STEVEN A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

MARY FALLIN
Governor

October 24, 2013

J.C. Shepherd, Project Engineer
Reactor Decommissioning Branch
Division of Waste Management and Environmental Protection
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, Maryland 20852

Re: FMRI Closure Plan, ponds 6 and 7

Dear Mr. Shepherd:

I am enclosing a copy of FMRI's Closure Plan, submitted to and received by DEQ on October 2, 2013. The Plan is required by a DEQ Consent Order, Case No. 12-208. DEQ water quality staff members are now reviewing the plan for adequacy. We are requesting NRC's review and comments on the document. We are asking that your comments be submitted by November 1, 2013. If this is not feasible, please let me know so that I can advise our reviewing staff.

Sincerely,

Pam Dizikes

Pamela Brown Dizikes, Attorney
Office of General Counsel

One Enclosure

c: Document Control Center

FMRI

01 October 2013

Mr. Steven Gunnels District Representative
Industrial Wastewater Enforcement Section
Water Quality Division
Department of Environmental Quality
P.O. Box 1677
Oklahoma City, OK 73101-1677

Subject: Closure Plan, ponds 6 and 7

Dear Mr.Gunnels:

This letter provides the Oklahoma Department of Environmental Quality (DEQ) with FMRI's Closure Plan for ponds 6 and 7. Please note that cleanup criteria for arsenic in soil must be established in order to complete the closure activities. Upon approval from DEQ, FMRI will provide for closure performance and certification in accordance with OAC 252:616-13-4.

Please contact me if you have any questions.

Sincerely,

Jan Burgess for Robert Compernolle

Robert Compernolle
FMRI
#10 Tantalum Place
Muskogee, OK 74403
918-687-6303

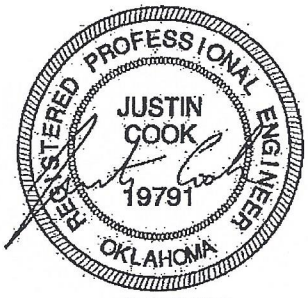
cc: James Burgess
Attachment: Engineering Report Closure Plan Ponds 6 & 7

RECEIVED
OCT 02 2013
WATER QUALITY DIVISION

FMRI

# Closure Plan
# Ponds 6 and 7

30 September 2013




**9/30/13**


**COOK & ASSOCIATES ENGINEERING, INC**

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# Table of Contents

## 1.0 General Information

The scope of this Closure Plan includes the permanent closure of ponds 6 and 7 at FMRI, Muskogee, OK. This Closure Plan is submitted pursuant to FMRI's approved Consent Order.[1]

A general layout of the facility is provided in Figure 1.

### 1.1 Purpose of Closure

Ponds 6 and 7 are not required to support operation or decommissioning of the facility.

All fluids, sediments, and soils will be removed from ponds 6 and 7.

The closure will be a clean closure.

### 1.2 Industrial Permit Number

The current wastewater discharge permit is OPDES Permit Number OK001643.

Ponds 6 and 7 are identified in the Permit as surface impoundments F01 and F02, respectively.

### 1.3 Owner Information

Contact information for the facility is as follows:

James Burgess, General Manager
FMRI
Number 10 Tantalum Place
Muskogee, OK 74403
Phone: (918) 687-6303

### 1.4 Schedule

FMRI will complete the closure of ponds 6 and 7 within two years of DEQ approval of the Closure Plan. Closure activities will be conducted June through October. The schedule allows for delays due to weather, etc.

[1] Oklahoma Department of Environmental Quality, Water Quality Division, In the Matter of FMRI, Inc., Case No. 12-208, Consent Order.

## 2.0 Site Assessment

The FMRI site is located in Muskogee County, Oklahoma, and occupies approximately 91 acres of land adjacent to the 406-acre Port of Muskogee Industrial Park. It is 2.5 miles northeast (Latitude 35.46.30, Longitude 095.18.15) of the Town of Muskogee. The site lies along the western edge of the Arkansas River (Webbers Falls Lock and Dam and Reservoir, part of the McClellan-Kerr Arkansas River Navigation System) and is bounded on the north by land owned by the Muskogee Port Authority, on the south by U.S. Highway 62, and on the west by Oklahoma State Highway 165 (Muskogee Turnpike) and a service road.

There are 15 structures on the site, primarily of concrete or brick construction; a few are metal "butler buildings." Of the nine ponds constructed during site operations, two have been closed (1 and 4) and the others contain process waste contaminated with chemical and radioactive materials.

### 2.1 Soil Information

Regional

Muskogee, Oklahoma is in the unglaciated Osage Section of the Central Lowlands Physiographic Province. The eastern boundary of the section is delineated by the lapping of westward-dipping Pennsylvanian rocks onto the western edge of the Ozark and the Ouachita uplifts. On the south, the Osage Section abuts the Arkansas Valley and Ouachita Mountains. Much of the Osage Section can be described as scarped plains. The topography ranges from nearly featureless plain and low escarpments to bold escarpments that rise as much as 600 feet above the adjacent plains. Bedrock in the southeastern portion of the Osage Section consists of mostly thin- to massive-bedded sandstone, shale, siltstone, and limestone of Pennsylvanian Age. The sandstone beds are hard and well cemented and the shales and siltstones are compact and dense. Units identified in the Muskogee area include the Hartshorne Sandstone, the McCurtain Shale, and the Warner Sandstone, in ascending order. Permeability in this type of bedrock is generally low and groundwater movement depends on secondary porosity (joints and fractures) rather than primary porosity (intergranular).

The regional structural geology is influenced by its proximity to the Boston Mountains Section of the Ozark Plateau Physiographic Province and the Arkansas Valley Section of the Ouachita Physiographic Province. The Arkansas Valley Section is a trough both topographically and structurally. Closed folding with an east-west trend characterizes the Arkansas Valley. The FMRI site is on the northern flank of the Arkansas Valley. Bedrock dips typically are to the south toward the axis of the basin. Alluvial deposits nearly entirely overlie bedrock at the FMRI site. The general regional topography of the bedrock beneath the alluvial deposits is relatively uniform with minor variations due to differential erosion. Terrace deposits having upper surfaces ranging from 20 to 120 feet above the floodplain border the alluvial deposits in segments on both sides of the

Arkansas River. These deposits are composed predominantly of silt, fine sand, coarse sand, and gravel near the base.

Site

The FMRI site is on the west-plunging faulted nose of the Ozark Uplift. The bedrock is Pennsylvanian Age, consisting of mostly sandstone and shales. The site is on the west bank of the Arkansas River that has a low relief but reaches a topographic difference of 50 to 60 feet above the river channel. The subsurface geology of the study area is characterized by a downward vertical gradation of finer-grained alluvial materials into coarser-grained unconsolidated sediments that bottom in shale.

Unconsolidated deposits underlying the FMRI site range in thickness from approximately 8.75 feet to approximately 34.5 feet. These unconsolidated materials consist of natural soils and heterogeneous fill material. At the base of the unconsolidated deposits and overlying bedrock is a medium- to-coarse-grained sand unit ranging in thickness from approximately 1.5 feet to 17.5 feet. This sand unit is generally saturated throughout its entirety with few exceptions. The bedrock encountered beneath the facility is the McCurtain Shale. Few relatively intense zones of horizontal fracturing were observed which included the presence of a few fractures on a 45-degree plane from horizontal. Some fractures in the basal 30 feet of shale are clay filled, indicating groundwater flow through fractures in this portion of the shale. The overall morphology of the bedrock surface beneath the FMRI site resembles an elongate swale with a north-south axis. A depression occurs on the bedrock surface in the northeast quadrant of the site.

## 2.2 Groundwater Information

Regional

Shale bedrock permeability is generally low and, therefore, does not readily transmit groundwater in the Muskogee area. However, a small amount of water is produced from bedrock aquifers throughout the area for domestic and stock use, presumably from fractures or joints with the bedrock. Depths to water measured in wells completed into the bedrock average approximately 30 feet below ground surface. Alluvial deposits are the most important aquifers in the Muskogee area and along the Arkansas River in general. Precipitation is the primary recharge. Natural discharge is mainly by seepage into streams and evapotranspiration. Quantities of groundwater adequate for domestic or stock use are available almost everywhere on the alluvial floodplain. Wells completed into the alluvium have been recorded to yield between 300 and 5,000 gallons per minute (gpm). Groundwater in the alluvium is predominantly a hard, calcium, magnesium bicarbonate type. Precipitation, geology, water movement, and hydraulics of the alluvium affect the observed groundwater quality. The water is suitable for irrigation and for domestic, stock, and limited industrial purposes.

The most important source of groundwater in the region is the shallow alluvial aquifer found along the Arkansas River. The alluvial deposits consist of sand and gravel which are typically highly permeable and often relatively thick. Wells yield from 20 to 400 gpm or more, and a properly built well should yield 100 gpm anywhere along this stretch of river. Terrace deposits along the Arkansas River are another favorable source of groundwater. This aquifer is defined as Class II (potential drinking water source) by the Oklahoma Department of Environmental Quality (ODEQ).

Site

Groundwater flow through the unconsolidated materials is at the base of the sediments within the coarse-grained materials; across the majority of the FMRI site it is toward the east and the Arkansas River. There is an east-west divide in the direction of groundwater flow in the northwest corner of the facility which results in radial flow to the northeast, southeast, and southwest. The hydraulic gradient across the facility is very low and varied according to the flow direction. Shallow groundwater flow across the southernmost portion of the site is toward the south, parallel to the flow direction of the river.

Groundwater within the McCurtain Shale was encountered in deep monitoring wells installed to communicate with a zone of fractured shale that produced a measurable quantity of water. (The rock core above and below this fractured sequence was dry, based on core inspection.) Groundwater in this zone of saturation was encountered under confined conditions and is separated from the overlying unconsolidated zone of saturation by approximately 30 feet of shale bedrock. The significant difference in static groundwater elevation observed between shallow monitoring wells (designed to communicate with the overlying unconsolidated material) and deep monitoring wells (designed to communicate with the shale bedrock) indicates that these sets of monitoring wells communicate with two distinct zones of saturation. Groundwater in the shale bedrock unit beneath the FMRI site has bidirectional flow: one component of flow is to the west-northwest, and the second is to the east. The flow to the northwest has a hydraulic gradient of 0.017. The hydraulic gradient of the easterly flow is 0.00565.

## 2.3 Surface Water Information

The FMRI site is in the Middle Arkansas Basin. Major tributaries in Basin One are the Verdigris and Neosho rivers. Waters of the Arkansas River at Muskogee are generally well regulated by upstream flood protection facilities on the main stem of the Arkansas River and its major tributaries. During the period of record, peak streamflow ranged from 63,000 cubic feet per second (cfs) to 384,000 cfs. Mean annual streamflow for the period of record ranged from 1,902 cfs to 42,120 cfs. The 100-year floodplain zone is approximately 517 feet msl and the maximum probable flood level is reported as 525 feet msl; the FMRI buildings and ponds are above 530 feet msl.

## 2.4 Plans and Specifications

General

The legal description for ponds 6 and 7, surface impoundments, is NW¼, SW¼, SW¼, Section 16, Township 15N, Range 19EIM, Muskogee County, Oklahoma.

Pond 6 and Pond 7

Ponds 6 and 7 are single surface impoundments centrally located at the facility (Figure 1). Each pond is clay soil lined. Pond 6 is approximately 200 feet long (North-South), 100 feet wide (East-West), and nine feet deep. Pond 6 has an estimated capacity of 1.01E6 gallons. Pond 7 is approximately 150 feet long (North-South), 250 feet wide (East-West), and seven feet deep. Pond 7 has an estimated capacity of 1.61E6 gallons.

# 3.0 Wastewater Characterization

## 3.1 Inventory of Wastewater

Pond 6 provides temporary storage of storm water, effluent from the wastewater treatment plant, and effluent from Pond 7. It is normally discharged to Outfall 001.

Pond 7 provides temporary storage of storm water, effluent from the wastewater treatment plant, and effluent from ponds 8 and 9 (F03 and F04). It is normally discharged to Pond 6 .

## 3.2 Chemical Analysis

The waters in ponds 6 and 7 were sampled in September 2007. The sampling event was completed in accordance with the Pre-Closure Sampling and Analysis Plan of April 2007 and approved by ODEQ June, 27, 2007.[2][3] The results of this sampling effort were provided to ODEQ November 2007.[4] The results satisfied Permit limits for discharge via Outfall 001. Laboratory reports for these samples have been provided previously.[4]

[2] Ronald Doumont, Penn Environmental & Remediation, to Ed Dihrberg, Industrial Permits Section, Water Quality Division, ODEQ, Pre-Closure Sampling and Analysis Plan Pond Nos. 6 and 7 FMRI, Inc. ..., April 27, 2007.

[3] Leslie Smith, Industrial Permits Section, Water Quality Division, ODEQ, to Jon Jackson, FMRI, Inc., Pre-Closure Sampling and Analysis Plan - Pond Nos. 6 and 7 FMRI, Inc. ..., June 27, 2007.

[4] Ronald Doumont, Penn Environmental & Remediation, to Ed Dihrberg, Industrial Permits Section, Water Quality Division, ODEQ, Pre-Closure Sampling and Analysis Report Pond Nos. 6 and 7 FMRI, Inc. ..., November 19, 2007.

## 4.0 Sampling, Analysis, and Monitoring Plan

### 4.1 Sampling and Analysis

Sampling and analysis of the sludge in ponds 6 and 7 were performed in accordance with the Pre-Closure Sampling and Analysis Plan referenced in Section 3.2. The analytical results for these samples are summarized in Table 1. Laboratory reports for these samples have been provided previously.[4]

Sample results for chemical parameters were compared to U.S. EPA Region 6 RCRA Human Health Medium-Specific Screening Levels. The respective screening levels are included in Table 1.

Comparison of sample results with the screening levels indicates arsenic as the only parameter with concentration exceeding the screening level.

### 4.2 Monitoring

Monitoring of groundwater is performed in accordance with the requirements of FMRI existing OPDES Permit and FMRI U.S. NRC Radioactive Material License SMB-911. Monitoring of storm water is performed in accordance with the requirements of FMRI existing OPDES Permit.

### 4.3 Sampling and Monitoring Locations

Pre-closure plan sludge sampling locations are identified Pre-Closure Sampling and Analysis Report.[4]

## 5.0 Treatment, Removal and Disposal

### 5.1 Treatment

Storm water collected in the basin during closure activities will be transferred to Pond 8 and eventually discharged to Outfall 001. This process is in accordance with the requirements and provisions of FMRI's existing OPDES permit.

No treatment of sludge or soils is anticipated in support of closure.

### 5.2 Removal

Sludge

The depth of sludge in ponds 6 and 7 is estimated as approximately one foot. The volume of sludge to be removed from ponds 6 and 7 is estimated as 40,000 cubic feet. The sludge will be transferred to ponds 8 and/or 9.

Soils

Soils removed from ponds 6 and 7 will be moved to Pond 3. The soils will be excavated and relocated using standard earth moving equipment. Protection of the environment will be those methods common to the construction industry; e.g. dust control with water, erosion and runoff control with cover, silt fence, or diversion.

The volume of soil to be removed from ponds 6 and 7 is estimated as 0.5 foot across the combined footprint, or 20,000 cubic feet.

During the pond closure additional samples will be collected to confirm that the contaminated material has been removed to satisfy a yet-to-be determined cleanup criteria for arsenic. A final sampling event will be conducted to include at least 10 locations evenly spaced over the combined footprint of the impoundments. The samples will provide that the soils satisfy the cleanup criteria for arsenic.

### 5.3 Backfill

The residual excavated surface of ponds 6 and 7 will be regraded or backfilled with existing berms. Any additional fill will consist of clean soil from on-site borrow area west of ponds 8 and 9, or off-site sources.

### 5.4 Disposal

No sludge will be disposed off-site.

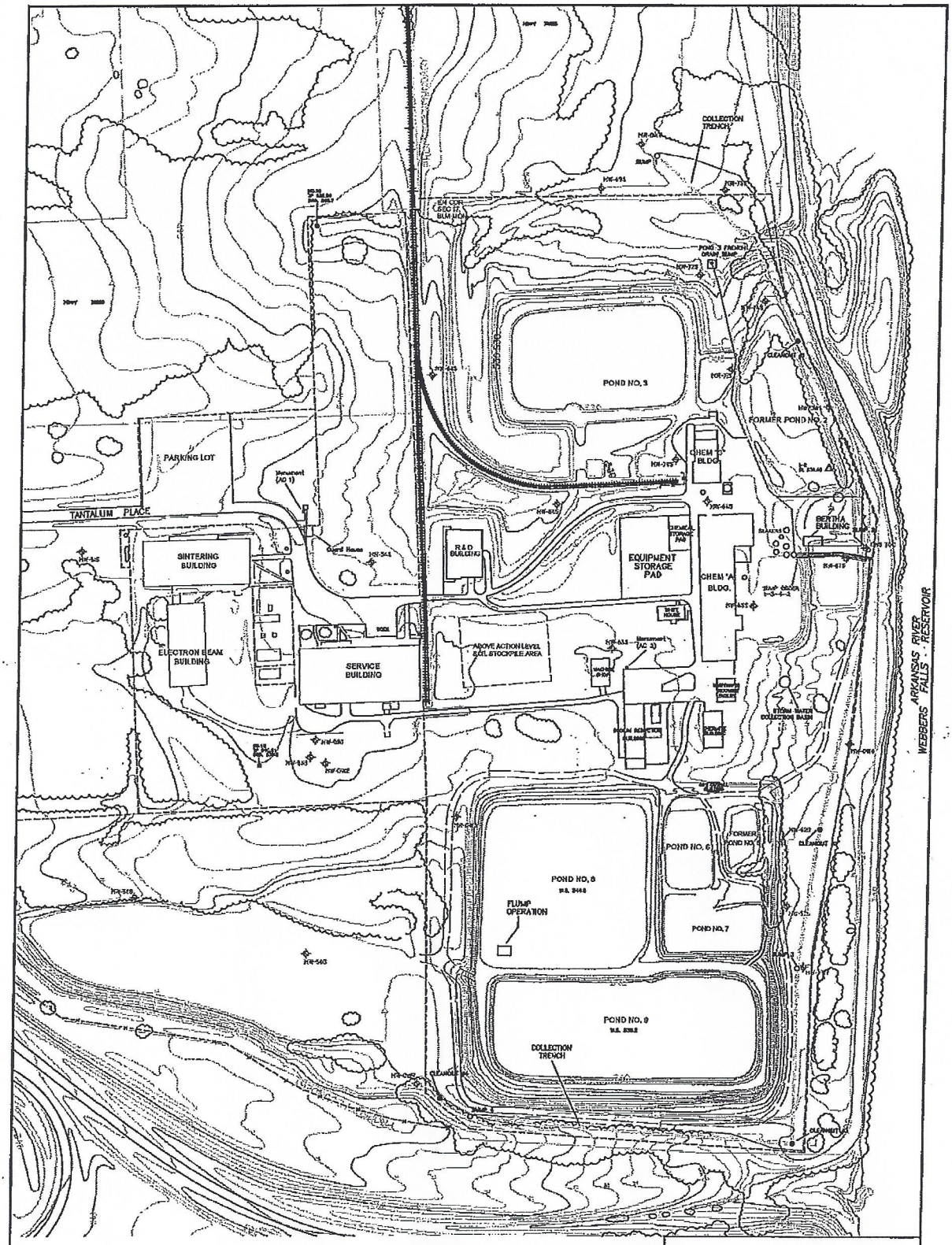
No soils will be disposed off-site.

## 6.0 Clean Closure

The closure of Sanitary Lagoon will be a clean closure in accordance with OAC 252:616-13-3(d)(7)

The FMRI facility is a complex site that is being remediated in accordance with a Decommissioning Plan approved by the U.S. Nuclear Regulatory Commission. Post-closure maintenance of the site will be conducted as described in the Decommissioning Plan. The Decommissioning Plan includes description of post-closure maintenance of the site.

## 7.0 Certification




EXPLANATION

MW-1xx MONITORING WELL

NORTH

0 200 400

Scale (ft)

CONTOUR INTERVAL = 2 ft

FMRI, Inc

Figure No. 1
General Layout

| | |
|---|---|
| Scale: | Date: 9/10/2013 |
| Project No: | County: |
| | File: FMRI-BaseMap_4r.dwg |
| | Drawn/Checked By: RHM |

# Table 1
## Analytical Results of Pre-closure Samples

| Parameter / Sample ID | | Pond 6 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | North | South | East | West | Middle | | Influent | Effluent |
| Date Sampled | | 9/11/2007 | 9/12/2007 | 9/11/2007 | 9/12/2007 | 9/12/2007 | | 9/12/2007 | 9/12/2007 |
| Sample Depth, feet | | | | | | | | | |
| **Metals** | **Screening Level*** | | | | | | | | |
| Ammonia (N), mg/kg | none | 36 | 20 | 36 | 35 | 11 | | 19 | 26 |
| Arsenic, mg/kg | 2.4 | 6 | 4 | 4 | 3 | 36 | | 4 | 9 |
| Cadmium, mg/kg | 800 | 2 | 2 | 2 | 2 | 2 | | 2 | 2 |
| Chromium, mg/kg | 1400 | 386 | 198 | 124 | 135 | 552 | | 108 | 148 |
| Columbium, mg/kg | none | 439 | 359 | 348 | 190 | 240 | | 170 | 128 |
| Copper, mg/kg | 41000 | 22 | 18 | 19 | 23 | 48 | | 14 | 30 |
| Fluoride, mg/kg | 41000 | 14400 | 22400 | 10700 | 8300 | 29500 | | 21900 | 18500 |
| Lead, mg/kg | 800 | 31 | 26 | 27 | 20 | 201 | | 20 | 52 |
| Nickel, mg/kg | 20000 | 44 | 23 | 27 | 28 | 77 | | 16 | 43 |
| Nitrate (N) | 1600000 | 20 | 14 | 16 | 10 | 34 | | 10 | 16 |
| Tantalum, mg/kg | none | 9 | 595 | 537 | 4 | 8 | | 3 | 3 |
| Zinc, mg/kg | 310000 | 63 | 42 | 39 | 37 | 48 | | 57 | 45 |
| pH, SI | none | 7.73 | 7.98 | 7.78 | 7.68 | 7.57 | | 7.58 | 7.59 |
| VOCs | n/a | below detection limit | | | | | | | |

| Parameter / Sample ID | | Pond 7 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | North | South | East | West | Middle | Influent 8 | Influent 9 | Effluent |
| Date Sampled | | 9/11/2007 | 9/11/2007 | 9/11/2007 | 9/11/2007 | 9/12/2007 | 9/12/2007 | 9/11/2007 | 9/11/2007 |
| Sample Depth, feet | | | | | | | | | |
| **Metals** | **Screening Level*** | | | | | | | | |
| Ammonia (N), mg/kg | none | 6 | 29 | 13 | 10 | 16 | BDL | 16 | 13 |
| Arsenic, mg/kg | 2.4 | 19 | 9 | 16 | 20 | 54 | 24 | 19 | 15 |
| Cadmium, mg/kg | 800 | 2 | 2 | 1 | 3 | 3 | 3 | 3 | 3 |
| Chromium, mg/kg | 1400 | 295 | 181 | 88 | 523 | 613 | 1260 | 739 | 621 |
| Columbium, mg/kg | none | 10 | 777 | 737 | 798 | 7810 | 2800 | 6730 | 4860 |
| Copper, mg/kg | 41000 | 43 | 24 | 13 | 41 | 49 | 39 | 41 | 32 |
| Fluoride, mg/kg | 41000 | 17900 | 15800 | 16600 | 41200 | 32600 | 3730 | 32300 | 30000 |
| Lead, mg/kg | 800 | 73 | 45 | 52 | 228 | 448 | 91 | 143 | 123 |
| Nickel, mg/kg | 20000 | 28 | 30 | 16 | 51 | 68 | 57 | 88 | 43 |
| Nitrate (N) | 1600000 | 84 | 26 | 249 | 70 | 59 | 73 | 44 | 52 |
| Tantalum, mg/kg | none | 10 | 101 | 79 | 474 | 5370 | 1560 | 2380 | 1090 |
| Zinc, mg/kg | 310000 | 69 | 37 | 36 | 40 | 40 | 94 | 51 | 43 |
| pH, SI | none | 7.66 | 8.02 | 10.10 | 7.93 | 7.93 | 7.50 | 7.96 | 7.68 |
| VOCs | n/a | below detection limit | | | | | | | |

* U.S. EPA, Region 6, Regional Screening Levels, Industrial Soil Supporting, Traditional Table, May 2013.