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Our ref: HEM-17-35
Date: May 15, 2017

Subject: Westinghouse Hematite Decommissioning Project - Request for NRC Review of Final Status Survey Final Report Volume 3, Chapter 23, Survey Area Release Record for Land Survey Area 03, Survey Units 01 and 02 (License No. SNM-00033, Docket No. 070-00036)

The purpose of this letter is to provide for the U.S. Nuclear Regulatory Commission review of the Final Status Survey document Final Status Survey Final Report Volume 3, Chapter 23, Survey Area Release Record for Land Survey Area 03, Survey Units 01 and 02 (LSA 03-01 and LSA 03-02).

Attachment 1 contains Final Status Survey Final Report Volume 3, Chapter 23, with a CD containing Appendices.

Please contact me at 314-810-3353, should you have questions or need additional information.

Sincerely,

/Kenneth E. Pallagi/

Kenneth E. Pallagi
Licensing Manager,
Hematite Decommissioning Project

Attachment: 1) Final Status Survey Final Report Volume 3, Chapter 23, Survey Area Release Record for Land Survey Area 03, Survey Units 01 and 02 (LSA 03-01 and LSA 03-02), with a CD containing Appendices (HDP-RPT-FSS-225)

cc: J. W. Smetanka, Westinghouse
S. S. Koenick, NRC/DUWP/MDB
J. A. Smith, NRC/DUWP/MDB

Attachment 1

Final Status Survey Final Report Volume 3, Chapter 23

Survey Area Release Record for Land Survey Area 03, Survey Units 01 and 02
with CD containing Appendices

Westinghouse Electric Company LLC, Hematite Decommissioning Project

Docket No. 070-00036

Westinghouse

Final Status Survey Report

Hematite Decommissioning Project

Final Status Survey Final Report Volume 3, Chapter 23

TITLE: **Survey Area Release Record for Land Survey Area 03, Survey Units 01 and 02 (LSA 03-01 and LSA 03-02)**

REVISION: **0**

EFFECTIVE DATE: MAY 15 2017

Approvals:

Author: Kenneth E. Pallagi — 05-15-2017 Date

Owner/Manager: W. Clark Evers — 5/15/17 Date

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ALARA	As Low As Reasonably Achievable
bgs	below ground surface
CFR	Code of Federal Regulations
cm	centimeter(s)
cpm	count(s) per minute
CSM	Conceptual Site Model
DCGL	Derived Concentration Guideline Level
$DCGL_W$	DCGL for average concentrations over a survey unit, used with statistical tests. ("W" suffix denotes "Wilcoxon")
DGPS	Digital Global Positioning System
DP	Hematite Decommissioning Plan
DQO	Data Quality Observation
EMC	Elevated Measurement Comparison
EPA	U.S. Environmental Protection Agency
ft	foot (feet)
FSS	Final Status Survey
FSSFR	Final Status Survey Final Report
gcpm	gross count(s) per minute
GIS	Graphical Information Software
GPS	Global Positioning System
GWS	Gamma Walkover Survey
HDP	Hematite Decommissioning Project
HP	Health Physics
HRCR	Hematite Radiological Characterization Report
HSA	Historical Site Assessment
IAL	Investigation Action Level
LSA	Land Survey Area
m	meter(s)
m^2	square meter(s)
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCL	Maximum Concentration Limit
MDC	Minimum Detectable Concentration
mrem	milliroentgen equivalent man
NAD	North American Datum
NaI	Sodium Iodide
ncpm	net count(s) per minute
NCS	Nuclear Criticality Safety
NRC	U.S. Nuclear Regulatory Commission
pCi/g	picocurie(s) per gram
QC	Quality Control
Ra	Radium
RAI	Request for Additional Information
RASS	Remedial Action Support Survey
RSO	Radiation Safety Officer

SOF	Sum of Fractions
SU	Survey Unit
Tc	Technetium
TEDE	Total Effective Dose Equivalent
Th	Thorium
U	Uranium
WRS	Wilcoxon Rank Sum

EXECUTIVE SUMMARY

This Survey Area Release Record (SARR) presents the results of the final status radiological surveys of the Hematite Decommissioning Project (HDP) Land Survey Area (LSA) 03, Survey Unit (SU) 01 (LSA 03-01), and SU 02 (LSA 03-02). As provided in Final Status Survey Final Report (FSSFR), Volume 1, Chapter 1, Section 7.0 {ML15257A307}, the final report summary, FSSFR Volume 7, *Final Status Survey Final Report*, will be submitted at the conclusion of the post-remediation groundwater monitoring period. FSSFR Volume 7 will be submitted to demonstrate that the site has met the requirements for unrestricted release consistent with the requirements of the Title 10 Code of Federal Regulations (CFR) 20 Subpart E, "Criteria for License Termination."

The land area that comprises LSA 03-01 was initially designated as a Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) Class 3 SU. Subsequently LSA 03-01 was divided into SU LSA 03-01, which remained a Class 3 SU, and LSA 03-02 which was designated a Class 2 SU.

For SU LSA 03-01 and LSA 03-02 evaluation of analytical results against the Derived Concentration Guideline Levels (DCGL) for the Uniform Stratum Conceptual Site Model (CSM) was the selected approach. The objective of the FSS for the SUs was to obtain and document measurement results, analytical data, and other supporting information in order to demonstrate that the residual radioactivity levels in LSA 03-01 and LSA 03-02 SUs are below the applicable Uniform Stratum DCGLs and therefore the land area of these SUs meet the criteria for unrestricted release.

The Uniform Stratum CSM assumes residual radioactivity is uniformly distributed over the entire depth profile of the SU from ground surface to 6.7 meter (m) below ground surface (bgs). As described in FSSFR Volume 3, Chapter 1, 6.2.1, *Systematic Soil Sampling*, systematic soil samples were obtained at depths dependent upon the systematic soil sample location.

This SARR was prepared as described in FSSFR Volume 3, Chapter 1, Section 7.0, *Survey Area Release Record Organization*, as implemented by FSS procedure HDP-PR-FSS-722.

1.0 REPORT BACKGROUND

As a result of the U. S. Nuclear Regulatory Commission (NRC) feedback regarding the submittal of the FSSFR, Westinghouse and the NRC agreed that Westinghouse would develop an outline presenting the format and content of FSS documents required for NRC review. Westinghouse provided the outline to the NRC for discussion during the August 19, 2015, publicly noticed teleconference and the format was agreed upon {ML15238B032}.

FSSFR Volume 3, Chapter 1, Revision 3, *Land Survey Areas (LSA) Overview* provides the information common to land survey areas. This report, FSSFR Volume 3, Chapter 23, builds upon the general information provided in FSSFR Volume 3, Chapter 1, Revision 3.

2.0 HDP SITE, LSA AND SURVEY UNIT DESCRIPTIONS

2.1 HDP Site Description

A general description of the HDP site is given in FSSFR Volume 1, Chapter 1.

2.2 LSA 03 Configuration

The DP Chapter 14 and DP Figure 14-14 provided the conceptual approach for the configuration of LSAs and the SUs within a LSA. Figure 2-1 indicates the conceptual LSA configurations for the HDP site. Figure 2-2 provides the final LSA configuration for the HDP site.

LSA 03 encompasses the area west of the Site Pond. LSA 03 consists of SUs LSA 03-01 and LSA 03-02 (See Figure 2-3).

The DP stated that it was expected that the conceptual boundaries of the SUs would be altered based on the actual configuration and condition of the SU at the time of survey design. As expected, it was necessary to modify the boundary of SUs within LSA 03 to facilitate the FSS process. A portion of the land area that comprises LSA 03 was elevated in MARSSIM classification. No classification of any land area of LSA 03 was lowered, thus ensuring compliance with the DP.

2.2.1 LSA 03 Configuration Change

A small area of LSA 03 was transferred to LSA 02 and LSA 05 to ensure compliance with the DP in regards to FSS classification due to the progress of remediation work and radiological status in the Site Pond and Site Spring Area. Transferring the land areas to LSA 02 and LSA 05 resulted in those land areas being upgraded to MARSSIM Class 1. Therefore ensuring compliance with the DP for the specific land areas that were transferred. Figure 2-4 provides a depiction of the final configuration of land survey areas and survey units.

2.2.2 LSA 03 Survey Unit Configuration and Classification Change - Flooding

LSA 03 was originally designated as one SU, the Class 3 SU LSA 03-01 (see Figure 2-1).

On April 18, 2013, Jefferson County, Missouri, experienced a weather pattern that created heavy rainfall following prior rainfall that had largely saturated the soil. The heavy rainfall led to significant runoff within the watershed of Joachim Creek, creating a flash flood all along Joachim Creek. The extent of the flash flooding was sufficient to encroach upon the Hematite Decommissioning Project site, which is approximately 1000 feet from Joachim Creek. The flash flooding included two on-site tributaries to Joachim Creek, the Northeast Site Creek and the Site Creek/Pond.

To address the impacts to the site of the rain/flooding event site personnel developed and issued report HDP-RPT-EM-006, *Joachim Creek Flash Flood Event*.

The flooding caused a backup of the Site Pond. As the Site Creek is an effluent pathway for the site, radiological survey and sampling was conducted after the flood waters receded. The radiological sample results were below the DCGLs and were consistent with license conditions for site discharges. The radiological sample results for sediment, particularly samples 5079-SS-

130424-00-02, 5079-SS-130424-00-03, and 5095-SS-130425-00-02, indicate that these areas required further evaluation as part of FSS. The LSA 03 land area to the west of the Site Pond/Creek that had standing water as a result of the April 18, 2013 flooding was established as LSA 03-02 and designated as Class 2 SU for FSS. The unaffected area of LSA 03 remained designated as LSA 03-01 a Class 3 SU.

The SU configuration and classification change was reviewed by NRC Region III as documented in Inspection Report 07000036/2014002 {ML14160B134}.

2.3 LSA 03-01 Survey Unit Description and Configuration

The LSA 03-01 SU is comprised of the land area that contains the western most portion of the site adjacent to the Site Pond, and borders State Road P within the Westinghouse site property boundary. The land area is an open field with a small number of trees. Due to its location west of the Site Pond it was not amenable to and was not utilized during site licensed operations. During site remediation activities the SU was used to store reuse soil collected from the construction of the Site Pond Diversion. As prepared for FSS the SU consists of native soils, grass and a small number of trees.

In its final configuration as prepared for FSS, LSA 03-01 presents 10,540 square meters (m^2) in planar (2-dimensional) extent.

2.4 LSA 03-02 Survey Unit Description and Configuration

The LSA 03-02 SU is comprised of the land area southwest and adjacent to the Site Pond and Site Pond Dam. The land area is an open field with a small number of trees. As prepared for FSS the SU consists of native soils, grass and a small number of trees.

In its final configuration as prepared for FSS, LSA 03-02 presents 2,553 m^2 in planar (2-dimensional) extent.

Figure 2-1
Initial Configuration of Land Survey Areas and Survey Units as provided in DP (Figure 14-14)

Figure 2-2
HDP Land Survey Areas

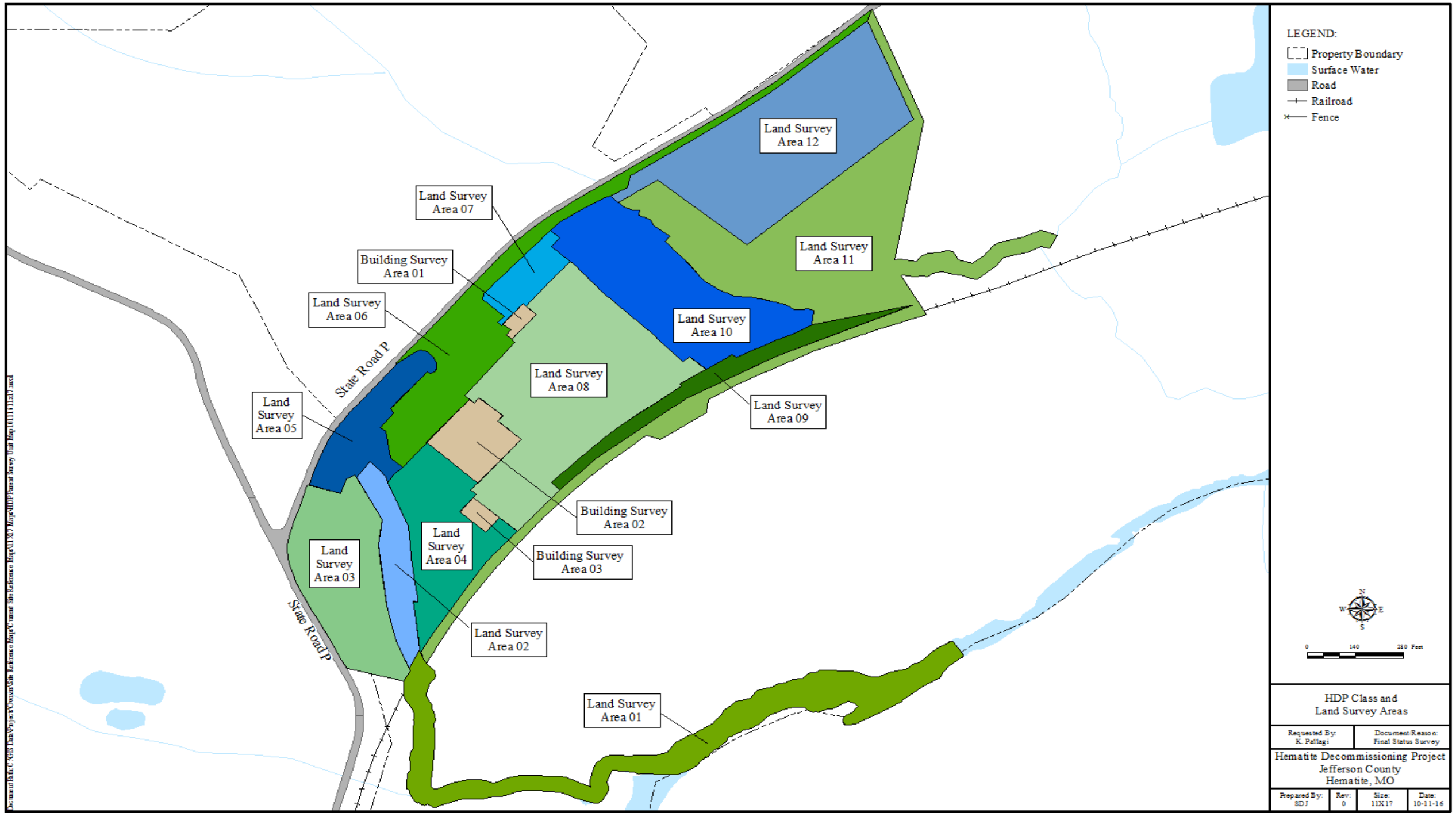


Figure 2-3
Final Configuration of Land Survey Area 03 and Survey Units

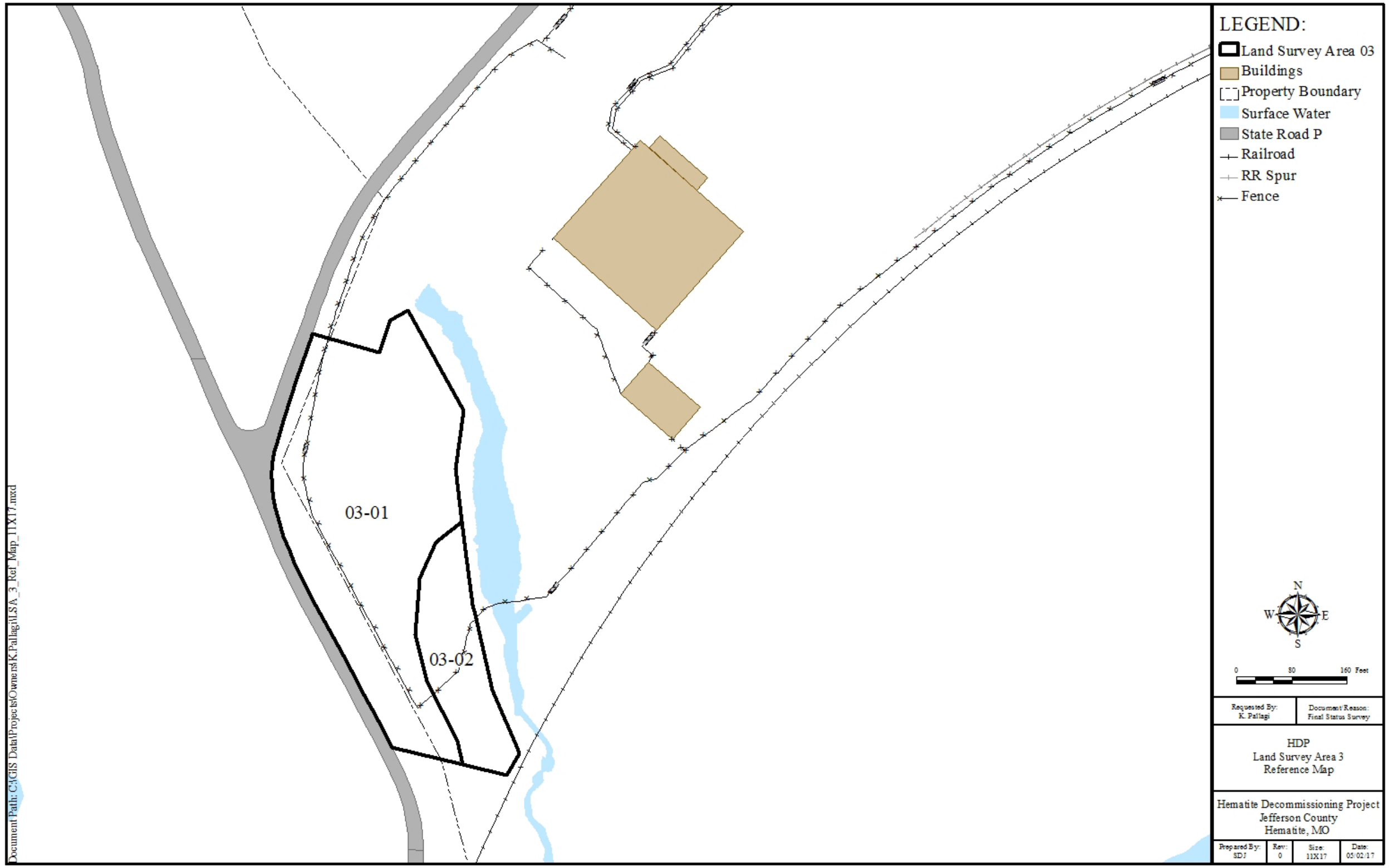
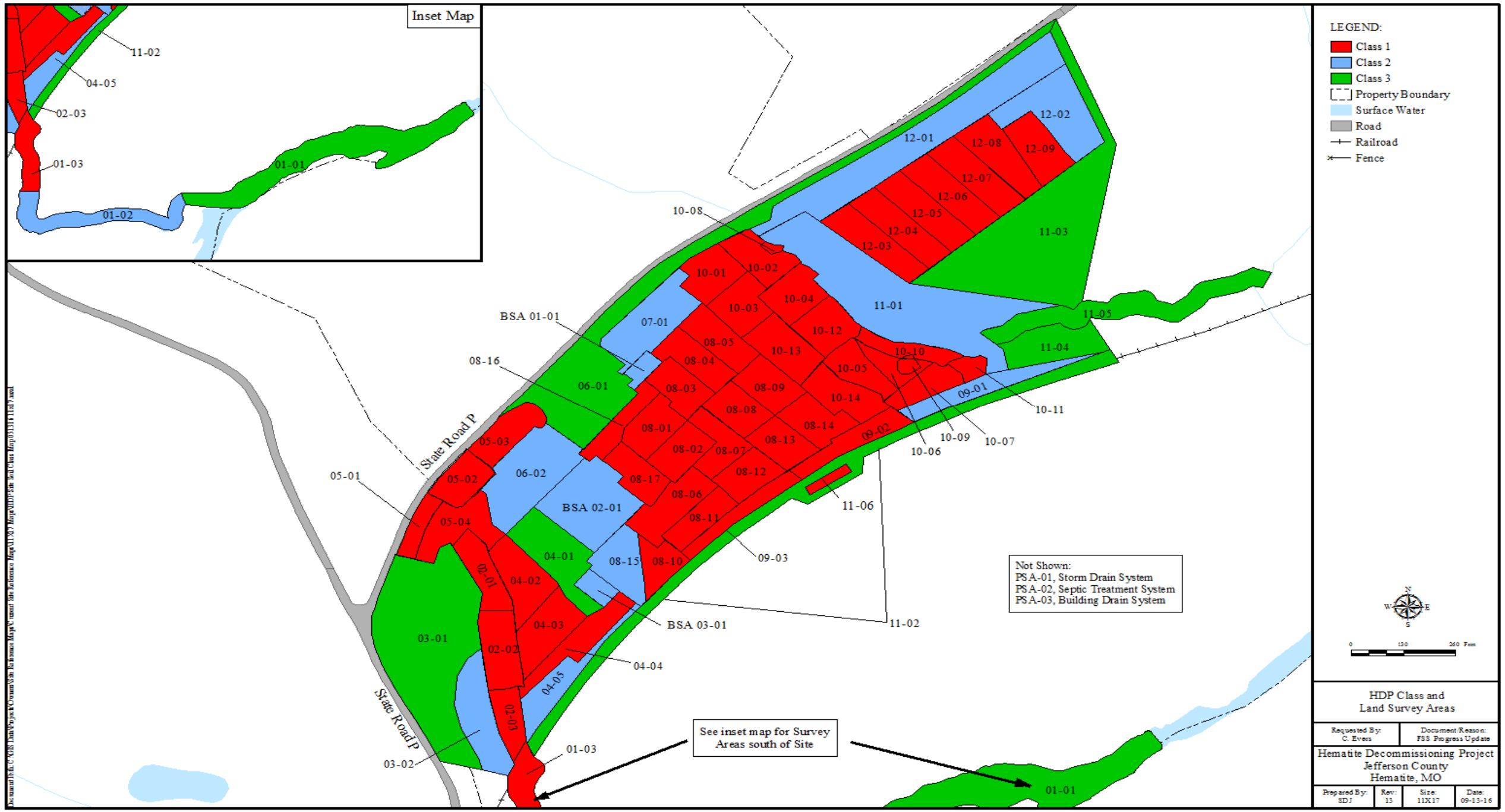


Figure 2-4
Final Configuration of Land Survey Areas and Survey Units



3.0 HISTORY OF OPERATIONS

A discussion of site historical operations prior to the decommissioning phase of the HDP is presented in the FSSFR Volume 1, Chapter 1, Section 3.0, *Site Historical Operations*.

The LSA 03 land area is west of and adjacent to the Site Creek and Site Pond. The Historical Site Assessment (HSA) determined that prior to purchase of the property by Mallinckrodt for licensed activities, the LSA 03 land area consisted of the homestead for the dairy farm that was located on the site property. Aerial photographs in the HSA indicate that by 1971 the homestead no longer existed. During site operations due to its location west of the Site Pond it was not amenable to and was not utilized during site operations.

To accomplish remediation of the Site Pond it was necessary to divert flow from the Site Spring to allow the Site Pond to be drained and then remediated. Due to its location away from land areas subject to site operation the land area that comprises LSA 03-01 was utilized to construct the Site Pond Diversion and to process and store the reuse soil that was generated within LSA 03-01.

3.1 Radioactive Materials in LSA 03-01 and LSA 03-02

The land area that comprises LSA 03-01 and LSA 03-02 was not used during the operational history of the site, and as such had no history of radioactive materials present within the boundaries of the SUs.

As described in Section 2.2.2 flooding that occurred on April 18, 2013, provided a potential for transfer of radioactive material suspended in the Site Pond water to be deposited on the land area that comprises LSA 03-02. The radioactive material in LSA 03-01 and LSA 03-02 is consistent with the Radionuclides of Concern as described in FSSFR Volume 1, Chapter1.

3.2 Reuse Soil Disposition and Characterization

During remediation operations, LSA 03-01 was used to process and store the reuse soil that was generated from the construction of the Site Pond Diversion. During the construction of the Site Pond Diversion the soil that was excavated to construct the diversion was placed within LSA 03-01 and LSA 03-02 with the intent to return the soil to the area upon restoration of the area. The soil was designated as Reuse Soil Stockpile 8b and processed in accordance with site procedures (See Figure 3-1). The radiological data for Reuse Soil Stockpile 8b is contained in FSSFR Volume 2, Chapter 6 {ML16285A368}.

The successful processing of Reuse Soil Stockpile 8b indicated that there was no impact to the land area of LSA 03-01 from site remediation activities. As such the Class 3 classification of LSA 03-01 remained appropriate.

Figure 3-1
Construction of Site Pond Diversion and Reuse Soil Stockpile 8b

3.3 Remediation and Remedial Action Support Surveys (RASS) Phase of LSA 03-01 and LSA 03-02

Based upon the results of the Final RASS and FSS field activities performed in LSA 03 no remediation was required to be performed in LSA 03-01 and LSA 03-02.

3.3.1 Nuclear Criticality Safety (NCS) Borings

NCS Borings were not required within LSA 03 as the land area of the SUs was never subject to NCS controls.

3.3.2 Groundwater Monitoring Wells

A detailed discussion of history, purpose, use, issues, and results of the groundwater monitoring wells at HDP is presented in the FSSFR Volume 6, Chapter 1.

Two groundwater monitoring wells (both bedrock design) are located within the boundary of SU LSA 03-01. Bedrock groundwater monitoring well BR-01-JC is currently in service and is screened in the Jefferson City-Cotter bedrock formation. Bedrock monitoring well BR-01-RB is currently in service and is screened in the Roubidoux bedrock formation. Both of these wells will continue to be monitored as part of the post-remediation groundwater monitoring. See FSSFR Volume 6, Chapter 1 for a discussion on post-remediation groundwater monitoring.

No monitoring wells were/are installed within the boundary of LSA 03-02.

3.3.3 Subterranean Piping

No buried piping existed or exists within the footprint of LSA 03-01, and LSA 03-02. As such, there is no dose contribution from this pathway.

3.3.4 Characterization History

Radiological characterization surveys for the HDP were conducted in several phases by multiple contractors over several years prior to the approval of the DP. During the various characterization campaigns a total of seven (7) core borings to depths as deep as 15 feet bgs were performed for within LSA 03. None of these characterization sample results produced elevated Uniform SOF results. For these samples the maximum result was 0.05 Uniform SOF. Therefore the MARSSIM Class 2 and Class 3 classification were determined to be appropriate for FSS as no remediation was required in LSA 03.

3.3.5 Remedial Action Support Survey for FSS Design

RASS was conducted within LSA 03-01 and LSA 03-02, 1) to determine when a SU had been adequately prepared for FSS, and 2) to provide updated estimates of the parameters to be used for planning the FSS. Upon the completion of remediation of the SU and prior to implementation of FSS activities, a Final RASS was performed to validate the status of the SU prior to implementing Isolation and Control postings.

The RASS included a GWS, systematic surface sample collection based on an eight (8) point triangular grid, and biased surface sampling. The Final RASS results were used to develop the FSS Plan for each SU. The Final RASS systematic sample results used to develop the FSS sampling grid are summarized in Table 3-1 below.

Table 3-1
Summary of Final RASS Results for LSA 03-01 and LSA 03-02

LSA	Ra-226 (net)		Tc-99		Th-232 (net)		U-234		U-235		U-238	
	Mean	Max	Mean	Max	Mean	Max	Mean	Max	Mean	Max	Mean	Max
03-01	<BKG	<BKG	0.06	0.10	0.08	0.25	2.39	4.61	0.13	0.25	1.29	1.78
03-02	0.02	0.07	0.04	0.09	0.11	0.23	1.81	2.50	0.10	0.14	1.02	1.27
DCGL[3]	1.9		25.1		2.0		195.4		51.6		168.8	

Notes:
1. All units are in picocuries per gram (pCi/g)
2. Results reflect net concentrations after subtraction of background (Ra-226 bkg = 0.9 pCi/g; Th-232 bkg = 1.0 pCi/g).
3. Uniform Stratum DCGLs (From Table 4-1)

All Final RASS systematic sample and biased sample results were less than the appropriate $DCGL_W$, therefore the Final RASS data set was considered sufficient to support FSS design.

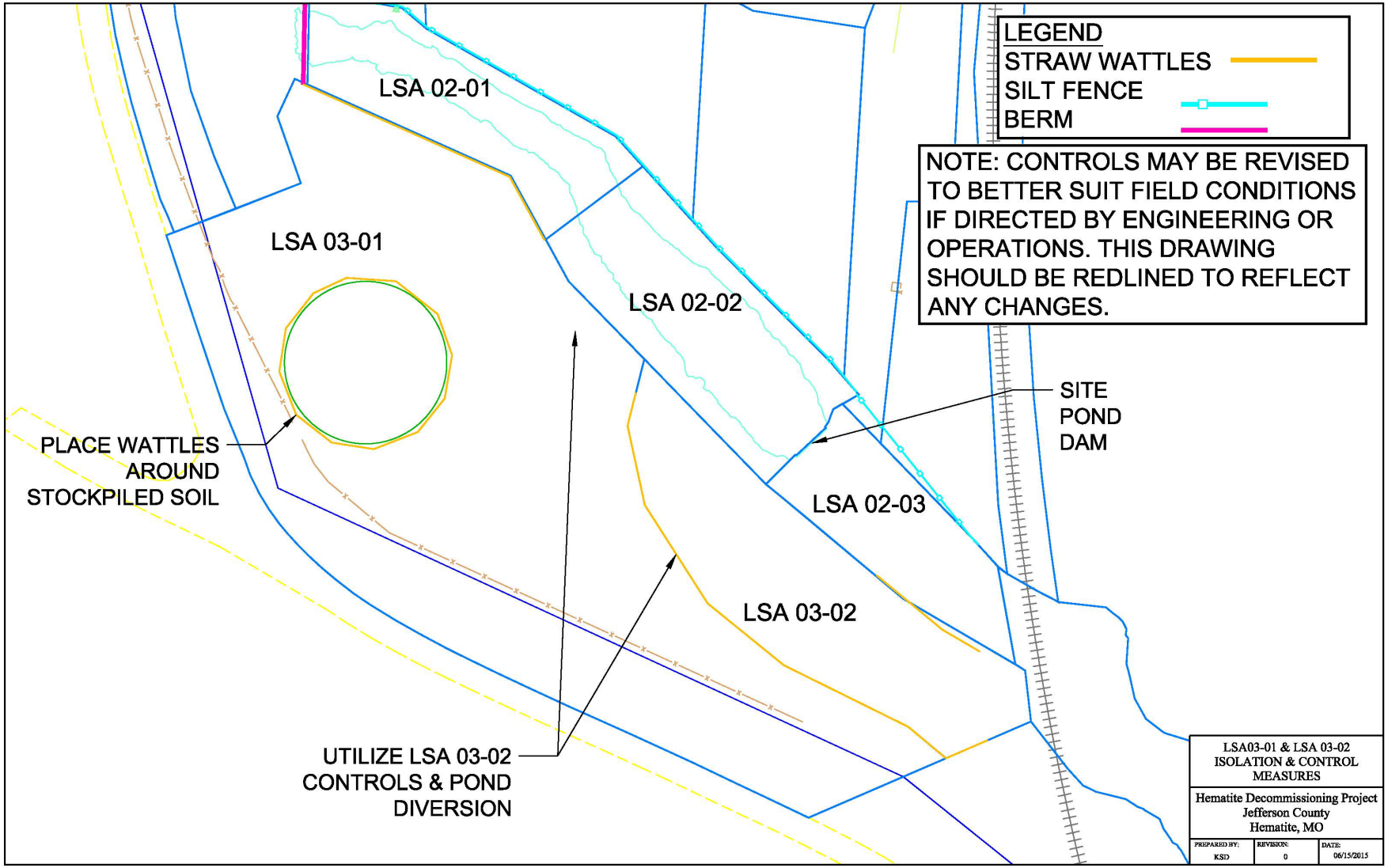
3.3.6 Isolation and Control

As directed by HDP-PR-HP-602, *Data Package Development and Isolation and Control Measures to Support Final Status Survey,* in June of 2015, the SUs in LSA 03 were isolated and controlled in accordance with Work Package HDP-WP-ENG-803, *Isolation and Control Measures,* (See Figure 3-2). Only limited isolation and control measures were required for LSA 03-01 and LSA 03-02 as they were Class 2 and Class 3 SUs, and as the adjacent LSA 02 (Site Pond) area was already subjected to isolation and control protocols. To ensure the integrity of

the FSS the only isolation controls necessary were the placement of straw waddles between the boundaries of LSA 03-01 and LSA 03-02, and surrounding the reuse soil stockpile remaining in LSA 03-01.

The administrative control of multiple postings labeled "Contact Health Physics Prior to Entry" were installed around the entire perimeter of the SUs prior to FSS field activities to prevent inadvertent entry by site personnel. The LSA 03 SUs are isolated from the remainder of the property by the Site Pond Diversion and are bounded by the public roadway State Road P.

Figure 3-2
Isolation and Control Instruction for LSA 03-01 and LSA 03-02



3.4 Surveillance Following FSS

Following the completion of a FSS, the DP requires continued surveillance to minimize the potential to re-contaminate a SU (e.g., surface water transport of potentially contaminated sediment or a soil pile that was not present during FSS).

During the timeframe since the completion of FSS field activities to the date of completion of all physical work at HDP and project demobilization, LSA 03-01 and LSA 03-02 did not evidence an event that would cause them to be suspect and thus require investigation.

3.5 Backfill of Survey Units

As there were no remediation excavation activities in LSA 03 there were no backfill activities required to fill excavations. During the restoration phase of the project Reuse Soil Stockpile 8b was used to establish the final grade contour in LSA 03 for proper drainage. As such, the dose associated with Reuse Soil Stockpile 8b will be added to the total dose for LSA 03-01 and LSA 03-02.

3.6 Groundwater Monitoring

In response to NRC RAI Chapter 3-4, during the review and approval process for the DP, Westinghouse documented in letter HEM-11-96 {ML111880290} the revised text of DP Section 14.5.1 to be as follows:

> "*Post-remediation monitoring wells will be sampled quarterly after the completion of remediation until license termination. The data collected will be used to confirm that the sum of the annual dose from groundwater for all the radionuclides does not exceed the EPA Maximum Contaminant Level (MCL) of 4 millirem/year. Separately, the sum of the dose from all residual sources remaining after remediation, including soil and groundwater pathways, will be confirmed to result in an annual dose that does not exceed 25 millirem/year*."

As stated in the Executive Summary section, the exposure results of this report will be combined with the dose attributed to groundwater to demonstrate that the site has met the requirements for unrestricted release consistent with the requirements of the Title 10 CFR 20 Subpart E, "Criteria for License Termination." As such, for the purpose of this report, groundwater will be assigned a conservative SOF of 0.16 which equates to 4 mrem/yr until such time that the post-remediation groundwater sampling has been completed and reported as part of FSSFR Volume 6, Chapter 7, *Post-remediation Groundwater Monitoring Summary*. The final dose for LSA 03-01 and LSA 03-02 will be reported in FSSFR Volume 7, reflecting the updated results of the post-remediation groundwater monitoring.

4.0 LSA RELEASE CRITERIA

As the release criteria for all LSA SUs is common, FSSFR Volume 3, Chapter 1, Section 3.0, *Release Criteria*, provides a detailed discussion on the release criteria that is applicable to LSA 03-01 and LSA 03-02. Table 4-1 provides the applicable DCGLs.

Table 4-1
Adjusted Soil $DCGL_w$'s by CSM[a]

Radionuclide	Three Layer Approach $DCGL_w$ Values (pCi/g)[b]			Uniform Stratum (pCi/g)
	Surface Stratum	Root Stratum	Excavation Scenario	
Radium-226+C[d]	5.0	2.1	5.4	**1.9**
Technetium-99	151.0	30.1	74.0	**25.1**
Thorium-232+C[d]	4.7	2.0	5.2	**2.0**
Uranium-234	508.5	235.6	872.4	**195.4**
Uranium-235+D[c]	102.3	64.1	208.1	**51.6**
Uranium-238+D[c]	297.6	183.3	551.1	**168.8**

[a] Table as presented in FSSFR Volume 3, Chapter 1.
[b] The reported DCGLw's are the activities for the parent radionuclide and were calculated to account for the dose contribution from insignificant radionuclides.
[c] +D indicates the $DCGL_w$ includes short-lived (half-life ≤ 6 mo.) decay products.
[d] +C indicates the $DCGL_w$ includes all radionuclides in the associated decay chain.

5.0 FINAL STATUS SURVEY DESIGN LSA 03-01

This section of the report describes the method for determining the number of samples required for the FSS of LSA 03-01 as well as summarizing the applicable requirements of the FSS Plan. These include the $DCGL_W$, scan survey coverage, and Investigation Action Levels (IAL). The radiological instrumentation used in the FSS of LSA 03-01 and the detection sensitivities are also discussed.

5.1 FSS Plan Design Requirements

FSS Plan requirements for LSA 03-01 were driven by the type (Open Land) and Class (Class 3) of the SU and developed in accordance with HDP procedure, HDP-PR-FSS-701, Revision 8, *Final Status Survey Plan Development*, August 2015.

5.1.1 Surrogate Evaluation Areas

A discussion of Surrogate Evaluation Areas is given in the FSSFR Volume 3, Chapter 1, Section 5.0, *Final Status Survey Design*.

5.1.2 $DCGL_W$

During the FSS design process a review was performed of the RASS data for LSA 03-01. The RASS data was used as confirmation that no known areas of residual radioactivity remained within the SU that exceeded the Uniform Stratum $DCGL_W$. Therefore the Uniform Stratum $DCGL_W$ was selected for use in demonstrating compliance with the release criteria.

5.1.3 GWS Coverage

As a Class 3 SU, LSA 03-01 was required to undergo a minimum of a 10% GWS.

5.1.4 Instrumentation

Radiological instrumentation selected for performance of GWS within LSA 03-01 was the Ludlum 44-10 2" x 2" sodium iodide (NaI) detectors, coupled to a Ludlum 2221 scaler-ratemeter.

5.1.5 Scan Minimum Detectable Concentration (MDC)

Scan MDCs for LSA 03-01 were calculated in accordance with HDP-PR-FSS-701, Revision 10, *Final Status Survey Plan Development* and HDP-TBD-FSS-002, Revision 3, *Evaluation and Documentation of the Scanning Minimum Detectable Concentrations (MDC) for Final Status Surveys (FSS)*. As background levels were approximately 9,000 counts per minute (cpm) within LSA 03-01, the Scan MDC calculation for total uranium given in HDP-PR-FSS-701, *Final Status Survey Plan Development*, Step 8.2.6.d, was applied:

$$\text{Scan MDC}_{\text{(total uranium)}} = \frac{1}{\left(\left(\frac{f_{U-234}}{3471\ pCi/g}\right)+\left(\frac{f_{U-235}}{2.20 pCi/g}\right)+\left(\frac{f_{U-238}}{29.0\ pCi/g}\right)\right)}$$

Equation 5-1

To determine isotopic Uranium fractions HDP-PR-FSS-701, Revision 10, *Final Status Survey Plan Development* assumes that the average LSA enrichment is 4% or less. Based on the systematically collected RASS samples in LSA 03-01, the average enrichment for the SU was 1.6%. All other Scan MDC parameters agreed upon between Westinghouse and the NRC were applied (e.g. use of a 2 in air gap, scan rate of 1 ft/sec, 0.75 surveyor efficiency), therefore no subsequent changes to the calculated Scan MDCs need to be made.

Prospectively calculated Scan MDCs for 2" x 2" NaI detectors that were used in LSA 03-01 are shown below:

Table 5-1
Scan MDCs for 2" x 2" NaI detector, 9,000 cpm background: LSA 03-01

	Scan MDC (Total U)	DCGLw (Total U)	Scan MDC (Ra-226)	DCGLw* (Ra-226)	Scan MDC (Th-232)	DCGLw* (Th-232)
LSA 03-01	38.8	54.1	1.14	2.8	0.82	3.0

*$DCGL_w$ includes background concentrations of 0.9 pCi/g for Ra-226 (no ingrowth) and 1.0 pCi/g for Th-232. DCGLw values are based on the Uniform Stratum release criteria.

The values in Table 5-1 reflect those presented in the FSS Plan prepared for SU LSA 03-01 prior to FSS.

5.1.6 Investigation Action Level

FSSFR Volume 3, Chapter 1, Section 6.1.3, *Investigation Action Level (IAL)*, provides a discussion in regards to the IAL. The basis of the IAL is detailed in HDP-TBD-FSS-003, *Modeling and Calculation of Investigative Action Levels for Final Status Soil Survey Units*. The IAL used during the GWS of LSA 03-01 was established at 1,624 ncpm, which is the equivalent of an activity concentration that is less than the Uniform Stratum $DCGL_W$.

5.1.7 LSA 03-01 FSS Design Summary

The FSS Plan for LSA 03-01 can be found in Appendix D. Table 5-2 presents an overall FSS design and implementation summary for LSA 03-01.

Table 5-2
FSS Design Summary for LSA 03-01

Gamma Walkover Survey (GWS):		
Scan Coverage	Minimum 10% of LSA 03-01 total area	
Scan MDC	38.8 pCi/g total Uranium; 0.82 pCi/g Th-232; 1.14 pCi/g Ra-226 (based on a 9,000 cpm background)*	
Investigation Action Level (IAL)	1,624 net cpm **	
Systematic Sampling Locations:		
Depth	Number of Sample	Comments
0 – 15 cm (Surface)	8	These samples will be taken on a systematic grid. ***Excavation stratum samples will be collected and archived, but will be analyzed *only* in the event the overlying root stratum sample exceeds a SOF of 0.5
15 cm – 1.5 m (Root)	8	
> 1.5m (Excavation)	8***	
Biased Survey/Sampling Locations:		
Collect a minimum of one biased sample at the maximum GWS measurement within the SU. Biased samples may be collected during GWS at the discretion of the HP Technician, after statistical analysis of the survey data, or at the direction of the FSS Supervisor.		
Sidewall Sampling Locations:		
Supplemental Sidewall Sampling: Not applicable; SU is an unexcavated (remediation not required) Class 3 area.		
Instrumentation:		
Ludlum 2221 with 44-10 (2x2 NaI) detector	Used for GWS and to obtain static count rates at biased measurement locations.	
*Values based on information provided in HDP-TBD-FSS-002, "*Evaluation and Documentation of the Scanning Minimum Detectable Concentrations (MDC) for Final Status Surveys (FSS).* The Scan MDC for total Uranium reflects a conservative assumption of 4% enrichment. The actual RASS enrichment (1.6%) would result in Scan MDC values slightly less than those calculated for FSS planning purposes.		
**IAL is the net count per minute (ncpm) equivalent of an activity concentration less than the Uniform Stratum $DCGL_W$ derived from the technical bases presented in HEM-MEMO-15-021 and HDP-TBD-FSS-003 "*Modeling and Calculation of Investigative Action Levels for Final Status Soil Survey Units*", Westinghouse, March 2015.		

6.0 FINAL STATUS SURVEY IMPLEMENTATION LSA 03-01

FSS was performed in accordance with procedure HDP-PR-FSS-711, *Final Status Surveys and Sampling of Soil and Sediment*.

6.1 Gamma Walkover Survey

6.1.1 Instrumentation

The selected instrumentation to perform the GWS in LSA 03-01 was a 2" x 2" NaI detector in combination with a Ludlum 2221 rate meter. Each NaI instrumentation set was interfaced with a Trimble DGPS (Digital Global Positioning System) and handheld data logger.

Prior to the first field use of the GWS instrumentation, initial set-ups were performed. Also, daily pre- and post-use source checks were performed for each day that GWS was performed within the SU. Initial set-ups, daily source checks, and control charting were performed according to the requirements of HDP-PR-HP-416, *Operation of the Ludlum 2221 for Final Status Survey*.

6.1.2 GWS Performance

All GWS measurements were collected with the NaI detector(s) were connected to a Trimble DGPS and with a hand-held data logger. The logging frequency in the SU was 1 GWS measurement per second. Each gross gamma measurement is correlated to a set of coordinates based on the Missouri East State Plane, NAD 1983.

The GWS requirements involved moving the NaI detector in a side-to-side fashion no faster than 1 foot per second while holding the probe as close as possible to the excavation surface (nominally 1", but not to exceed 3"). At the same time, the Health Physics (HP) Technician was required to slowly advance, causing the detector to trace out a serpentine path over the excavation surface.

HP Technicians performing GWS in LSA 03-01 used the 1,624 ncpm IAL as a field guide to know when to slow or pause the GWS for more deliberate investigation. If during the GWS, audible count rates noticeably increase above the general area average (i.e., > minimum detectable count rate), HP Technicians were required to pause momentarily and observe count rates. If sustained count rates approached the IAL, further focused investigation was conducted within the locally elevated area.

To use the IAL effectively, HP Technicians first determined the local background count rate before starting the GWS. Although the ambient gamma level may vary across the SU due to the geometry and relative distance from contaminated materials in nearby remedial excavations, the average background rate (measured at waist level) within the LSA ranged between 9,000 and 10,000 gross counts per minute (gcpm). Therefore, at locations where the 2" x 2" NaI detector measurements exceeded 10,624 to 11,624 gcpm, HP Technicians slowed or paused the GWS for more careful investigation of the small areas of elevated activity before deciding if "flagging" a point for potential biased sampling was warranted.

After the GWS survey was complete, the GPS/GWS data was reviewed by Radiological Engineering and the HP Technician performing the survey to determine if possible areas of

elevated residual activity remained within the SU that required biased sample investigation. Areas that were flagged by the HP Technician were considered, as well as a statistical evaluation of the GWS data set. The statistical evaluation determined the mean count rate and standard deviation associated with the GWS and then could be used to identify any areas that exceeded 3 standard deviations above the mean. The number of biased samples to be collected and the locations are based on flagged locations exceeding the IAL, the statistical evaluation of the GWS data set, and the professional judgment of Radiological Engineering.

6.2 Soil Sampling

6.2.1 Systematic Soil Sampling Summary

Table 6-1 provides a summary of systematic sampling by stratum for LSA 03-01.

Table 6-1
Systematic Sampling Summary by Stratum for LSA 03-01

LSA	SU Area, planar (m^2)	Systematic			QC
		Surface	Root	Deep (Excavation)	
03-01	10,540	8	8	0	2

6.2.2 Systematic Sampling LSA 03-01

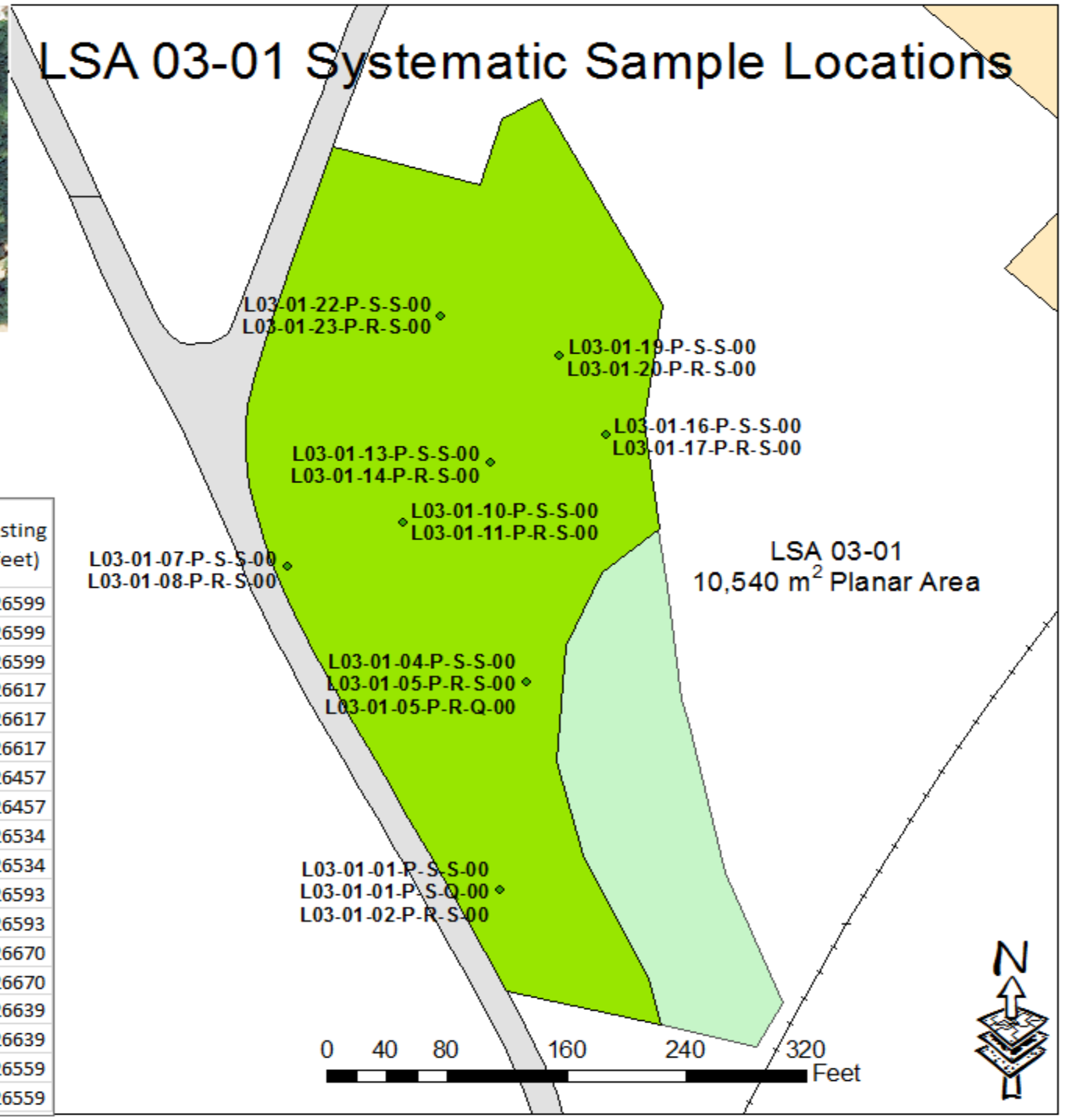
Within LSA 03-01, there were 8 systematic locations in which the surface stratum [0 – 15 centimeters (cm)] was sampled in the SU. The underlying root stratum was also sampled at all 8 locations. Excavation stratum samples were collected at all 8 locations, although they were not required to be analyzed since no root stratum sample exceeded a 0.5 Uniform SOF.

While there were eight (8) systematic locations on the LSA 03-01 sampling grid, a total of eighteen (18) samples were collected and analyzed at these locations, including:

- Eight (8) samples collected and analyzed within the surface stratum
- Eight (8) samples collected and analyzed within the root stratum
- Zero (0) samples analyzed within the excavation, or "deep" stratum
- Two (2) Quality Control (QC) field replicate

Figure 6-1 presents the map of the eight systematic sample locations, and three sediment sample locations, which were sampled within LSA 03-01. The inset table notes the location coordinates (Missouri East, North American Datum (NAD) 1983) and collection intervals for each systematic location.

Figure 6-1
LSA 03-01 Systematic Soil Sample Locations



Sample ID	Start Depth (inches)	End Depth (inches)	Northing (feet)	Easting (feet)
L03-01-01-P-S-S-00	0	6	863957	826599
L03-01-01-P-S-Q-00	0	6	863957	826599
L03-01-02-P-R-S-00	6	66	863957	826599
L03-01-04-P-S-S-00	0	6	864105	826617
L03-01-05-P-R-S-00	6	66	864105	826617
L03-01-05-P-R-Q-00	6	66	864105	826617
L03-01-07-P-S-S-00	0	6	864187	826457
L03-01-08-P-R-S-00	6	66	864187	826457
L03-01-10-P-S-S-00	0	6	864219	826534
L03-01-11-P-R-S-00	6	66	864219	826534
L03-01-13-P-S-S-00	0	6	864261	826593
L03-01-14-P-R-S-00	6	66	864261	826593
L03-01-16-P-S-S-00	0	6	864281	826670
L03-01-17-P-R-S-00	6	66	864281	826670
L03-01-19-P-S-S-00	0	6	864337	826639
L03-01-20-P-R-S-00	6	66	864337	826639
L03-01-22-P-S-S-00	0	6	864366	826559
L03-01-23-P-R-S-00	6	66	864366	826559

Table 6-2 below presents a tabular listing of all FSS samples collected within LSA 03-01 with associated IDs, sample types, collection intervals, coordinates, and notes.

Table 6-2
FSS Sample Locations and Coordinates for LSA 03-01

Hematite Decommissioning Project	Procedure: HDP-PR-FSS-701, Final Status Survey Plan Development		
		Revision: 10	Appendix P-4 Page 1 of 1

APPENDIX P-4
FSS SAMPLE & MEASUREMENT LOCATIONS & COORDINATES

Survey Area:	LSA 03	**Description:**	Plant Open Land Area
Survey Unit:	01	**Description:**	West of Site Pond in "Area 5"
Survey Type:	FSS	**Classification:**	Class 3

Measurement or Sample ID	Surface or CSM	Type	Start Elevation*	End Elevation*	Northing** (Y Axis)	Easting** (X Axis)	Remarks / Notes
L03-01-01-P-S-S-00	Uniform	S	430.3	429.8	863957	826599	Surface 6-inch grab
L03-01-02-P-R-S-00	Uniform	S	429.8	425.3	863957	826599	Root 5-foot composite
L03-01-04-P-S-S-00	Uniform	S	430.1	429.6	864105	826617	Surface 6-inch grab
L03-01-05-P-R-S-00	Uniform	S	429.6	425.2	864105	826617	Root 5-foot composite
L03-01-07-P-S-S-00	Uniform	S	438.0	437.5	864187	826457	Surface 6-inch grab
L03-01-08-P-R-S-00	Uniform	S	437.5	433.1	864187	826457	Root 5-foot composite
L03-01-10-P-S-S-00	Uniform	S	437.4	436.9	864219	826534	Surface 6-inch grab
L03-01-11-P-R-S-00	Uniform	S	436.9	432.5	864219	826534	Root 5-foot composite
L03-01-13-P-S-S-00	Uniform	S	435.2	434.7	864261	826593	Surface 6-inch grab
L03-01-14-P-R-S-00	Uniform	S	434.7	430.2	864261	826593	Root 5-foot composite
L03-01-16-P-S-S-00	Uniform	S	431.9	431.4	864281	826670	Surface 6-inch grab
L03-01-17-P-R-S-00	Uniform	S	431.4	426.9	864281	826670	Root 5-foot composite
L03-01-19-P-S-S-00	Uniform	S	433.4	432.9	864337	826639	Surface 6-inch grab
L03-01-20-P-R-S-00	Uniform	S	432.9	428.5	864337	826639	Root 5-foot composite
L03-01-22-P-S-S-00	Uniform	S	437.5	437.1	864366	826559	Surface 6-inch grab
L03-01-23-P-R-S-00	Uniform	S	437.1	432.6	864366	826559	Root 5-foot composite
L03-01-01-P-S-Q-00	Uniform	Q	430.3	429.8	863957	826599	Root 5-foot composite
L03-01-05-P-R-Q-00	Uniform	Q	429.6	425.2	864105	826617	Surface 6-inch grab
L03-01-25-P-S-B-00	Uniform	B	436.7	436.2	864274	826568	Surface 6-inch grab

Green shaded samples are the samples at each sample location, for use in WRS test.

*Elevations are in feet above mean sea level.
** Missouri - East State Plane Coordinates [North American Datum (NAD) 1983] (Open Land Area) OR
Distance in feet from lower left corner of the surface (Structures); each surface has its own (X,Y) = (0,0); OR
For piping the distance from the beginning of the survey unit.
Surface: Floor = F; Wall = W; Ceiling = C; Roof = R
CSM: Three-Layer (Surface-Root-Deep) or Uniform
Type: Systematic = S, Biased = B; QC =Q; Investigation = I

Quality Record

6.3 Biased Soil Sampling

As discussed in FSSFR Volume 3, Chapter 1, Section 6.1.3, there are three key methods for identifying areas for biased soil sampling, the IAL, the Z-score of the FSS GWS, and the professional judgment of the HP Staff. For LSA 03-01 one (1) biased sample location was selected within the SU based on the evaluation of the GWS survey data and HP Technician professional judgment. The biased location represented the maximum GWS measurement encountered within the SU. Biased samples are collected at the prescribed location to a depth of 6 inches below the exposed ground surface.

6.4 Judgmental/Sidewall Sampling for Tc-99

As an unexcavated Class 3 SU, no Tc-99 sidewall sampling was required for LSA 03-01.

6.5 Quality Control Soil Sampling

Two QC field duplicate sample point were randomly selected and collected at systematic locations L03-01-01 and L03-01-05 for LSA 03-01.

7.0 FINAL STATUS SURVEY RESULTS LSA 03-01

7.1 Gamma Walkover Survey

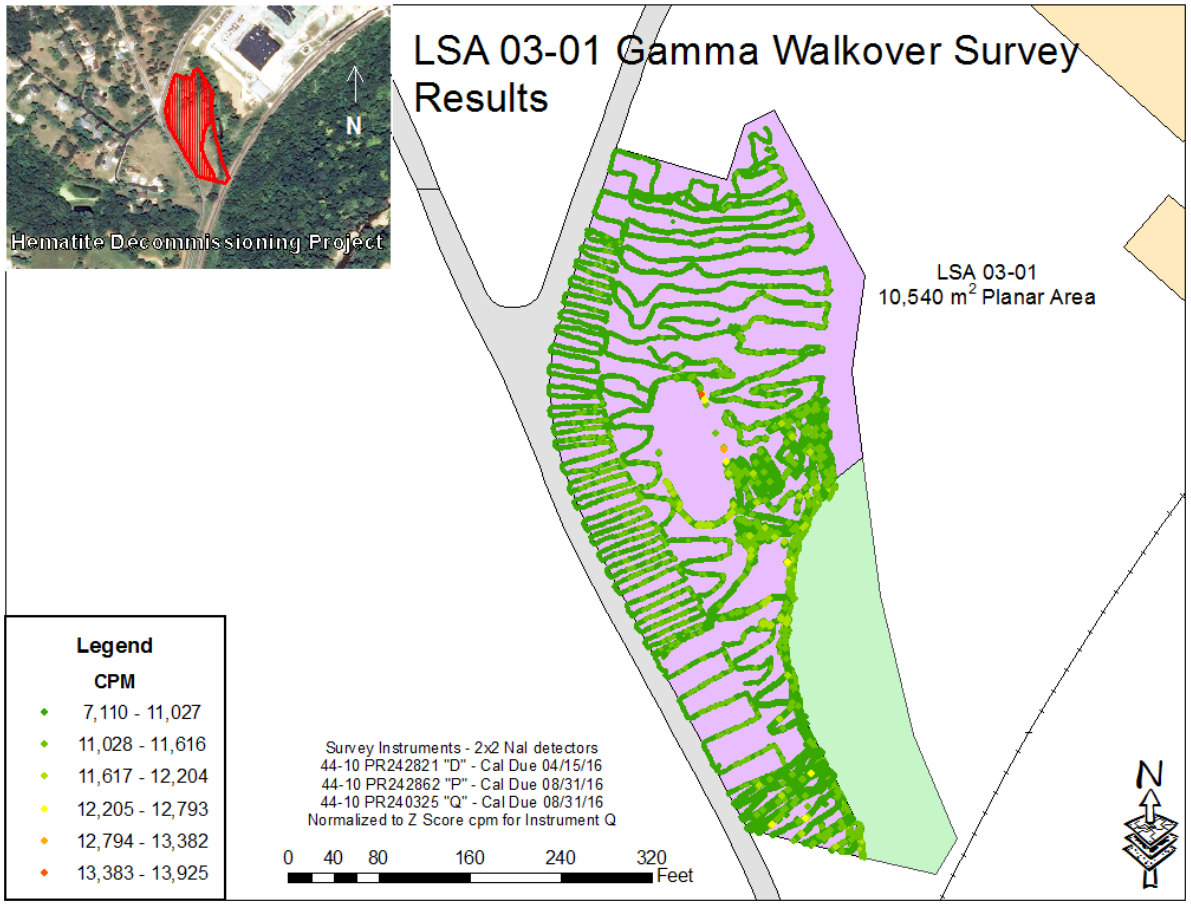
Post-processed GPS coordinate data is accurate to within ± 0.1 m for the handheld GPS models used during the GWS. The GWS maps are plotted and presented in a 2-D format. When multiple data points are collected at the same GPS location during the walkover, the most elevated radiological measurements are plotted.

GWS measurements were collected in LSA 03-01 from September 30, 2015 to October 6, 2015.

7.1.1 GWS Results for LSA 03-01

For LSA 03-01, GWS count rates ranged between 7,106 gcpm and 13,925 gcpm, with a mean count rate of 10,438 gcpm. The median count rate was 10,461 gcpm and the standard deviation was 589 cpm. Figure 7-1 below presents a map of the complete GWS data set.

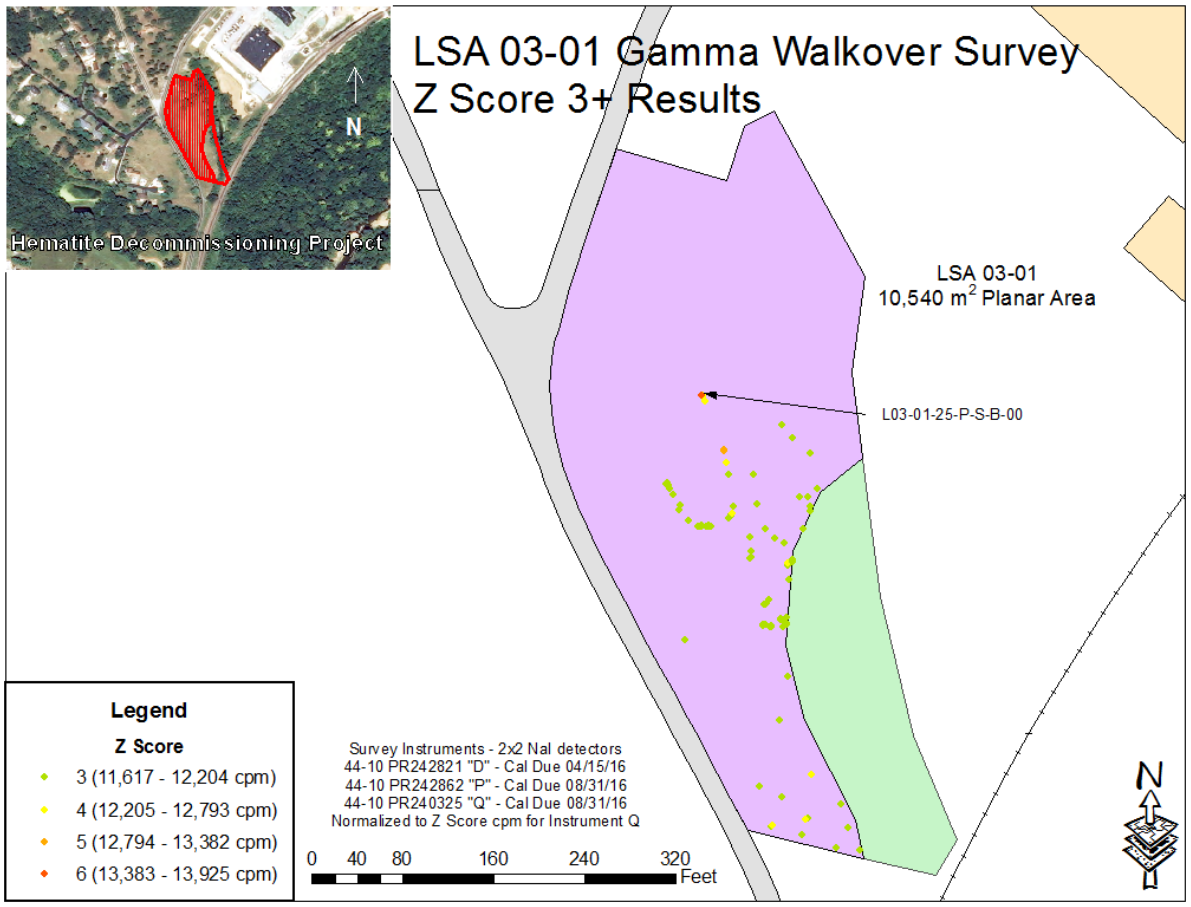
Figure 7-1
Colorimetric GWS Plot for LSA 03-01



An evaluation of the entire GWS data set was performed to evaluate those small areas of elevated activity which exceeded three (3) standard deviations above the GWS mean measurement, (i.e., "+3 Z-score"). One location, L03-01-25 was selected for biased sample collection. The biased location represented the maximum GWS measurement encountered within the SU.

Figure 7-2 below presents a map of the +3 Z-score GWS measurements within LSA 03-01, including the selected biased sampling location.

Figure 7-2
Colorimetric GWS Plot for LSA 03-01 (Measurements > Z-score of 3)



All GWS data collected in LSA 03-01 was datalogged and post-processed in Graphical Information Software (GIS).

7.1.2 GWS Coverage Results LSA 03-01

As a Class 3 SU LSA 03-01 was required to undergo a minimum of a 10% GWS as specified by the FSS Plans. The GWS coverage for FSS was 25.3% of the SU surface.

7.2 Soil Sample Results LSA 03-01

Appendix A presents the analytical results and associated statistics for all FSS surface samples collected within LSA 03-01.

7.2.1 Surface Soil Sample Results LSA 03-01

There were eight systematic samples collected within the surface stratum (0 – 15 cm) of LSA 03-01. Additionally one QC sample and one biased sample were collected in the topmost layer of soil. The maximum Uniform SOF result for the surface samples was 0.18.

7.2.2 Subsurface Soil Sample Results LSA 03-01

There were eight systematic locations within LSA 03-01 where root stratum composite sampling was necessary. Additionally there was one QC sample collected from the root stratum. The root stratum zone is between 0.15 and 1.50 m below the surface. At all of the eight root stratum composite sampling locations, the top six inches (1.50 – 1.65 m below final grade surface) of the underlying excavation stratum was also collected, however these excavation samples were not required to be analyzed as no overlying root stratum sample exceeded a 0.5 SOF. The maximum SOF result of the subsurface samples collected in LSA 03-01 was 0.19.

7.2.3 WRS Test Evaluation

Per Step 7.8.3 of HDP-PR-FSS-721 *Final Status Survey Data Evaluation*, the Wilcoxon Rank Sum (WRS) statistical test was not required for LSA 03-01 since the difference between the maximum SU data set gross SOF and the minimum background area SOF was less than one using the Uniform Stratum criteria. However, for illustrative purposes, the WRS Test evaluation was still performed for LSA 03-01. All systematically collected samples regardless of depth are used to perform the WRS Test, however biased and QC sample results are not utilized in the WRS Test. The 22 systematically collected samples in LSA 03-01 were ranked against the adjusted activity concentrations of the 32 samples collected within the Background Reference Area. The SU passed the WRS Test since the ranked sum of the reference area ranks, or test statistic W_R, (1040) was greater than the critical value (860) for the test. As such, the null hypothesis that the SU average concentration is greater than the $DCGL_W$ was rejected. The WRS Test Evaluation is also included in Appendix A.

7.2.4 Graphical Data Review LSA 03-01

Table 7-1 below presents summary results for the all systematically collected samples (includes surface, and root, but not biased or QC samples) collected within LSA 03-01, and the associated SOF when compared to the Uniform Stratum $DCGL_WS$. The arithmetic average concentration resulted in a SOF of 0.09.

Table 7-1
LSA 03-01 FSS Sample Data Summary and Calculated SOF Values (Systematic)

Statistic	Ra-226 DCGL = 1.9 BKG = 1.07 (pCi/g)	Tc-99 DCGL = 25.1 (pCi/g)	Th-232 DCGL = 2.0 BKG = 1.0 (pCi/g)	U-234 DCGL=195.4 (pCi/g)	U-235 DCGL=51.6 (pCi/g)	U-238 DCGL=168.8 (pCi/g)	Sample SOF (Uniform DCGL)
Average	0.053	0.222	0.065	1.879	0.099	1.091	**0.09**
Minimum	0.00 (<BKG)	0.00 (NEG)	0.00 (<BKG)	0.746	0.033	0.634	0.02
Maximum	0.160	1.070	0.180	3.615	0.199	1.780	0.19

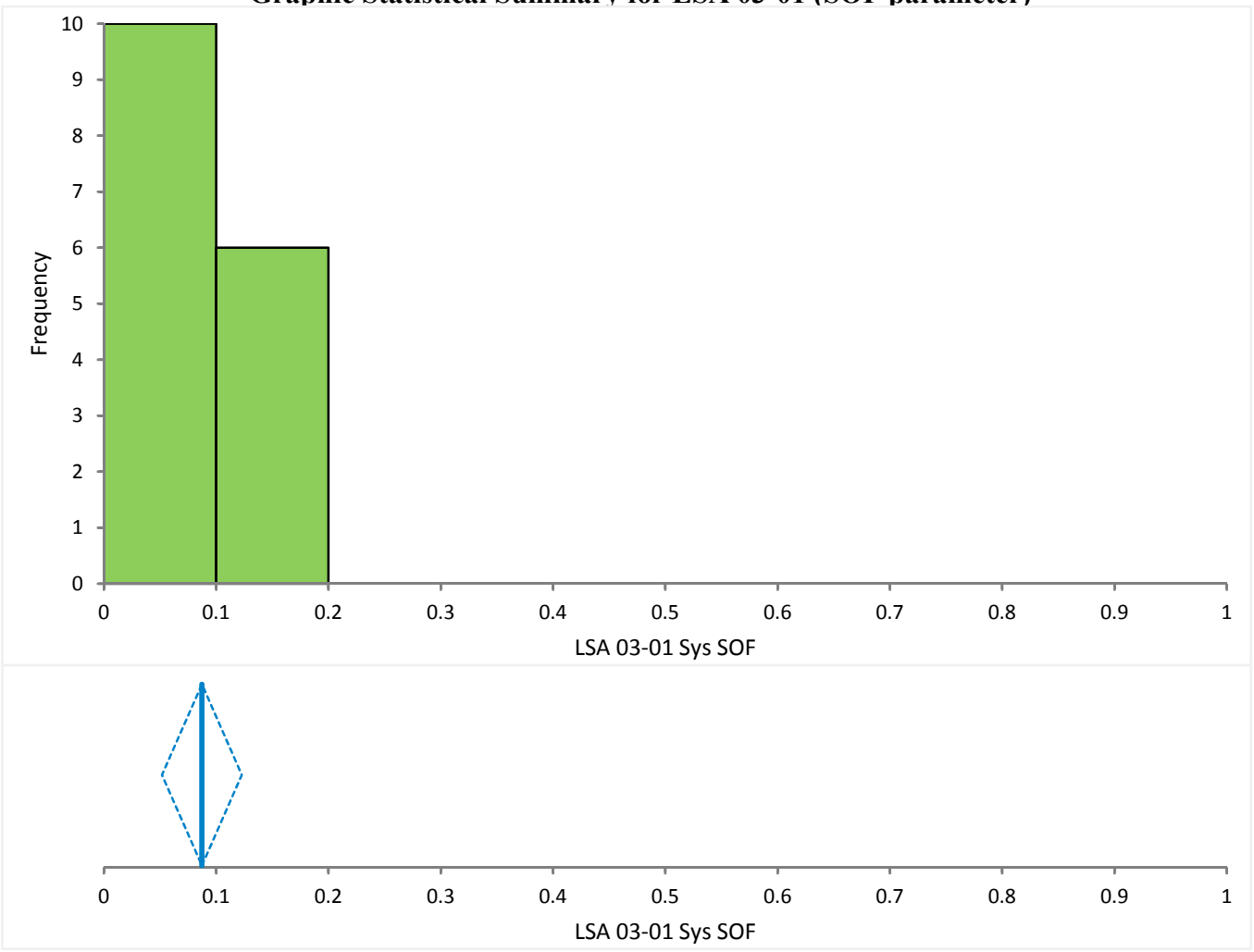
Notes:
1. Ra-226 and Th-232 background activities subtracted prior to calculating SOF value. Ra-226 background without ingrowth = 0.9 pCi/g; Ra-226 background with ingrowth = 1.07 pCi/g. Negative SOF components are set to zero in SOF calculation.
2. Average SOF for data set calculated using average radionuclide concentrations.
3. U-234 values are inferred from the U-235/U-238 ratio.

Section 8.2.2.2 of MARSSIM recommends a graphical review of FSS analytical data, to include at a minimum, a posting plot and a histogram. A frequency plot, or histogram, is a useful tool for examining the general shape of a data distribution. This plot is a bar chart of the number of data points within a certain range of values. The frequency plot will reveal any obvious departures from symmetry, such as skewness or bimodality (two peaks), in the data distribution for the SU. The presence of two peaks in the SU frequency plot may indicate the existence of isolated areas of residual radioactivity.

Figure 7-3 presents the overall statistical metrics for the SOF parameter for the 16 systematically collected samples from LSA 03-01. The top graph is a histogram and line plot of the SOF for the systematic data population for LSA 03-01. The middle graph presents the mean SOF (0.01 as indicated by the blue vertical line) of the sample population and the 95% confidence interval of the mean SOF represented by the blue diamond which is 0.05 to 0.12. The 97.87% confidence interval based on the median (0.07) of the sample results is 0.02 to 0.16. The bottom two charts present the various statistical metrics of the LSA 03-01 SOF data set, including the mean, median, standard deviation, minimum, maximum, confidence intervals, etc.

Figure 7-3 exhibits no unusual symmetry or bimodality concerns for the LSA 03-01 data associated with the systematically collected measurement locations.

Figure 7-3
Graphic Statistical Summary for LSA 03-01 (SOF parameter)



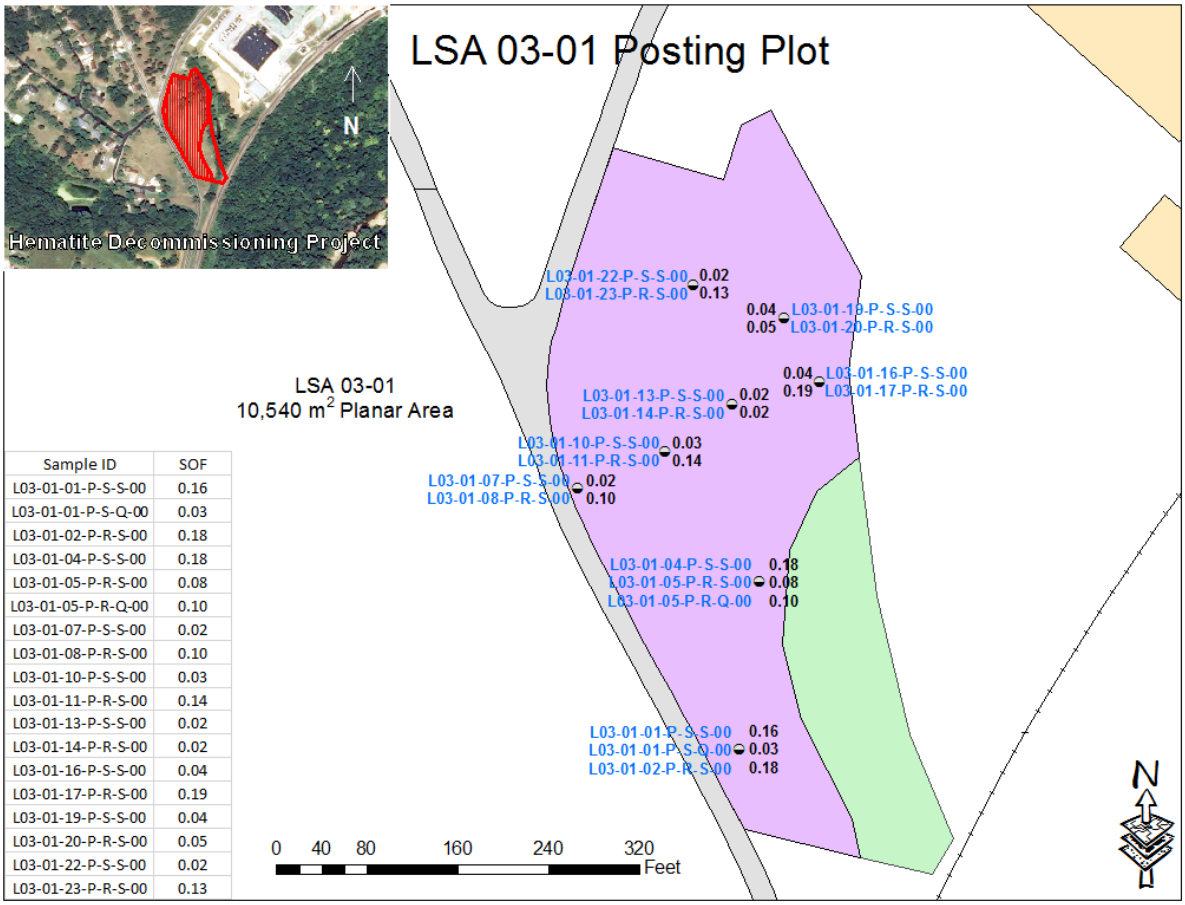
N	16

	Mean	95% CI		Mean SE	SD	Variance	Skewness	Kurtosis
LSA 03-01 Sys SOF	0.09	0.05	to 0.12	0.017	0.07	0.00	0.4	-1.56

	Minimum	1st quartile	Median	97.87% CI		3rd quartile	Maximum	IQR
LSA 03-01 Sys SOF	0.02	0.02	0.07	0.02	to 0.16	0.15	0.2	0.13

A posting plot is simply a map of the SU with the data values (in this case the SOF values for each systematically collected sample) entered at the measurement locations. This potentially reveals heterogeneities in the data – especially possible patches of elevated residual radioactivity. The posting plot for LSA 03-01 is presented below in Figure 7-4. Figure 7-4 shows no unusual patterns in the data.

Figure 7-4
Posting Plot for LSA 03-01 Systematic Measurement Locations



Sample ID	SOF
L03-01-01-P-S-S-00	0.16
L03-01-01-P-S-Q-00	0.03
L03-01-02-P-R-S-00	0.18
L03-01-04-P-S-S-00	0.18
L03-01-05-P-R-S-00	0.08
L03-01-05-P-R-Q-00	0.10
L03-01-07-P-S-S-00	0.02
L03-01-08-P-R-S-00	0.10
L03-01-10-P-S-S-00	0.03
L03-01-11-P-R-S-00	0.14
L03-01-13-P-S-S-00	0.02
L03-01-14-P-R-S-00	0.02
L03-01-16-P-S-S-00	0.04
L03-01-17-P-R-S-00	0.19
L03-01-19-P-S-S-00	0.04
L03-01-20-P-R-S-00	0.05
L03-01-22-P-S-S-00	0.02
L03-01-23-P-R-S-00	0.13

Appendix A to this report presents the complete analytical data set (in Microsoft Excel format) used to derive the summary statistics presented in Table 7-1, Figure 7-3, and Figure 7-4 above. A summary of the analytical data is presented in Table 7-2 below. Appendix G to this report presents the TestAmerica Analytical Laboratory soil sample reports.

Table 7-2
Final Status Survey Analytical Data: LSA 03-01

Sample ID	Sample Depth (ft)	Type (Systematic, Bias, QC)	TestAmerica Analytical Results																										Enr.	SOF_N
			Ra-226						Tc-99					Th-232						Inferred U-234				U-235				U-238					
			Result	Uncertainty	MDC	Qualifier	Net Result*	Corrected Result	Result	Corrected Result	Uncertainty	MDC	Qualifier	Result	Uncertainty	MDC	Qualifier	Net Result**	Corrected Result	Result	Uncertainty	MDC	Qualifier	Result	Uncertainty	MDC	Qualifier	Result	Uncertainty	MDC	Qualifier	Enrichment (%)	SOF_N
L03-01-01-P-S-S-00	0.49	S	1.180	0.165	0.073	NA	0.110	0.110	1.070	1.070	2.560	0.335	NA	1.070	0.157	0.115	NA	0.070	0.070	1.655	NA	NA	NA	0.081	0.120	0.262	U	1.710	0.527	0.751	NA	0.8	0.16
L03-01-02-P-R-S-00	4.43	S	1.230	0.161	0.053	NA	0.160	0.160	0.565	0.565	1.150	0.381	NA	1.110	0.173	0.103	NA	0.110	0.110	1.635	NA	NA	NA	0.084	0.105	0.209	U	1.110	0.448	0.682	NA	1.2	0.18
L03-01-04-P-S-S-00	0.49	S	1.200	0.182	0.070	NA	0.130	0.130	0.295	0.295	0.677	0.310	U	1.170	0.223	0.124	NA	0.170	0.170	1.519	NA	NA	NA	0.072	0.144	0.277	U	1.780	0.897	1.080	NA	0.7	0.18
L03-01-05-P-R-S-00	4.43	S	1.060	0.150	0.069	NA	-0.010	0.000	0.096	0.096	0.275	0.367	U	1.130	0.167	0.068	NA	0.130	0.130	1.210	NA	NA	NA	0.062	0.135	0.223	U	0.852	0.289	0.809	NA	1.2	0.08
L03-01-07-P-S-S-00	0.49	S	0.819	0.119	0.054	NA	-0.251	0.000	0.143	0.143	0.514	0.346	U	0.742	0.130	0.085	NA	-0.258	0.000	1.387	NA	NA	NA	0.074	0.107	0.130	U	0.650	0.231	0.664	U	1.8	0.02
L03-01-08-P-R-S-00	4.43	S	1.170	0.165	0.072	NA	0.100	0.100	-0.026	0.000	0.179	0.372	U	1.050	0.167	0.084	NA	0.050	0.050	2.289	NA	NA	NA	0.125	0.155	0.236	U	0.784	0.270	0.677	NA	2.5	0.10
L03-01-10-P-S-S-00	0.49	S	1.050	0.149	0.072	NA	-0.020	0.000	0.021	0.021	0.252	0.343	U	0.903	0.131	0.096	NA	-0.097	0.000	2.919	NA	NA	NA	0.158	0.137	0.178	U	1.180	0.474	0.720	NA	2.1	0.03
L03-01-11-P-R-S-00	4.43	S	1.220	0.180	0.077	NA	0.150	0.150	-0.027	0.000	0.158	0.356	U	1.090	0.191	0.162	NA	0.090	0.090	1.886	NA	NA	NA	0.096	0.161	0.243	U	1.400	0.562	0.849	NA	1.1	0.14
L03-01-13-P-S-S-00	0.49	S	0.945	0.130	0.052	NA	-0.125	0.000	0.031	0.031	0.268	0.329	U	0.897	0.141	0.109	NA	-0.103	0.000	1.398	NA	NA	NA	0.068	0.136	0.236	U	1.320	0.487	0.728	NA	0.8	0.02
L03-01-14-P-R-S-00	4.43	S	1.080	0.154	0.070	NA	0.010	0.010	-0.090	0.000	0.042	0.339	U	0.821	0.135	0.086	NA	-0.179	0.000	1.183	NA	NA	NA	0.063	0.096	0.214	U	0.634	0.255	0.681	U	1.6	0.02
L03-01-16-P-S-S-00	0.49	S	1.120	0.149	0.052	NA	0.050	0.050	-0.021	0.000	0.113	0.339	U	0.855	0.129	0.086	NA	-0.145	0.000	1.941	NA	NA	NA	0.104	0.142	0.216	U	0.917	0.304	0.734	NA	1.8	0.04
L03-01-17-P-R-S-00	4.43	S	1.180	0.181	0.085	NA	0.110	0.110	0.378	0.378	0.996	0.385	U	1.180	0.176	0.086	NA	0.180	0.180	3.615	NA	NA	NA	0.199	0.157	0.201	U	0.966	0.321	0.905	NA	3.2	0.19
L03-01-19-P-S-S-00	0.49	S	1.040	0.147	0.063	NA	-0.030	0.000	0.511	0.511	1.150	0.380	NA	0.957	0.148	0.104	NA	-0.043	0.000	2.250	NA	NA	NA	0.118	0.121	0.232	U	1.340	0.609	0.782	NA	1.4	0.04
L03-01-20-P-R-S-00	4.43	S	1.060	0.151	0.063	NA	-0.010	0.000	0.253	0.253	0.528	0.392	U	1.060	0.174	0.136	NA	0.060	0.060	0.746	NA	NA	NA	0.033	0.099	0.232	U	1.030	0.465	0.714	NA	0.5	0.05
L03-01-22-P-S-S-00	0.49	S	0.747	0.113	0.051	NA	-0.323	0.000	0.135	0.135	0.372	0.342	U	0.802	0.128	0.113	NA	-0.198	0.000	1.610	NA	NA	NA	0.085	0.115	0.194	U	0.915	0.462	0.725	NA	1.5	0.02
L03-01-23-P-R-S-00	4.43	S	1.100	0.165	0.073	NA	0.030	0.030	0.056	0.056	0.089	0.343	U	1.180	0.203	0.085	NA	0.180	0.180	2.812	NA	NA	NA	0.154	0.143	0.182	U	0.869	0.316	0.871	U	2.7	0.13
L03-01-01-P-S-Q-00	0.49	Q	1.000	0.145	0.068	NA	-0.070	0.000	-0.005	0.000	0.154	0.385	U	0.930	0.168	0.127	NA	-0.070	0.000	4.400	NA	NA	NA	0.243	0.150	0.183	NA	0.888	0.309	0.854	NA	4.1	0.03
L03-01-05-P-R-Q-00	4.43	Q	1.190	0.168	0.071	NA	0.120	0.120	-0.026	0.000	0.074	0.341	U	1.040	0.176	0.110	NA	0.040	0.040	1.310	NA	NA	NA	0.064	0.140	0.225	U	1.270	0.540	0.825	NA	0.8	0.10
L03-01-25-P-S-B-00	0.49	B	0.926	0.131	0.060	NA	-0.144	0.000	-0.012	0.000	0.200	0.386	U	0.829	0.148	0.131	NA	-0.171	0.000	4.012	NA	NA	NA	0.221	0.122	0.163	NA	1.030	0.501	0.782	NA	3.3	0.03
Systematic Minimum			0.000						0.000					0.000						0.746				0.033				0.634				**1.6**	0.02
Systematic Maximum			0.160						1.070					0.180						3.615				0.199				1.780				Average Enrichment (%)	0.19
Systematic Mean			0.053						0.222					0.065						1.879				0.099				1.091					0.09
Systematic Median			0.020						0.116					0.055						1.645				0.085				0.998					0.07
Systematic Standard Deviation			0.062						0.292					0.070						0.743				0.043				0.343					0.07
			With ingrowth, use Ra226 bkg = 1.07											Th232 bkg = 1.0																				

NOTES:

Gross results in units of pCi/g.

* Background with ingrowth, 1.07 pCi/g subtracted from gross result.

**Background, 1.0 pCi/g subtracted from gross result.

U Qualifier: Result is less than the sample detection limit.

All uncertainty values are reported at the 2-sigma confidence level.

7.2.5 Biased Soil Sample Result LSA 03-01

One (1) biased sample was collected from LSA 03-01. The sample collected at location L03-01-25 represented the maximum GWS measurement (13,925 gcpm) within the SU, and had a result of 0.03 Uniform SOF.

7.2.6 Quality Control Soil Sample Result LSA 03-01

Two QC field duplicate sample points were randomly selected for LSA 03-01 which were collected at systematic locations L03-01-01 and L03-01-05.

For the 17 samples (i.e., 16 systematic + 1 biased) collected within LSA 03-01, two field duplicate samples were collected. This frequency equates to 11.8%, (i.e. 2/17). Form HDP-PR-FSS-703-1 documents that the duplicate sample result comparison with the partner's sample results that all comparison criteria were less than the calculated warning limits (see Figure 7-5 below).

Figure 7-5
Form HDP-PR-FSS-703-1 Field Duplicate Sample Assessment LSA 03-01 (1 of 2)

Hematite Decommissioning Project	Procedure: HDP-PR-FSS-703, Final Status Survey Quality Control	Revision: 2	Page 1 of 1

FORM HDP-PR-FSS-703-1
FIELD DUPLICATE SAMPLE ASSESSMENT

Survey Unit No.:	LSA 03-01				Survey Unit Description:		Class 3 Survey Unit West of Site Pond in "Area 5"					
			Sample (pCi/g)		Field Duplicate Sample (pCi/g)		Average Activity ($\bar{X}$)	Nuclide DCGL				Statistic Exceeds
Sample ID	Field Duplicate Sample ID	Radionuclide	Activity (x_i)	MDC	Activity (x_i)	MDC	(pCi/g)	(pCi/g)	Statistic[2]	Warning Limit	Control Limit	Limit? (Y/N)
L03-01-01-P-S-S-00	L03-01-01-P-S-Q-00	Ra-226	1.180	0.0725	1.000	0.068	1.09	1.9	0.18	0.269	0.403	N
L03-01-01-P-S-S-00	L03-01-01-P-S-Q-00	Tc-99	1.07	0.335	-0.00462	0.385	0.53269	25.1	NA	3.552	5.321	NA
L03-01-01-P-S-S-00	L03-01-01-P-S-Q-00	Th-232	1.07	0.115	0.930	0.127	1.000	2.0	0.140	0.283	0.424	N
L03-01-01-P-S-S-00	L03-01-01-P-S-Q-00	U-234[1]	1.655	NA	4.400	NA	3.027	195.4	2.745	27.649	41.425	N
L03-01-01-P-S-S-00	L03-01-01-P-S-Q-00	U-235	0.0805	0.262	0.243	0.183	0.162	51.6	NA	7.301	10.939	NA
L03-01-01-P-S-S-00	L03-01-01-P-S-Q-00	U-238	1.71	0.751	0.888	0.854	1.299	168.8	0.822	23.885	35.786	N

Comments:
1. U-234 is inferred, no MDC available.
2. Duplicate assessment is not necessary if the result of either sample is < MDC.

Performed by: Thomas Yardy

Date: 5-3-17

Reviewed by: Clark Evers

Date: 5/8/17

Quality Record

Figure 7-5
Form HDP-PR-FSS-703-1 Field Duplicate Sample Assessment LSA 03-01 (2 of 2)

Hematite Decommissioning Project	Procedure: HDP-PR-FSS-703, Final Status Survey Quality Control	Revision: 2	Page 1 of 1

FORM HDP-PR-FSS-703-1
FIELD DUPLICATE SAMPLE ASSESSMENT

Survey Unit No.: LSA 03-01 | Survey Unit Description: Class 3 Survey Unit West of Site Pond in "Area 5"

Sample ID	Field Duplicate Sample ID	Radionuclide	Sample (pCi/g) Activity (x_i)	Sample (pCi/g) MDC	Field Duplicate Sample (pCi/g) Activity (x_i)	Field Duplicate Sample (pCi/g) MDC	Average Activity ($\bar{X}$) (pCi/g)	Nuclide DCGL (pCi/g)	Statistic[2]	Warning Limit	Control Limit	Statistic Exceeds Limit? (Y/N)
L03-01-05-P-R-S-00	L03-01-05-P-R-Q-00	Ra-226	1.06	0.0686	1.19	0.071	1.125	1.9	0.13	0.269	0.403	N
L03-01-05-P-R-S-00	L03-01-05-P-R-Q-00	Tc-99	0.0962	0.367	-0.0256	0.341	0.0353	25.1	NA	3.552	5.321	NA
L03-01-05-P-R-S-00	L03-01-05-P-R-Q-00	Th-232	1.13	0.0676	1.04	0.11	1.085	2.0	0.090	0.283	0.424	N
L03-01-05-P-R-S-00	L03-01-05-P-R-Q-00	U-234[1]	1.210	NA	1.310	NA	1.260	195.4	0.100	27.649	41.425	N
L03-01-05-P-R-S-00	L03-01-05-P-R-Q-00	U-235	0.0624	0.223	0.0637	0.225	0.063	51.6	NA	7.301	10.939	NA
L03-01-05-P-R-S-00	L03-01-05-P-R-Q-00	U-238	0.852	0.809	1.27	0.825	1.061	168.8	0.418	23.885	35.786	N

Comments:
1. U-234 is inferred, no MDC available.
2. Duplicate assessment is not necessary if the result of either sample is < MDC.

Performed by: Thomas Yardy

Date: 5-3-17

Reviewed by: Clark Evers

Date: 5/8/17

Quality Record

7.3 Tc-99 Hot Spot Assessment LSA 03-01

As a Class 3 SU, there is no history of any sample from the SU exceeding the Tc-99 $DCGL_W$, or a SOF of 1.0. The highest Tc-99 sample result collected from both Final RASS and FSS was 1.07 pCi/g. There is no indication of a potential Tc-99 hot spot exceeding the $DCGL_W$ of 25.1 pCi/g, and therefore a Tc-99 hot spot assessment is not required.

8.0 ALARA EVALUATION LSA 3-01

All samples collected within LSA 03-01 were evaluated against the Uniform Stratum $DCGL_W$. For LSA 03-01 no FSS sample result exceeded a SOF of 1.0. The average SOF result, based on all systematically collected samples, was 0.09 for LSA 03-01. The average SOF equates to residual activity contributions from the SU area of 2.25 mrem/year for LSA 03-01. Groundwater monitoring well data provided in FSSFR Volume 6, Chapters 2 and 3 {ML16287A528}, and Chapter 4 {ML16342B552}, and Chapter 5 {ML17018A105} indicate that the groundwater dose contribution will be a fraction of the MCLs. Nevertheless, a maximum groundwater contribution assumption of 4.0 mrem/yr based upon the U.S. Environmental Protection Agency (EPA) MCLs will be added to the total estimated dose for LSA 03-01. Additionally, 4.25 mrem/year will be added to LSA 03-01 to account for the dose contribution from the presence of Reuse Soil Stockpile 8b soil. Adding these dose contributions together, the total estimated dose for LSA 03-01 is 10.5 mrem/year.

Since the estimated Total Effective Dose Equivalent (TEDE) is below the regulatory release criterion of 25 mrem/yr, the conclusion of the ALARA evaluation is that the FSS of LSA 03-01 was successful and that there would be no discernable benefit to the health and safety of the public in attempting to further reduce the results of FSS by performing remediation of LSA 03-01.

9.0 FSS PLAN DEVIATIONS LSA 03-01

9.1 Remedial Actions during FSS

There was no remedial action after FSS in LSA 03-01.

9.2 Adjustments to Scan MDC Calculations

Scan MDCs for LSA 03-01 were calculated in accordance with HDP-PR-FSS-701, Revision 10, *Final Status Survey Plan Development* and HDP-TBD- FSS-002, Revision 3, *Evaluation and Documentation of the Scanning Minimum Detectable Concentrations (MDC) for Final Status Surveys (FSS)*. The assumed LSA background count rate of 9,000 cpm was applied to determine the prospective Scan MDCs, and the actual mean count rate from the FSS survey was 10,438 cpm. Therefore the calculated Scan MDCs will be updated to the following:

Table 9-1

Revised Scan MDCs for 2" x 2" NaI detector background of 11,000 cpm

	Scan MDC (Total U)	DCGLw (Total U)	Scan MDC (Ra-226)	DCGLw (Ra-226)	Scan MDC (Th-232)	DCGLw (Th-232)
LSA 03-01	42.9	54.1	1.26	1.9	0.91	2.0

The revised Scan MDCs presented in Table 9-1 above better reflect the actual field conditions encountered in LSA 03-01 during the performance of FSS GWS. However, the change has little effect of the results of the FSS performed as the calculated Scan MDCs remain under the respective DCGLs for each nuclide of concern.

10.0 DATA QUALITY ASSESSMENT

The DQO process is thoroughly integrated within the DP and Hematite FSS procedures. The steps of the DQO process are presented in Volume 3, Chapter 1, Section 4.0 of the FSSFR and correspond to the DQO steps described in Chapter 14, Section 4.2.1 of the DP. The HDP DQO process reflects the recommendations given in MARSSIM, Chapter 2, Figure 2-2.

10.1 Data Quality Assessment for LSA 03-01

The Data Quality Assessment of the survey methodology, sampling and sample analysis results, and the Quality Control sampling and analysis results to ascertain the validity of the conclusion for LSA 03-01 (see Figure 10-1) provides the following:

- The field and laboratory instruments utilized were capable of detecting activity at a MDC less than the appropriate investigation level, and were verified to be operable prior to and after use in accordance with HDP-PR-HP-416 (*Operation of the Ludlum 2221 for Final Status Survey*).
- The calibration of all instruments that were used to measure or analyze data was current at the time of use and the calibrations of the instruments were performed using a NIST traceable source. The instruments used were successfully source checked prior to and after use.
- The systematic samples that were collected (on a random grid) and the gamma scan surveys that were conducted were performed in accordance with procedure HDP-PR-FSS-711, *Final Status Surveys and Sampling of Soil and Sediment*.
- All samples sent for analysis at the approved offsite laboratory (TestAmerica) were tracked on a chain of custody form in accordance with HDP-PR-QA-006, *Chain of Custody*.
- Quality Control sample results were verified to meet the acceptance criteria as specified in HDP-PR-FSS-703, *Final Status Survey Quality Control*.
- LSA 03-01 survey and sample results were independently reviewed and validated in accordance with HDP-PR-FSS-721 *Final Status Survey Data Validation*.

- The WRS Test is not necessary when the difference between the maximum survey unit data set measurement SOF and the minimum background area measurement SOF is less than or equal to one. For LSA 03-01, no individual gross SOF result in the FSS data set exceeded the SOF of the minimum background reference area measurement by more than one using the Uniform Stratum criteria. Therefore, the WRS Test was not required for LSA 03-01. However, the WRS Test was still performed for illustrative purposes. Since the test statistic, WR (1040) exceeded the critical value (860), the FSS data set passed the WRS Test and the null hypothesis was rejected. The WRS Test worksheet is presented in Appendix A.
- One biased soil sample was collected from the location of the highest gamma count rate within the SU, with a maximum result of 0.03 Uniform SOF.
- The maximum SOF result for all surface samples within LSA 03-01 was 0.18. The maximum SOF result for all subsurface samples within LSA 03-01 was 0.19. The average SOF result for all systematically collected samples within LSA 03-01 was 0.09, with an upper 95% confidence level (UCL_{mean} 0.95) of 0.12.
- No FSS sample result in LSA 03-01 exceeded a SOF of 1.0 as compared to the Uniform Stratum criteria, therefore an elevated measurement comparison (EMC) or supplemental investigations was not required. For the same reason, no comparisons to the alternate "Three-Layer" multi-CSM (i.e. Surface, Root and Excavation) DCGLs were necessary.
- A retrospective sampling frequency evaluation was performed to determine if sufficient statistical power exists to reject the null hypothesis based on the total number (8) of systematic sample locations actually collected within LSA 03-01. The successful result of the retrospective power evaluation presented in Table 10-1 for LSA 03-01 indicates that the minimum number of sample locations required (8) for the WRS Test were equal to the number of sampling locations actually collected within LSA 03-01. The methodology used for the retrospective sampling frequency evaluation is similar to the prospective sample size determination performed during FSS Plan Development except that actual FSS sample results and statistics are used in the sample size verification. Specifically, the mean and standard deviation of the eight LSA surface samples (i.e., the WRS Test sample data set) are used to derive the relative shift for each LSA. Given the HDP Type I and Type II errors of 0.05 and 0.10, respectively, the calculated relative shift is then correlated to a minimum sample size number as provided in Table 5-1 of MARSSIM.
- HDP staff ensured that a visual inspection of the SU configuration was performed periodically, and confirmed that there were no instances of potential cross contamination from weather events until the FSS of all remaining areas at HDP were completed.

Table 10-1
Retrospective Sample Size Verification for LSA 03-01

Uniform DCGL Criteria Evaluation	
N/2 Value Verification	
Isotope(s)	**SOF (Ra/Tc/Th/Iso U)**
St. Dev.	0.07
$DCGL_{SOF}$	1
LBGR (Mean)	0.09
Shift	0.91
Relative Shift (Δ/σ)	13.69
MARSSIM Table 5.1 (P_r)	1.000000
N	12
N + 20%	14.4
N/2	8
FSS N/2	8
Verification Check	**SUFFICIENT MEASUREMENTS**
"N/2" Corresponds to the number of survey unit measurement locations required for the WRS Test	

MARSSIM Table 5.1

Δ/σ	P_r
0.1	0.528182
0.2	0.556223
0.3	0.583985
0.4	0.611335
0.5	0.638143
0.6	0.664290
0.7	0.689665
0.8	0.714167
0.9	0.737710
1.0	0.760217
1.1	0.781627
1.2	0.801892
1.3	0.820978
1.4	0.838864
1.5	0.855541
1.6	0.871014
1.7	0.885299
1.8	0.898420
1.9	0.910413
2.0	0.921319
2.25	0.944167
2.5	0.961428
2.75	0.974067
3.0	0.983039
3.5	0.993329
4.0	0.997658
4.01	1.000000

MARSSIM Table 5.2, α = 0.05, β = 0.10

α (or β)	$Z_{1-\alpha}$ (or $Z_{1-\beta}$)	
0.005	2.576	
0.01	2.326	
0.015	2.241	
0.025	1.960	
0.05	1.645	α
0.10	1.282	β
0.15	1.036	
0.2	0.842	
0.25	0.674	
0.30	0.524	

Figure 10-1
Data Evaluation Checklists prepared for LSA 03-01 (page 1 of 2)

Hematite Decommissioning Project	Procedure: HDP-PR-FSS-721, Final Status Survey Data Evaluation		
		Revision: 10	Appendix G-1, Page 1 of 2

APPENDIX G-1
FINAL STATUS SURVEY DATA QUALITY OBJECTIVES REVIEW CHECKLIST

Survey Area: LSA 03 **Description:** Plant Open Land Area
Survey Unit: 01 **Description:** West of Site Pond In "Area 5"

1.	Have all measurements and/or analysis results that will be subjected to data analysis for FSS been individually reviewed and validated in accordance with Section 8.1 of this procedure?	Yes ☒	No ☐	
2.	Have all systematic measurements and/or samples been taken or acquired at the locations specified in the FSSP and the FSS Sample Instructions?	Yes ☒	No ☐	
3.	Have all scans surveys been performed of the areas specified as required in the FSSP and the FSS Sample Instructions?	Yes ☒	No ☐	
4.	Have all biased measurements and/or samples been taken or acquired at the locations specified in the FSSP & the FSS Sample Instructions?	Yes ☒	No ☐	NA ☐
5.	Have duplicate and/or split samples or measurements been taken or acquired at each location designated as a QC sample?	Yes ☒	No ☐	NA ☐
6.	Were the instruments used to measure or analyze the survey data capable of detecting the ROCs or gross activity at a MDC less than the appropriate investigation level?	Yes ☒	No ☐	
7.	Was the calibration of all instruments that were used to measure or analyze data, current at the time of use and were those calibrations performed using a NIST traceable source?	Yes ☒	No ☐	
8.	Were the instruments successfully response-checked before use and, where required, after use on the day the data was measured?	Yes ☒	No ☐	
9.	Do the samples match those identified on the chain of custody?	Yes ☒	No ☐	NA ☐
10.	Do the QC Sample Results meet the acceptance criteria as specified in HDP-PR-FSS-703, Final Status Survey Quality Control?	Yes ☒	No ☐	NA ☐
11.	Are all Laboratory QC parameters within acceptable limits?	Yes ☒	No ☐	NA ☐

If "No" was the response to any of the questions above, then document the discrepancy as well as any corrective actions that were taken to resolve the discrepancy.

Comments: N/A

Quality Record

Figure 10-1
Data Evaluation Checklists prepared for LSA 03-01 (page 2 of 2)

Hematite Decommissioning Project	Procedure: HDP-PR-FSS-721, Final Status Survey Data Evaluation		
		Revision: 10	Appendix G-1, Page 2 of 2

APPENDIX G-1
FINAL STATUS SURVEY DATA QUALITY OBJECTIVES REVIEW CHECKLIST

Survey Area: No. LSA 03 **Description:** Plant Open Land Area
Survey Unit: No. 01 **Description:** West of Site Pond In "Area 5"

Discrepancy: None

Corrective Actions Taken: None

11. Have the corrective actions resolved the discrepancy with the data? Yes ☐ No ☐ NA ☒
    a. If "No", then forward this form to the RSO.
12. The following questions will be answered by the RSO.
    a. If the answer to question 11 was "No", then is the affected data still valid? Yes ☐ No ☐ NA ☒
    b. If "No", then are the existing valid measurements or samples sufficient to demonstrate compliance for the survey unit? Yes ☐ No ☐ NA ☒
    c. If "No", then direct the acquisition of additional measurements or samples as necessary to demonstrate compliance for the survey unit.

Prepared by (HP Staff): Thomas Yardy (Print Name) [signature] (Signature) 5-3-17 (Date)

Approved by (RSO): Clark Evers (Print Name) [signature] (Signature) 5/8/17 (Date)

Quality Record

11.0 SURVEILLANCE FOLLOWING FSS

FSS activities in LSA 03-01 were completed in October 2015. There were no events after the completion of FSS that would have the potential to cause contamination above the DCGLs in the SU.

12.0 CONCLUSION LSA 03-01

An adequate quantity and quality of radiological surveys and samples, as well as the corresponding laboratory analysis has been performed, evaluated and documented to demonstrate that the dose associated with all sources within SU LSA 03-01 of 10.5 mrem/year does not exceed the dose criterion for unrestricted release in accordance with 10 CFR 20.1402 of 25 mrem/year.

Table 12-1
LSA 03-01 SOF and Dose Summation

	AVE. SU SOIL RADIOACTIVITY	ELEVATED AREA CONTRIBUTION	GROUND WATER	BURIED PIPING	REUSE SOIL	**TOTAL**
SOF	0.09	N/A	0.16	N/A	0.17	**0.42**
DOSE	2.25 mrem/year	N/A	4.0 mrem/year	N/A	4.25 mrem/year	**10.5 mrem/year**

13.0 FINAL STATUS SURVEY DESIGN LSA 03-02

This section of the report describes the method for determining the number of samples required for the FSS of LSA 03-02 as well as summarizing the applicable requirements of the FSS Plan. These include the $DCGL_W$, scan survey coverage, and IAL. The radiological instrumentation used in the FSS of LSA 03-02 and their detection sensitivities are also discussed.

13.1 FSS Plan Design Requirements

FSS Plan requirements for LSA 03-02 were driven by the type (Open Land) and Class (Class 2) of the SU and developed in accordance with HDP procedure, HDP-PR-FSS-701, Revision 8, *Final Status Survey Plan Development*, August 2015.

13.1.1 Surrogate Evaluation Areas

A discussion of Surrogate Evaluation Areas is given in the FSSFR Volume 3, Chapter 1, Section 5.0, *Final Status Survey Design*.

13.1.2 $DCGL_W$

During the FSS design process a review was performed of the RASS data for LSA 03-02. The RASS data was used as confirmation that no known areas of residual radioactivity remained within the SU that exceeded the Uniform Stratum $DCGL_W$. Therefore the Uniform Stratum $DCGL_W$ was selected for use in demonstrating compliance with the release criteria.

13.1.3 GWS Coverage

As a Class 2 SU, LSA 03-02 was required to undergo a minimum of a 50% GWS.

13.1.4 Instrumentation

Radiological instrumentation selected for performance of GWS within LSA 03-02 was the Ludlum 44-10 2" x 2" NaI detectors, coupled to a Ludlum 2221 scaler-ratemeter.

13.1.5 Scan Minimum Detectable Concentration

Scan MDCs for LSA 03-02 were calculated in accordance with HDP-PR-FSS-701, Revision 10, *Final Status Survey Plan Development* and HDP-TBD- FSS-002, Revision 3, *Evaluation and Documentation of the Scanning Minimum Detectable Concentrations (MDC) for Final Status Surveys (FSS)*. As background levels were approximately 10,000 cpm within LSA 03-02, the Scan MDC calculation for total uranium given in HDP-PR-FSS-701, *Final Status Survey Plan Development*, Step 8.2.6.d, was applied:

$$\text{Scan MDC}_{\text{(total uranium)}} = \frac{1}{\left(\left(\frac{f_{U-234}}{3659\ pCi/g}\right)+\left(\frac{f_{U-235}}{2.32\ pCi/g}\right)+\left(\frac{f_{U-238}}{30.6\ pCi/g}\right)\right)}$$

Equation 13-1

To determine isotopic Uranium fractions HDP-PR-FSS-701, Revision 10, *Final Status Survey Plan Development* assumes that the average LSA enrichment is 4% or less. Based on the systematically collected RASS samples in LSA 03-02, the average enrichment for the SU was 1.5%. All other Scan MDC parameters agreed upon between Westinghouse and the NRC were applied (e.g. use of a 2 in air gap, scan rate of 1 ft/sec, 0.75 surveyor efficiency), therefore no subsequent changes to the calculated Scan MDCs need to be made.

Prospectively calculated Scan MDCs for 2" x 2" NaI detectors that were used in LSA 03-02 are shown below:

Table 13-1
Scan MDCs for 2" x 2" NaI detector, 10,000 cpm background: LSA 03-02

	Scan MDC (Total U)	DCGLw (Total U)	Scan MDC (Ra-226)	DCGLw* (Ra-226)	Scan MDC (Th-232)	DCGLw* (Th-232)
LSA 03-02	40.9	55.2	1.21	2.8	0.87	3.0

*$DCGL_w$ includes background concentrations of 0.9 pCi/g for Ra-226 (no ingrowth) and 1.0 pCi/g for Th-232. DCGLw values are based on the Uniform Stratum release criteria.

The values in Table 13-1 reflect those presented in the FSS Plan prepared for the SU prior to FSS.

13.1.6 Investigation Action Level

FSSFR Volume 3, Chapter 1, Section 6.1.3, *Investigation Action Level (IAL)*, provides a discussion in regards to the IAL. The basis of the IAL is detailed in HDP-TBD-FSS-003, *Modeling and Calculation of Investigative Action Levels for Final Status Soil Survey Units*. The IAL used during the GWS of LSA 03-02 was established at 1,624 ncpm, which is the equivalent of an activity concentration that is less than the Uniform Stratum $DCGL_W$.

13.1.7 LSA 03-02 FSS Design Summary

The FSS Plan for LSA 03-02 can be found in Appendix E. Table 13-2 presents an overall FSS design and implementation summary for LSA 03-02.

Table 13-2
FSS Design Summary for LSA 03-02

Gamma Walkover Survey (GWS):		
Scan Coverage	Minimum 50% of LSA 03-02 total area	
Scan MDC	40.9 pCi/g total Uranium; 0.87 pCi/g Th-232; 1.21 pCi/g Ra-226 (based on a 10,000 cpm background)*	
Investigation Action Level (IAL)	1,624 net cpm **	
Systematic Sampling Locations:		
Depth	Number of Sample	Comments
0 – 15 cm (Surface)	8	These samples will be taken on a systematic grid. ***Excavation stratum samples will be collected and archived, but will be analyzed *only* in the event the overlying root stratum sample exceeds a SOF of 0.5
15 cm – 1.5 m (Root)	8	
> 1.5m (Excavation)	8***	
Biased Survey/Sampling Locations:		
Collect a minimum of one biased sample at the maximum GWS measurement within the SU. Biased samples may be collected during GWS at the discretion of the HP Technician, after statistical analysis of the survey data, or at the direction of the FSS Supervisor.		
Sidewall Sampling Locations:		
Supplemental Sidewall Sampling: Not applicable; SU is an unremediated Class 2 area.		
Instrumentation:		
Ludlum 2221 with 44-10 (2x2 NaI) detector	Used for GWS and to obtain static count rates at biased measurement locations.	
*Values based on information provided in HDP-TBD-FSS-002, "*Evaluation and Documentation of the Scanning Minimum Detectable Concentrations (MDC) for Final Status Surveys (FSS).* The Scan MDC for total Uranium reflects a conservative assumption of 4% enrichment. The actual RASS enrichment (1.5%) would result in Scan MDC values slightly less than those calculated for FSS planning purposes.		
**IAL is the net count per minute (ncpm) equivalent of an activity concentration less than the Uniform Stratum $DCGL_W$ derived from the technical bases presented in HEM-MEMO-15-021 and HDP-TBD-FSS-003 "*Modeling and Calculation of Investigative Action Levels for Final Status Soil Survey Units*", Westinghouse, March 2015.		

14.0 FINAL STATUS SURVEY IMPLEMENTATION LSA 03-02

FSS was performed in accordance with procedure HDP-PR-FSS-711, *Final Status Surveys and Sampling of Soil and Sediment*.

14.1 Gamma Walkover Survey

14.1.1 Instrumentation

The selected instrumentation to perform the GWS in LSA 03-02 was a 2" x 2" NaI detector in combination with a Ludlum 2221 rate meter. Each NaI instrumentation set was interfaced with a Trimble DGPS and handheld data logger.

Prior to the first field use of the GWS instrumentation, initial set-ups were performed. Also, daily pre- and post-use source checks were performed for each day that GWS was performed within the SU. Initial set-ups, daily source checks, and control charting were performed according to the requirements of HDP-PR-HP-416, *Operation of the Ludlum 2221 for Final Status Survey*.

14.1.2 GWS Performance

All GWS measurements were collected with the NaI detector(s) were connected to a Trimble DGPS and with a hand-held data logger. The logging frequency in the SU was one (1) GWS measurement per second. Each gross gamma measurement is correlated to a set of coordinates based on the Missouri East State Plane, NAD 1983.

The GWS requirements involved moving the NaI detector in a side-to-side fashion no faster than 1 foot per second while holding the probe as close as possible to the excavation surface (nominally 1", but not to exceed 3"). At the same time, the HP Technician was required to slowly advance, causing the detector to trace out a serpentine path over the excavation surface.

HP Technicians performing GWS in LSA 03-02 used the 1,624 ncpm IAL as a field guide to know when to slow or pause the GWS for more deliberate investigation. If during the GWS, audible count rates noticeably increase above the general area average (i.e., > minimum detectable count rate), HP Technicians were required to pause momentarily and observe count rates. If sustained count rates approached the IAL, further focused investigation was conducted within the locally elevated area.

To use the IAL effectively, HP Technicians first determined the local background count rate before starting the GWS. Although the ambient gamma level may vary across the SU due to excavation geometry and relative distance from contaminated materials in nearby remedial excavations, the average background rate (measured at waist level) within the LSA ranged between 10,000 and 11,000 gcpm. Therefore, at locations where the 2" x 2" NaI detector measurements exceeded 11,624 to 12,624 gcpm, HP Technicians slowed or paused the GWS for more careful investigation of the small areas of elevated activity before deciding if "flagging" a point for potential biased sampling was warranted.

After the GWS survey was complete, the GPS/GWS data was reviewed by Radiological Engineering and the HP Technician performing the survey to determine if possible areas of elevated residual activity remained within the SU that required biased sample investigation. Areas that were flagged by the HP Technician were considered, as well as a statistical evaluation of the GWS data set. The statistical evaluation determined the mean count rate and standard deviation associated with the GWS and then could be used to identify any areas that exceeded 3 standard deviations above the mean. The number of biased samples to be collected and the locations are based on flagged locations exceeding the IAL, the statistical evaluation of the GWS data set, and the professional judgment of Radiological Engineering.

14.2 Soil Sampling

14.2.1 Systematic Soil Sampling Summary

Table 14-1 provides a summary of systematic sampling by stratum for LSA 03-02.

Table 14-1
Systematic Sampling Summary by Stratum for LSA 03-02

LSA	SU Area, planar (m^2)	Systematic			QC
		Surface	Root	Deep (Excavation)	
03-02	2,553	8	8	0	2

14.2.2 Systematic Sampling LSA 03-02

Within LSA 03-02, there were 8 systematic locations in which the surface stratum (0 – 15 cm) was sampled in the SU. The underlying root stratum was also sampled at all 8 locations. Excavation stratum samples were collected and archived, but were not required to be analyzed since no root stratum sample exceeded a 0.5 Uniform SOF.

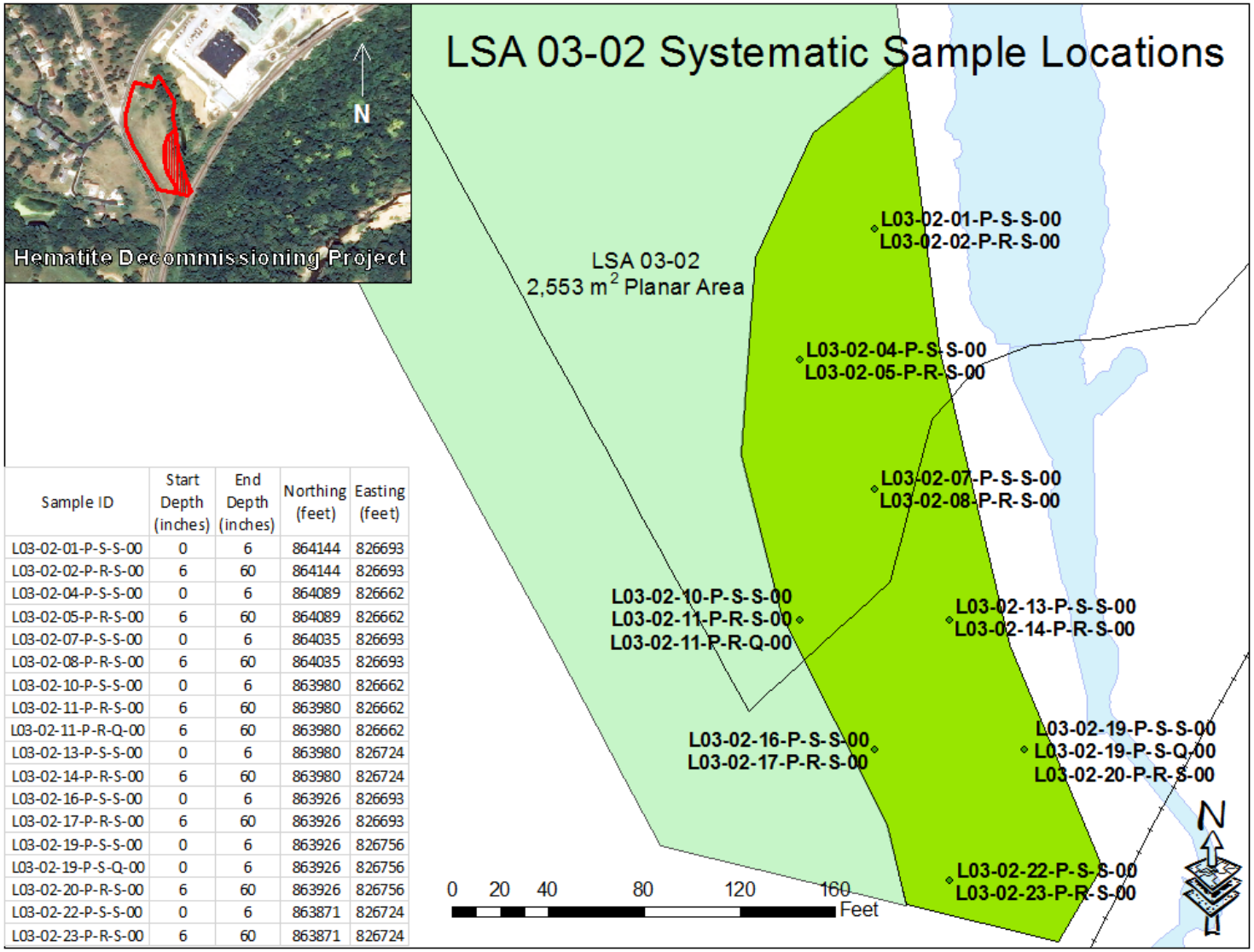
Given a planar area of 2,553 m^2 for LSA 03-02 and an eight - point systematic triangular grid, the point-to-point distance within each row was 24 m within the SU.

While there were eight (8) systematic locations on the LSA 03-02 sampling grid, a total of eighteen (18) samples were collected and analyzed at these locations, including:

- Eight (8) samples collected and analyzed within the surface stratum
- Eight (8) samples collected and analyzed within the root stratum
- Zero (0) samples analyzed within the excavation, or “deep” stratum
- Two (2) QC field replicate

Figure 14-1 presents the map of the eight systematic sample locations which were sampled within LSA 03-02. The inset table notes the location coordinates (Missouri East, NAD 1983) and collection intervals for each systematic location.

Figure 14-1
LSA 03-02 Systematic Soil Sample Locations



Sample ID	Start Depth (inches)	End Depth (inches)	Northing (feet)	Easting (feet)
L03-02-01-P-S-S-00	0	6	864144	826693
L03-02-02-P-R-S-00	6	60	864144	826693
L03-02-04-P-S-S-00	0	6	864089	826662
L03-02-05-P-R-S-00	6	60	864089	826662
L03-02-07-P-S-S-00	0	6	864035	826693
L03-02-08-P-R-S-00	6	60	864035	826693
L03-02-10-P-S-S-00	0	6	863980	826662
L03-02-11-P-R-S-00	6	60	863980	826662
L03-02-11-P-R-Q-00	6	60	863980	826662
L03-02-13-P-S-S-00	0	6	863980	826724
L03-02-14-P-R-S-00	6	60	863980	826724
L03-02-16-P-S-S-00	0	6	863926	826693
L03-02-17-P-R-S-00	6	60	863926	826693
L03-02-19-P-S-S-00	0	6	863926	826756
L03-02-19-P-S-Q-00	0	6	863926	826756
L03-02-20-P-R-S-00	6	60	863926	826756
L03-02-22-P-S-S-00	0	6	863871	826724
L03-02-23-P-R-S-00	6	60	863871	826724

Table 14-2 below presents a tabular listing of all FSS samples collected within LSA 03-02 with associated IDs, sample types, collection intervals, coordinates, and notes.

Table 14-2
FSS Sample Locations and Coordinates for LSA 03-02

Hematite Decommissioning Project	Procedure: HDP-PR-FSS-701, Final Status Survey Plan Development		
		Revision: 10	Appendix P-4 Page 1 of 1

APPENDIX P-4

FSS SAMPLE & MEASUREMENT LOCATIONS & COORDINATES

Survey Area:	LSA 03	**Description:**	Plant Open Land Area
Survey Unit:	02	**Description:**	West of Site Pond in "Area 5"
Survey Type:	FSS	**Classification:**	Class 2

Measurement or Sample ID	Surface or CSM	Type	Start Elevation*	End Elevation*	Northing** (Y Axis)	Easting** (X Axis)	Remarks / Notes
L03-02-01-P-S-S-00	Uniform	S	427.4	426.9	864144	826693	Surface 6-inch grab
L03-02-02-P-R-S-00	Uniform	S	426.9	422.5	864144	826693	Root 5-foot composite
L03-02-04-P-S-S-00	Uniform	S	427.6	427.1	864089	826662	Surface 6-inch grab
L03-02-05-P-R-S-00	Uniform	S	427.1	422.7	864089	826662	Root 5-foot composite
L03-02-07-P-S-S-00	Uniform	S	428.0	427.5	864035	826693	Surface 6-inch grab
L03-02-08-P-R-S-00	Uniform	S	427.5	423.1	864035	826693	Root 5-foot composite
L03-02-10-P-S-S-00	Uniform	S	430.1	429.6	863980	826662	Surface 6-inch grab
L03-02-11-P-R-S-00	Uniform	S	429.6	425.2	863980	826662	Root 5-foot composite
L03-02-13-P-S-S-00	Uniform	S	429.4	428.9	863980	826724	Surface 6-inch grab
L03-02-14-P-R-S-00	Uniform	S	428.9	424.5	863980	826724	Root 5-foot composite
L03-02-16-P-S-S-00	Uniform	S	430.6	430.2	863926	826693	Surface 6-inch grab
L03-02-17-P-R-S-00	Uniform	S	430.2	425.7	863926	826693	Root 5-foot composite
L03-02-19-P-S-S-00	Uniform	S	429.4	428.9	863926	826756	Surface 6-inch grab
L03-02-20-P-R-S-00	Uniform	S	428.9	424.5	863926	826756	Root 5-foot composite
L03-02-22-P-S-S-00	Uniform	S	431.4	430.9	863871	826724	Surface 6-inch grab
L03-02-23-P-R-S-00	Uniform	S	430.9	426.5	863871	826724	Root 5-foot composite
L03-02-11-P-R-Q-00	Uniform	Q	429.6	425.2	863980	826662	Root 5-foot composite
L03-02-19-P-S-Q-00	Uniform	Q	429.4	428.9	863926	826756	Surface 6-inch grab
L03-02-25-P-S-B-00	Uniform	B	427.4	426.9	864173	826679	Surface 6-inch grab
L03-02-26-P-S-B-00	Uniform	B	429.4	428.9	863924	826763	Surface 6-inch grab

Green shaded samples are the samples at each sample location, for use in WRS test.

*Elevations are in feet above mean sea level.
** Missouri - East State Plane Coordinates [North American Datum (NAD) 1983] (Open Land Area) OR
Distance in feet from lower left corner of the surface (Structures); each surface has its own (X,Y) = (0,0); OR
For piping the distance from the beginning of the survey unit.
Surface: Floor = F; Wall = W; Ceiling = C; Roof = R
CSM: Three-Layer (Surface-Root-Deep) or Uniform
Type: Systematic = S, Biased = B; QC =Q; Investigation = I

Quality Record

14.3 Biased Soil Sampling

As discussed in FSSFR Volume 3, Chapter 1, Section 6.1.3, there are three key methods for identifying areas for biased soil sampling, the IAL, the Z-score of the FSS GWS, and the professional judgment of the HP Staff. For LSA 03-02 two (2) biased sample location were selected within the SU based on the evaluation of the GWS survey data and HP Technician professional judgment. Biased samples are collected at the prescribed location to a depth of 6 inches below the exposed ground surface.

14.4 Judgmental/Sidewall Sampling for Tc-99

As a Class 2 SU no remediation was expected to be or was conducted in LSA 03-02. As such, sidewall samples were not required to be collected in LSA 03-02. Therefore, no sidewall samples were collected within the SU.

14.5 Quality Control Soil Sampling

Two QC field duplicate sample point were randomly selected and collected at systematic location L03-02-11 and L03-02-19 for LSA 03-02.

15.0 FINAL STATUS SURVEY RESULTS LSA 03-02

15.1 Gamma Walkover Survey

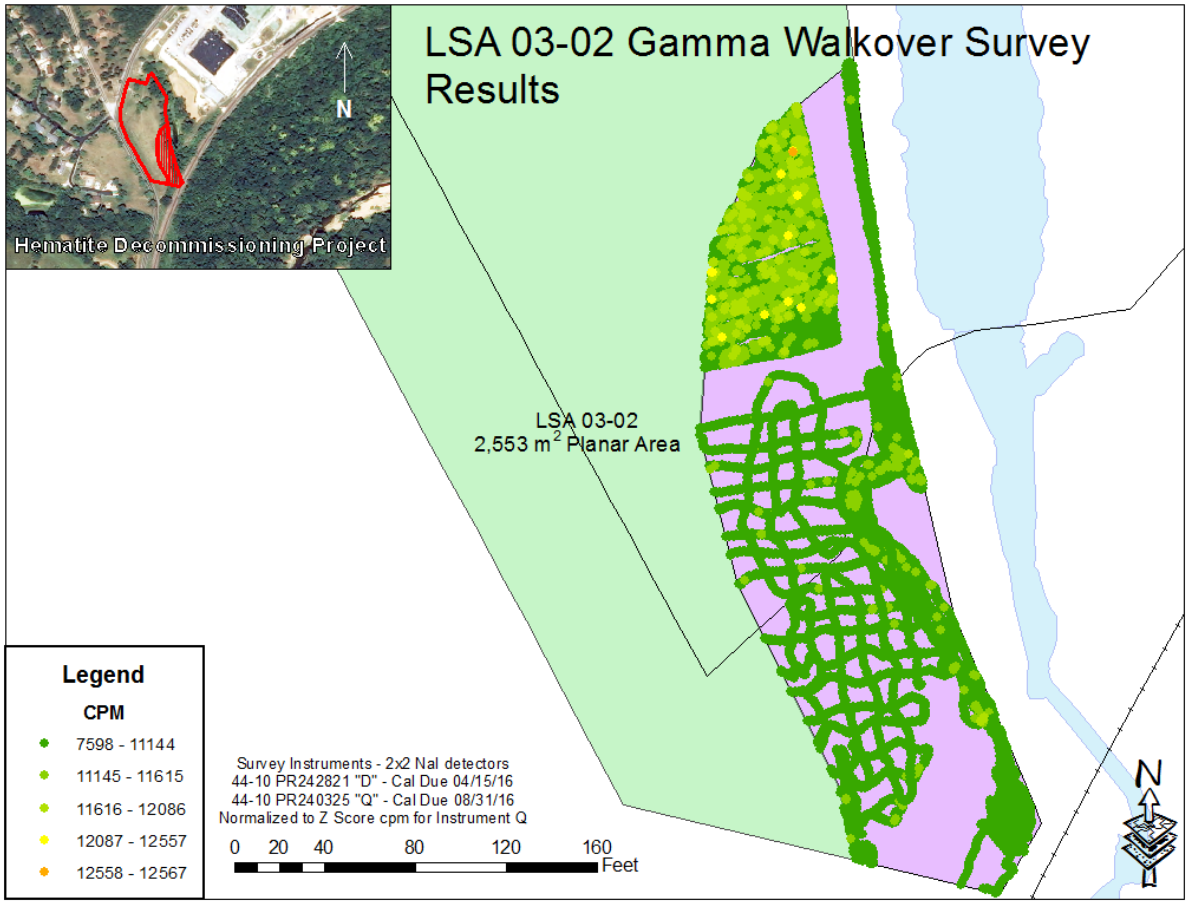
Post-processed GPS coordinate data is accurate to within ± 0.1 m for the handheld GPS models used during the GWS. The GWS maps are plotted and presented in a 2-D format. When multiple data points are collected at the same GPS location during the walkover, the most elevated radiological measurements are plotted.

GWS measurements were collected in LSA 03-02 between October 13, 2015, and October 14, 2015.

15.1.1 GWS Results for LSA 03-02

For LSA 03-02, GWS count rates ranged between 7,598 gcpm and 12,567 gcpm, with a mean count rate of 10,673 gcpm. The median count rate was 10,681 gcpm with a standard deviation of 471 cpm. Figure 15-1 below presents a map of the complete GWS data set.

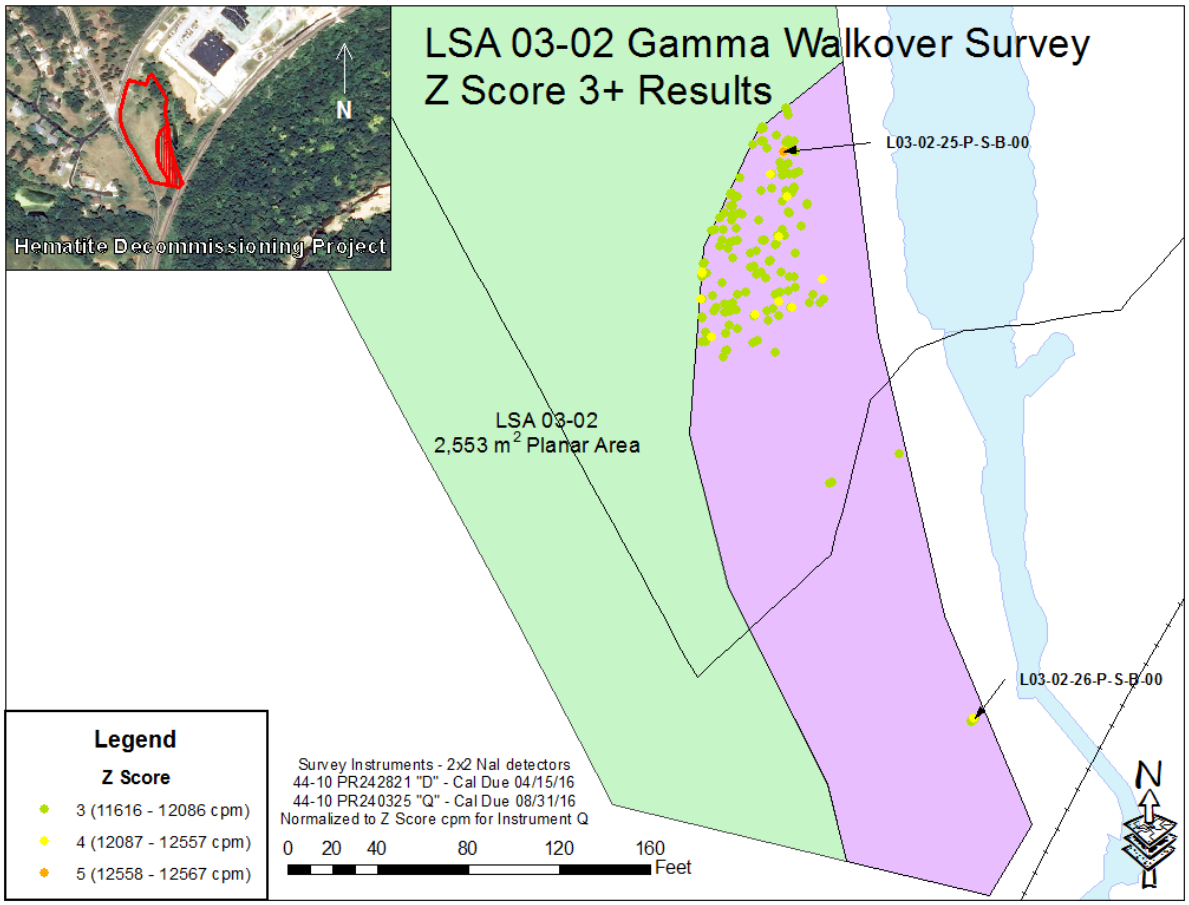
Figure 15-1
Colorimetric GWS Plot for LSA 03-02



An evaluation of the entire GWS data set was performed to evaluate those small areas of elevated activity which exceeded both the IAL (> 4000 ncpm) and three (3) standard deviations above the GWS mean measurement, (i.e., "+3 Z-score"). Two locations (L03-02-25 and L03-02-26) were selected for biased sample collection. The sample collected at location L03-02-25 represented the maximum GWS measurement (12,567 gcpm) within the SU.

Figure 15-2 presents a map of the +3 Z-score GWS measurements within LSA 03-02, including the selected biased sampling location.

Figure 15-2
Colorimetric GWS Plot for LSA 03-02 (Measurements > Z-score of 3)



All GWS data collected in LSA 03-02 was datalogged and post-processed in GIS software.

15.1.2 GWS Coverage Results LSA 03-02

FSSFR Volume 3, Chapter 1, Section 6.1.4, *Exposed Surfaces versus Accessible Surfaces*, provides a discussion and the criteria for evaluating the GWS coverage of a SU during FSS.

As a Class 2 SU LSA 03-02 was required to undergo a minimum of a 50% GWS. The actual GWS coverage was 52.5% of the SU surface.

15.2 Soil Sample Results LSA 03-02

Appendix B presents the analytical results and associated statistics for all FSS samples collected within LSA 03-02.

15.2.1 Surface Soil Sample Results LSA 03-02

There were eight systematic samples collected within the surface stratum (0 – 15 cm) of LSA 03-02. Additionally there were two biased and one QC sample collected in the topmost layer of soil. The maximum Uniform SOF result for the surface samples was 0.28.

15.2.2 Subsurface Soil Sample Results LSA 03-02

There were eight systematic locations within LSA 03-02 where root stratum composite sampling was necessary. Additionally there was one QC sample collected in the root stratum. The root stratum zone is between 0.15 and 1.50 m below final grade surface. At each of the eight root stratum composite sampling locations, the top six inches (1.50 – 1.65 m below final grade surface) of the underlying excavation stratum was also collected and archived, however these excavation samples were not required to be analyzed as no overlying root stratum sample exceeded a 0.5 SOF. The maximum SOF result of the subsurface samples collected in LSA 03-02 was 0.47.

15.2.3 WRS Evaluation LSA 03-02

Per Step 7.8.3 of HDP-PR-FSS-721 *Final Status Survey Data Evaluation*, the WRS statistical test was required for LSA 03-02 since the difference between the maximum SU data set gross SOF and the minimum background area SOF was greater than one using the Uniform Stratum criteria. All systematically collected samples regardless of depth are used to perform the WRS Test, however biased and QC sample results are not utilized in the WRS Test. The 16 systematically collected samples in LSA 03-02 were ranked against the adjusted activity concentrations of the 32 samples collected within the Background Reference Area. The SU passed the WRS Test since the ranked sum of the reference area ranks, or test statistic W_R, (1039) was greater than the critical value (860) for the test. As such, the null hypothesis that the SU average concentration is greater than the $DCGL_W$ was rejected. The WRS evaluation is also included in Appendix B.

15.2.4 Graphical Data Review LSA 03-02

Table 15-1 below presents summary results for the all systematically collected samples (includes surface, and root, but not biased or QC samples) collected within LSA 03-02, and the associated SOF when compared to the Uniform Stratum $DCGL_W$s. The arithmetic average concentration resulted in a SOF of 0.20.

Table 15-1
LSA 03-02 FSS Sample Data Summary and Calculated SOF Values (Systematic)

Statistic	Ra-226 DCGL = 1.9 BKG = 1.07 (pCi/g)	Tc-99 DCGL = 25.1 (pCi/g)	Th-232 DCGL = 2.0 BKG = 1.0 (pCi/g)	U-234 DCGL=195.4 (pCi/g)	U-235 DCGL=51.6 (pCi/g)	U-238 DCGL=168.8 (pCi/g)	Sample SOF (Uniform DCGL)
Average	0.166	0.072	0.183	2.107	0.111	1.202	**0.20**
Minimum	0.00 (<BKG)	0.00 (NEG)	0.00 (<BKG)	0.071	0.002	0.751	0.04
Maximum	0.490	0.213	0.420	5.236	0.289	1.960	0.47

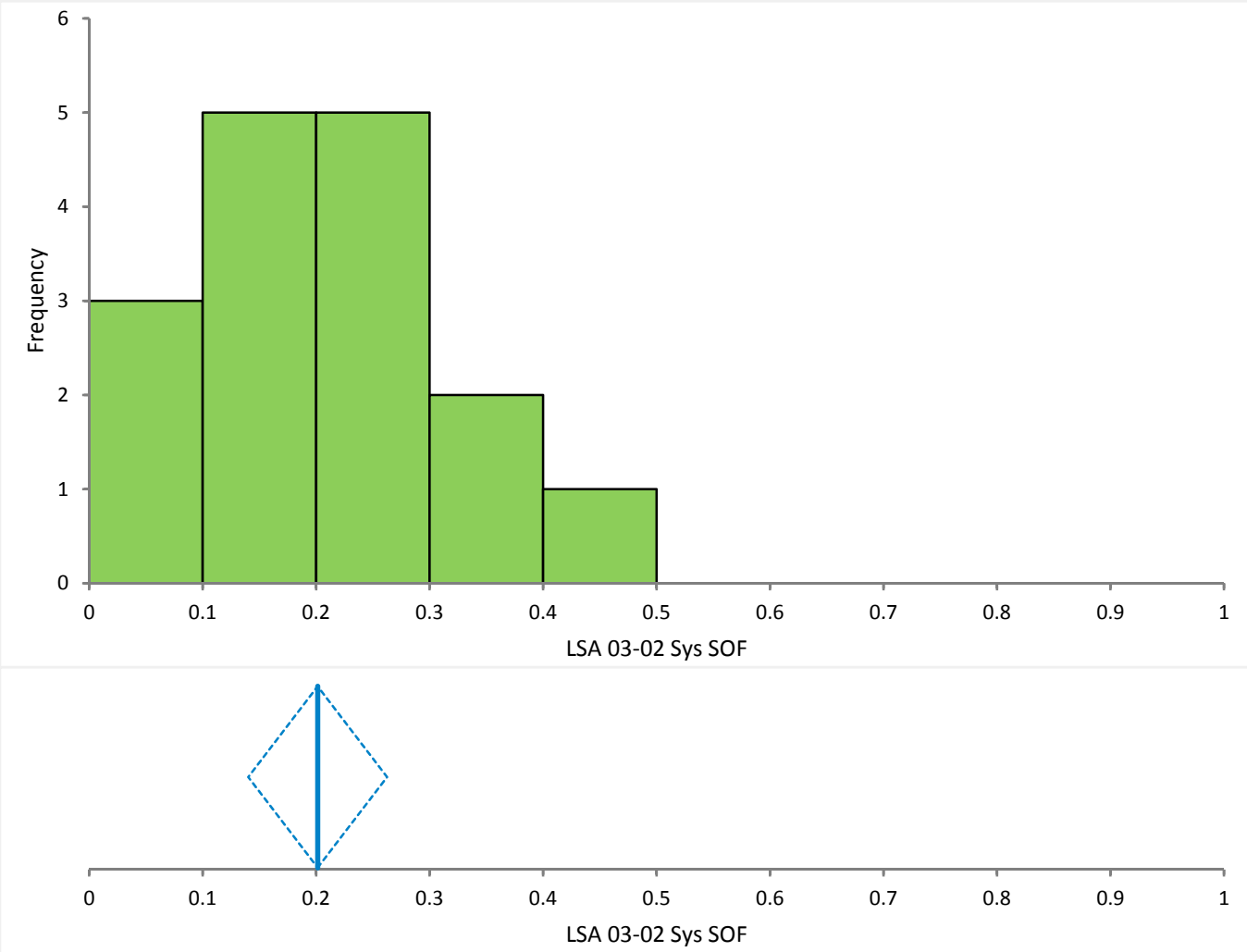
Notes:
1. Ra-226 and Th-232 background activities subtracted prior to calculating SOF value. Ra-226 background without ingrowth = 0.9 pCi/g; Ra-226 background with ingrowth = 1.07 pCi/g. Negative SOF components are set to zero in SOF calculation.
2. Average SOF for data set calculated using average radionuclide concentrations.
3. U-234 values are inferred from the U-235/U-238 ratio.

Section 8.2.2.2 of MARSSIM recommends a graphical review of FSS analytical data, to include at a minimum, a posting plot and a histogram. A frequency plot, or histogram, is a useful tool for examining the general shape of a data distribution. This plot is a bar chart of the number of data points within a certain range of values. The frequency plot will reveal any obvious departures from symmetry, such as skewness or bimodality (two peaks), in the data distribution for the SU. The presence of two peaks in the SU frequency plot may indicate the existence of isolated areas of residual radioactivity.

Figure 15-3 presents the overall statistical metrics for the SOF parameter for the 16 systematically collected samples from LSA 03-02. The top graph is a histogram and line plot of the SOF for the systematic data population for LSA 03-02. The middle graph presents the mean SOF (0.20) as indicated by the blue vertical line of the sample population and the 95% confidence interval of the mean SOF represented by the blue diamond which is 0.14 to 0.26. The 97.87% confidence interval based on the median (0.20) of the sample results is 0.12 to 0.28. The bottom two charts present the various statistical metrics of the LSA 03-02 SOF data set, including the mean, median, standard deviation, minimum, maximum, confidence intervals, etc.

Figure 15-3 exhibits no unusual symmetry or bimodality concerns for the LSA 03-02 data associated with the systematically collected measurement locations.

Figure 15-3
Graphic Statistical Summary for LSA 03-02 (SOF parameter)



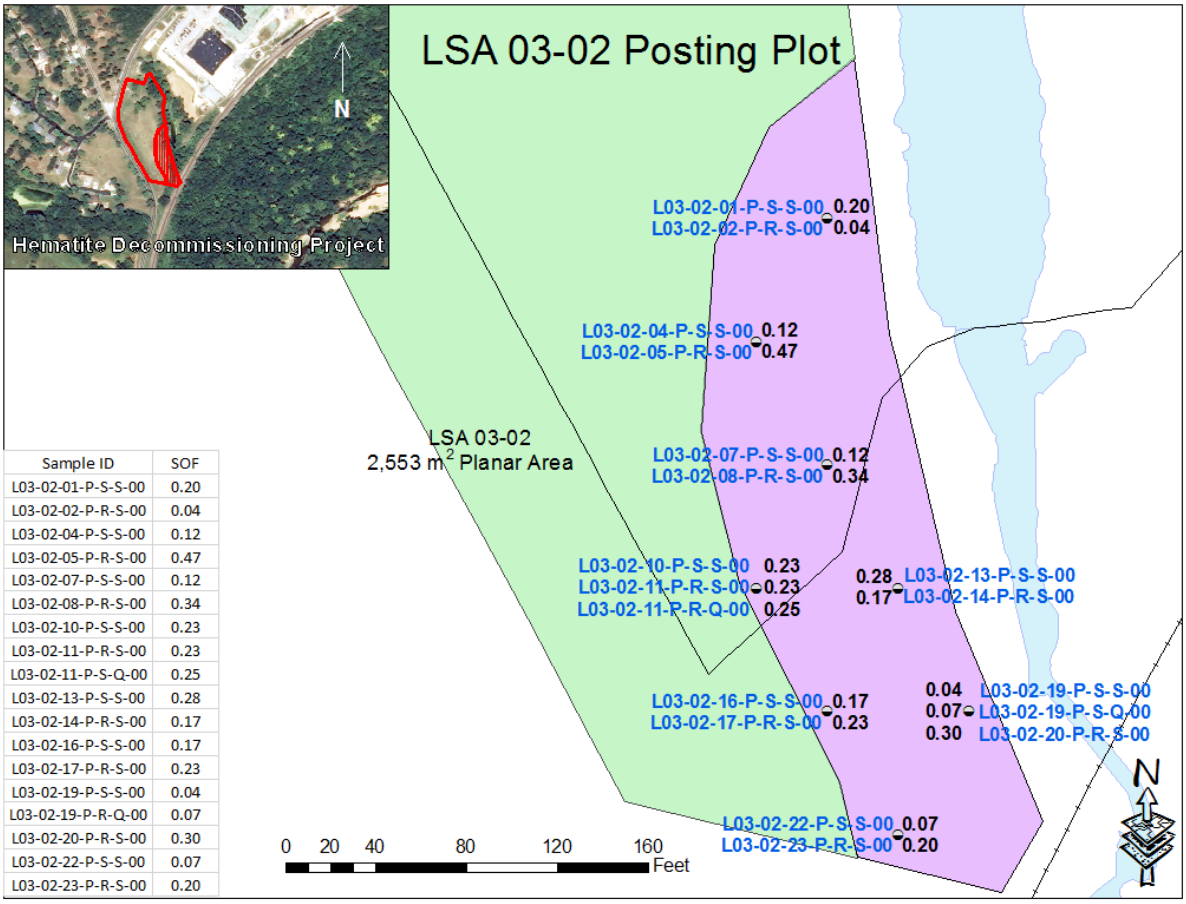
N	16

	Mean	95% CI	Mean SE	SD	Variance	Skewness	Kurtosis
LSA 03-02 Sys SOF	0.20	0.14 to 0.26	0.029	0.11	0.01	0.6	0.79

	Minimum	1st quartile	Median	97.87% CI	3rd quartile	Maximum	IQR
LSA 03-02 Sys SOF	0.04	0.12	0.20	0.12 to 0.28	0.26	0.5	0.14

A posting plot is simply a map of the SU with the data values (in this case the SOF values for each systematically collected sample) entered at the measurement locations. This potentially reveals heterogeneities in the data – especially possible patches of elevated residual radioactivity. The posting plot for LSA 03-02 is presented below in Figure 15-4. Figure 15-4 shows no unusual patterns in the data.

Figure 15-4
Posting Plot for LSA 03-02 Systematic Measurement Locations



Sample ID	SOF
L03-02-01-P-S-S-00	0.20
L03-02-02-P-R-S-00	0.04
L03-02-04-P-S-S-00	0.12
L03-02-05-P-R-S-00	0.47
L03-02-07-P-S-S-00	0.12
L03-02-08-P-R-S-00	0.34
L03-02-10-P-S-S-00	0.23
L03-02-11-P-R-S-00	0.23
L03-02-11-P-S-Q-00	0.25
L03-02-13-P-S-S-00	0.28
L03-02-14-P-R-S-00	0.17
L03-02-16-P-S-S-00	0.17
L03-02-17-P-R-S-00	0.23
L03-02-19-P-S-S-00	0.04
L03-02-19-P-R-Q-00	0.07
L03-02-20-P-R-S-00	0.30
L03-02-22-P-S-S-00	0.07
L03-02-23-P-R-S-00	0.20

Appendix B to this report presents the complete analytical data set (in Microsoft Excel format) used to derive the summary statistics presented in Table 15-1, Figure 15-3, and Figure 15-4 above. A summary of the analytical data is presented in Table 15-2 below. Appendix H to this report presents the Test America Analytical Laboratory soil sample reports.

Table 15-2
Final Status Survey Analytical Data: LSA 03-02

Sample ID	Sample Depth (ft)	Type (Systematic, Bias, QC)	TestAmerica Analytical Results																										Enr.	SOF_N
			Ra-226						Tc-99					Th-232						Inferred U-234				U-235				U-238					
			Result	Uncertainty	MDC	Qualifier	Net Result*	Corrected Result	Result	Corrected Result	Uncertainty	MDC	Qualifier	Result	Uncertainty	MDC	Qualifier	Net Result**	Corrected Result	Result	Uncertainty	MDC	Qualifier	Result	Uncertainty	MDC	Qualifier	Result	Uncertainty	MDC	Qualifier	Enrichment (%)	SOF_N
L03-02-01-P-S-S-00	0.00	S	1.360	0.187	0.067	NA	0.290	0.290	0.096	0.096	0.031	0.211	U	1.070	0.162	0.121	NA	0.070	0.070	0.071	NA	NA	NA	0.002	0.152	0.259	U	0.875	0.333	0.899	U	0.1	0.20
L03-02-02-P-R-S-00	0.50	S	1.090	0.151	0.066	NA	0.020	0.020	0.069	0.069	0.033	0.221	U	1.030	0.148	0.085	NA	0.030	0.030	1.405	NA	NA	NA	0.073	0.131	0.240	U	0.915	0.293	0.815	NA	1.3	0.04
L03-02-04-P-S-S-00	0.00	S	1.250	0.176	0.070	NA	0.180	0.180	0.105	0.105	0.032	0.218	U	0.995	0.166	0.123	NA	-0.005	0.000	2.136	NA	NA	NA	0.112	0.151	0.248	U	1.320	0.543	0.818	NA	1.4	0.12
L03-02-05-P-R-S-00	0.50	S	1.560	0.204	0.082	NA	0.490	0.490	0.054	0.054	0.044	0.264	U	1.400	0.217	0.114	NA	0.400	0.400	0.941	NA	NA	NA	0.041	0.093	0.276	U	1.510	0.573	0.866	NA	0.5	0.47
L03-02-07-P-S-S-00	0.00	S	1.170	0.161	0.067	NA	0.100	0.100	0.059	0.059	0.054	0.206	U	1.090	0.192	0.110	NA	0.090	0.090	3.054	NA	NA	NA	0.167	0.123	0.173	U	0.975	0.310	0.774	NA	2.6	0.12
L03-02-08-P-R-S-00	0.50	S	1.360	0.198	0.075	NA	0.290	0.290	0.054	0.054	0.014	0.262	U	1.310	0.223	0.141	NA	0.310	0.310	3.625	NA	NA	NA	0.199	0.198	0.247	U	1.070	0.386	1.060	NA	2.9	0.34
L03-02-10-P-S-S-00	0.00	S	1.220	0.167	0.067	NA	0.150	0.150	0.084	0.084	0.028	0.213	U	1.280	0.216	0.100	NA	0.280	0.280	1.293	NA	NA	NA	0.068	0.135	0.238	U	0.751	0.294	0.860	U	1.4	0.23
L03-02-11-P-R-S-00	0.50	S	1.270	0.169	0.052	NA	0.200	0.200	0.034	0.034	0.035	0.236	U	1.200	0.178	0.114	NA	0.200	0.200	2.368	NA	NA	NA	0.125	0.153	0.236	U	1.320	0.553	0.845	NA	1.5	0.23
L03-02-13-P-S-S-00	0.00	S	1.140	0.177	0.088	NA	0.070	0.070	0.048	0.048	0.075	0.225	U	1.420	0.278	0.142	NA	0.420	0.420	3.031	NA	NA	NA	0.160	0.162	0.280	U	1.670	0.660	0.992	NA	1.5	0.28
L03-02-14-P-R-S-00	0.50	S	1.270	0.172	0.066	NA	0.200	0.200	-0.001	0.000	0.051	0.219	U	1.100	0.171	0.124	NA	0.100	0.100	0.750	NA	NA	NA	0.031	0.143	0.220	U	1.520	0.587	0.884	NA	0.4	0.17
L03-02-16-P-S-S-00	0.00	S	1.130	0.170	0.079	NA	0.060	0.060	0.090	0.090	0.073	0.234	U	1.190	0.195	0.128	NA	0.190	0.190	5.236	NA	NA	NA	0.289	0.162	0.198	NA	0.862	0.339	0.978	U	5.0	0.17
L03-02-17-P-R-S-00	0.50	S	1.250	0.164	0.062	NA	0.180	0.180	0.061	0.061	0.062	0.234	U	1.240	0.194	0.134	NA	0.240	0.240	1.897	NA	NA	NA	0.102	0.142	0.243	U	0.856	0.296	0.801	NA	1.9	0.23
L03-02-19-P-S-S-00	0.00	S	1.040	0.148	0.068	NA	-0.030	0.000	0.213	0.213	0.163	0.240	U	0.997	0.156	0.088	NA	-0.003	0.000	3.133	NA	NA	NA	0.163	0.114	0.164	U	1.960	0.650	0.795	NA	1.3	0.04
L03-02-20-P-R-S-00	0.50	S	1.330	0.193	0.085	NA	0.260	0.260	0.041	0.041	0.022	0.233	U	1.310	0.203	0.119	NA	0.310	0.310	0.741	NA	NA	NA	0.033	0.169	0.284	U	1.110	0.338	0.887	NA	0.5	0.30
L03-02-22-P-S-S-00	0.00	S	1.090	0.155	0.069	NA	0.020	0.020	0.141	0.141	0.044	0.212	U	1.060	0.160	0.084	NA	0.060	0.060	2.103	NA	NA	NA	0.111	0.147	0.249	U	1.160	0.332	0.889	NA	1.5	0.07
L03-02-23-P-R-S-00	0.50	S	1.210	0.174	0.070	NA	0.140	0.140	0.009	0.009	0.031	0.221	U	1.220	0.185	0.167	NA	0.220	0.220	1.926	NA	NA	NA	0.099	0.145	0.240	U	1.350	0.601	0.919	NA	1.2	0.20
L03-02-11-P-S-Q-00	0.50	Q	1.260	0.166	0.069	NA	0.190	0.190	-0.001	0.000	0.025	0.233	U	1.230	0.181	0.093	NA	0.230	0.230	3.529	NA	NA	NA	0.191	0.119	0.173	NA	1.450	0.553	0.838	NA	2.1	0.25
L03-02-19-P-R-Q-00	0.00	Q	1.030	0.149	0.070	NA	-0.040	0.000	0.346	0.346	0.146	0.234	NA	1.070	0.165	0.131	NA	0.070	0.070	1.859	NA	NA	NA	0.090	0.150	0.249	U	1.830	0.587	0.850	NA	0.8	0.07
L03-02-25-P-S-B-00	0.00	B	1.010	0.159	0.079	NA	-0.060	0.000	0.022	0.022	0.117	0.222	U	0.978	0.203	0.114	NA	-0.022	0.000	2.962	NA	NA	NA	0.158	0.160	0.251	U	1.490	0.602	0.905	NA	1.7	0.03
L03-02-26-P-S-B-00	0.00	B	0.908	0.131	0.061	NA	-0.162	0.000	0.265	0.265	0.106	0.257	NA	0.935	0.139	0.082	NA	-0.065	0.000	2.473	NA	NA	NA	0.133	0.102	0.160	U	1.120	0.480	0.735	NA	1.9	0.03
Systematic Minimum			0.000						0.000					0.000						0.071				0.002				0.751				**1.6**	0.04
Systematic Maximum			0.490						0.213					0.420						5.236				0.289				1.960				Average Enrichment (%)	0.47
Systematic Mean			0.166						0.072					0.183						2.107				0.111				1.202					0.20
Systematic Median			0.165						0.060					0.195						2.014				0.107				1.135					0.20
Systematic Standard Deviation			0.127						0.051					0.138						1.302				0.073				0.341					0.11
			With ingrowth, use Ra226 bkg = 1.07											Th232 bkg = 1.0																				

NOTES:

Gross results in units of pCi/g.

* Background with ingrowth, 1.07 pCi/g subtracted from gross result.

**Background, 1.0 pCi/g subtracted from gross result.

U Qualifier: Result is less than the sample detection limit.

All uncertainty values are reported at the 2-sigma confidence level.

15.2.5 Biased Soil Sample Result LSA 03-02

Two (2) biased sample was collected from LSA 03-02. The sample collected at location L03-02-25 represented the maximum GWS measurement (12,567 gcpm) within the SU, and had a result of 0.03 Uniform SOF.

15.2.6 Quality Control Soil Sample Result LSA 03-02

Two QC field duplicate sample points were randomly selected for LSA 03-02 which were collected at systematic locations L03-02-11 and L03-02-19.

For the 18 samples (i.e., 16 systematic + 2 biased) collected within LSA 03-02, two field duplicate samples were collected. This frequency equates to 11.1%, (i.e. 2/18). Form HDP-PR-FSS-703-1 documents that the duplicate sample result comparison with the partner's sample results that all comparison criteria were less than the calculated warning limits (see Figure 15-5 below).

Figure 15-5
Form HDP-PR-FSS-703-1 Field Duplicate Sample Assessment LSA 03-02 (1 of 2)

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FORM HDP-PR-FSS-703-1
FIELD DUPLICATE SAMPLE ASSESSMENT

Survey Unit No.: LSA 03-02 | Survey Unit Description: Class 2 Survey Unit West of Site Pond in "Area 5"

Sample ID	Field Duplicate Sample ID	Radionuclide	Sample (pCi/g) Activity (x_i)	Sample (pCi/g) MDC	Field Duplicate Sample (pCi/g) Activity (x_i)	Field Duplicate Sample (pCi/g) MDC	Average Activity ($\bar{X}$) (pCi/g)	Nuclide DCGL (pCi/g)	Statistic[2]	Warning Limit	Control Limit	Statistic Exceeds Limit? (Y/N)
L03-02-11-P-R-S-00	L03-02-11-P-S-Q-00	Ra-226	1.270	0.0519	1.260	0.069	1.265	1.9	0.01	0.269	0.403	N
L03-02-11-P-R-S-00	L03-02-11-P-S-Q-00	Tc-99	0.0344	0.236	-0.0014	0.233	0.0165	25.1	NA	3.552	5.321	NA
L03-02-11-P-R-S-00	L03-02-11-P-S-Q-00	Th-232	1.2	0.114	1.230	0.093	1.215	2.0	0.030	0.283	0.424	N
L03-02-11-P-R-S-00	L03-02-11-P-S-Q-00	U-234[1]	2.368	NA	3.529	NA	2.949	195.4	1.161	27.649	41.425	N
L03-02-11-P-R-S-00	L03-02-11-P-S-Q-00	U-235	0.125	0.236	0.191	0.173	0.158	51.6	NA	7.301	10.939	NA
L03-02-11-P-R-S-00	L03-02-11-P-S-Q-00	U-238	1.32	0.845	1.45	0.838	1.385	168.8	0.13	23.885	35.786	N

Comments:
1. U-234 is inferred, no MDC available.
2. Duplicate assessment is not necessary if the result of either sample is < MDC.

Performed by: Thomas Yardy

Date: 5-8-17

Reviewed by: Clark Evers

Date: 5/18/17

Quality Record

Figure 15-5
Form HDP-PR-FSS-703-1 Field Duplicate Sample Assessment LSA 03-02 (2 of 2)

Hematite Decommissioning Project	Procedure: HDP-PR-FSS-703, Final Status Survey Quality Control	Revision: 2	Page 1 of 1

FORM HDP-PR-FSS-703-1
FIELD DUPLICATE SAMPLE ASSESSMENT

Survey Unit No.:	LSA 03-02				Survey Unit Description:		Class 2 Survey Unit West of Site Pond in "Area 5"					
			Sample (pCi/g)		Field Duplicate Sample (pCi/g)		Average Activity ($\bar{X}$)	Nuclide DCGL				Statistic Exceeds Limit?
Sample ID	Field Duplicate Sample ID	Radionuclide	Activity (x_i)	MDC	Activity (x_i)	MDC	(pCi/g)	(pCi/g)	Statistic[2]	Warning Limit	Control Limit	(Y/N)
L03-02-19-P-S-S-00	L03-02-19-P-R-Q-00	Ra-226	1.04	0.0682	1.03	0.0695	1.035	1.9	0.01	0.269	0.403	N
L03-02-19-P-S-S-00	L03-02-19-P-R-Q-00	Tc-99	0.213	0.24	0.346	0.234	0.2795	25.1	NA	3.552	5.321	NA
L03-02-19-P-S-S-00	L03-02-19-P-R-Q-00	Th-232	0.997	0.088	1.07	0.131	1.034	2.0	0.073	0.283	0.424	N
L03-02-19-P-S-S-00	L03-02-19-P-R-Q-00	U-234[1]	3.133	NA	1.859	NA	2.496	195.4	1.274	27.649	41.425	N
L03-02-19-P-S-S-00	L03-02-19-P-R-Q-00	U-235	0.163	0.164	0.0904	0.249	0.127	51.6	NA	7.301	10.939	NA
L03-02-19-P-S-S-00	L03-02-19-P-R-Q-00	U-238	1.96	0.795	1.83	0.85	1.895	168.8	0.13	23.885	35.786	N

Comments:
1. U-234 is inferred, no MDC available.
2. Duplicate assessment is not necessary if the result of either sample is < MDC.

Performed by: Thomas Yardy

Date: 5-8-17

Reviewed by: Clark Evers

Date: 5/8/17

Quality Record

15.3 Tc-99 Hot Spot Assessment LSA 03-02

As a Class 2 SU, there is no history of any sample from the SU exceeding the Tc-99 $DCGL_W$, or a SOF of 1.0. The highest Tc-99 sample result collected from both Final RASS and FSS was 0.2 pCi/g. There is no indication of a potential Tc-99 hot spot exceeding the $DCGL_W$ of 25.1 pCi/g, and therefore a Tc-99 hot spot assessment is not required.

16.0 ALARA EVALUATION LSA 03-02

All samples collected within LSA 03-02 were evaluated against the Uniform Stratum $DCGL_W$. For LSA 03-02 no sample result exceeded a SOF of 1.0. The average SOF result, based on all systematically collected samples, was 0.20 for LSA 03-02. The average SOF equates to residual activity contributions from the SU area of 5.0 mrem/yr for LSA 03-02. Groundwater Monitoring Well data provided in FSSFR Volume 6, Chapters 2 and 3 {ML16287A528}, and Chapter 4 {ML16342B552}, and Chapter 5 {ML17018A105} indicate that the groundwater dose contribution will be a fraction of the MCLs. Nevertheless, a maximum groundwater contribution assumption of 4.0 mrem/yr based upon the EPA MCLs will be added to the total estimated dose for LSA 03-02. Additionally, 4.25 mrem/year will be added to LSA 03-02 to account for the dose contribution from the presence of Reuse Stockpile 8b soil. Adding these dose contributions together, the total estimated dose for LSA 03-02 is 13.25 mrem/year.

Since the estimated TEDE is below the regulatory release criterion of 25 mrem/yr, the conclusion of the ALARA evaluation is that the FSS of LSA 03-02 was successful and that there would be no discernable benefit to the health and safety of the public in attempting to further reduce the results of FSS by performing remediation of LSA 03-02.

17.0 FSS PLAN DEVIATIONS LSA 03-02

17.1 Remedial Actions during FSS

There were no remedial actions after FSS in LSA 03-02.

17.2 Adjustments to Scan MDC Calculations

Scan MDCs for LSA 03-02 were calculated in accordance with HDP-PR-FSS-701, Revision 10, *Final Status Survey Plan Development* and HDP-TBD- FSS-002, Revision 3, *Evaluation and Documentation of the Scanning Minimum Detectable Concentrations (MDC) for Final Status Surveys (FSS)*. The assumed LSA background count rate of 10,000 cpm was applied to determine the prospective Scan MDCs, and the actual mean count rate from the FSS survey was 10,673 cpm. Therefore the calculated Scan MDCs are appropriate, and no adjustments need to be made.

18.0 DATA QUALITY ASSESSMENT

The DQO process is thoroughly integrated within the DP and Hematite FSS procedures. The steps of the DQO process are presented in Volume 3, Chapter 1, Section 4.0 of the FSSFR and correspond to the DQO steps described in Chapter 14, Section 4.2.1 of the DP. The HDP DQO process reflects the recommendations given in MARSSIM, Chapter 2, Figure 2-2.

18.1 Data Quality Assessment for LSA 03-02

The Data Quality Assessment of the survey methodology, sampling and sample analysis results, and the Quality Control sampling and analysis results to ascertain the validity of the conclusion for LSA 03-02 (see Figure 18-1) provides the following:

- The field and laboratory instruments utilized were capable of detecting activity at an MDC less than the appropriate investigation level, and were verified to be operable prior to and after use in accordance with HDP-PR-HP-416 (*Operation of the Ludlum 2221 for Final Status Survey*).
- The calibration of all instruments that were used to measure or analyze data was current at the time of use and the calibrations of the instruments were performed using a NIST traceable source. The instruments used were successfully source checked prior to and after use.
- The systematic samples that were collected (on a random-start triangular grid) and the gamma scan surveys that were conducted were performed in accordance with procedure HDP-PR-FSS-711, *Final Status Surveys and Sampling of Soil and Sediment*.
- All samples sent for analysis at the approved offsite laboratory (TestAmerica) were tracked on a chain of custody form in accordance with HDP-PR-QA-006, *Chain of Custody*.
- Quality Control sample results were verified to meet the acceptance criteria as specified in HDP-PR-FSS-703, *Final Status Survey Quality Control*.
- LSA 03-02 survey and sample results were independently reviewed and validated in accordance with HDP-PR-FSS-721 *Final Status Survey Data Validation*.
- The WRS Test is necessary when the difference between the maximum survey unit data set measurement SOF and the minimum background area measurement SOF is less than or equal to one. For LSA 03-02, one individual gross SOF result in the FSS data set exceeded the SOF of the minimum background reference area measurement by more than one using the Uniform Stratum criteria. Therefore, the WRS Test was required for LSA 03-02. Since the test statistic, WR (1039) exceeded the critical value (860), the FSS data set passed the WRS Test and the null hypothesis was rejected. The WRS Test worksheet is presented in Appendix B.
- A biased soil sample was collected from the location of the highest gamma count rate within the SU, with a maximum result of 0.03 Uniform SOF.

- The maximum SOF result for all surface samples within LSA 03-02 was 0.23. The maximum SOF result for all subsurface samples within LSA 03-02 was 0.47. The average SOF result for all systematically collected samples within LSA 03-02 was 0.03, with an upper 95% confidence level (UCL_{mean} 0.95) of 0.20.
- No FSS sample result in LSA 03-02 exceeded a SOF of 1.0 as compared to the Uniform Stratum criteria, therefore an EMC or supplemental investigations were not required. For the same reason, no comparisons to the alternate "Three-Layer" multi-CSM (i.e. Surface, Root and Excavation) DCGLs were necessary.
- A retrospective sampling frequency evaluation was performed to determine if sufficient statistical power exists to reject the null hypothesis based on the total number of systematic sample locations actually collected within LSA 03-02. The successful result of the retrospective power evaluation presented in Table 18-1 for LSA 03-02 indicates that the minimum number of sample locations required (8) for the WRS Test was equal to the number of sampling locations actually collected (8) within LSA 03-02. The methodology used for the retrospective sampling frequency evaluation is similar to the prospective sample size determination performed during FSS Plan Development except that actual FSS sample results and statistics are used in the sample size verification. Specifically, the mean and standard deviation of the eight LSA surface samples (i.e., the WRS Test sample data set) are used to derive the relative shift for each LSA. Given the HDP Type I and Type II errors of 0.05 and 0.10, respectively, the calculated relative shift is then correlated to a minimum sample size number as provided in Table 5-1 of MARSSIM.
- HDP staff ensured that a visual inspection of the SU configuration and of the Isolation & Control measures were performed periodically, and confirmed that there were no instances of potential cross contamination from weather events until the FSS of all remaining areas at HDP were completed.

Table 18-1
Retrospective Sample Size Verification for LSA 03-02

Uniform DCGL Criteria Evaluation	
N/2 Value Verification	
Isotope(s)	**SOF (Ra/Tc/Th/Iso U)**
St. Dev.	0.11
$DCGL_{SOF}$	1
LBGR (Mean)	0.20
Shift	0.80
Relative Shift (Δ/σ)	6.96
MARSSIM Table 5.1 (P_r)	1.000000
N	12
N + 20%	14.4
N/2	8
FSS N/2	8
Verification Check	**SUFFICIENT MEASUREMENTS**
"N/2" Corresponds to the number of survey unit measurement locations required for the WRS Test	

MARSSIM Table 5.1

Δ/σ	P_r
0.1	0.528182
0.2	0.556223
0.3	0.583985
0.4	0.611335
0.5	0.638143
0.6	0.664290
0.7	0.689665
0.8	0.714167
0.9	0.737710
1.0	0.760217
1.1	0.781627
1.2	0.801892
1.3	0.820978
1.4	0.838864
1.5	0.855541
1.6	0.871014
1.7	0.885299
1.8	0.898420
1.9	0.910413
2.0	0.921319
2.25	0.944167
2.5	0.961428
2.75	0.974067
3.0	0.983039
3.5	0.993329
4.0	0.997658
4.01	1.000000

MARSSIM Table 5.2, α = 0.05, β = 0.10

α (or β)	$Z_{1-\alpha}$ (or $Z_{1-\beta}$)	
0.005	2.576	
0.01	2.326	
0.015	2.241	
0.025	1.960	
0.05	1.645	α
0.10	1.282	β
0.15	1.036	
0.2	0.842	
0.25	0.674	
0.30	0.524	

Figure 18-1
Data Evaluation Checklists prepared for LSA 03-02 (page 1 of 2)

Hematite Decommissioning Project	Procedure: HDP-PR-FSS-721, Final Status Survey Data Evaluation		
		Revision: 10	Appendix G-1, Page 1 of 2

APPENDIX G-1
FINAL STATUS SURVEY DATA QUALITY OBJECTIVES REVIEW CHECKLIST

Survey Area: LSA 03 **Description:** Plant Open Land Area
Survey Unit: 02 **Description:** West of Site Pond In "Area 5"

1.	Have all measurements and/or analysis results that will be subjected to data analysis for FSS been individually reviewed and validated in accordance with Section 8.1 of this procedure?	Yes ☒	No ☐	
2.	Have all systematic measurements and/or samples been taken or acquired at the locations specified in the FSSP and the FSS Sample Instructions?	Yes ☒	No ☐	
3.	Have all scans surveys been performed of the areas specified as required in the FSSP and the FSS Sample Instructions?	Yes ☒	No ☐	
4.	Have all biased measurements and/or samples been taken or acquired at the locations specified in the FSSP & the FSS Sample Instructions?	Yes ☒	No ☐	NA ☐
5.	Have duplicate and/or split samples or measurements been taken or acquired at each location designated as a QC sample?	Yes ☒	No ☐	NA ☐
6.	Were the instruments used to measure or analyze the survey data capable of detecting the ROCs or gross activity at a MDC less than the appropriate investigation level?	Yes ☒	No ☐	
7.	Was the calibration of all instruments that were used to measure or analyze data, current at the time of use and were those calibrations performed using a NIST traceable source?	Yes ☒	No ☐	
8.	Were the instruments successfully response-checked before use and, where required, after use on the day the data was measured?	Yes ☒	No ☐	
9.	Do the samples match those identified on the chain of custody?	Yes ☒*	No ☐	NA ☐
10.	Do the QC Sample Results meet the acceptance criteria as specified in HDP-PR-FSS-703, Final Status Survey Quality Control?	Yes ☒	No ☐	NA ☐
11.	Are all Laboratory QC parameters within acceptable limits?	Yes ☒	No ☐	NA ☐

If "No" was the response to any of the questions above, then document the discrepancy as well as any corrective actions that were taken to resolve the discrepancy.

Comments: *Item 9 Sample IDs for QC samples were labeled with the wrong CSM, i.e. sample ID L03-02-11-P-**S**-Q-00 should be L03-02-11-P-**R**-Q-00 and L03-02-19-P-**R**-Q-00 should be L03-02-19-P-**S**-Q-00. This mis-labeling does not affect any results or calculations. The FSS Plan was prepared using the correct IDs.

Quality Record

Figure 18-1
Data Evaluation Checklists prepared for LSA 03-02 (page 2 of 2)

Hematite Decommissioning Project	Procedure: HDP-PR-FSS-721, Final Status Survey Data Evaluation		
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APPENDIX G-1
FINAL STATUS SURVEY DATA QUALITY OBJECTIVES REVIEW CHECKLIST

Survey Area: No. LSA 03 **Description:** Plant Open Land Area
Survey Unit: No. 02 **Description:** West of Site Pond In "Area 5"

Discrepancy: None

Corrective Actions Taken: None

11. Have the corrective actions resolved the discrepancy with the data? Yes ☐ No ☐ NA ☒
    a. If "No", then forward this form to the RSO.
12. The following questions will be answered by the RSO.
    a. If the answer to question 11 was "No", then is the affected data still valid? Yes ☐ No ☐ NA ☒
    b. If "No", then are the existing valid measurements or samples sufficient to demonstrate compliance for the survey unit? Yes ☐ No ☐ NA ☒
    c. If "No", then direct the acquisition of additional measurements or samples as necessary to demonstrate compliance for the survey unit.

Prepared by (HP Staff):	Thomas Yardy (Print Name)	(Signature)	5-5-17 (Date)
Approved by (RSO):	Clark Evers (Print Name)	(Signature)	5/9/17 (Date)

Quality Record

19.0 SURVEILLANCE FOLLOWING FSS

FSS activities in LSA 03-02 were completed in October 2015. There were no events after the completion of FSS that would have the potential to cause contamination above the DCGLs in the SU.

20.0 CONCLUSION LSA 03-02

An adequate quantity and quality of radiological surveys and samples, as well as the corresponding laboratory analysis has been performed, evaluated and documented to demonstrate that the dose associated with all sources within SU LSA 03-02 of 13.25 mrem/year does not exceed the dose criterion for unrestricted release in accordance with 10 CFR 20.1402 of 25 mrem/year.

Table 20-1
LSA 03-02 SOF and Dose Summation

	AVE. SU SOIL RADIOACTIVITY	ELEVATED AREA CONTRIBUTION	GROUND WATER	BURIED PIPING	REUSE SOIL	**TOTAL**
SOF	0.20	N/A	0.16	N/A	0.17	**0.53**
DOSE	5.0 mrem/year	N/A	4.0 mrem/year	N/A	4.25 mrem/year	**13.25 mrem/year**

21.0 REFERENCES

21.1 DO-08-004, Hematite Decommissioning Plan {ML092330123}.

21.2 DO-08-003, Radiological Characterization Report, July 2009 {ML092870496}

21.3 HDP-TBD-FSS-002, *Evaluation and Documentation of the Scanning Minimum Detectable Concentrations (MDC) for Final Status Surveys (FSS)*

21.4 Westinghouse letter HEM-10-80, *Response to request for Additional Information Concerning Hematite Decommissioning Plan: Chapter 14, Characterization Report and Surrogates Report* {ML102140158}

21.5 Westinghouse letter HEM-11-96, *Final Supplemental Response to NRC Request for Additional Information on the Hematite Decommissioning Plan and Related Revision to a Pending License Amendment Request* {ML111880290}

22.0 APPENDICES (To Be Provided On Separate Data Disc)

APPENDIX A: Analytical Data Evaluation Spreadsheets for LSA 03-01

APPENDIX B: Analytical Data Evaluation Spreadsheets for LSA 03-02

APPENDIX C: FSS Plan Development for LSA 03-01

APPENDIX D: FSS Plan Development for LSA 03-02

APPENDIX E: TestAmerica Laboratory Analytical Data Reports for LSA 03-01

APPENDIX F: TestAmerica Laboratory Analytical Data Reports for LSA 03-02

APPENDIX G: Completed Field Logs