier must be in place to minimize the potential for cross contamination.
2. **Rad. Engineering/HP Technician:** Walk the area looking specifically for any debris material (e.g. asphalt, plastic, concrete, etc…) that may indicate further remediation efforts are necessary.
3. **Rad. Engineer/HP Technician:** Perform a daily task-specific briefing; documenting the attendants, planned work activities, anticipated hazards, and controls on the FSS Daily Task Briefing log sheet.

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

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

and underground utilities have been identified and marked.

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.

    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.

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

Sampling

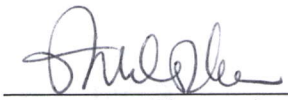
Note: The following instructions provide directions for sampling the floor of the unit. An addendum will be provided with instructions for sampling the sidewalls of the unit.

1. Collect soil samples in accordance with HDP-PR-FSS-711 at locations identified in Appendix P-4. 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 on the results obtained from monitoring the locations of biased sampling to receive instructions for further investigation or the need for additional excavation.

5. Collect bias samples from the surface to a depth of 6 inches.
6. Monitor the count rates within the depression created by the collection of biased soil samples.
7. 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 to determine additional characterization methods, if necessary.
8. Submit samples for analysis following sample chain of custody requirements contained in HDP-PR-QA-006.

Prepared by:	Michelle Bresnahan (Print Name)	 (Signature)	10/15/13 (Date)
Peer Reviewed by:	Rock NeVeau (Print Name)	 (Signature)	10-15-2013 (Date)
Approved by (RSO):	Joseph Gurdo (Print Name)	 (Signature)	10-15-2013 (Date)

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

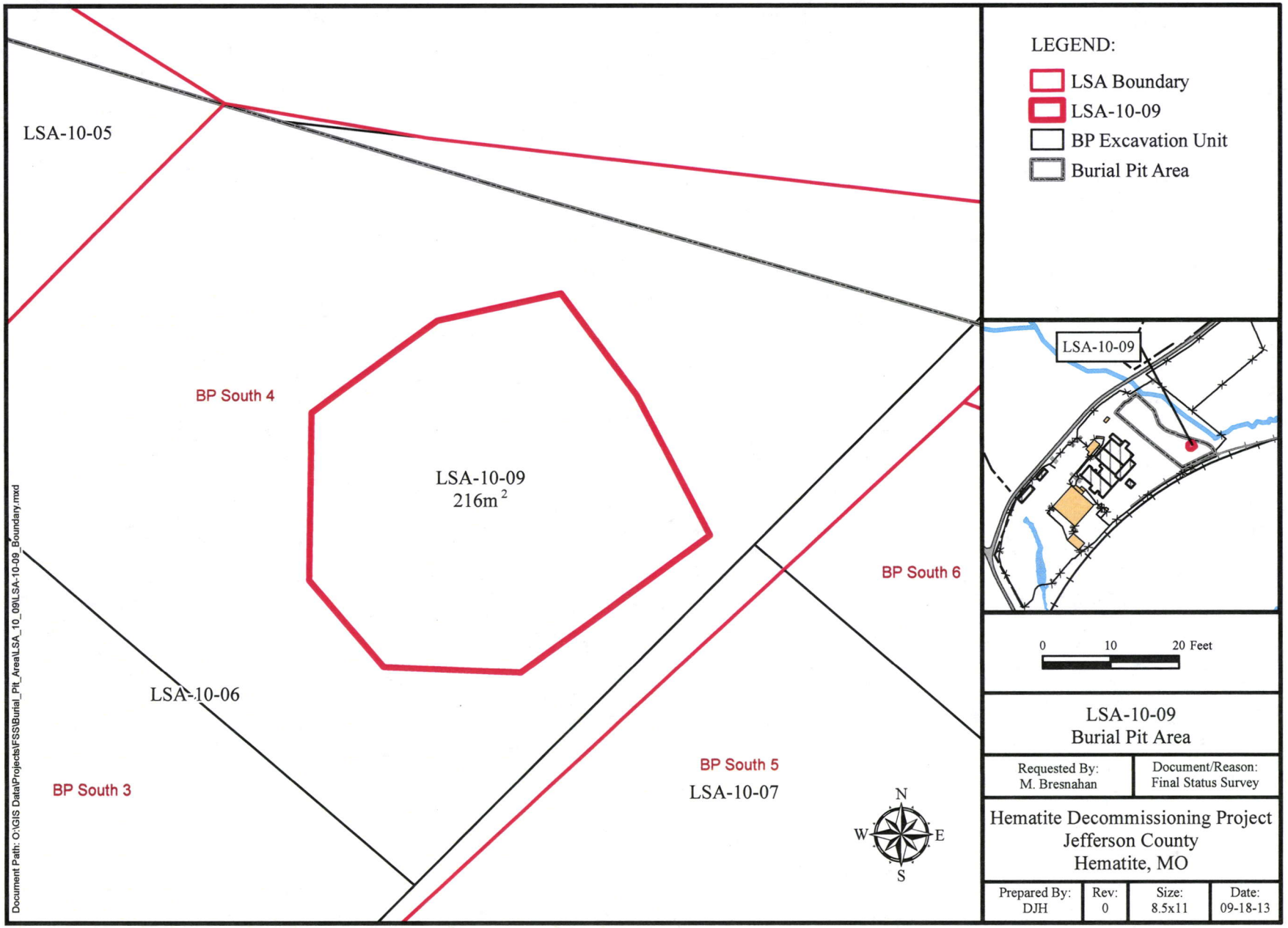
Survey Area: No. LSA 10 **Description:** Burial Pits Open Land Area

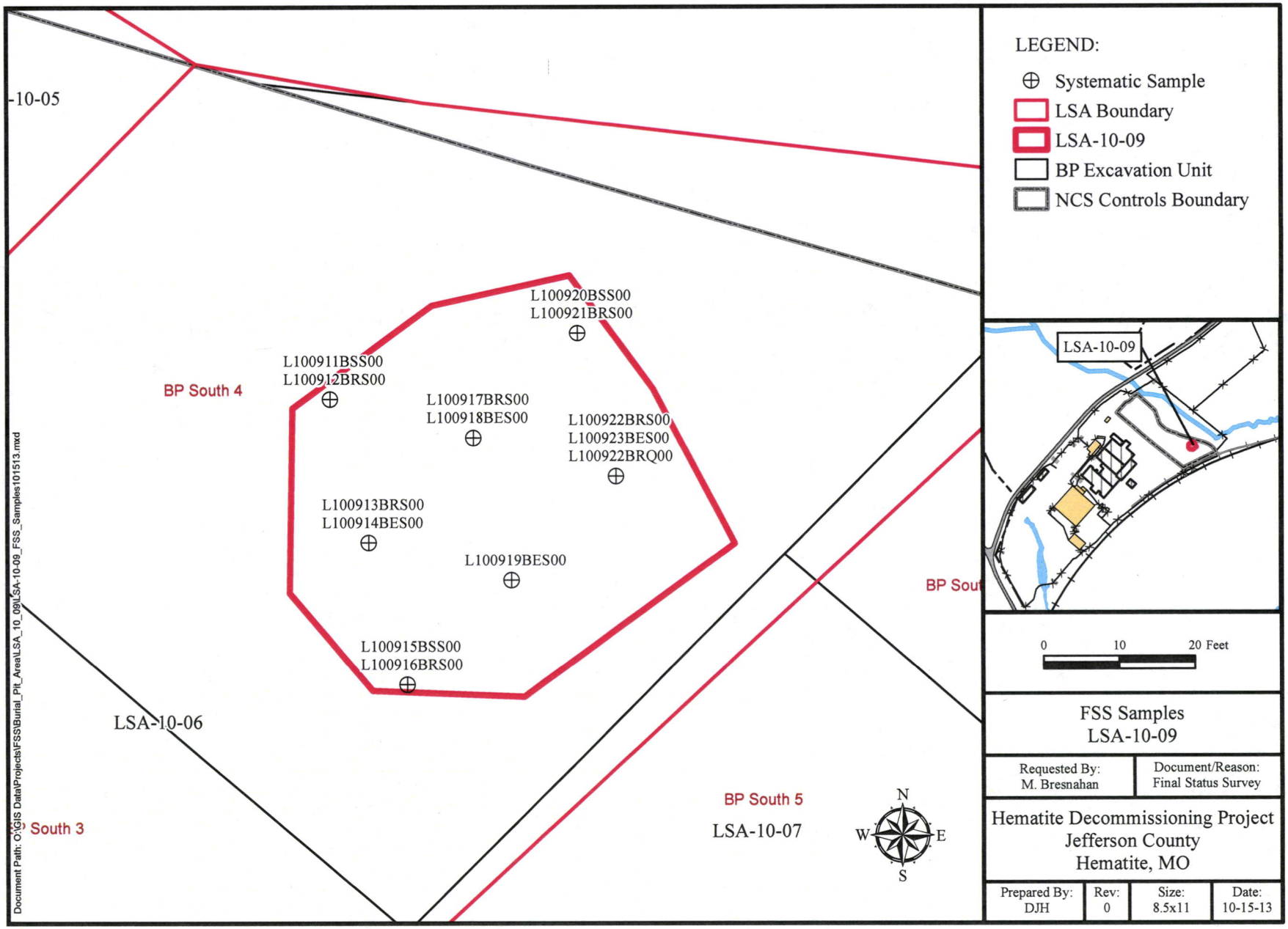
Survey Unit: No. 09 **Description:** VOC Pit in LSA 10-06

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

Measurement or Sample ID	Surface or CSM	Type	Start Depth (feet)	End Depth (feet)	Northing (Y Axis)*	Easting (X Axis)*
L100911BSS00	Surface	S	0	0.5	865051.2	827750.7
L100912BRS00	Root	S	0.5	5	865051.2	827750.7
L100913BRS00	Root	S	0	4.5	865032.2	827755.8
L100914BES00	Deep	S	4.5	5	865032.2	827755.8
L100915BSS00	Surface	S	0	0.5	865013.3	827760.9
L100916BRS00	Root	S	0.5	5	865013.3	827760.9
L100917BRS00	Root	S	0	1	865046.1	827769.7
L100918BES00	Deep	S	1	1.5	865046.1	827769.7
L100919BES00	Deep	S	0	0.5	865027.2	827774.7
L100920BSS00	Surface	S	0	0.5	865060.0	827783.5
L100921BRS00	Root	S	0.5	5	865060.0	827783.5
L100922BRS00	Root	S	0	4	865041.0	827788.6
L100922BRQ00	Root	Q	0	4	865041.0	827788.6
L100923BES00	Deep	S	4	4.5	865041.0	827788.6

* 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-10-05
BP South 4
LSA-10-09
216m 2
BP South 6
LSA-10-06
BP South 3
BP South 5
LSA-10-07
N
W
E
S
Document Path: O:\GIS Data\Projects\FSS\Burial_Pit_Area\LSA_10_09\LSA-10-09_Boundary.mxd
LEGEND:
LSA Boundary
LSA-10-09
BP Excavation Unit
Burial Pit Area
LSA-10-09
0
10
20 Feet
LSA-10-09
Burial Pit Area
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:
09-18-13


-10-05
L100920BSS00
L100921BRS00
L100911BSS00
L100912BRS00
BP South 4
L100917BRS00
L100918BES00
L100922BRS00
L100923BES00
L100922BRQ00
L100913BRS00
L100914BES00
L100919BES00
L100915BSS00
L100916BRS00
LSA-10-06
BP South 5
LSA-10-07
N
W
E
S
LEGEND:
Systematic Sample
LSA Boundary
LSA-10-09
BP Excavation Unit
NCS Controls Boundary
LSA-10-09
0
10
20 Feet
FSS Samples
LSA-10-09
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:
10-15-13
Document Path: O:\GIS Data\Projects\FSS\Burial_Pit_Area\LSA_10_09\LSA-10-09_FSS_Samples101513.mxd

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: 09 **Description:** VOC Pit in LSA 10-06

Comments: Addendum to Revision 1: 10/17/2013

The survey unit is classified as MARSSIM Class 1. LSA 10-09 is a new survey unit created out of a need to backfill this "low point" in LSA 10-06 to prevent ground water infiltration. LSA 10-09 is a small excavated pit within the footprint of LSA 10-06. The foot print of LSA 10-09 covers a small area that was necessary to excavate due to the presence of VOC contamination. There were no radiological concerns related to the excavation.

The following instructions provide direction on sampling the sidewalls in LSA 10-09.

The surface area from the side walls is as follows:

Surface Area (Sq. Meters)
12.1
12.1
8.8
7.9
12.2
23.6
9.0

The area bounded by the statistical sample population is 30.9 sq. m. The surface area from each side wall is smaller; therefore 7 samples is statistically sufficient as shown in Appendix P-1 of procedure HDP-PR-FSS-701.

END OF COMMENTS

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

Systematic Sampling Locations:		
Depth	Number of Sample	Comments
0 – 15 cm	7	Sample locations are spaced along a line.
Biased Sampling Locations:		
Biased samples may be collected during the Gamma Walkover Survey (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) and samples collected 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 for resolution. All changes to the survey instructions shall be approved by the RSO before continuing work and be documented in the FSS Field Log.
2. In accordance with HDP-PR-FSS-701, *Final Status Survey Plan Development (Sec. 8.4.2),* documentation of activities performed, equipment used, 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.
3. This is a Class 1 Survey Unit. Each sample location will be selected systematically and have associated GPS coordinates specified. In the case of inaccessible sampling locations additional pairs of random sample coordinates may be generated with the Radiological Engineering's approval in order to identify an acceptable sampling location.
4. A map of the survey unit showing predetermined sample locations will be generated. A copy of the sample map and survey locations will be attached to the survey instruction.
5. Verify that isolation controls established in accordance with HDP-PR-HP-602 are in place prior to the start of FSS. Ensure isolation controls include, as necessary, the use of "waddles", a berm, or trenching to minimize the potential for contaminated soils and water from surrounding areas to cross the boundary of this unit.
6. Perform daily pre and post QC source checks in accordance with HDP-PR-HP-416.
7. At each 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 7 (seven) samples taken at a depth of 0 – 15 cm (surface).
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

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

the HP Technician will log the reason for collection of biased samples in the Field Log sheet and record the location of biased samples on Appendix P-4 of this survey instruction.

NOTE: If trash, waste, or other non-native materials are observed during sample collection, stop sampling activities and notify HP Supervision (or Radiological Engineering) before collecting samples at any sample location in the unit.

9. 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 and for Tc-99 by liquid scintillation counting or ICPMS.

Specific Instructions:

NOTE: Unless otherwise indicated, the performance of these specific instructions is the responsibility of the HP Technician.

Before Beginning Work

1. **Rad. Engineer/HP Technician:** Verify 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. LSA 10-09 is bordered on all sides by LSA 10-06. LSA 10-09 is a low point within LSA 10-06 and therefore a physical barrier must be in place to minimize the potential for cross contamination.
2. **Rad. Engineering/HP Technician:** Walk the area looking specifically for any debris material (e.g. asphalt, plastic, concrete, etc…) that may indicate further remediation efforts are necessary.
3. **Rad. Engineer/HP Technician:** Perform a daily task-specific briefing; documenting the attendants, planned work activities, anticipated hazards, and controls on the FSS Daily Task Briefing log sheet.

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

Sampling

Note: The following instructions provide directions for sampling the sidewalls of the unit.

1. Collect soil samples in accordance with HDP-PR-FSS-711 at locations identified on the attached figure. Note that additional biased sampling locations may also be identified as determined by the GWS or as determined by Radiological Engineering.
2. 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.
3. 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 on the results obtained from monitoring the locations of biased sampling to receive instructions for further investigation or the need for additional excavation.
4. Collect bias samples from the surface to a depth of 6 inches.
5. Monitor the count rates within the depression created by the collection of biased soil samples.
6. 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 to determine additional characterization methods, if necessary.
7. Submit 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

Prepared by:	Michelle Bresnahan (Print Name)	(Signature)	10/17/13 (Date)
Peer Reviewed by:	Rock Nevcan (Print Name)	(Signature)	10.17.2013 (Date)
Approved by (RSO):	Joseph Guido (Print Name)	(Signature)	10/17/13 (Date)

Square feet to square meters conversion				
923	ft^2	=	85.749469	m^2

Excavation Wall Sampling (Sample Spacing Along a Line)

Random start

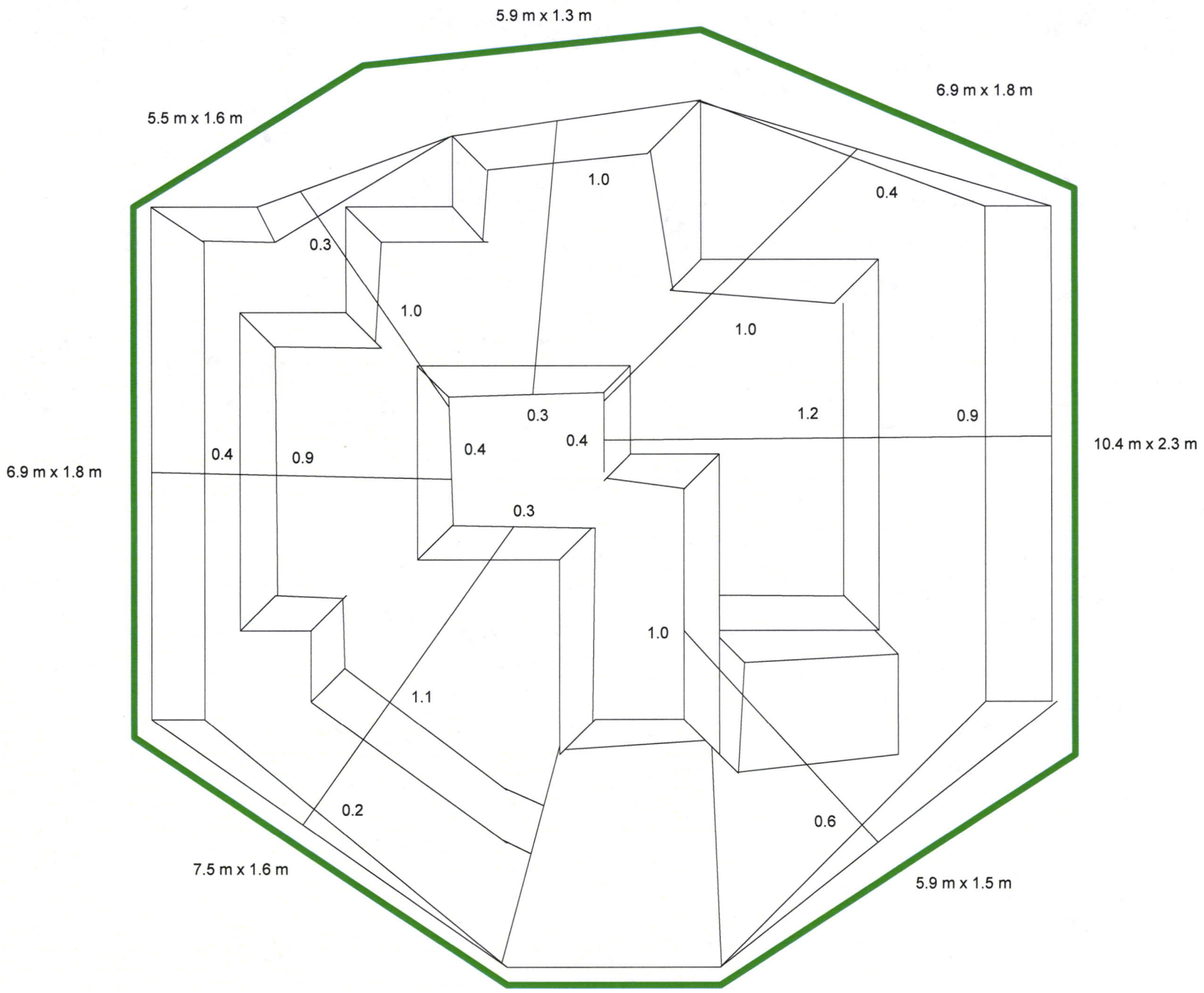
Height	Width
0.8	**4**

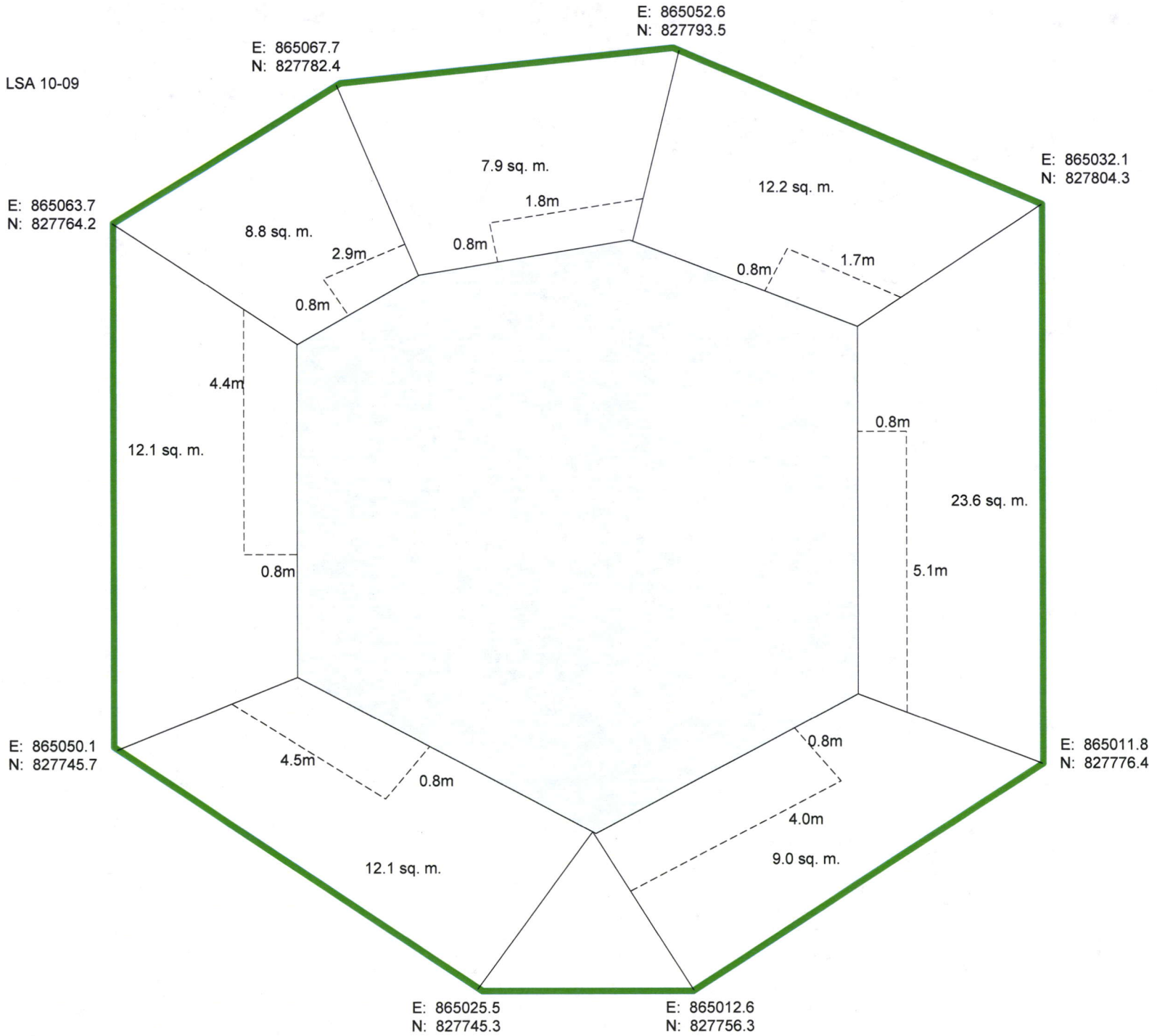
Line section length	49
# Samples	7
Spacing	7

Plug whole number and decimal of spacing into random number generator above to find your starting point

cm	feet						
3.10	20.00	Feet (width)	Feet (height)	Sq Feet (area)	Width (Meters)	Height (Meters)	Area (sq. meters)
3.00	0.05	19.35	5.00	96.77	5.9	1.5	9.0
5.30	0.03	34.19	7.42	253.72	10.4	2.3	23.6
3.50	0.04	22.58	5.83	131.65	6.9	1.8	12.2
3.00	0.05	19.35	4.42	85.55	5.9	1.3	7.9
2.80	0.06	18.06	5.25	94.84	5.5	1.6	8.8
3.50	0.04	22.58	5.75	129.84	6.9	1.8	12.1
3.80	0.04	24.52	5.33	130.67	7.5	1.6	12.1
				923	49.0		85.75

LSA 1


5.9 m x 1.3 m
6.9 m x 1.8 m
5.5 m x 1.6 m
1.0
0.4
0.3
1.0
1.0
0.3
1.2
0.9
10.4 m x 2.3 m
6.9 m x 1.8 m
0.4
0.9
0.4
0.4
0.3
1.0
1.1
0.2
0.6
7.5 m x 1.6 m
5.9 m x 1.5 m


LSA 10-09
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E: 865067.7
N: 827782.4
E: 865032.1
N: 827804.3
E: 865063.7
N: 827764.2
E: 865050.1
N: 827745.7
E: 865011.8
N: 827776.4
E: 865025.5
N: 827745.3
E: 865012.6
N: 827756.3
7.9 sq. m.
1.8m
0.8m
8.8 sq. m.
2.9m
0.8m
12.2 sq. m.
0.8m
1.7m
4.4m
12.1 sq. m.
0.8m
0.8m
23.6 sq. m.
5.1m
4.5m
0.8m
12.1 sq. m.
0.8m
4.0m
9.0 sq. m.

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

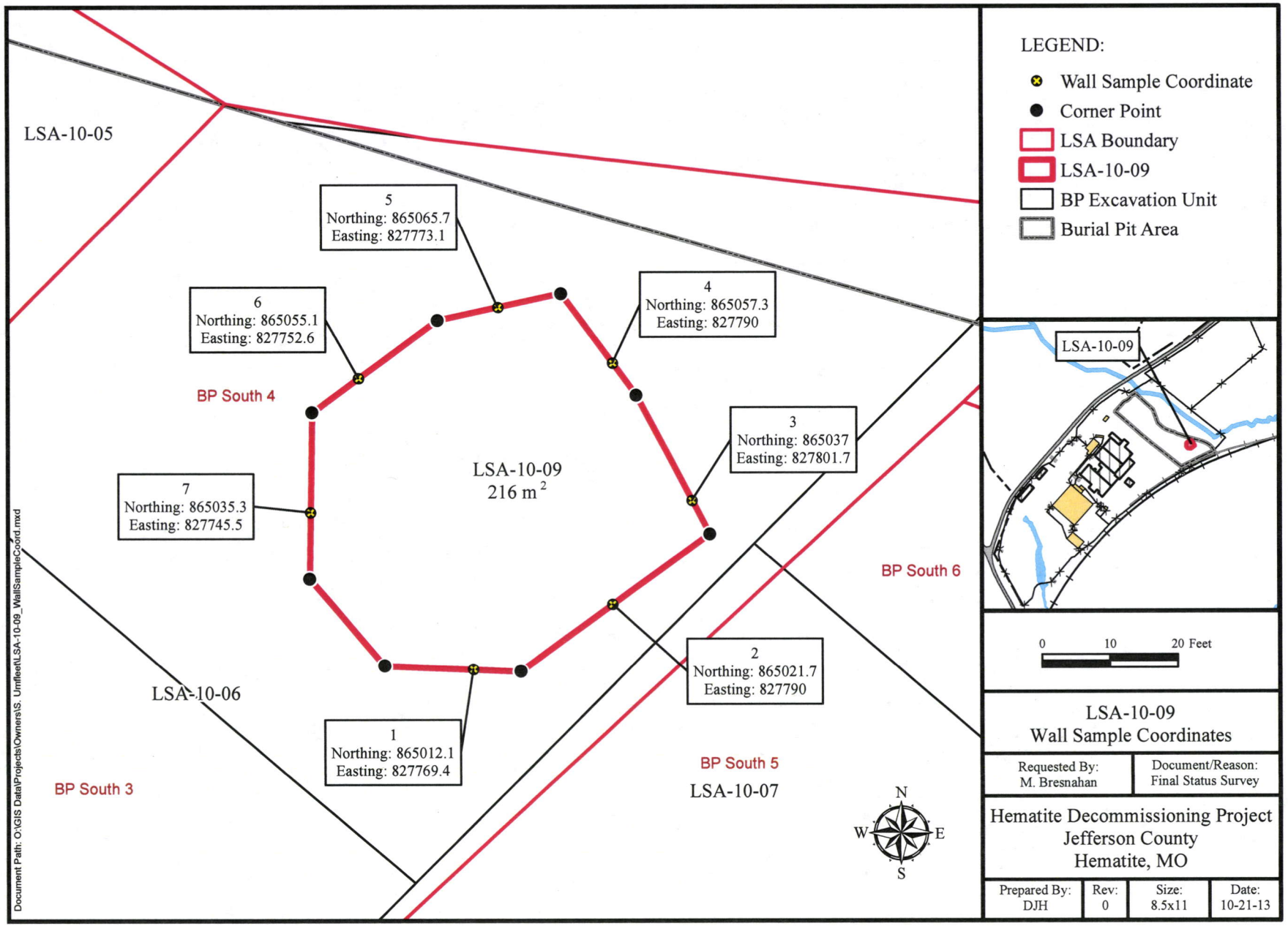
Survey Area: No. LSA 10 **Description:** Burial Pits Open Land Area

Survey Unit: No. 09 **Description:** VOC Pit in LSA 10-06

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

Measurement or Sample ID	Surface or CSM	Type	Start Depth (feet)	End Depth (feet)	Northing (Y Axis)*	Easting (X Axis)*
L100924BSS00	Surface	S	0	0.5	865012.1	827769.4
L100925BSS00	Surface	S	0	0.5	865021.7	827790.0
L100926BSS00	Surface	S	0	0.5	865037.0	827801.7
L100927BSS00	Surface	S	0	0.5	865057.3	827790.0
L100928BSS00	Surface	S	0	0.5	865065.7	827773.1
L100929BSS00	Surface	S	0	0.5	865055.1	827752.6
L100930BSS00	Surface	S	0	0.5	865035.3	827745.5

* 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-10-05
5
Northing: 865065.7
Easting: 827773.1
4
Northing: 865057.3
Easting: 827790
6
Northing: 865055.1
Easting: 827752.6
BP South 4
3
Northing: 865037
Easting: 827801.7
LSA-10-09
216 m 2
7
Northing: 865035.3
Easting: 827745.5
BP South 6
2
Northing: 865021.7
Easting: 827790
LSA-10-06
1
Northing: 865012.1
Easting: 827769.4
BP South 5
LSA-10-07
BP South 3
N
W
E
S
LEGEND:
Wall Sample Coordinate
Corner Point
LSA Boundary
LSA-10-09
BP Excavation Unit
Burial Pit Area
LSA-10-09
0
10
20 Feet
LSA-10-09
Wall Sample Coordinates
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:
10-21-13
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