February 25, 2011

U.S. Nuclear Regulatory Commission
ATTN: Mr. James Shepherd, Project Manager
Decommissioning Branch, Division of Waste Management
Washington D.C. 20555

Reference: Final Status Survey Plans for Phases 3 and 4
License Condition 54
FMRI, License SMB-911, Docket 40-7580

Dear Mr. Shepherd:

Please find enclosed FMRIs Final Status Survey Plans, February 2011 (Plan), for subsurface soils and groundwater. The Plan was developed pursuant to FMRI License SMB-911, License Condition 54.

Should you have any questions on this matter, please contact James Burgess of FMRI at 918 687 6303

Sincerely,

Robert Compernolle
President, FMRI

Enclosure FMRI, Final Status Survey Plans, February 2011

Copy to: James Burgess (FMRI)
Document Control (02252011)

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Final Status Survey Plans

License Condition 54

February 2011

FMRI
#10 Tantalum Place
Muskogee, OK 74402
Docket No. 40-7580

Table of Contents

1 INTRODUCTION 1
1.1 Background 1
1.2 Purpose 1
1.3 Objective 1
2 APPROACH TO FINAL STATUS SURVEY 2
2.1 Condition 2
2.2 Requirement 2
2.3 Implementation 2
2.4 Report 2
3 GENERAL INFORMATION 3
3.1 Site Description and History 3
3.2 General Physical Setting 3
4 NATURE AND EXTENT OF CONTAMINATION 4
4.1 Nature of Contamination 4
4.2 Extent of Contamination 4
5 PLANS FOR FINAL STATUS SURVEY 5
5.1 Volumetric 5
5.2 Subsurface Soils 6
5.3 Groundwater 8
6 REFERENCES 12
Tables
Figures

1 INTRODUCTION

1.1 Background

The FMRI site (site) is about 4 kilometers (2.5 miles) east of the city center of Muskogee, OK, with the Arkansas River (Mile 395) on the east, Highway US-62 on the south, and the Muskogee Turnpike on the west. The current site comprises about 38 ha (75 a). The site produced tantalum and columbium metals from 1957 until it ceased operations in 1989. The raw materials (ore) used for tantalum and columbium production contained uranium and thorium as naturally occurring trace constituents. The concentrations of natural uranium and natural thorium were sufficient to cause the ores and slags to be classified as source materials by the Atomic Energy Commission, which originally issued License No. SMB-911 in 1967 to Fansteel, Inc.

In November, 2001, Fansteel suspended all operations at the Muskogee site. Fansteel subsequently filed for bankruptcy protection under Chapter 11 (reorganization). In conjunction with the bankruptcy proceedings, in July, 2003, Fansteel submitted:

i) a revised decommissioning plan,

ii) a request for exemption from financial assurance requirements, and

iii) a request for authorization to transfer the site license to a subsidiary to be formed as part of the bankruptcy reorganization plan.

On November 17, 2003, the bankruptcy court approved Fansteel's corporate reorganization plan. FMRI, a new subsidiary of Reorganized Fansteel, became the licensee for the Muskogee site on the effective date of the reorganization. On December 4, 2003, NRC approved the revised decommissioning plan, the request for exemption to financial assurance requirements, and the license transfer authorization, subject to the bankruptcy reorganization.

The FMRI Muskogee, Oklahoma site is currently being decommissioned under the authority of the U.S. Nuclear Regulatory Commission (NRC) pursuant to FMRI Source Materials License SMB-911 (License) and approved Decommissioning Plan.

1.2 Purpose

The purpose of this final status survey plan (Plan) is as described in FMRI License at Condition 54:

> 54. Not later than February 28, 2011, Licensee shall submit, applicable FSSPs for Phases 3 and 4, for prior NRC approval, which shall include measures to evaluate volumetric, subsurface, and groundwater contamination that are beyond the scope of MARSSIM (NUREG-1575, Table 1.1)

1.3 Objective

The objective of the Plan is to provide applicable final status survey plans to support decommissioning of the site.

2 APPROACH TO FINAL STATUS SURVEY

2.1 Condition

In 2003 the NRC issued a Safety Evaluation Report (SER) in support of the license amendment to approve the DP. The SER recognized the final status survey described in the DP was not comprehensive in scope. The SER included proposed license conditions for development of final status survey plans.

2.2 Requirement

The regulatory requirement for final status survey plans is as described previously in Section 1.2; i.e., FMRI Source Materials License SMB-911, Condition 54.

2.3 Implementation

FMRI will complete final status survey activities described in this plan with the assistance of contractors, subcontractors, and consultants.

FMRI intends to complete final status survey activities described in this plan in conformance with FMRI License at Condition 53:

> 53. Licensee shall conduct the following final status surveys and submit reports to NRC to demonstrate compliance with decommissioning criteria. NRC will be notified 30 days before a survey is performed, and NRC or its contractor will be given the opportunity to observe the licensee's survey and perform an independent confirmatory survey. If NRC does not approve a survey, additional remediation and survey shall be promptly conducted.
>
> a. Immediately following completion of remediation of all soils, buildings and equipment, but not later than nine months after approval of the FSSP, Licensee shall conduct a final status survey of all areas remediated and submit a Phase 3 FSSR.
>
> b. Immediately following completion of remediation of groundwater, Licensee shall conduct a final status survey of site groundwater and submit a Phase 4 FSSR.

2.4 Report

Report(s) of final status survey results will be developed as described in Section 2.3.

3 GENERAL INFORMATION

3.1 Site Description and History

3.1.1 Site Description

The Decommissioning Plan, Section 3.0 *Facility Description*, provides information describing the specific site location.

3.1.2 Site History

The Decommissioning Plan (DP), Section 2.0 *Facility Operating History*, provides background information describing the site history including previous investigations with respect to licensed activities.

FMRI began Phase 1 decommissioning in 2005 in accordance with the DP. Phase 1 includes removal of work-in-progress (WIP) material from ponds 2 and 3, and transfer of the material to an out-of-state uranium mill for use as alternate feed material. All residual WIP material has been removed from Pond 3: the berms and interior of Pond 3 have been reshaped for erosion control. About 200 tons of bulk WIP material remains in a drying bed near the southeast corner of Pond 3. Approximately 180 two-ton bags of WIP material from Pond 3 remain staged for shipment in the Thermite Building.

There have been no other DP activities conducted at the site.

3.2 General Physical Setting

The Decommissioning Plan, Section 3.0 *Facility Description*, summarizes the general-physical setting of the site, including general physical characteristics of the site and its proximity to people who could be affected by existing contamination or decommissioning activities.

4 NATURE AND EXTENT OF CONTAMINATION

4.1 Nature of Contamination

Natural uranium and natural thorium were present in the ores and slags used for tantalum and columbium production at an approximate concentration of 0.1 percent uranium oxide and 0.25 percent thorium oxide. These raw materials were digested in a hydrofluoric acid (HF) solution. The uranium and thorium were not extracted from the raw materials by the digestion process. The byproduct of the process - residues from the work in progress (WIP) - was disposed in holding ponds. Wastewaters from the holding ponds, the process, groundwater capture, and other activities were collected and treated prior to discharge through a National Pollutant Discharge Elimination System (NPDES) discharge outfall to the Arkansas River.

Radioactive contaminants at the site are natural uranium, natural thorium, and associated transformation products.

4.2 Extent of Contamination

In 1993, a characterization survey was performed to determine existing conditions site wide. Radiological survey activities were conducted over the interior and exterior of the site structures and the open land areas of the site. Structures and equipment associated with the ore-processing activities include the Chemical "C" Building, the Chemical "A" Building, and the R&D Building. The Chemical "C" Building is contaminated throughout by radioactive ore residues. Isolated areas of radioactive contamination were also identified in the Chemical "A" Building and some of the other site structures. Surface and subsurface soils at the site appear locally contaminated at low concentrations of natural uranium and natural thorium; i.e. a few or several 10's of pCi/g total activity. Further, the characterization surveys identified the highest concentrations of radiological contaminants in Pond Nos. 2 and 3, to the east and north respectively of the "Chem C" building. The average concentration of radiological contaminants in Pond Nos. 2 and 3 are 360 and 640 picocuries per gram (pCi/g) of U-238 respectively, and 360 and 440 pCi/g of Th-232 respectively. The surveys also determined that the average concentration of radiological contaminants in Pond Nos. 5 through 9, at the southern end of the site are less than 0.05% source material by weight. Survey data indicate that the natural uranium and natural thorium are present with their radioactive progeny in secular equilibrium.

Further description of extent of contamination at the site is provided in the DP.

Further description of extent of contamination at the site will be provided in a forthcoming report of site characterization; see Section 6.4.

5 PLANS FOR FINAL STATUS SURVEY

5.1 Volumetric

FMRI does not release materials and equipment for unrestricted release using volumetric criteria. Tools, equipment, piping, furniture, etc. will be released for unrestricted release in conformance with limits established by FMRI License SMB-911 at License Condition 33 and implemented by operating procedures.

Pavement, slabs, and structures will be released in accordance with the building surface DCGLs provided in the DP. The slab of building Chem C will not be released for unrestricted use, thus final status survey is not applicable.

The DP describes that sludge from ponds (i.e., WIP and CaF_2) and solids stored in containers (i.e., bags of soil in Sodium Reduction Building) will not be released for unrestricted use, thus final status survey is not applicable.

5.2 Subsurface Soils

This section describes the design and evaluation of the final status survey (Survey) for subsurface soils. The Survey incorporates to the extent practical guidance of the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM).

5.2.1 Survey Design

The Survey design recognizes that all of the subsurface soils do not have the same potential for residual radioactivity and, accordingly, do not need the same level of survey coverage to demonstrate satisfaction of the release criterion.

5.2.1.1 Reference (Background) Area

The DP, Section 4.3.2.1 *Soil Background Radioactivity*, provides background soil radioactivity concentrations for radionuclides of interest.

5.2.1.2 Reference Coordinate System

Survey locations will be referenced to the Oklahoma State Plane (NAD 83(OK83-NF) horizontal, NAVD 88 vertical). Sample depth will be recorded to the nearest tenth meter measured from ground surface.

5.2.1.3 Radionuclides of Interest

The DP, Section 5.0 *Dose Modeling Evaluations*, identifies the radionuclides for which the Survey design is applicable. The radionuclides of interest are summarized herein at Section 4.1.

5.2.1.4 Release Criterion

The DP, Section 5.0 *Dose Modeling Evaluations*, provides derived concentration guideline levels (DCGL) for the radionuclides of interest.

The radionuclides of interest and the respective DCGL will be evaluated by the sum of fractions rule. The release criterion is the sum of fractions less than or equal to one: $SoF \leq 1$.

5.2.1.5 Scope of Survey

Subsurface soils are those soils greater than one meter below ground surface.[1]

[1] Section 6.1 at Table 5-10 shows that the DCGLs are insensitive to thickness of contamination over a range of 0.085m to 8.5m. Section 6.2 at pages 19 and 20 acknowledges this condition of insensitivity. Then by definition the insensitivity is true for the release criterion.

5.2.1.6 Categorization and Classification of Areas

The subsurface soils have been initially categorized as either non-impacted or impacted. Areas that have no reasonable potential for residual radioactivity are designated as non-impacted areas and are not provided any level of survey coverage. Areas that have potential for containing residual radioactivity are designated as impacted areas. Impacted areas are subsequently subdivided into classes according to known or suspected levels of residual radioactivity. Classes are further subdivided into units.

Categorization

The subsurface soils categorized as impacted are depicted in Figure 1. The categorization is based on site operating history and/or known contamination as provided in Section 6.1.

Classification

Three classes of survey are identified such that areas with higher potential for contamination receive a higher degree of survey effort:

1. Class 1 areas: Areas known or expected to have residual radioactivity above the release criterion.
2. Class 2 areas: Areas known or expected to have residual radioactivity above background but less than the release criterion.
3. Class 3 areas: Areas that are not expected to contain residual radioactivity, or are expected to contain residual radioactivity at a small fraction of the release criterion. These are areas with very low potential for residual radioactivity but insufficient information to justify categorization as non-impacted.

Class 1 areas have the greatest potential for residual radioactivity and, therefore, receive the highest degree of survey effort, followed by Class 2, and then Class 3 areas.

The boundaries of the different classes will be identified from information provided in a forthcoming report of site characterization; see Section 6.4.

5.2.1.7 Units

Classes will be subdivided into units according to Table1.

5.2.1.8 Hypothesis

The DP, Section 14.4.2 *Null Hypothesis*, provides "that the residual contamination is equal to or greater than the acceptance criteria and the alternative hypothesis ... is that the residual contamination is less than the acceptance criteria".

5.2.1.9 Survey Technique

The method used to generate data for the Survey of subsurface soil will be collection of samples of subsurface soil which are analyzed for the radionuclides of interest.

Sampling of subsurface soil will be conducted in accordance with written operating procedures. The soil will be collected by mechanized auger or tube. Soil will be retrieved from successive one meter intervals beginning one meter below ground surface and continuing until first occurrence of bedrock or groundwater at each survey location. The soil from a depth interval will be mixed by hand and then an aliquot collected as the soil sample.

Sample collection activities will include documentation of sampling activities on a field log, decontamination of equipment between sample collection, and collection of a duplicate sample at a rate of one per 20 or at least one per day. Chain-of-custody will be conducted in accordance with written operating procedure.

Soil samples will be sent to a laboratory for preparation and analysis. The preparation will include removing rocks and vegetation, drying, grinding, mixing/blending, and then acid leaching an aliquot of the prepared soil. These preparation techniques will be carried out in accordance with laboratory-specific procedures.

The analysis technique and typical detection limit for each radionuclide of interest is provided in Table 2.

5.2.1.10 Decision Error Rates

The DP, Section 14.4.3 *Decision Error Rates*, provides that decision error probabilities for testing the hypothesis are α is 0.05 and β will be between 0.05 and 0.4.

5.2.1.11 Calculate Relative Shift

The DP, Section 14.4.5 *Method to Determining Number of Samples*, provides the delta for calculating the relative shift in terms of upper and lower bounds of the gray region. The same DP section also provides for determination of standard deviation to be used in calculating the relative shift.

5.2.1.12 Number of Survey Locations

The method provided in the DP, Section 14.4.6 *Number of Samples – WRS Test*, will be used to determine the number of surface locations from which subsurface samples will be collected (i.e., boreholes).

5.2.1.13 Determining Survey Locations

The DP, Section 14.4.8 *Method for Determining Grid Spacing*, provides for establishing the grid pattern and grid spacing for Class 1 and Class 2 areas. Survey locations for Class 3 areas will be generally evenly spaced and based on professional judgment.

5.2.2 Survey Evaluation

Evaluation of Survey results will include comparison of results of individual soil sample analyses (measurement) to the release criterion and a statistical evaluation of measurements from a unit against the release criterion.

5.2.2.1 Investigation Levels

The investigation levels for the Survey of subsurface soils are provided in Table 3.

A comparison will be performed against each measurement to determine whether the measurement exceeds the respective investigation level of Table 3. If any measurement(s) exceeds the respective investigation level, the unit will be evaluated for additional measurement, reclassification or recategorization, or remediation.

5.2.2.2 Statistical Test

The DP, Section 14.4.1 *Nonparametric Statistical Test*, provides "[a] nonparametric statistical test will be applied to the sampling data taken at distinct survey locations in each survey unit to determine whether the release criteria have been met."

Measurements from a survey unit will be compared to equivalent measurements from the reference area. In general, the comparison will be whether the survey unit exceeds the reference area by more than the release criterion. The comparison will be made using the Wilcoxen Rank Sum (WRS) test. The WRS test will be completed using SoF values to represent the measurements from the reference area and the survey unit.

5.2.3 Quality Assurance and Quality Control

The DP, Section 13 *QA Program*, describes the quality assurance and quality control for decommissioning activities including final status surveys.

5.3 Groundwater

This section describes the design and evaluation of the Final Status Survey (Survey) for groundwater.

5.3.1 Survey Design

The Survey design for groundwater will evaluate groundwater in the shallow (unconsolidated) water-bearing zone.

5.3.1.1 Radionuclides of Interest

The radionuclides of interest in groundwater are total uranium and isotopic thorium.

5.3.1.2 Scope of Survey

The Survey design for groundwater will utilize existing monitoring wells, sumps, and other available groundwater sampling locations.

5.3.1.3 Survey Technique

The method used to generate data for the Survey of groundwater will be collection of groundwater samples which are analyzed for the radionuclides of interest.

Groundwater purging and sampling will be conducted in accordance with the groundwater monitoring plan in effect for the site. Chain-of-custody will be conducted in accordance with written operating procedure. Groundwater samples will be sent to a certified analytical laboratory for analysis in accordance with the laboratory's QA/QC program.

5.3.1.4 Number of Samples

An adequate number of samples will be evaluated from each groundwater sampling point to meet appropriate statistical confidence levels.

5.3.1.5 Release Criterion

Relevant and appropriate requirements for groundwater will be developed based on the industrial site worker exposure scenario. Groundwater fate and transport modeling (e.g., RESRAD or PATHRAE/PATHRAD) will be applied to evaluate alternate concentrations limits (ACLs) for the radionuclides of interest. The Survey will evaluate potential risks from exposure to groundwater by an on-site worker.

Based on future site uses, ACLs may provide a more applicable release criterion that drinking water maximum contaminant levels (MCLs) or Oklahoma groundwater standards. Drinking water standards generally are not relevant and appropriate for ground waters that are not a current or potential source of drinking water (see 55 FR 8732, March 8, 1990).

5.3.2 Survey Evaluation

Evaluation of Survey results will include comparison groundwater sampling results at individual wells to the release criterion and a statistical evaluation of groundwater results and trends for each radionuclide of interest.

The Survey and evaluation of Survey results will be conducted either during groundwater pump and treat operations with forward predictions for system shutdown, or after pump and treat operations cease. Groundwater is currently collected in an interceptor trench system and for treatment prior to discharge at NPDES-permitted Outfall 001. Groundwater treatment was projected to occur for 17 years after decommissioning of WIP. Final status for the groundwater medium will be the condition in which groundwater collection and treatment is no longer occurring. The final status survey evaluation will be based on this condition, although the interim condition (active treatment) may also be evaluated.

5.3.3 Quality Assurance and Quality Control

The QA/QC program for groundwater will be conducted in accordance with the groundwater monitoring plan currently in effect for the site.

6 REFERENCES

6.1 Fansteel, Inc., Decommissioning Plan, January 15, 2003. [ML030240051]

6.2 U.S. Nuclear Regulatory Commission, Safety Evaluation Report for License Amendment Application to Approve Decommissioning, July 24, 2003, October 31, 2003. [ML033250083]

6.3 Mallinkrodt, Inc., C-T Phase II Decommissioning Plan, Revision 1, Section 14 *Facility Radiation Surveys*, August 12, 2008. [ML083150652]

6.4 FMRI, Plan for Additional Site Characterization, February 2011.

6.5 U.S. Nuclear Regulatory Commission, Multi-Agency Radiation Survey and Site Assessment Manual, NUREG-1575, Rev 1,. [ML082470583]

6.6 U.S. Nuclear Regulatory Commission, Consolidated Decommissioning Guidance, Characterization, Survey, and Determination of Radiological Criteria, Final Report, NUREG-1757, Vol 2, Rev 1, September 2006. [ML063000252]

Table 1 Final Status Survey Unit Size Subsurface Soils

Survey Classification	Unit Surface Area m^2
Class 1	2000
Class 2	10000
Class 3	no limit

Table 2 Final Status Survey Radioanalytical Methods Subsurface Soils

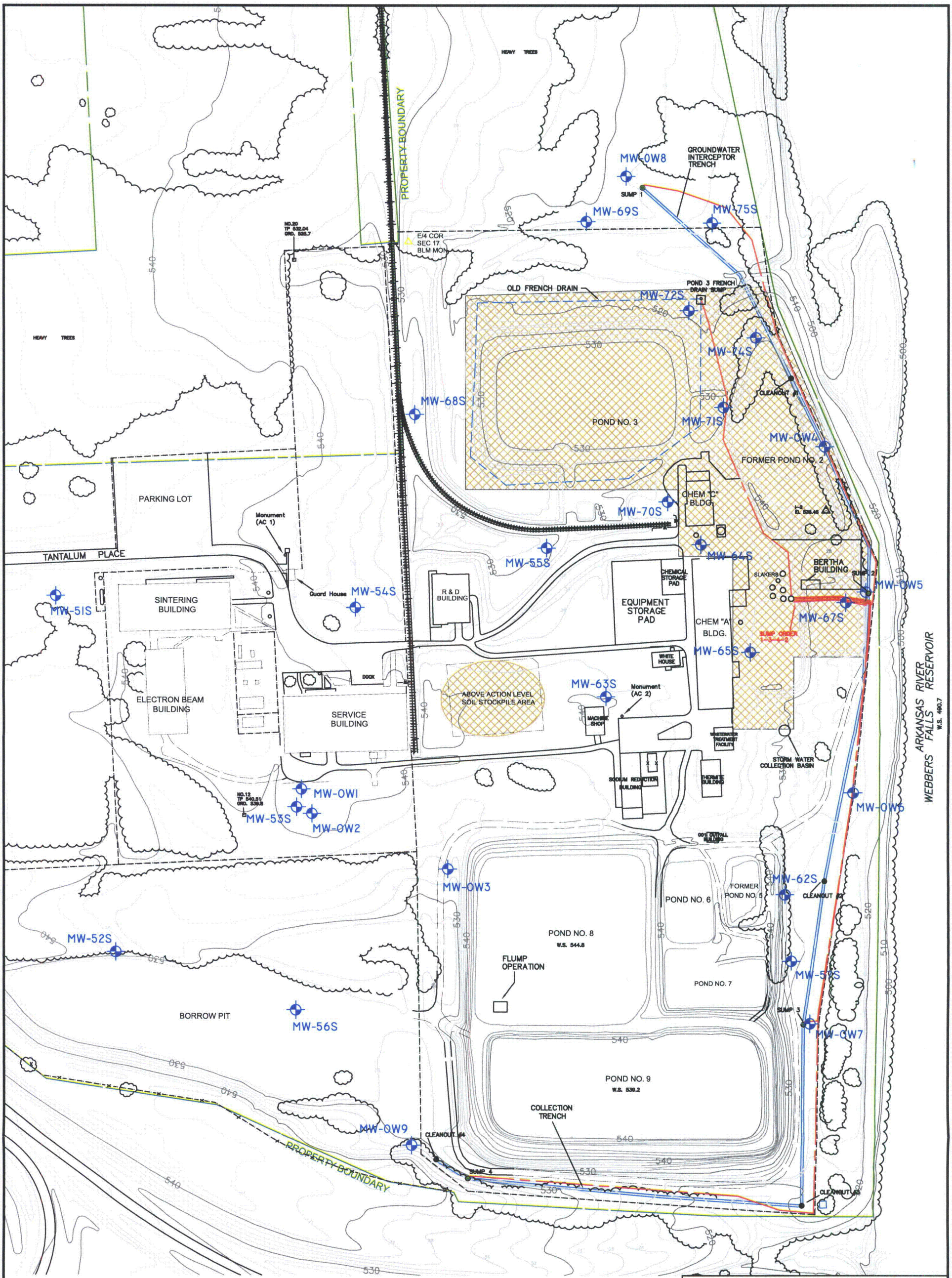
Radionuclide	Analytical Method	Detection Limit[1] (pCi/g)
Total Uranium	kinetic phosphorescence analysis	1
Isotopic Thorium	alpha spectrometry	1
Radium-226, 228	co-precipitation gross alpha and gross beta	1

[1] nominal values

Table 3 Final Status Survey Investigation Levels Subsurface Soils

Survey Unit Classification	Individual Sample Investigation Level
Class 1	SoF >1
Class 2	SoF ≥ 0.5
Class 3	SoF ≥ 0.25

SoF – sum of fraction value



EXPLANATION

MW-56S — MONITORING WELL

GROUNDWATER INTERCEPTOR TRENCH

APPROXIMATE HISTORICAL PROCESS AREA FOOTPRINT & SOIL STOCKPILE

NORTH

0 200 400

Scale (ft)

CONTOUR INTERVAL = 2 ft

FMRI

Final Status Survey Plan - Phase 3
License Condition 54

FIGURE 1.
AREAS FOR APPLICATION OF FINAL STATUS SURVEY PLAN SUBSURFACE SOILS

Scale: 1" = 200' 1:2,400	Date: February 2011
Project No: 4145A	County: Muskogee County, OK
Whetstone Associates	File: FMRI-BaseMap_9.dwg
	Drawn/Checked By: NP/SW