FIVE-YEAR REVIEW REPORT FOR RYELAND ROAD ARSENIC SUPERFUND SITE BERKS COUNTY, PENNSYLVANIA

September 2016

Prepared By:
United States Environmental Protection Agency
Region 3
Philadelphia, Pennsylvania

SEP 21 2016

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Date

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LIST OF ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirement
bgs	Below Ground Surface
BTAG	Biological Technical Assistance Group
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
ESI	Expanded Site Investigation
FYR	Five-Year Review
GMUC	Groundwater Migration Under Control
GPRA	Government Performance Results Act
HEPR	Human Exposure Controlled and Protective Remedy in Place
IC	Institutional Control
MCL	Maximum Contaminant Level
mg/kg	Milligram per Kilogram
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
NSA	Northern Source Area
O&M	Operation and Maintenance
OU	Operable Unit
PADEP	Pennsylvania Department of Environmental Protection
PRP	Potentially Responsible Party
RA	Remedial Action
RAO	Remedial Action Objective
RAU	Ready for Anticipated Reuse
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager
SPLP	Synthetic Precipitation Leaching Procedure
SSA	Southern Source Area
TBC	To-Be-Considered
USACE	United States Army Corps of Engineers
VFW	Veterans of Foreign Wars
XRF	X-ray Fluorescence
µg/L	Microgram per Liter

EXECUTIVE SUMMARY

The Ryeland Road Arsenic Superfund Site (the Site) is located 0.75 miles southeast of the town of Womelsdorf, in Heidelberg Township, Berks County, Pennsylvania (Figure 1). This is the second Five-Year Review and the triggering action is the last Five-Year Review completed on September 29, 2011.

Operations at a former manufacturing plant resulted in the arsenic contamination of soil, sediment, surface water, and groundwater at the Site.

In 2006, EPA issued a Record of Decision (ROD) to address contaminated soil and source material at the Site. The remedy included excavation and off-site disposal of contaminated soil, sediment, and brick piles; the permanent relocation of three families; restoration of a wetland area; and phytoremediation of contaminated sediment. The remedy was completed in 2009.

The remedy is currently protective of human health and the environment because contaminated soil and source material was removed to the extent practicable, ongoing monitoring is being performed, and exposure to remaining contamination is being controlled through the use of Institutional Controls (ICs). However, in order for the remedy to be protective in the long-term, contaminated groundwater which migrates into surface water, shallow soil, and sediment via seeps and springs will need to be addressed as part of a future remedy.

Government Performance and Results Act (GPRA) Measure Review

As part of this FYR, the GPRA Measures have also been reviewed. The GPRA Measures and their status are provided as follows:

Environmental Indicators
Human Health: Current Human Exposure under Control (HEUC)
Groundwater Migration: Groundwater Migration under Control (GMUC)

Sitewide Ready for Anticipated Use (SWRAU)
The Site has not achieved Sitewide Ready for Anticipated Use (SWRAU).

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Ryeland Road Arsenic Superfund Site		
EPA ID: PAD981033459		
Region: 3	**State:** PA	**City/County:** Heidelberg Township, Berks County

SITE STATUS	
NPL Status: Final	
Multiple OUs? Yes	**Has the site achieved construction completion?** No

REVIEW STATUS
Lead agency: EPA **If "Other Federal Agency" selected above, enter Agency name:** Click here to enter text.
Author name: Sibyl Dinkins, with additional support provided by Skeo Solutions
Author affiliation: EPA Region 3
Review period: November 2015 – September 2016
Date of site inspection: November 19, 2015
Type of review: Statutory
Review number: 2
Triggering action date: September 29, 2011
Due date *(five years after triggering action date)*: September 29, 2016

FIVE-YEAR REVIEW SUMMARY FORM (CONTINUED)

Issues/Recommendations				
Issues and Recommendations Identified in the Five-Year Review:				
OU(s): 1	**Issue Category: Remedy Performance**			
	Issue: Contaminated soil and waste material beneath a portion of the rail road embankment leaches arsenic into shallow groundwater which moves into surface water and sediment via seeps and springs. The excavation of all waste material under the embankment was not performed during the remedy due to concerns about potentially damaging the structural support for the rail line.			
	Recommendation: Evaluate potential remedial alternatives to address remaining contaminated subsurface soil and waste material as part of the remedy for groundwater (OU2).			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	10/01/2020
OU(s): 1	**Issue Category: Remedy Performance**			
	Issue: Arsenic concentrations are present in shallow soil and sediment in the spring-fed creek, at concentrations exceeding the site performance standards as a result of groundwater seeps.			
	Recommendation: Continue monitoring areas in and along the spring-fed creek.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	10/01/2020
OU(s): 1	**Issue Category: Institutional Controls**			
	Issue: Contaminated subsurface soil is under the rail line embankment, near MW3 well cluster, and in spring-fed creek sediments.			
	Recommendation: Determine if additional ICs are needed to prevent long-term exposure to contaminated subsurface soil and sediment.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	10/01/2017

Protectiveness Statement(s)		
Operable Unit: OU-1	*Protectiveness Determination:* Short-term Protective	*Addendum Due Date (if applicable):* Click here to enter date.

Protectiveness Statement:

The remedy is currently protective of human health and the environment because contaminated soil and source material (OU1) was removed to the extent practicable, ongoing monitoring is being performed, and exposure to remaining contamination is being controlled through the use of ICs. However, in order for the OU1 remedy to be protective in the long-term, contaminated groundwater which migrates into shallow soil, and sediment via seeps and springs in the creek will need to be addressed as part of the OU2 remedy. Remedial alternatives to address contamination remaining in place in subsurface soil (in the railroad embankment and SSA near MW-3), and sediments (in the spring-fed creek) should also be evaluated as part of the OU2 remedy. In the meantime, existing ICs will remain in place to prevent exposure to contaminated soil, sediment, and groundwater as long as needed to ensure protectiveness of the remedy.

Second Five-Year Review Report
for
Ryeland Road Arsenic Superfund Site

1.0 Introduction

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy will continue to be protective of human health and the environment. FYR reports document FYR methods, findings and conclusions. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The United States Environmental Protection Agency (EPA) prepares FYRs pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Section 121 and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA Section 121 states:

> If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each 5 years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.

EPA interpreted this requirement further in the NCP, 40 Code of Federal Regulations (CFR) Section 300.430(f)(4)(ii), which states:

> If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after initiation of the selected remedial action.

EPA has conducted a Five-Year Review of the remedial actions implemented at the Ryeland Road Superfund Site in Heidelberg Township, Berks County, Pennsylvania. EPA conducted this FYR from November 2015 to September 2016. EPA is the lead agency for developing and implementing the remedy for the Superfund-financed cleanup at the Site. The Pennsylvania Department of Environmental Protection (PADEP), as the support agency representing the Commonwealth of Pennsylvania, has reviewed all supporting documentation and provided input to EPA during the FYR process.

This is the second FYR for the Site. The triggering action for this statutory review is the previous FYR which is dated September 29, 2011. The FYR is required by statute because hazardous

substances, pollutants or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure.

2.0 Site Chronology

Table 1 lists the dates of important events for the Site.

Table 1: Chronology of Site Events

Event	Date
Waste disposal began on the Site property from the manufacture of pesticides, fungicides, insecticides, paints and varnishes	1927
Fire destroyed manufacturing plant	1940
Tobacco crushing operations performed at former manufacturing location	1940-1942
Property was vacant	1942-1970s
Residential structures built on the property	late 1970s
PADEP conducted site investigations	1983-1985
Heidelberg Township requested EPA assistance after discovering grayish white material in the intermittent tributary	1985
EPA conducted Preliminary Assessment; initiated removal action for contaminated soil	
EPA performed additional removal action for contaminated soil	1989
EPA notified of grayish white material discovered during excavation for new residential construction at Southern Source Area	July 2001
EPA conducted removal actions to address contaminated soil and waste material	2001-2002
EPA conducted Expanded Site Investigation	2002
EPA proposed the Site for listing on the National Priorities List (NPL)	March 8, 2004
EPA listed the Site on the NPL	July 22, 2004
EPA conducted Remedial Investigation and Feasibility Study	2004-2005
EPA signed Record of Decision (ROD) for OU1	January 11, 2006
EPA initiated remedial action to implement OU1 ROD	
EPA purchased residential properties, provided relocation assistance	2006
EPA signed ROD Amendment	May 2, 2008
EPA signed Explanation of Significant Differences	September 30, 2008
EPA initiated phytoremediation	May 2009
EPA completed excavation of contaminated soil and sediment portion of OU1 ROD	July 2009
EPA began Groundwater Remedial Investigation (OU2)	August 2009
Properties transferred to Heidelberg Township	October 2010
EPA implemented institutional controls specified in OU1 ROD	
EPA signed first FYR	September 29, 2011
EPA completed remedial action completion report for OU1	August 2012
EPA conducted Supplemental Remedial Investigation for Groundwater (OU2)	July 2014
EPA discontinued phytoremediation pending selection of a final OU2 remedy	October 2014

3.0 Background

3.1 Physical Characteristics

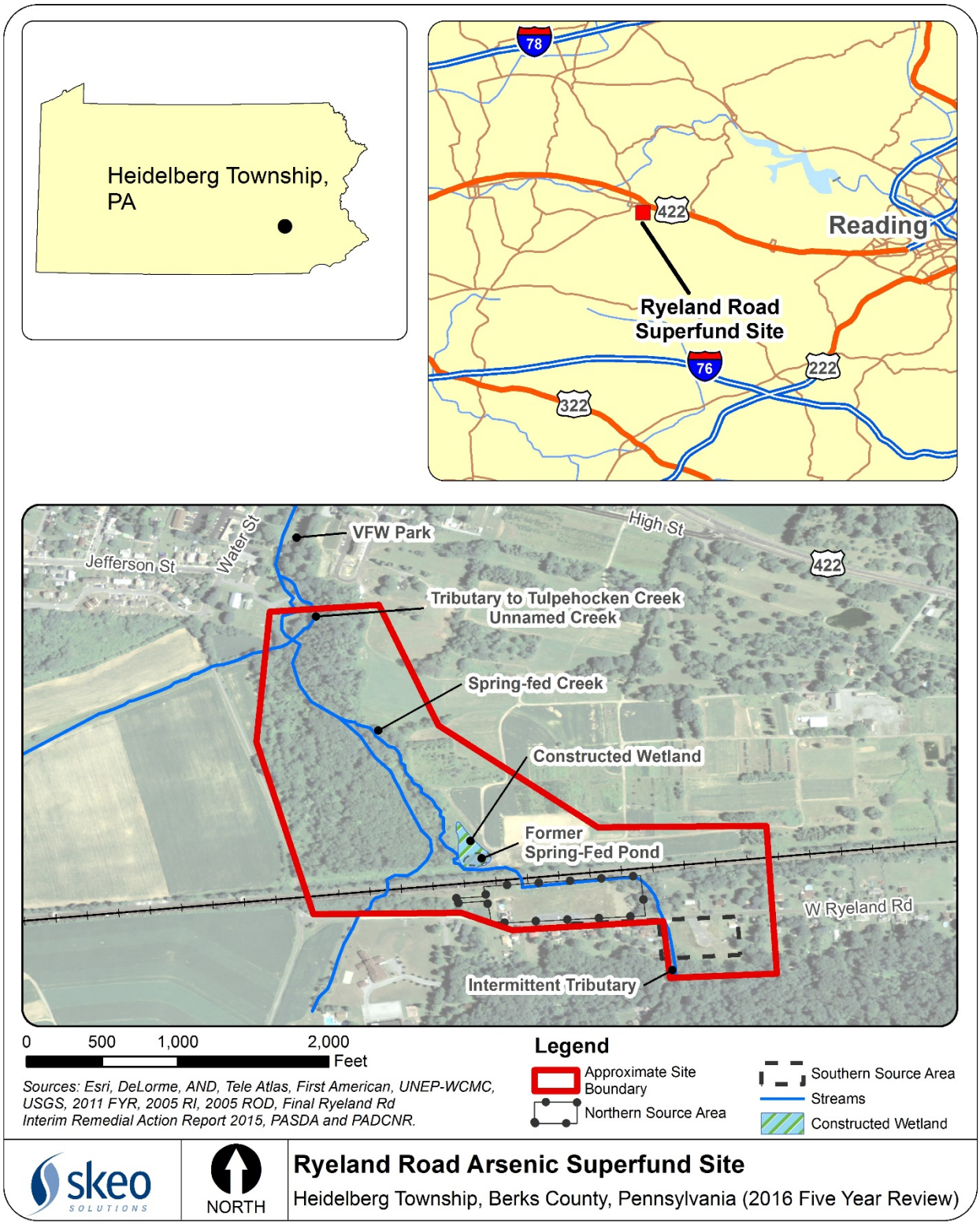
The Ryeland Road Superfund Site is located approximately 0.75 miles southeast of the town of Womelsdorf, in Heidelberg Township, Berks County, Pennsylvania in a rural, agricultural, and residential area (Figure 1).

The Site was separated into two source areas on the north and south sides of West Ryeland Road referred to as the Northern Source Area (NSA) and the Southern Source Area (SSA). The NSA includes approximately five acres and is the location of the former chemical plant. The SSA includes approximately 2.7 acres and was used by the former plant as the main waste disposal area. Additional areas of the Site include: an intermittent tributary that flows through the NSA and SSA; agricultural property including the former plant nursery, a spring-fed creek, a forested area, and an unnamed tributary to the Tulpehocken Creek which flows through the Veterans of Foreign Wars property.

Areas of the Site that were remediated from 2006 to 2009 include: the NSA; SSA; portions of the former plant nursery; and a former spring-fed pond, where EPA constructed a wetland.

Shallow groundwater beneath the Site migrates to the northwest and follows the flow of the intermittent tributary and spring-fed creek (Figure 1). Contaminated shallow groundwater discharges into the spring-fed creek through seeps and springs.

Figure 1: Site Location Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site

3.2 Land and Resource Use

The former manufacturing plant disposed of waste material from 1927 until it was destroyed by a fire in 1940. After the fire, a tobacco crushing operation used the property until 1942. The property was vacant from 1942 until the late 1970s, when individual lots were sold for residential development. Current land use at the Site is residential, agricultural, and recreational. Sources of drinking water in the immediate vicinity of the Site include residential wells and a nearby spring called Bethany spring.

3.3 History of Contamination

The former chemical plant manufactured pesticides, fungicides, insecticides, paint and varnishes. Byproducts from plant operations such as lead arsenate, calcium arsenate and copper acetoarsenate were disposed at the NSA and SSA.

3.4 Initial Response

In 1983, in response to complaints from local residents, PADEP (formerly Pennsylvania Department of Environmental Resources), conducted the first environmental investigations at the Site. In 1984 and 1985, PADEP conducted additional investigations at the Site which confirmed the presence of contamination in soil, sediment, and waste pile samples. In 1985, Heidelberg Township requested EPA's assistance after uncovering grayish-white waste material while excavating a section of the intermittent tributary along the northern boundary of the NSA.

Between 1985 and 2002, EPA removed over 8,300 tons of contaminated soil and waste material from NSA and SSA, waste piles at the Site, and three residential properties during multiple removal actions.

EPA collected water samples from nearby residences with private wells for potable use. Results indicated copper and lead above background levels. EPA provided water filtration systems, but later determined the elevated metals were likely due to plumbing materials and not related to contaminants at the Site.

EPA proposed the Site for listing on the Superfund Program's National Priorities List (NPL) in March 2004 and added the Site to the NPL in July 2004.

3.5 Basis for Taking Action

EPA began a Remedial Investigation/Feasibility Study (RI/FS) in May 2004. The RI revealed elevated metals concentrations, including arsenic, copper, and lead, in soil, sediment, surface water, and groundwater at the Site. The most contaminated areas were in soil in the NSA and SSA from 2 to 15 feet below ground surface (bgs). Arsenic concentrations over 100,000 milligrams/kilogram (mg/kg) were identified in the NSA.

EPA conducted human health and ecological risk assessments for the RI. The human health risk assessment (HHRA) indicated potential risk from exposure to contaminated soil, shallow groundwater, and sediment via dermal contact and ingestion. The ecological risk assessment (ERA) indicated the greatest risk posed by Site contaminants in soil and sediment was to insectivorous birds and mammals, and sediment invertebrates. Surface water was not found to pose a threat to human health or the environment. Therefore, aquatic receptors were not found to be at risk from metals attributable to the Site. Arsenic was found to be the primary risk driver.

Table 2 lists notable areas of contamination identified during the RI.

Table 2: Contaminated Media Identified in Remedial Investigation

Media	Location of Contamination
Soil	• NSA • SSA • Adjacent residential properties • Brick piles • Plant nursery (former)
Surface Water	• Intermittent tributary on north side of NSA • Spring-fed creek • Unnamed Tributary to the Tulpehocken Creek
Sediment	• Spring-fed creek • Spring-fed pond (former) • Unnamed tributary to the Tulpehocken Creek • Ponds at the VFW Park
Groundwater	• Overburden groundwater downgradient of NSA • Springs and seeps in spring-fed creek and former spring-fed creek

Current Groundwater RI

EPA deferred selection of a remedial action (RA) for groundwater, which is Operable Unit 2 (OU2), until completion of the remedial activities for OU1 and further investigation of groundwater at the Site.

4.0 Remedial Actions

In accordance with CERCLA and the NCP, the overriding goals for any RA are protection of human health and the environment and compliance with applicable or relevant and appropriate requirements (ARARs). ARARs for this Site are further described in Section 6.3. A number of remedial alternatives were considered for OU1 at the Site, and final selection was made based on an evaluation of each alternative against nine evaluation criteria that are specified in Section 300.430(e)(9)(iii) of the NCP.

4.1 Remedy Selection

On January 11, 2006, EPA issued a ROD for OU1 to address contaminated soil, sediment, surface water, and brick piles and included the following:

- Permanent relocation of three households and temporary relocation of additional families;
- Excavation and off-site disposal of approximately 94,000 tons of contaminated soil;
- Off-site stabilization of soils that exhibit the characteristic of toxicity using the Toxicity Characteristic Leaching Procedure;
- Excavation and off-site disposal of contaminated brick piles;
- Restoration of excavated areas with clean fill, topsoil, wildflowers and/or grasses;
- IC's such as enforceable orders, deed notices, easements and/or restrictive covenants to prevent disturbing any contaminated soil beneath the railroad embankment;
- Excavation of approximately 4,200 tons of contaminated sediment;
- Restoration of a wetland area to filter out sediment and metals before they flow into a spring-fed creek;
- Phytoremediation using ferns to reduce arsenic in sediment bordering the spring-fed creek and residual arsenic in shallow soil and groundwater near seeps and springs; and
- Hydraulic control using hybrid poplars to reduce the lateral migration of shallow groundwater.

Table 3 summarizes the remedial action objectives (RAOs) for the OU1 cleanup.

Table 3: RAOs for OU1 Cleanup

Media	RAO
Soil	• Prevent current and future direct contact to exposed soil and bricks posing unacceptable human health risks. • Prevent future releases to groundwater to minimize the migration of contaminants into surface water and sediment. • Minimize further degradation of groundwater quality by reducing sources of contaminants and prevent migration of contaminants via leaching that results in groundwater contamination in excess of respective Maximum Contaminant Levels (MCLs) established pursuant to the Safe Drinking Water Act. • Comply with site-specific ARARs including, but not limited to the Resource Conservation and Recovery Act (RCRA) Land Disposal Restrictions.
Sediment and Stream-fed Pond	• Remove sediment that may pose a direct contact threat to human health. • Protect sensitive environments (wetlands and streams) from adverse ecological risks that result from exposure to contaminated sediment. • Remove sediment that contributes to contaminant loading of nearby streams and surface water bodies.

EPA signed a ROD Amendment in May 2008 and an Explanation of Significant Differences (ESD) in September 2008. Table 4 summarizes the changes from these two decision documents. Table 5 summarizes the current cleanup goals for OU1 based on the 2006 ROD, 2008 ROD Amendment, and 2008 ESD.

Table 4: Summary of Remedy Modifications in the 2008 ROD Amendment and 2008 ESD

Decision Document	Change to Selected Remedy
2008 ROD Amendment	• Eliminated the requirement to excavate soil with trace levels of arsenic (between 12 and 22 mg/kg) located at or below 8 feet of clean soil. • Eliminated the requirement to excavate contaminated sediment from the pond at the former plant nursery. Instead, the sediment would be covered with about 9 feet of clean fill and topsoil to create a new wetland area. • Included the installation of new potable water lines to homes along West Ryeland Road. • Eliminated the requirement to plant the poplar trees.
2008 ESD	• The addition of a stabilizing agent to the residual contamination located below the railroad embankment to further reduce the potential impact to groundwater from the contaminated soil; and • The use of 32 mg/kg as the cleanup standard for arsenic in shallow surface soil (see Table 5) directly surrounding established trees and structural features, such as septic systems and building foundations, on residential properties.

Table 5: Performance Standards, 2006 ROD and 2008 ESD

Media and Land-Use		COC	Performance Standard (mg/kg)
Soil	Residential	Arsenic	12[a]
	Residential	Lead	400[b]
	Residential, shallow surface soil directly surrounding established trees and structures	Arsenic	32[c]
	Non-residential	Arsenic	53[d]
Sediment	Intermittent tributary	Arsenic	12
	Spring-fed pond (former)	Arsenic	53[e]
	VFW Park	Arsenic	46[f]
	Spring-fed creek	Arsenic	140[g]
	Site-wide	Zinc	200[h]

Notes:

a. To depth of 15 feet bgs or the depth that bedrock or groundwater is encountered; PADEP Land Recycling Program (Act 2) Medium-Specific Concentrations for soil
b. To a depth of 15 feet bgs or the depth that bedrock or groundwater is encountered; EPA Revised Interim Soil Lead Guidance
c. ESD 2008; Site-Specific Performance Standard developed by EPA for shallow soil surrounding established trees and structures
d. To depth of 2 feet bgs or the depth that bedrock or groundwater is encountered; PADEP Act 2 Medium-Specific Concentrations in soil
e. The 2008 ROD Amendment eliminated the requirement to excavate contaminated sediment from the pond at the former nursery, however the performance standard was not removed from the final remedy
f. Site-Specific Performance Standard developed by EPA to prevent unacceptable risks from consuming watercress (2006 ROD)
g. Site-Specific Performance Standard developed by EPA to protect human health based on protecting trespasser/recreational child from noncarcinogenic risks (2006 ROD)
h. Site-Specific Performance Standard developed by EPA to protect ecological receptors (2006 ROD)

bgs = below ground surface
mg/kg = milligrams per kilogram

4.2 Remedy Implementation

EPA implemented the OU1 remedy under three main components. A brief summary of each is provided below.

Property Acquisition and Resident Relocation

EPA acquired four properties in 2006 with assistance from the U.S. Army Corps of Engineers Real Estate Division. Three of the properties, located in the NSA, were demolished and the residents were permanently relocated. After completion of the RA in 2009, Heidelberg Township assumed possession of the four properties, including the three former residences and the former

plant property. In 2010, deeds covering the properties were registered with the Berks County Public Records Office.

Demolition, Excavation, and Restoration Activities

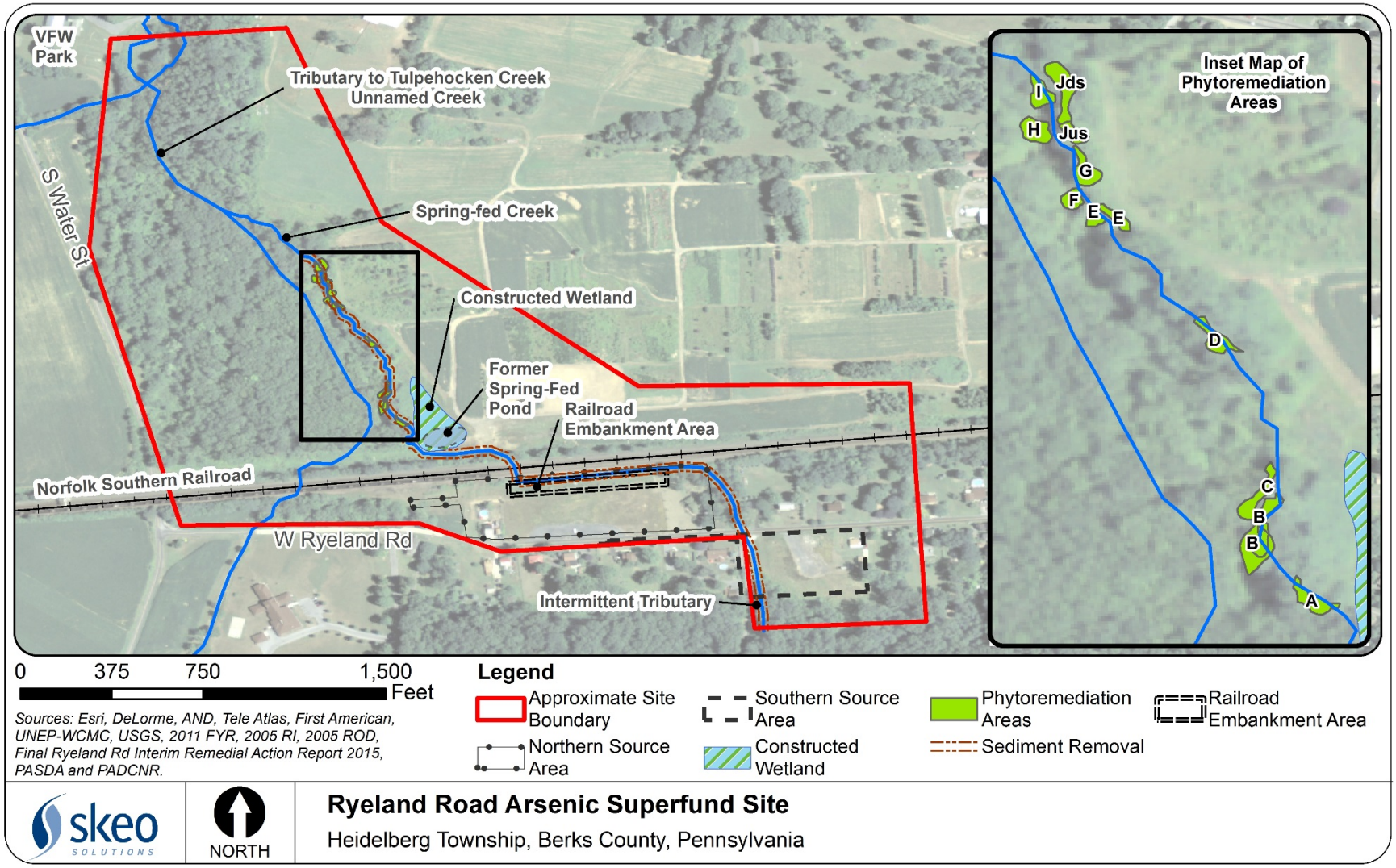
From 2006-2009, approximately 140,000 tons of contaminated soil, sediment, brick piles and other debris were removed from the Site. The following RAs were conducted at the Site:

- Demolition of three residential properties and excavation of approximately 115,000 tons of contaminated soil. Clean backfill and topsoil were compacted and brought to grade;
- Approximately 25,000 tons of contaminated soil, brick piles, and sediment were excavated from the SSA;
- Removal of contaminated surface soil from the railroad embankment;
- Replacement of a deteriorating water line extending from a natural groundwater spring to the eastern edge of the NSA;
- Removal of contaminated soil from residential properties near the NSA;
- Excavation of contaminated soil and sediment at the former plant nursery, spring-fed pond, and the unnamed tributary of the Tulpehocken creek;
- Construction of a wetland in the area of the former spring-fed pond to filter out sediment and metals. The spring that had served as the primary water source for the pond was diverted to act as the headwater source for the created wetland;
- Excavation of contaminated sediment that had accumulated in a network of constructed ponds at the VFW Park;
- Excavation of two areas of arsenic- and lead-contaminated soil from underneath West Ryeland Road, next to the NSA;
- Excavated areas were backfilled with clean soil and brought to grade;
- Contaminated soil and sediment was disposed of in an approved off-site landfill; and
- Restoration activities were completed in July 2009 and details of the RAs are provided in the 2012 Remedial Action Completion Report.

Phytoremediation of Shallow Soil and Sediment at the Spring-fed Creek

In 2007, EPA conducted a study to determine if phytoremediation, a method of using plants to remove contaminants from the environment, would be effective at the Site. From 2009 through 2014, Chinese brake ferns (*Pteris vittata)* were planted and harvested in the forested wetland next to the spring-fed creek (Figure 2). The results of the study proved to be successful; however, 2014 results showed a decrease in uptake of arsenic by the plants. In 2015, EPA determined that the phytoremediation program would be unable to achieve performance standards in the spring-fed creek soil and sediment due to continuing impact from groundwater seeps. This portion of the remedy may be resumed after contaminated groundwater is addressed in a future remedy. The details of the study are provided in Section 6.4 of this report.

Figure 2: Detailed Site Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

4.3 Operation and Maintenance (O&M)

The remedy consisted of the removal of contaminated soil and there is no operating treatment system at this time. EPA conducts annual sampling activities for shallow soil, sediment, and groundwater.

5.0 Progress Since the Last Five-Year Review

The protectiveness statement from the previous FYR for the Site stated the following:

The remedy at OU1 is protective of human health and the environment in the short term, because exposure pathways that could result in unacceptable risks are being controlled. In order for the remedy to be protective in the long-term, additional sediment sampling in the spring-fed creek and VFW park needs to be conducted. Also, sediment samples collected from the fern plots, as well as the spring-fed creek and VFW park, need to be analyzed for both arsenic and zinc concentrations.

The previous FYR included two issues and recommendations. Table 6 summarizes each recommendation and its current status below.

Table 6: Progress on Recommendations from the 2011 FYR

Recommendation	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
Conduct sediment sampling along the stream bed of the spring-fed creek and depositional areas in the VFW park to determine if storm-related deposition of contaminated sediment occurred.	EPA	12/30/11	-----COMPLETED--- On October 24, 2011, EPA collected six sediment samples from depositional areas in the spring-fed creek and VFW park. The results of this sampling did not show significant impact to sediment from storm-related deposition.	10/24/11
EPA will add zinc to the list of analytes for the 2011 post-harvest confirmation soil sampling event.	EPA	12/30/11	----COMPLETED---- EPA collected post-harvest, shallow soil samples October 2011 and analyzed samples for target analyte list metals, including zinc. All zinc concentrations were below 200 mg/kg (ROD performance standard for sitewide sediment).	10/24/11

6.0 Five-Year Review Process

6.1 Administrative Components

EPA initiated the FYR in November 2015 and completed it in September 2016. Remedial Project Manager (RPM) Sibyl Dinkins led the EPA Site review team, which also included RPM Brad White, Community Involvement Coordinator (CIC) Larry Johnson, Biological Technical

Assistance Group (BTAG) member Bruce Pluta, Toxicologist Jeff Tuttle, PADEP Project Manager Larry Smith, and EPA contractors from EA Engineering and Skeo Solutions.

6.2 Community Involvement

On June 30, 2016, EPA published a public notice in *The Reading Eagle* newspaper announcing the commencement of the FYR for the Site, providing contact information for RPM Sibyl Dinkins and CIC Larry Johnson, and inviting community participation. The press notice is available in Appendix B. To date, no one contacted EPA as a result of the advertisement.

EPA will make the final FYR Report available to the public. EPA will place copies of the document in the designated Site repository located at the Womelsdorf Public Library at 203 West High Street, Womelsdorf, PA 19567.

6.3 Document Review

This FYR included a review of relevant site-related documents, including the ROD, ROD Amendment, ESD, RI, Supplemental RI, FS, RA completion reports, and recent monitoring data. Appendix A provides a complete list of the documents reviewed.

ARARs/Performance Standards

CERCLA Section 121(d)(1) requires that Superfund RAs attain "a degree of cleanup of hazardous substance, pollutants, and contaminants released into the environment and of control of further release at a minimum which assures protection of human health and the environment." The RA must achieve a level of cleanup that complies with ARARs. A complete list of ARARs for the Site are provided in the ROD. Performance standards were developed to address unacceptable risks posed by the Site and to comply with ARARs and are summarized below.

Soil

The performance standards for arsenic in soil shown in Table 5 above are based on the PADEP Land Recycling Program (Act 2) Medium-Specific Concentrations. There have been no changes in these standards since the 2006 ROD. The lead performance standard is from the EPA Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. This standard is currently the same as the 2006 ROD.

Sediment

The performance standards for arsenic and zinc in sediment shown in Table 5 above are based on the PADEP Land Recycling Program (Act 2) Medium-Specific Concentrations. There have been no changes in these standards since the 2006 ROD.

Surface Water

No site-specific performance standards or RAOs were established for arsenic in surface water in the ROD. However, historical arsenic levels have been compared to EPA's National Recommended Water Quality Criteria (NRWQC) of 150 ug/L for the protection of aquatic life.

Institutional Control Review

In 2010, as described in Section 4.2 above, three properties on the NSA and one property on the SSA were transferred to Heidelberg Township. The deeds for these properties include environmental covenants which restrict use of the railroad embankment in the NSA, and the potable use of groundwater at the four properties due to the presence of arsenic in groundwater above the MCL of 10 ug/L. The properties with ICs are shown in Figure 3.

A portion of the former plant nursery property that includes the contaminated sediment has been designated as an agricultural conservation easement under the Pennsylvania Agricultural Conservation Easement Purchase Program (Figure 3). The easement prevents development or improvement of the land for any purpose other than agricultural development. Berks County recorded the easement on June 18, 2003, before EPA signed the ROD. Future use of this part of the property is considered non-residential. Table 7 provides a list of the deed documents located at the Berks County Public Records Office pertaining to the Site. Table 8 lists the ICs associated with the Site.

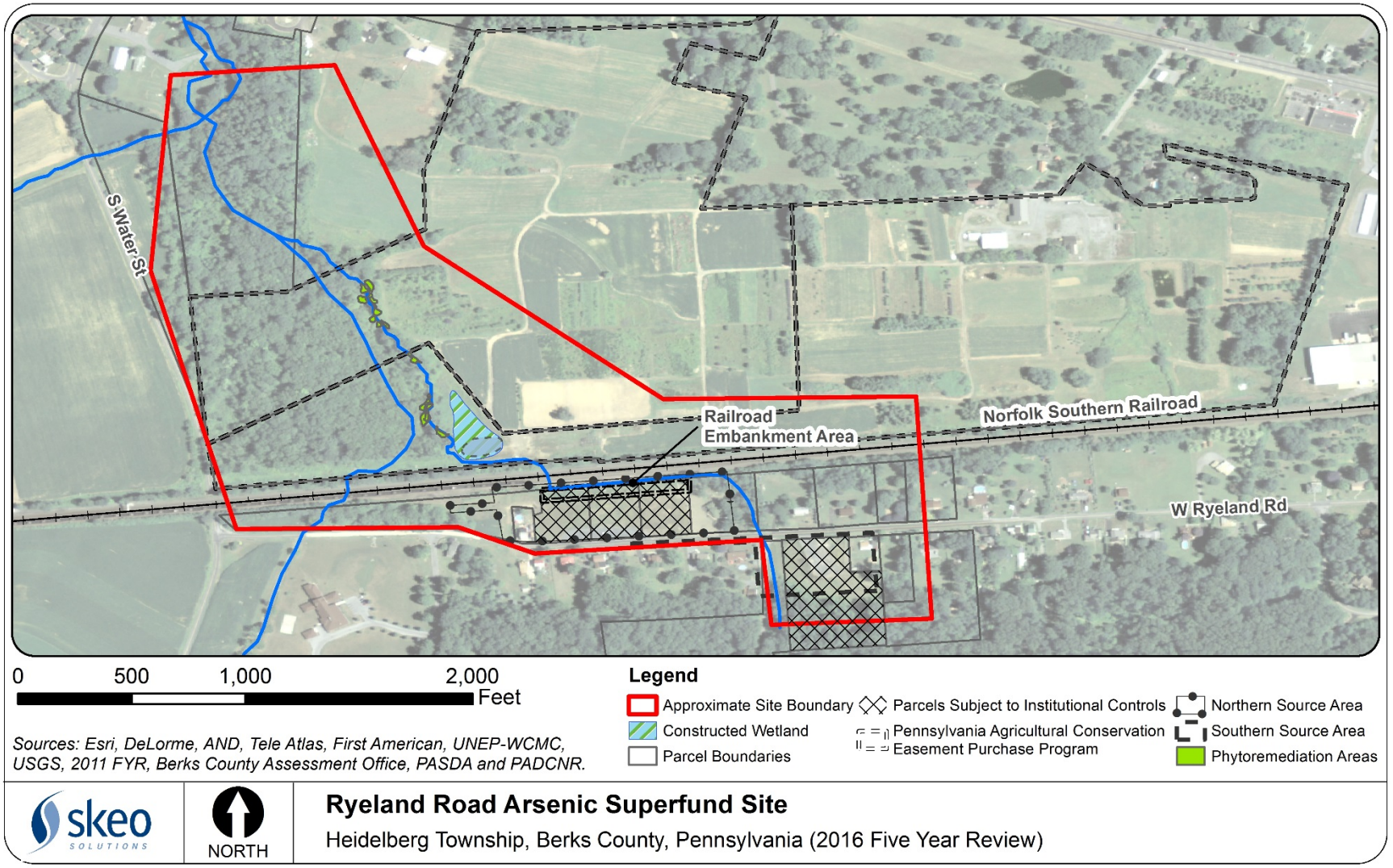
Table 7: Deed Documents from Berks County Public Records Office

Date	Type of Document	Description	Book #	Page #
10/20/2010	Deed	Transfer of deed from US EPA to Heidelberg Township – 74 West Ryeland Road, Map Number 17	5051	1018
10/20/2010	Deed	Transfer of deed from US EPA to Heidelberg Township – 59 West Ryeland Road, Map Number 8	5051	1011
10/20/2010	Deed	Transfer of deed from US EPA to Heidelberg Township – 63 West Ryeland Road, Map Number 9	5051	1025
10/20/2010	Deed	Transfer of deed from US EPA to Heidelberg Township – 67 West Ryeland Road, Map Number 10	5051	1032
7/11/2003	Deed of Easement	Transfer from Farr Nursery and Landscape Company to Commonwealth of PA and County of Berks, in joint ownership pursuant to the Agricultural Security Law (Map Numbers 4 and 5)	3806	1031

Table 8: Institutional Control Summary Table

Media	ICs Needed	ICs Called for in the Decision Documents	Impacted Areas	IC Objective	Instrument in Place
Soil (OU1)	Yes	Yes	NSA	Restrict use of railroad embankment	Environmental Covenant in Deed prohibits the development of the railroad embankment area for residential or agricultural purposes, and prohibits digging and other types of earth-moving activities without EPA written approval.
Sediment (OU1)	To be determined	No	Former Nursery	Restrict use of land containing impacted sediment along the spring-fed creek	Conservation easement prevents development or improvement of the land for any purpose other than agricultural development.
Groundwater (OU2)	Yes	Yes	NSA	Restrict use of impacted groundwater	Environmental Covenant in Deed prohibits the use of groundwater beneath the properties for any purpose. The properties cannot be used in any way that interferes with wells installed by EPA or PADEP.

Figure 3: Institutional Control Base Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

6.4 Data Review

Data collected since the 2011 FYR is provided in the Final Supplemental RI dated July 2014, and annual Final Interim Remedial Action Reports dated from 2012 through 2016. A summary of these reports is provided below.

Final Supplemental RI Report (July 2014)

The Supplemental RI expanded on the 2005 RI by collecting and evaluating additional soil, sediment, surface water, seep, and groundwater data from March 2010 and November 2013.

Soil

Samples collected during the Supplemental RI confirmed that arsenic-contaminated soil and waste material was effectively removed to the performance standard throughout most of the Site.

During the 2005 RI, elevated levels of arsenic were found in a section of the railroad embankment in the NSA. This contamination was not removed during the RA due to concerns about digging into the structural support of the active rail line. In accordance with the ESD, a stabilizing agent was placed at the bottom of the excavation trench next to the embankment to further reduce the potential for soil contamination to impact Site groundwater. Sampling conducted in 2012, and summarized in the 2014 Supplemental RI, determined that approximately 761.5 cubic yards of contaminated waste material is present beneath the rail line embankment, with a maximum arsenic concentration of 6,380 mg/kg at 6-8 feet bgs. Waste material was visible in the soil samples collected from this area. Elevated levels of arsenic were found to a depth of 16 feet bgs. This area is shown on Figure 5. A Synthetic Precipitation Leaching Procedure (SPLP) analysis indicates that source material under the rail line embankment can leach from soil into shallow groundwater. Groundwater from this area acts as a continuing source of contamination to the surface water and sediment in the spring-fed creek on the north side of the railroad via seeps and springs. The SPLP data is provided in Tables F-1 and F-2 of Appendix F. This area will be addressed as part of the future remedy for groundwater.

In 2012, confirmatory soil sampling conducted in the SSA near the MW3 well cluster identified arsenic levels exceeding the performance standard of 12 mg/kg. The highest concentration of arsenic was 447 mg/kg in a sample collected from 6-8 feet bgs. This area is shown on Figure 4. No residual arsenic waste material was visible in the confirmatory borings. This area will continue to be monitored and may be addressed as part of a remedy for groundwater.

Results of the SSA and NSA confirmatory soil sampling are provided in Table F-3 and F-4 of Appendix F. SPLP data from the MW3 well area indicates that arsenic can leach from subsurface soil into groundwater in this area.

Figure 4: SSA Delineation Sample Locations (February/March 2012 and March 2013)

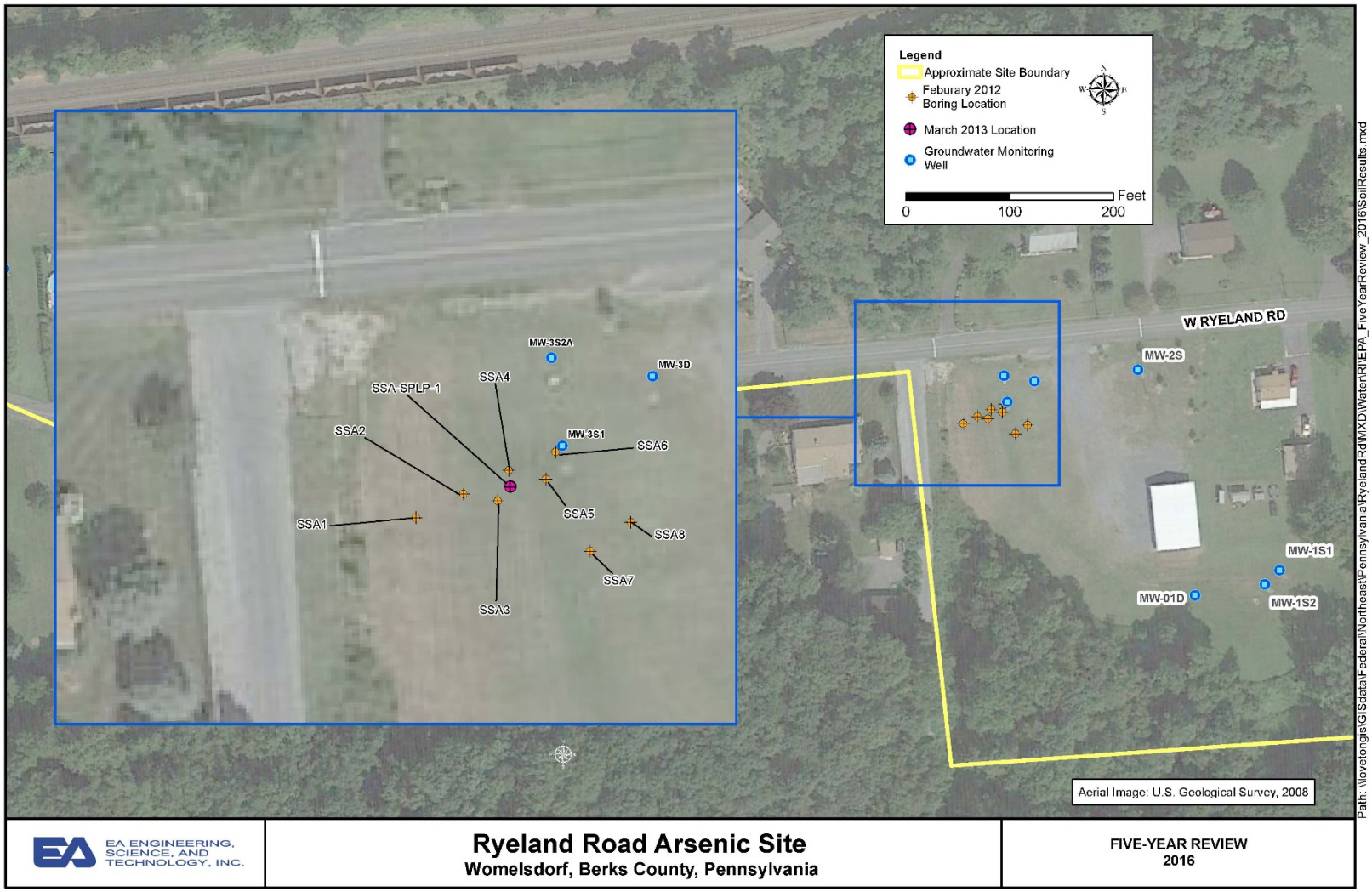
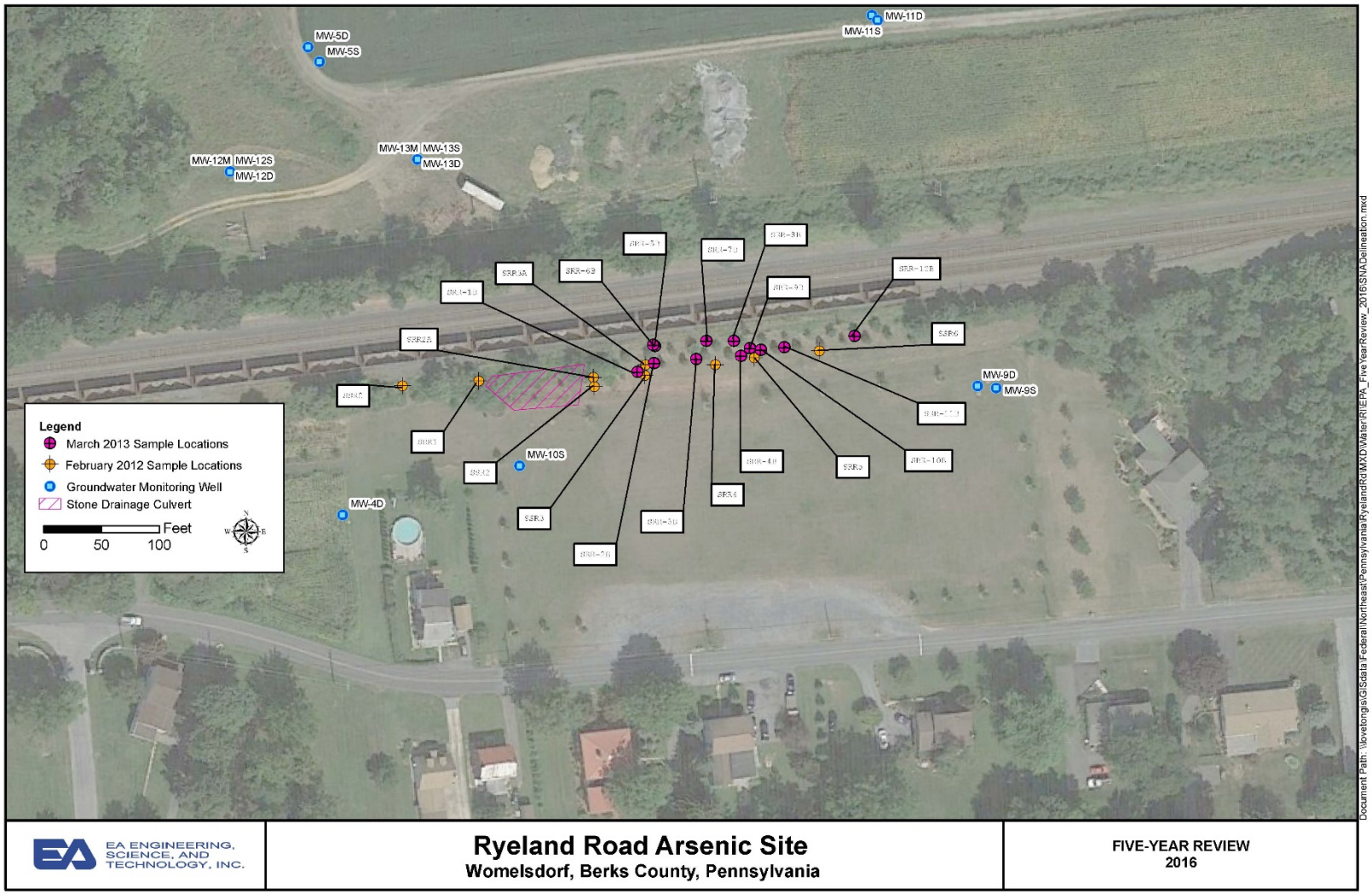


Figure 5: NSA Delineation Sample Locations (February/March 2012 and March 2013)



Sediment

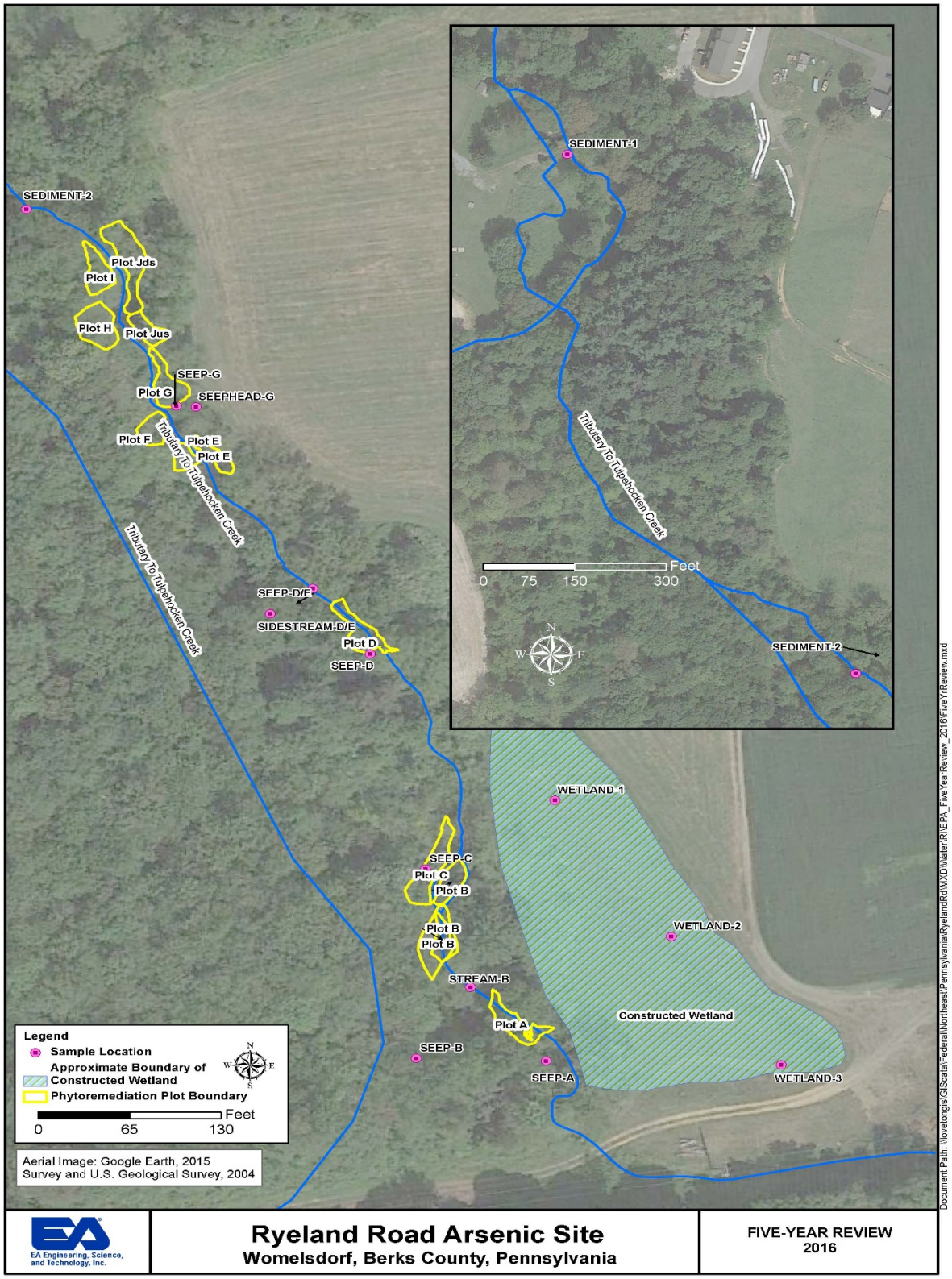
Sediment samples were collected between 2011 and 2013 in the intermittent tributary, the constructed wetland, the spring-fed creek, and the unnamed tributary to the Tulpehocken Creek near the VFW Park. As shown in Table 9 below, concentrations above the performance standards were found in these areas. Therefore, continued monitoring of sediment is recommended for the Site. There were no exceedances of the zinc performance standard. A summary of the maximum concentrations detected between April 2011 and June 2013 are shown in Table 9. Sample locations are shown in Figures 6 and 7. The complete sediment sample results are included in Table F-5 in Appendix F.

Table 9: Summary of Maximum COC Concentrations in Sediment

Area	COC	Performance Standard (mg/kg)	Maximum Concentration (mg/kg) (April 2011 – June 2013)
Intermittent tributary	Arsenic	12	**16.5**
Former Spring-fed pond	Arsenic	53	**170**
Spring-fed creek	Arsenic	140	**183**
VFW Park	Arsenic	46	**47.6**
Site-wide	Zinc	200	156

Note:
Table 5 of this FYR summarizes the performance standards from the 2006 ROD and the 2008 ESD.

Figure 6: Sediment Sample Locations (April 2011)



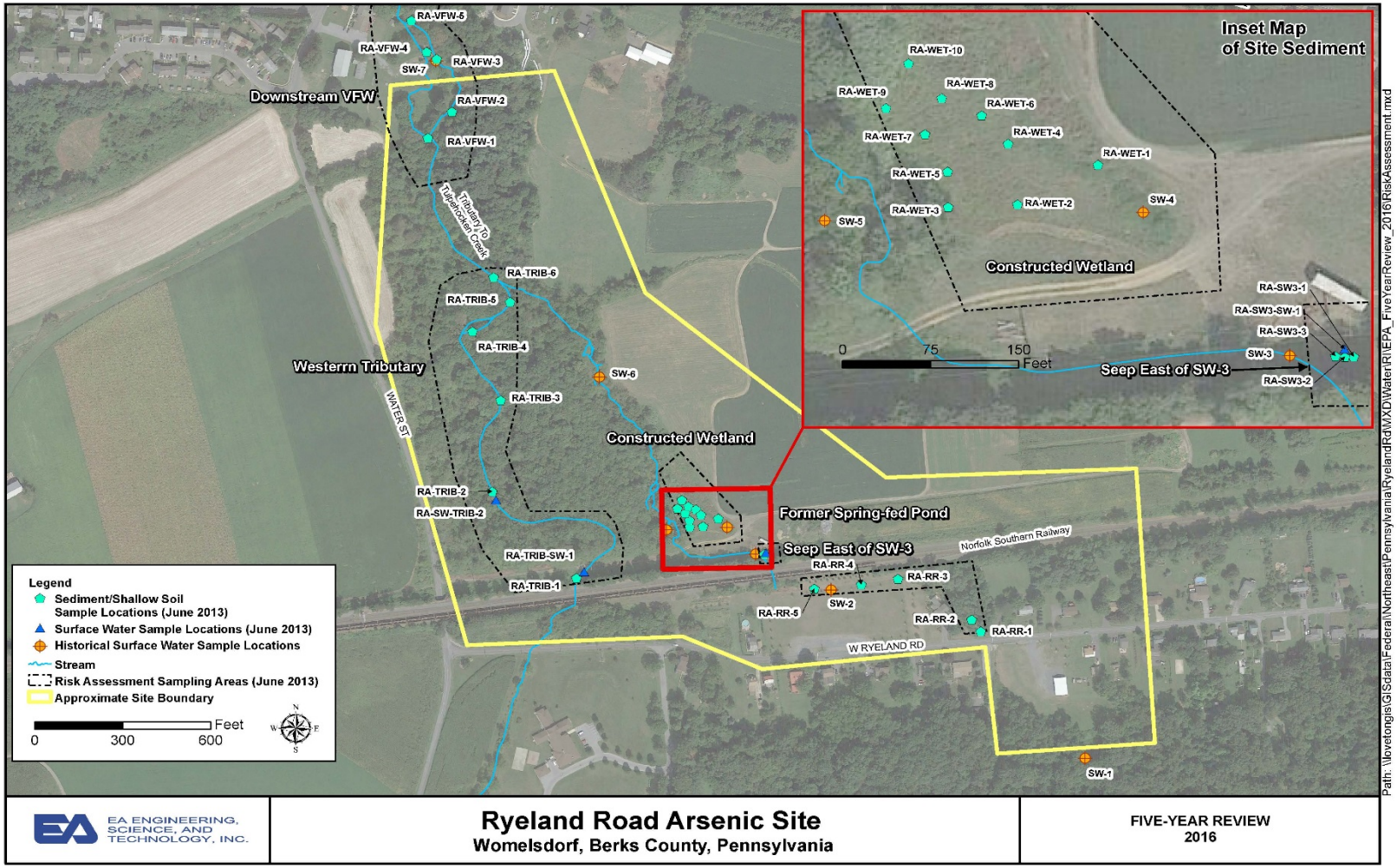


Figure 7: Sediment and Surface Water Locations (June 2013)

Surface Water/Seeps

The 2005 RI concluded that there was no unacceptable risk posed to aquatic receptors from surface water at the Site, therefore, no performance standard was established for surface water. However, surface water sampling shows concentrations of arsenic above the NRWQC of 150 ug/L as shown in Table 10. Since March 2010, seven rounds of surface water samples have been collected from seven locations across the Site that correspond to the identified groundwater seeps. The sampling locations are shown on Figure 7 and the data is presented in Table F-6 of Appendix F. Due to the contribution of impacted groundwater to surface water and seeps, surface water will continue to be monitored.

Table 10 – Maximum Arsenic Concentrations in Surface Water

Area	Maximum Total and Dissolved Arsenic Concentration (µg/L)		
	2010	2011	2012
SW-3	***394 (T)*** ***378 (D)***	***378 (T)*** ***382 (D)***	***230 (T)*** ***224 (D)***
SW-4	***356 (T)*** ***252 (D)***	***303 (T)*** ***289 (D)***	***182 (T)*** ***185 (D)***
SW-5	***291 (T)*** ***277 (D)***	***279 (T)*** ***243 (D)***	***210 (T)*** ***201 (D)***
SW-6	***138 (T)*** 4.1 (D)	***154 (T)*** ***148 (D)***	***122 (T)*** ***119 (D)***
Notes: T = Total D = Dissolved ***Bold Italic*** = Exceeds NRWQC for Arsenic (150 µg/L) Source = Supplemental Remedial Investigation Report, Table 3-9, July 2014.			

Groundwater

Historical and recent groundwater sampling shows concentrations of arsenic above the MCL of 10 ug/L. The most recent data is shown in Table 11 below. Residential wells have not been impacted by groundwater at the Site. Groundwater exceeding the MCL at the Site will be addressed in a future remedy.

Table 11 – Maximum Arsenic Concentrations in Groundwater

Monitoring Well (MW)	Maximum Total and Dissolved Arsenic Concentrations (ug/L)	
	2012	**2013**
MW-5S	***24 (T)*** ***22 (D)***	***20 (T)*** ***18 (D)***
MW-12S	***357 (T)*** ***316 (D)***	***336 (T)*** ***280 (D)***
MW-12M	***156 (T)*** ***118 (D)***	***166 (T)*** ***158 (D)***
MW-13S	***47 (T)*** ***41 (D)***	***33 (T)*** ***24 (D)***
Notes: T = Total D = Dissolved ***Bold Italic*** = Exceeds MCL for Arsenic (10 µg/L) Source = Supplemental Remedial Investigation Report, Table 3-7, July 2014		

Final Interim Remedial Action Report – Phytoremediation Program (May 2015)

Phytoremediation Areas (Shallow Soil and Sediment)

In May 2007, EPA initiated a phytoremediation study to determine the effectiveness of arsenic uptake by Chinese brake ferns. The study proved successful in reducing arsenic concentrations in shallow soil and sediment in the spring-fed creek. From 2009 through 2014, additional ferns were planted along the seeps of the spring-fed creek. Overall, concentrations of arsenic in shallow soil samples, collected from the spring-fed creek, decreased from the baseline levels from 2010 through 2014. In 2014, concentrations in shallow soil increased compared to 2013 levels. As discussed in Section 4.2, EPA has temporarily discontinued the phytoremediation program until a remedy for groundwater is implemented due to the continued migration of contaminated groundwater into soil and sediment in the spring-fed creek. Sample results from the annual shallow sediment sampling events are provided in Table F-7 of Appendix F.

6.5 Site Inspection

The site inspection was held on November 19, 2015. Participants included Sibyl Dinkins, Brad White, Larry Johnson, Jeff Tuttle, and Bruce Pluta, EPA; Larry Smith, PADEP; Steven Yankay,

EA Engineering; and Hagai Nassau and Kristin Sprinkle, Skeo Solutions. The Site Inspection Checklist is provided in Appendix D and the site photographs are in Appendix E.

The inspection of the NSA area, on the northern side of West Ryeland Road, determined that the grass cover established at the site during the RA, continues to be well established and vegetated, including the rail line embankment. The former spring-fed pond which is now the EPA-constructed wetland, the existing spring-fed creek, tributaries of the Tulpehocken creek, and VFW post area were inspected. The former spring-fed pond area where the wetland was constructed is in good condition though some invasive species (phragmites and knotweed) were observed. The (former) phytoremediation area was also in good shape. The VFW Park area showed no sign of site-related issues. There was heavy rainfall on the day of the inspection but the land surface was drier than usual due to low rainfall in the preceding months.

Groundwater monitoring wells and permeable reactive barrier (PRB) logs, placed in the spring-fed creek as part of a pilot study to treat groundwater seeps, were also inspected and found to be in good condition.

The SSA is well-maintained by the Township and shows no site-related issues. The property now houses a building used by the Township to store equipment.

The Administrative Record for the Site is available to the public at the Womelsdorf Public Library at 203 West High Street, Womelsdorf, PA 19567.

6.6 Interviews

The FYR process included interviews with current landowners and regulatory agencies involved in Site activities or aware of the Site. The purpose was to document the perceived status of the Site and any perceived problems or successes with the phases of the remedy implemented to date. The interviews are summarized below.

EPA conducted interviews with affected citizens, appointed local officials and area business owners near the Site. In general, the overall impression of EPA's ongoing work at the Ryeland Road Site is positive. EPA worked closely with affected property owners during the removal and remedial phases of the arsenic cleanup. The Ryeland Road cleanup is viewed by the community as having been well managed, efficient, and minimally disruptive of everyday activities. The OU1 soil remedy completed in 2009 is viewed as being protective for the long term. There is some concern that ongoing groundwater remediation will become disruptive and hope that what EPA plans for future work will not involve any major site activity. Negative responses to EPA's RA were minimal. Elected officials for the Lower Heidelberg Township did express concerns that the public sewer system was not extended to residences on Ryeland Road.

The Ryeland Road Arsenic Site is viewed as representing an effective cooperative effort between the Agency and the numerous residential properties involved in the project. Community members feel that they have been effectively informed about ongoing Site activities. They remarked about how open we were during the active phases of the cleanup and particularly appreciated our "open door" policy when problems arose. None of the interviewees regarded any

problems as ongoing and consider them resolved. The community looks forward to the Ryeland Road Site being returned to beneficial reuse but insist that any such reuse be predicated on approval and input from current residents.

7.0 Technical Assessment

7.1 Question A: Is the remedy functioning as intended by the decision documents?

Yes, the review of documents, ARARS, risk assumptions, decision documents and the results of the site inspection indicate that the site remedy is functioning as intended by the decision documents. The removal of approximately 140,000 tons of contaminated soil, sediment, and waste material from the Site during the RA achieved the RAO to prevent current and future direct contact with exposed soil and waste material resulting in an unacceptable human health risk.

The phytoremediation program identified in the ROD was effective in removing arsenic in sediment for several years. Recent data shows that contaminated groundwater continues to migrate into the creek via seeps which has reduced the effectiveness of phytoremediation. EPA has temporarily discontinued fern planting along the creek until a remedy for groundwater is implemented. The need for additional IC's in this area will be evaluated.

Further degradation of groundwater has been greatly minimized by the removal of contaminated material from soil at the Site. However, as anticipated by the ROD, an OU2 remedy will be implemented to address contaminated groundwater.

7.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels and remedial action objectives (RAOs) used at the time of remedy selection still valid?

Yes, the exposure assumptions, toxicity data, cleanup levels and RAOs used at the time of remedy selection are still valid.

7.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

7.4 Technical Assessment Summary

The implemented remedy involved the removal of approximately 140,000 tons of arsenic-contaminated soil, sediment, and source material from the Site. Confirmation sampling conducted since the RA was completed in 2009 shows that arsenic-contaminated soil and waste material was removed to the site-specific action levels for residential and non-residential surface soil, and to action levels in subsurface soil to the extent practicable throughout the Site.

Data shows that arsenic leaches from source material in the railroad embankment to shallow groundwater which moves into soil and sediment in the spring-fed creek via seeps and springs. The leaching of contaminants into shallow groundwater, and ultimately the creek, will be addressed as part of the groundwater remedy for OU2.

Continued monitoring of surface water, sediment, and groundwater is recommended at the Site. Additional measures to address sediment may be taken as part of the remedy for groundwater.

8.0 Issues

Table 12 summarizes the current site issues.

Table 12: Current Site Issues

Issue No.	Issue	Affects Current Protectiveness?	Affects Future Protectiveness?
1	Contaminated soil and waste material beneath a portion of the rail road embankment leaches arsenic into shallow groundwater which moves into surface water and sediment via seeps and springs. The excavation of all waste material under the embankment was not performed during the remedy due to concerns about potentially damaging the structural support of the rail line.	No	Yes
2	Arsenic concentrations are present in the shallow soil and sediment in the spring-fed creek, at concentrations exceeding the site performance standards as a result of groundwater seeps.	No	Yes
3	Contaminated subsurface soil and sediment is present in some areas of the Site.	No	Yes

9.0 Recommendations and Follow-up Actions

Table 13 provides recommendations to address the current site issues.

Table 13: Recommendations to Address Current Site Issues

Issue	Recommendation / Follow-Up Action	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness?	
					Current	Future
1	Evaluate remedial alternatives to address arsenic leaching from railroad embankment and area near MW-3 well cluster with elevated concentrations.	EPA	EPA	10/01/2020	No	Yes
2	Continued monitoring of areas which exceed sediment performance standards during implementation of groundwater remedy.	EPA	EPA	10/01/2020	No	Yes
3	Further evaluate current and future risk scenarios for sediment. Implement additional IC's if necessary.	EPA	EPA	10/01/2017	No	Yes

10.0 Protectiveness Statement

The remedy is currently protective of human health and the environment because contaminated soil and source material (OU1) was removed to the extent practicable, ongoing monitoring is being performed, and exposure to remaining contamination is being controlled through the use of ICs. However, in order for the OU1 remedy to be protective in the long-term, contaminated groundwater which migrates into surface water, shallow soil, and sediment via seeps and springs will need to be addressed as part of the OU2 remedy, and remedial alternatives to address contamination remaining in place in shallow soil (in the railroad embankment and SSA near MW-3) and sediments (in the spring-fed creek) should be evaluated. In the meantime, ICs will remain in place to prevent exposure to contaminated soil, sediment, and groundwater as long as needed to ensure protectiveness of the remedy.

11.0 Next Review

The next FYR will be due within five years of the signature/approval date of this FYR.

Appendix A: List of Documents Reviewed

Remedial Investigation Report for the Ryeland Road Arsenic Site, Tetra Tech NUS, June 2005.

Feasibility Study Report for Ryeland Road Arsenic Site, Tetra Tech NUS, October 2005.

Record of Decision for the Ryeland Road Arsenic Site, Operable Unit (OU) 1, U.S. EPA, January 2006.

Amendment to the Record of Decision, OU 1, Ryeland Road Arsenic Superfund Site, May 2008.

Explanation of Significant Differences, Ryeland Road Arsenic Site, OU1, U.S. EPA, September 2008.

First Five Year Review Report for Ryeland Road Arsenic Superfund Site, U.S. EPA, October 2011.

Final Interim Remedial Action Report, Phytoremediation, Ryeland Road Arsenic Site, U.S. EPA, July 2012.

Remedial Action Completion Report, Ryeland Road Arsenic Site, U.S. EPA, August 2012.

Final Interim Remedial Action Report, Phytoremediation, Ryeland Road Arsenic Site, U.S. EPA, April 2013.

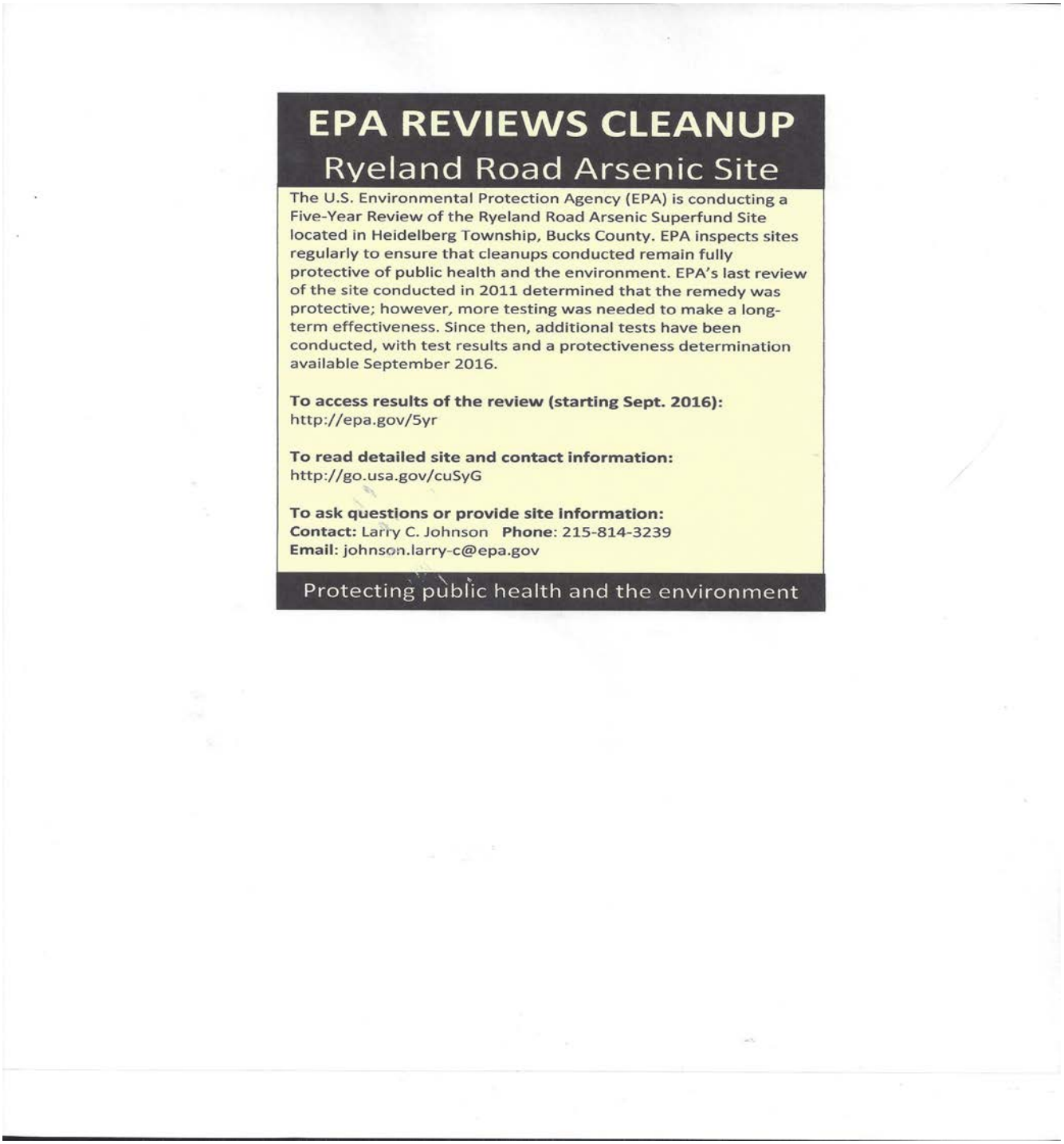
Supplemental Remedial Investigation Report, Ryeland Road Arsenic Site, Prepared by EA Engineering, Science, and Technology, Inc., Prepared for U.S. EPA, July 2014.

Final Interim Remedial Action Report, Phytoremediation, Ryeland Road Arsenic Site, U.S. EPA, September 2014.

Final Interim Remedial Action Report, Phytoremediation, Ryeland Road Arsenic Site, U.S. EPA, May 2015.

Final Interim Remedial Action Report, Phytoremediation, Ryeland Road Arsenic Site, U.S. EPA, March 2016.

Appendix B: Press Notice



EPA REVIEWS CLEANUP

Ryeland Road Arsenic Site

The U.S. Environmental Protection Agency (EPA) is conducting a Five-Year Review of the Ryeland Road Arsenic Superfund Site located in Heidelberg Township, Bucks County. EPA inspects sites regularly to ensure that cleanups conducted remain fully protective of public health and the environment. EPA's last review of the site conducted in 2011 determined that the remedy was protective; however, more testing was needed to make a long-term effectiveness. Since then, additional tests have been conducted, with test results and a protectiveness determination available September 2016.

To access results of the review (starting Sept. 2016):
http://epa.gov/5yr

To read detailed site and contact information:
http://go.usa.gov/cuSyG

To ask questions or provide site information:
Contact: Larry C. Johnson **Phone**: 215-814-3239
Email: johnson.larry-c@epa.gov

Protecting public health and the environment

Appendix C: Interview Forms

The interviews are summarized in Section 6.6 above.

Appendix D: Site Inspection Checklist

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION

Site Name: Ryeland Road Arsenic	**Date of Inspection:** 11/19/2015
Location and Region: Womelsdorf, PA	**EPA ID:** PAD981033459
Agency, Office or Company Leading the Five-Year Review: EPA Region 3	**Weather/Temperature:** Rainy and 60F°

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☐ Access controls
- ☒ Institutional controls
- ☐ Ground water pump and treatment
- ☐ Surface water collection and treatment
- ☒ Other: Soil Removal, Phytoremediation
- ☐ Monitored natural attenuation
- ☐ Ground water containment
- ☐ Vertical barrier walls

Attachments: ☒ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (check all that apply)

1. **O&M Site Manager** _____ (Name) _____ (Title) _____ (Date)
   Interviewed ☐ at site ☐ at office ☐ by phone Phone: _____
   Problems, suggestions ☐ Report attached: _____

2. **O&M Staff** _____ (Name) _____ (Title) _____ (Date)
   Interviewed ☐ at site ☐ at office ☐ by phone Phone: _____
   Problems/suggestions ☐ Report attached: _____

3. **Local Regulatory Authorities and Response Agencies** (i.e., state and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices). Fill in all that apply.

   Agency _____
   Contact _____ (Name) _____ (Title) _____ (Date) _____ (Phone No.)
   Problems/suggestions ☐ Report attached: _____

   Agency _____
   Contact _____Name _____ (Title) _____ (Date) _____ (Phone No.)
   Problems/suggestions ☐ Report attached:_____

   Agency _____
   Contact _____ (Name) _____ (Title) _____ (Date) _____ (Phone No.)
   Problems/suggestions ☐ Report attached:_____

   Agency _____
   Contact _____ (Name) _____ (Title) _____ (Date) _____ (Phone No.)
   Problems/suggestions ☐ Report attached: _____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone No.
Problems/suggestions ☐ Report attached:_____

4. **Other Interviews** (optional) ☐ Report attached: _____

III. ON-SITE DOCUMENTS AND RECORDS VERIFIED (check all that apply)

1. **O&M Documents**

☐ O&M manual	☐ Readily available	☐ Up to date	☒ N/A
☐ As-built drawings	☐ Readily available	☐ Up to date	☒ N/A
☐ Maintenance logs	☐ Readily available	☐ Up to date	☒ N/A

Remarks: _____

2. **Site-Specific Health and Safety Plan**	☐ Readily available	☐ Up to date	☒ N/A
☐ Contingency plan/emergency response plan	☐ Readily available	☐ Up to date	☒ N/A

Remarks: _____

3. **O&M and OSHA Training Records**	☐ Readily available	☐ Up to date	☒ N/A

Remarks: _____

4. **Permits and Service Agreements**

☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
☐ Effluent discharge	☐ Readily available	☐ Up to date	☒ N/A
☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A
☐ Other permits: _____	☐ Readily available	☐ Up to date	☒ N/A

Remarks: _____

5. **Gas Generation Records**	☐ Readily available	☐ Up to date	☒ N/A

Remarks: _____

6. **Settlement Monument Records**	☐ Readily available	☐ Up to date	☒ N/A

Remarks: _____

7. **Ground Water Monitoring Records**	☐ Readily available	☐ Up to date	☒ N/A

Remarks: _____

8. **Leachate Extraction Records**	☐ Readily available	☐ Up to date	☒ N/A

Remarks: _____

9. **Discharge Compliance Records**

☐ Air ☐ Readily available ☐ Up to date ☒ N/A

☐ Water (effluent) ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

10. **Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☒ Contractor for state

☐ PRP in-house ☐ Contractor for PRP

☐ Federal facility in-house ☐ Contractor for Federal facility

☐ _____

2. **O&M Cost Records**

☐ Readily available ☐ Up to date

☐ Funding mechanism/agreement in place ☐ Unavailable

Original O&M cost estimate: _____ ☐ Breakdown attached

Total annual cost by year for review period if available

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs during Review Period**

Describe costs and reasons: _____

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing Damaged** ☐ Location shown on site map ☐ Gates secured ☒ N/A

Remarks: _____

B. Other Access Restrictions

1. **Signs and Other Security Measures** ☐ Location shown on site map ☒ N/A

   Remarks: _____

C. Institutional Controls (ICs)

1. **Implementation and Enforcement**

   Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A

   Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

   Type of monitoring (e.g., self-reporting, drive by): _____

   Frequency: _____

   Responsible party/agency: _____

   Contact _____ _____ _____ _____

   Name Title Date Phone no.

   Reporting is up to date ☐ Yes ☐ No ☐ N/A

   Reports are verified by the lead agency ☐ Yes ☐ No ☐ N/A

   Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ☐ N/A

   Violations have been reported ☐ Yes ☐ No ☐ N/A

   Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A

   Remarks: Current ICs are adequate. Determine if additional ICs are needed to prevent long-term exposure to contaminated subsurface soil.

D. General

1. **Vandalism/Trespassing** ☐ Location shown on site map ☒ No vandalism evident

   Remarks: _____

2. **Land Use Changes On Site** ☒ N/A

   Remarks: _____

3. **Land Use Changes Off Site** ☒ N/A

   Remarks: _____

VI. GENERAL SITE CONDITIONS

A. Roads ☐ Applicable ☒ N/A

1. **Roads Damaged** ☐ Location shown on site map ☐ Roads adequate ☐ N/A

   Remarks: _____

B. Other Site Conditions

Remarks: _____

VII. LANDFILL COVERS	☐ Applicable ☒ N/A	
A. Landfill Surface		
1. **Settlement** (low spots)	☐ Location shown on site map	☐ Settlement not evident
Arial extent: _____		Depth: _____
Remarks: _____		
2. **Cracks**	☐ Location shown on site map	☐ Cracking not evident
Lengths: _____	Widths: _____	Depths: _____
Remarks: _____		
3. **Erosion**	☐ Location shown on site map	☐ Erosion not evident
Arial extent: _____		Depth: _____
Remarks: _____		
4. **Holes**	☐ Location shown on site map	☐ Holes not evident
Arial extent: _____		Depth: _____
Remarks: _____		
5. **Vegetative Cover**	☐ Grass	☐ Cover properly established
☐ No signs of stress	☐ Trees/shrubs (indicate size and locations on a diagram)	
Remarks: _____		
6. **Alternative Cover** (e.g., armored rock, concrete)		☐ N/A
Remarks: _____		
7. **Bulges**	☐ Location shown on site map	☐ Bulges not evident
Arial extent: _____		Height: _____
Remarks: _____		
8. **Wet Areas/Water Damage**	☐ Wet areas/water damage not evident	
☐ Wet areas	☐ Location shown on site map	Arial extent: _____
☐ Ponding	☐ Location shown on site map	Arial extent: _____
☐ Seeps	☐ Location shown on site map	Arial extent: _____
☐ Soft subgrade	☐ Location shown on site map	Arial extent: _____
Remarks: _____		
9. **Slope Instability**	☐ Slides	☐ Location shown on site map
☐ No evidence of slope instability		
Arial extent: _____		
Remarks: _____		

B. Benches ☐ Applicable ☒ N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1. **Flows Bypass Bench** ☐ Location shown on site map ☐ N/A or okay

   Remarks: _____

2. **Bench Breached** ☐ Location shown on site map ☐ N/A or okay

   Remarks: _____

3. **Bench Overtopped** ☐ Location shown on site map ☐ N/A or okay

   Remarks: _____

C. Letdown Channels ☐ Applicable ☒ N/A

(Channel lined with erosion control mats, riprap, grout bags or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. **Settlement** (Low spots) ☐ Location shown on site map ☐ No evidence of settlement

   Arial extent: _____ Depth: _____

   Remarks: _____

2. **Material Degradation** ☐ Location shown on site map ☐ No evidence of degradation

   Material type:_____ Arial extent: _____

   Remarks: _____

3. **Erosion** ☐ Location shown on site map ☐ No evidence of erosion

   Arial extent: _____ Depth: _____

   Remarks: _____

4. **Undercutting** ☐ Location shown on site map ☐ No evidence of undercutting

   Arial extent: _____ Depth: _____

   Remarks: _____

5. **Obstructions** Type: _____ ☐ No obstructions

   ☐ Location shown on site map Arial extent: _____

   Size: _____

   Remarks: _____

6. **Excessive Vegetative Growth** Type: _____

   ☐ No evidence of excessive growth

   ☐ Vegetation in channels does not obstruct flow

   ☐ Location shown on site map Arial extent: _____

   Remarks: _____

D. Cover Penetrations ☐ Applicable ☒ N/A

1. **Gas Vents** ☐ Active ☐ Passive
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A
   Remarks: _____

2. **Gas Monitoring Probes**
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A
   Remarks: _____

3. **Monitoring Wells** (within surface area of landfill)
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A
   Remarks: _____

4. **Extraction Wells Leachate**
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A
   Remarks: _____

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☐ N/A
   Remarks: _____

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

1. **Gas Treatment Facilities**
   ☐ Flaring ☐ Thermal destruction ☐ Collection for reuse
   ☐ Good condition ☐ Needs maintenance
   Remarks: _____

2. **Gas Collection Wells, Manifolds and Piping**
   ☐ Good condition ☐ Needs maintenance
   Remarks: _____

3. **Gas Monitoring Facilities** (e.g., gas monitoring of adjacent homes or buildings)
   ☐ Good condition ☐ Needs maintenance ☐ N/A
   Remarks: _____

F. Cover Drainage Layer ☐ Applicable ☒ N/A

1. **Outlet Pipes Inspected** ☐ Functioning ☐ N/A
   Remarks: _____

2. **Outlet Rock Inspected** ☐ Functioning ☐ N/A
   Remarks: _____

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

1. **Siltation** Area extent: _____ Depth: _____ ☐ N/A
   ☐ Siltation not evident
   Remarks: _____

2. **Erosion** Area extent: _____ Depth: _____
   ☐ Erosion not evident
   Remarks: _____

3. **Outlet Works** ☐ Functioning ☐ N/A
   Remarks: _____

4. **Dam** ☐ Functioning ☐ N/A
   Remarks: _____

H. Retaining Walls ☐ Applicable ☒ N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident
   Horizontal displacement: _____ Vertical displacement: _____
   Rotational displacement: _____
   Remarks: _____

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident
   Remarks: _____

I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☒ N/A

1. **Siltation** ☐ Location shown on site map ☐ Siltation not evident
   Area extent: _____ Depth: _____
   Remarks: _____

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A
   ☐ Vegetation does not impede flow
   Area extent: _____ Type: _____
   Remarks: _____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
   Area extent: _____ Depth: _____
   Remarks: _____

4. **Discharge Structure** ☐ Functioning ☐ N/A
   Remarks: _____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident

   Area extent: _____ Depth: _____

   Remarks: _____

2. **Performance Monitoring** Type of monitoring: _____

   ☐ Performance not monitored

   Frequency: _____ ☐ Evidence of breaching

   Head differential: _____

   Remarks: _____

IX. GROUND WATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Ground Water Extraction Wells, Pumps and Pipelines ☐ Applicable ☒ N/A

1. **Pumps, Wellhead Plumbing and Electrical**

   ☐ Good condition ☐ All required wells properly operating ☐ Needs maintenance ☒ N/A

   Remarks: _____

2. **Extraction System Pipelines, Valves, Valve Boxes and Other Appurtenances**

   ☐ Good condition ☐ Needs maintenance

   Remarks: _____

3. **Spare Parts and Equipment**

   ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

   Remarks: _____

B. Surface Water Collection Structures, Pumps and Pipelines ☐ Applicable ☒ N/A

1. **Collection Structures, Pumps and Electrical**

   ☐ Good condition ☐ Needs maintenance

   Remarks: _____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes and Other Appurtenances**

   ☐ Good condition ☐ Needs maintenance

   Remarks: _____

3. **Spare Parts and Equipment**

   ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

   Remarks: _____

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (check components that apply)

☐ Metals removal ☐ Oil/water separation ☒ Bioremediation

☐ Air stripping ☐ Carbon adsorbers

☐ Filters: _____

☐ Additive (e.g., chelation agent, flocculent): _____

☐ Others: _____

☐ Good condition ☐ Needs maintenance

☐ Sampling ports properly marked and functional

☐ Sampling/maintenance log displayed and up to date

☐ Equipment properly identified

☐ Quantity of ground water treated annually: _____

☐ Quantity of surface water treated annually: _____

Remarks: Phytoremediation ferns removed until groundwater remedy is determined

2. **Electrical Enclosures and Panels** (properly rated and functional)

☒ N/A ☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Tanks, Vaults, Storage Vessels**

☒ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs maintenance

Remarks: _____

4. **Discharge Structure and Appurtenances**

☒ N/A ☐ Good condition ☐ Needs maintenance

Remarks: _____

5. **Treatment Building(s)**

☒ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair

☐ Chemicals and equipment properly stored

Remarks: _____

6. **Monitoring Wells** (pump and treatment remedy)

☒ Properly secured/locked ☒ Functioning ☐ Routinely sampled ☐ Good condition

☐ All required wells located ☐ Needs maintenance ☐ N/A

Remarks: _____

D. Monitoring Data

1. **Monitoring Data**

☒ Is routinely submitted on time ☒ Is of acceptable quality

2. **Monitoring Data Suggests:**

☒ Ground water plume is effectively contained ☐ Contaminant concentrations are declining

E. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ All required wells located ☐ Needs maintenance ☒ N/A

Remarks: _____

X. OTHER REMEDIES

If there are remedies applied at the site and not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is designed to accomplish (e.g., to contain contaminant plume, minimize infiltration and gas emissions).

Contaminated surface soil has been removed. A remedy will be selected and implemented to address contaminated groundwater. The phytoremediation program included in the ROD has been discontinued and may be started again following the selection of a remedy for groundwater. ICs are in place to prevent exposure to contaminated subsurface soil and groundwater.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

There are no O&M concerns.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

_____

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

_____

Appendix E: Photographs from Site Inspection Visit

Vegetated and landscaped NSA field

Municipal building on SSA

Vernal pond near the SSA

Former Spring-fed pond

Open wells MW 12 S, M and D. All wells observed were flush mounted, locked and appeared to be in good working order, labels are on inside

Plot A fern bioremediation area - the seep feeding the stream at Plot A is undergoing pilot studies to determine if a permeable reactive barrier can treat arsenic coming out of the seep

Constructed wetland on the Site

Plot B fern bioremediation area - this area was washed out during the previous FYR. Rocks deposited during the flood event are sinking back into the ground

Stream leading to the dam at the VFW Park

Ponds at the VFW Park. EPA dredged ponds during removal actions

Watercress growing in ponds at VFW Park

Close-up of watercress found growing in the pond at VFW Park

Appendix F: Data Tables

Soil Sampling Results

Table F-1. Synthetic Precipitation Leaching Procedure and Total Metals Results (Spring 2013)

	Maximum Contaminant Level	**National Recommended Water Quality Criteria, Freshwater**		Boring SRR-2B 10-12 ft bgs		Boring SRR-3B 4-6 ft bgs		Boring SRR-3B 4-6 ft bgs (duplicate)		Boring SSA-SLP-1 8-10 ft bgs		Boring SSA-SLP-1 10-12 ft bgs	
		Acute	Chronic	Total Metals	SPLP	Total Metals	SPLP	Total Metals	SPLP	Total Metals	SPLP	Total Metals	SPLP
Analyte	µg/L	µg/L	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L
Aluminum	--	750	87	1290	282 J+	5630	2990 J+	2240	1430 J+	3720	1980 J+	2930	15300 J+
Antimony	6	--	--	8.8 U	60.0 U	8.2 U	60.0 U	8.6 U	60.0 U	6.8 U	60.0 U	6.4 U	60.0 U
Arsenic	10	340	150	187	**73.4**	80.7	**42.2**	138	**50.3**	45.7	**38**	19.9	**101**
Barium	2000	--	--	6.2 J	6.0 J	13.5 J	19.0 J	30	17.2 J	11.7 J	9.9 J	3.7 J	26.1 J
Beryllium	4	--	--	0.74 U	5.0 U	0.42 J	5.0 U	0.71 U	5.0 U	0.26 J	5.0 U	0.53 U	1.4 J
Cadmium	5	2	0.25	1.1	5.0 U	0.24 J	5.0 U	0.71 U	5.0 U	0.56 U	5.0 U	0.30 J	**13.8**
Calcium	--	--	--	216000 J	628000 J	218000 J	638000 J	235000 J	634000 J	14500 J	97700 J	1150 J	4300 J
Chromium	100	16	11	0.94 J	10.0 U	4.1	3.4 J	3.4	10.0 U	7.1	3.3 J	4.4	33.2
Cobalt	--	--	--	7.4 U	50.0 U	6.8 U	50.0 U	7.1 U	50.0 U	5.6 U	50.0 U	5.3 U	24.8 J
Copper	1300	--	--	11.7	25.0 U	81.9	43.6	25.2	11.9 J	3.9	25.0 U	3.9	44.1
Iron	--	--	1000	1930	220 J+	8090	**3500 J+**	6950	**2670 J+**	8240	**1350 J+**	2450	**4600 J+**
Lead	15	65	2.5	91.5	**20.3**	304	**114**	142	**67.1**	4.7	3.7 J	2.5	**17.2**
Magnesium	--	--	--	36000	58000	2470	4820 J	2730	5410	4570	4830 J	159 J	665 J
Manganese	--	--	--	168	17.5	253	267	171	212	34.6	97.5	4.6	39.9
Nickel	--	470	52	5.9 U	40.0 U	6.6	8.0 J	5.7 U	40.0 U	4.5 U	40.0 U	4.3 U	16.4 J
Potassium	--	--	--	80.9 J	357 J	85.7 J	835 J	107 J	489 J	342 J	960 J	169 J	826 J
Selenium	50	--	5	5.2 U	35.0 U	4.8 U	35.0 U	5.0 U	35.0 U	4.0 U	35.0 U	3.7 U	35.0 U
Silver	--	3.2	--	1.5 U	10.0 U	1.4 U	10.0 U	1.4 U	10.0 U	1.1 U	10.0 U	1.1 U	10.0 U
Sodium	--	--	--	736 U	5000 U	685 U	1320 J	713 U	5000 U	564 U	5000 U	532 U	5000 U
Thallium	2	--	--	3.7 U	25.0 U	3.4 U	25.0 U	3.6 U	25.0 U	2.8 U	25.0 U	2.7 U	25.0 U
Vanadium	--	--	--	7.4 U	50.0 U	10	50.0 U	11.7	50.0 U	12.8	50.0 U	7.9	20.9 J
Zinc	--	120	120	241	21.4 J	99	88.2	44	21.8 J	18.4	9.7 J	50.6	1630

Notes:
BOLDED results exceed at least one screening criterion.
J = Reported value may not be accurate or precise.
J+ = The analyte was positively identified; the associated numerical value is an approximate concentration of the analyte, but may be biased high.
U = Compound was analyzed but not detected.
Sample ID with "SPLP" in sample ID have µg/L units; Sample IDs without "SPLP" in Sample ID have mg/kg units.
µg/L = Micrograms per liter.
mg/kg = Milligrams per kilogram.

Table F-2. Comparison of Total Arsenic and Synthetic Precipitation Leaching Procedure Results

Sampling Location	Total Arsenic (mg/kg)	SPLP Arsenic (ug/L)	Standard Liquid: Solid Ratio Used in SPLP (1)	Approximate SPLP Result if all Arsenic Dissolved (2)	Approximate Percent of Total Arsenic Dissolved in SPLP (3)
Boring SSA-SLP-1, 8-10 feet bgs	45.7	38	20	2,285	1.7
Boring SRR-2B, 10-12 feet bgs	187	73.4	20	9,350	0.8
Boring SRR-3B, 4-6 feet bgs	138(4)	50.3(4)	20	6,900	0.7

Notes:
Bgs=Below ground surface
Mg/kg=milligrams per kilogram
ug/L=micrograms per liter

The results for the deeper sample from boring SSA (SSA-SLP-10-12) are not included. The data for this sample indicated a low total arsenic concentration combined with a high SPLP result, and were identified as outliers relative to the trend seen in other areas of the Site. Based on consultation with EPA, the data for this sample were not used in the analysis, and the data for the shallower sample (SSA-SLP-8-10) are used instead to represent the SSA.

(1) Liquid:solid ratio of 20:1 is the standard specified for SPLP in ISM 2.0.

(2) The approximate SPLP concentration that would result from dissolution of all arsenic present in the solid was calculated by dividing the total arsenic concentration by 20, based on the standard SPLP liquid:solid ratio of 20:1. Note that the results were multiplied by 1,000 to convert from milligrams to micrograms.

(3) Percent arsenic dissolved was calculated by dividing the concentration of arsenic measured during the SPLP procedure by the approximate SPLP result if all arsenic dissolved times 100 percent. This calculation also assumes that a 20:1 ratio was used in the SPLP extractions performed on the filed samples.

(4) The total and SPLP arsenic values shown for SRR-3B represent the results for the duplicate sample, which were higher than the values for the parent sample. These higher values are used in the analysis of the data.

Table F-3. Southern Source Area 2012 Confirmatory Soil Analytical Results

			Location Name:	SSA1	SSA1	SSA2	SSA2	SSA3	SSA3	SSA3
			EPA Sample Name:	MC0AC4	MC0AA2	MC0AC6	MC0AA1	MC0AA3	MC0AC8	MC0AA7
			Sample Date:	2/29/2012	2/29/2012	2/29/2012	2/29/2012	2/29/2012	2/29/2012	2/29/2012
			Depth Interval (ft)	6-8	12-14	2-4	10-12	4-6	6-8	8-10
Analyte	**CRQL**	**PS**	**Unit**							
Arsenic	0.5	12	mg/kg	**18**	8.2	3.2	8.4	**97.0**	**80.0**	**193**

Notes:
CRQL = Contract Required Quantitation Limits
PS = 2006 ROD Performance Standard
Bolded and shaded values exceed the PS

			Location Name:	SSA3	SSA3	SSA4	SSA4	SSA4	SSA4
			EPA Sample Name:	MC0AC3	MC0AC5	MC0AB4	MC0AC0	MC0AB3	MC0AB8
			Sample Date:	2/29/2012	2/29/2012	2/29/2012	2/29/2012	2/29/2012	2/29/2012
			Depth Interval (ft)	10-12	12-14	4-6	6-8	8-10	12-14
Analyte	**CRQL**	**PS**	**Unit**						
Arsenic	0.5	12	mg/kg	**106**	**125**	**79.1**	**447**	**120**	**35.5**

Notes:
CRQL = Contract Required Quantitation Limits
PS = 2006 Performance Standard
Bolded and shaded values exceed the PS

			Location Name:	SSA5	SSA6	SSA7	SSA8
			EPA Sample Name:	MC0AB5	MC0AC9	MC0AA8	MC0AD0
			Sample Date:	2/29/2012	2/29/2012	3/1/2012	2/29/2012
			Depth Interval (ft)	6-8	12-14	6-8	12-14
Analyte	**CRQL**	**PS**	**Unit**				
Arsenic	0.5	12	mg/kg	**55.1**	7.2	**29.6**	**31**

Notes:
CRQL = Contract Required Quantitation Limits
PS = 2006 Performance Standard
Bolded and shaded values exceed the PS

Table F-4. Northern Source Area 2012 Confirmatory Soil Analytical Results

		Location Name:	SRR2A	SRR2A	SRR2A	SRR3A	SRR3A	SRR3A
		EPA Sample Name:	MC0AC2	MC0AB6	MC0AB0	MC0AB2	MC0AB9	MC0AB1
		Sample Date:	3/1/2012	3/1/2012	3/1/2012	3/1/2012	3/1/2012	3/1/2012
		Depth Interval (ft)	2-4	8-10	10-12	4-6	6-8	8-10
Analyte	**PS**	**Unit**						
Arsenic	12	mg/kg	9.6	**113**	**42.4**	**85.9**	**92.9**	**1210**

Notes:

PS = 2006 ROD Performance Standard

		Location Name:	SRR4	SRR4	SRR4	SRR4	SRR4	SRR5	SRR5
		EPA Sample Name:	MC0AC1	MC0AC7	MC0AA6	MC0AB7	MC0AA5	MC0AA4	MC0AA9
		Sample Date:	2/29/2012	2/29/2012	2/29/2012	2/29/2012	2/29/2012	2/29/2012	2/29/2012
		Depth Interval (ft)	4-6	6-8	8-10	12-14	14-16	12-14	14-16
Analyte	**PS**	**Unit**							
Arsenic	12	mg/kg	**62.1**	**6380**	**4770**	**786**	**333**	15.2	**569**

Notes:

PS = 2006 ROD Performance Standard

Sediment Sampling Results

Table F-5. Ecological Risk Sediment Sample Results (Jun 2013)

				Location Name:	**RA-RR-1**	**RA-RR-2**	**RA-RR-3**	**RA-RR-3-Dup**	**RA-RR-4**	**RA-RR-5**	**RA-SW3-1**	**RA-SW3-2**	**RA-SW3-3**	**RA-TRIB-1**	**RA-TRIB-2**	**RA-TRIB-2-DUP**
				EPA Sample Name:	MC0C77	MC0C78	MC0C79	MC0C80	MC0C81	MC0C82	MC0C45	MC0C46	MC0C47	MC0C60	MC0C64	MC0C63
				Sample Date:	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013
Analyte	**CRQL**	**BTAG**	**Unit**													
Aluminum	20	--	mg/kg		10500	11600	9560	9930	10900	10500	5210	3040	3660	6390	1720	1940
Antimony	6	2	mg/kg		0.47 J	1.7 J	0.54 J	0.56 J	0.60 J	0.50 J	1.6 J	0.87 J	1.8 J	0.45 J	0.32 J	0.20 J
Arsenic	1	9.8	mg/kg		**14.1**	**16.5**	5.6	5.7	8.6	5.9	**10.8 J**	5.4 J	8.7 J	3.7 J	2.8 J	3.0 J
Barium	20	--	mg/kg		87.1	51.5	61.4	63.6	80.2	67.1	144	82.7	108	35.2	18.4 U	22.6
Beryllium	0.5	--	mg/kg		1.6	1.4	0.70	0.74	0.94	0.71	0.52 J	0.28 J	0.41 J	0.62	0.19 J	0.26 J
Cadmium	0.5	0.99	mg/kg		**1.2 J**	0.15 J	0.22 J	0.21 J	0.41 J	0.23 J	0.90 U	0.88 U	1.1 U	0.52 U	0.46 U	0.46 U
Calcium	500	--	mg/kg		58300	3770	1340	1400	1870	2420	20500	23000	25000	3150	852	1380
Chromium	1	43.4	mg/kg		**53.5**	24.4	13.9	13.8	21.6	15.0	11.7	6.9	11.3	18.1	6.3	5.3
Cobalt	5	50	mg/kg		19.8 J	13.2 J	15.9 J	16.2 J	20.1 J	15.8 J	3.7 J	2.3 J	3.4 J	9.2	3.1 J	2.6 J
Copper	2.5	31.6	mg/kg		14.0	**34.0**	8.9	9.0	13.6	11.0	**39.8**	28.4	**43.4**	16.3	3.0	4.3
Iron	10	20000	mg/kg		**23100**	**52000**	18200	18900	**21800**	19600	15900	8860	14800	16800	11700	6130
Lead	1	35.8	mg/kg		**45.7 J**	27.3 J	27.2 J	27.7 J	33.4 J	28.9 J	**63.4**	32.1	**56.4**	26.2	9.7	12.3
Magnesium	500	--	mg/kg		12600	1740	1020	1040	1510	1350	2310	1950	2310	1850	588	851
Manganese	1.5	460	mg/kg		**1310**	399	**629**	**682**	**620**	**676**	382	260	359	217	97.7	112
Nickel	4	22.7	mg/kg		**25.1 J**	**25.9 J**	17.1 J	15.6 J	19.8 J	15.5 J	10.0	6.3 J	9.5	11.0	3.1 J	3.1 J
Potassium	500	--	mg/kg		340 J	526 J	299 J	288 J	444 J	308 J	898 U	884 U	1140 U	521 U	459 U	455 U
Selenium	3.5	2	mg/kg		5.6 U	3.2 U	3.5 U	3.7 U	3.8 U	3.6 U	1.3 J	1.2 J	1.2 J	3.7 UJ	3.2 UJ	3.2 UJ
Silver	1	1	mg/kg		**2.1**	**3.8**	**1.6**	**1.7**	**2.0**	**1.8**	**1.6 J**	0.97 J	**1.6 J**	**1.6**	**1.1**	0.64 J
Sodium	500	--	mg/kg		95.7 J-	53.6 J-	76.2 J	62.3 J-	93.1 J	86.6 J	95.8 J-	884 UJ	1140 UJ	55.7 J-	459 UJ	455 UJ
Thallium	2.5	--	mg/kg		4.0 U	2.3 U	2.5 U	2.6 U	2.7 U	2.6 U	4.5 U	4.4 U	5.7 U	2.6 U	2.3 U	2.3 U
Vanadium	5	--	mg/kg		44.0	32.2	23.9	24.8	27.4	26.0	15.8	9.3	11.4	16.5	5.7	5.9
Zinc	6	121	mg/kg		**156**	81.2	39.5	35.9	65.5	40.3	98.0	67.6	101	53.1	19.9	38.1

Notes:

CRQL = Contract Required Quantitation Limits

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				RA-TRIB-3	RA-TRIB-4	RA-TRIB-5	RA-TRIB-6	RA-VFW-1	RA-VFW-2	RA-VFW-3	RA-VFW-4	RA-VFW-5	RA-VFW-6	RA-VFW-7	RA-VFW-8
Location Name:															
EPA Sample Name:				MC0C65	MC0C66	MC0C67	MC0C68	MC0C69	MC0C70	MC0C71	MC0C72	MC0C73	MC0C74	MC0C75	MC0C76
Sample Date:				6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013
Analyte	**CRQL**	**BTAG**	**Unit**												
Aluminum	20	--	mg/kg	2240	5570	1700	2570	4020	4630	2490	1680	9910	14600	5830	4330
Antimony	6	2	mg/kg	0.30 J	0.44 J	0.26 J	6.4 UJ	0.40 J	0.44 J	0.25 J	0.20 J	0.65 J	0.75 J	0.41 J	0.32 J
Arsenic	1	9.8	mg/kg	3.0 J	3.3	3.1	**10.7**	**26.5**	**26.0**	**21.6**	**21.0**	**37.9**	**45.9**	**22.1**	**28.8**
Barium	20	--	mg/kg	18.9 U	57.8	20.4 U	24.3	32.0	41.0	23.8	22.6	88.1	126	48.6	40.9
Beryllium	0.5	--	mg/kg	0.36 J	0.50 J	0.31 J	0.37 J	0.36 J	0.47 J	0.26 J	0.30 J	0.84	1.2	0.62	0.47 J
Cadmium	0.5	0.99	mg/kg	0.47 U	0.14 J	0.040 J	0.070 J	0.080 J	0.080 J	0.040 J	0.030 J	0.29 J	0.40 J	0.19 J	0.10 J
Calcium	500	--	mg/kg	936	1420	1410	7540	5030	2580	2480	3280	10400	13400	49100	23600
Chromium	1	43.4	mg/kg	9.1	9.1	6.1	6.0	11.9	9.7	7.6	7.8	14.3	21.1	14.9	10.8
Cobalt	5	50	mg/kg	5.5	4.2 J	2.8 J	3.0 J	4.1 J	7.6 J	4.3 J	3.4 J	8.4 J	11.6 J	6.9 J	5.3 J
Copper	2.5	31.6	mg/kg	5.7	11.2	4.0	6.1	5.0	6.8	4.0	3.4	24.5	31.0	13.4	8.2
Iron	10	20000	mg/kg	9360	10600	6100	6730	9790	11100	8390	8210	15600	**22200**	13800	11100
Lead	1	35.8	mg/kg	13.0	**43.3 J**	12.9 J	21.5 J	25.1 J	25.3 J	12.8 J	11.2 J	**66.8 J**	**85.8 J**	33.1 J	24.1 J
Magnesium	500	--	mg/kg	1910	1200	866	3550	3950	3030	1690	2120	5420	7670	16300	6720
Manganese	1.5	460	mg/kg	114	120	69.9	146	199	353	243	135	257	375	222	247
Nickel	4	22.7	mg/kg	7.3	6.7 J	3.2 J	4.1 J	6.1 J	7.4 J	4.9 J	3.8 J	14.0 J	20.6 J	11.7 J	8.1 J
Potassium	500	--	mg/kg	662	177 J	43.6 J	173 J	398 J	555 J	182 J	26.2 J	760 J	1100 J	615 J	444 J
Selenium	3.5	2	mg/kg	3.3 UJ	0.41 J	0.39 J	3.7 U	3.3 U	3.5 U	3.7 U	3.4 U	0.85 J	1.6 J	3.8 U	0.56 J
Silver	1	1	mg/kg	0.90 J	0.99 J	0.60 J	0.64 J	0.91 J	1.0	0.79 J	0.78 J	**1.5 J**	**2.1 J**	**1.2**	0.98 J
Sodium	500	--	mg/kg	472 U	527 UJ	510 UJ	530 UJ	469 UJ	507 UJ	533 UJ	485 UJ	831 UJ	115 J-	68.4 J-	65.5 J-
Thallium	2.5	--	mg/kg	2.4 U	2.6 U	2.5 U	2.6 U	2.3 U	2.5 U	2.7 U	2.4 U	4.2 U	5.8 U	2.7 U	2.6 U
Vanadium	5	--	mg/kg	7.6	13.6	6.0	6.7	9.3	10.9	6.8	5.9	18.5	26.3	14.1	10.7
Zinc	6	121	mg/kg	24.5	49.6	23.9	31.2	27.3	31.9	20.5	19.2	78.4	113	70.4	48.6

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			Location Name:	RA-WET-1	RA-WET-10	RA-WET-2	RA-WET-3	RA-WET-4	RA-WET-5	RA-WET-6	RA-WET-7	RA-WET-8	RA-WET-9
			EPA Sample Name:	MC0C48	MC0C52	MC0C49	MC0C50	MC0C51	MC0C53	MC0C55	MC0C56	MC0C57	MC0C58
			Sample Date:	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013	6/11/2013
Analyte	**CRQL**	**BTAG**	**Unit**										
Aluminum	20	--	mg/kg	11000	17200	17100	12900	11300	14000	11500	9850	10600	13200
Antimony	6	2	mg/kg	0.58 J	1.1 J	1.8 J	0.78 J	1.1 J	1.6 J	1.3 J	0.68 J	**2.2 J**	0.82 J
Arsenic	1	9.8	mg/kg	8.2 J	**81.6 J**	**13.2 J**	**35.5 J**	**98.6 J**	**73.0 J**	**170 J**	8.9 J	**43.1 J**	**19.8 J**
Barium	20	--	mg/kg	82.9	84.2	170	91.1	89.8	92.5	54.4	49.0	119	84.0
Beryllium	0.5	--	mg/kg	0.91	1.2	1.1	1.0	1.0	1.4	1.6	0.97	1.5	1.1
Cadmium	0.5	0.99	mg/kg	0.45 U	0.30 J	0.43 U	0.46 U	0.50 U	0.74 U	0.47 U	0.50 U	**1.2**	0.52
Calcium	500	--	mg/kg	1270	13800	905	12000	18600	3350	34400	2680	3640	6140
Chromium	1	43.4	mg/kg	16.3	17.9	20.1	15.4	14.1	20.8	17.4	13.0	16.4	21.6
Cobalt	5	50	mg/kg	12.1	12.6	37.7	14.9	12.4	12.8	12.2	8.7	29.4	16.0
Copper	2.5	31.6	mg/kg	9.4	**42.2**	**43.3**	21.4	**57.7**	**33.4**	**53.5**	12.9	15.8	26.2
Iron	10	20000	mg/kg	**23100**	**27700**	**55400**	**21400**	**20200**	**32900**	**25400**	**21600**	**93100**	**24700**
Lead	1	35.8	mg/kg	15.7	**54.2**	33.2	**46.9**	**59.5**	**129**	**59.8**	21.6	**55.7**	**81.6**
Magnesium	500	--	mg/kg	2230	12300	3580	5300	8030	3130	20300	1400	3760	4720
Manganese	1.5	460	mg/kg	**1040**	358	**1020**	**686**	**565**	**629**	**470**	128	**6290**	**663**
Nickel	4	22.7	mg/kg	14.3	**23.0**	**42.2**	21.2	19.6	**25.6**	20.6	15.8	**23.1**	**23.8**
Potassium	500	--	mg/kg	622	2390	745	895	662	741 U	1410	498 U	1100	673
Selenium	3.5	2	mg/kg	3.1 UJ	1.1 J	3.0 UJ	3.2 UJ	3.5 UJ	0.76 J	3.3 UJ	3.5 UJ	3.8 UJ	3.4 UJ
Silver	1	1	mg/kg	**2.2**	**3.2**	**4.3**	**2.1**	**2.0**	**3.2**	**2.4**	**2.1**	**5.8**	**2.4**
Sodium	500	--	mg/kg	75.2 J	112 J	97.0 J	90.5 J	93.2 J	101 J	79.5 J	102 J	148 J	86.3 J
Thallium	2.5	--	mg/kg	2.2 U	2.9 U	2.2 U	2.3 U	2.5 U	3.7 U	2.3 U	2.5 U	2.7 U	2.4 U
Vanadium	5	--	mg/kg	22.2	31.5	30.7	24.2	23.0	35.8	22.3	24.4	26.4	28.0
Zinc	6	121	mg/kg	31.1	85.7	60.2	56.0	84.0	75.3	41.7	33.1	70.8	79.4

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Surface Water Sampling Results

Table F-6. Ecological Risk Surface Water Sample Results

				Location Name:	**RA-SW3-SW-1**	**RA-SW3-SW-1**	**RA-SW-TRIB-1**	**RA-SW-TRIB-1**	**RA-SW-TRIB-2**	**RA-SW-TRIB-2**
				EPA Sample Name:	MC0C85	MC0C86	MC0C88	MC0C87	MC0C89	MC0C90
				Fraction:	Dissolved	Total	Dissolved	Total	Dissolved	Total
				Sample Date:	6/12/2013	6/12/2013	6/12/2013	6/12/2013	6/12/2013	6/12/2013
Analyte	**CRQL**	**BTAG**	**Unit**							
Aluminum	20	87	ug/l		**169**	**93.0**	**173**	20.0 U	20.0 U	**609**
Antimony	2	30	ug/l		2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Arsenic	1	5	ug/l		**104**	**107**	1.9	2.2	2.3	2.4
Barium	10	4	ug/l		**57.1**	**55.6**	**32.4**	**25.8**	**30.6**	**34.6**
Beryllium	1	0.66	ug/l		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Cadmium	1	0.25	ug/l		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Calcium	500	116000	ug/l		45600	44500	31300	26400	32500	30300
Chromium	2	85	ug/l		0.73 J	3.0	0.79 J	1.8 J	0.65 J	2.0
Cobalt	1	23	ug/l		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Copper	2	9	ug/l		2.0 U	2.0 U	2.8	2.0 U	2.0 U	4.2
Iron	200	300	ug/l		235	**330**	**379**	200 U	200 U	**1030**
Lead	1	2.5	ug/l		1.0 UJ	**6.6 J**	**3.1 J**	1.0 UJ	1.0 UJ	**6.0 J**
Magnesium	500	82000	ug/l		16600	16200	12700	10600	12700	12300
Manganese	1	120	ug/l		3.3	17.5	15.2	4.3	4.0	29.2
Mercury	0.2	0.026	ug/l		0.20 UJ	0.20 UJ	0.20 UJ	0.20 UJ	0.20 UJ	0.20 UJ
Nickel	1	52	ug/l		1.0 U	4.0	1.0 U	1.5	1.0 U	1.8
Potassium	500	53000	ug/l		2660	2600	2070	1750	2080	2040
Selenium	5	1	ug/l		5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Silver	1	3.2	ug/l		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Sodium	500	680000	ug/l		2410	2820	6950	5620	6510	6400
Thallium	1	0.8	ug/l		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vanadium	5	20	ug/l		5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Zinc	2	120	ug/l		2.9	21.2	8.6	4.8	2.8	13.1

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Phytoremediation Shallow Soil Sampling Results

Table F-7: Average Arsenic Shallow Soil Sample Result Summary

Plot	Arsenic Concentration (mg/kg)				
	Baseline (April 2010)	**Second Post-Harvest (October 2011)**	**Third Post-Harvest (November 2012)**	**Fourth Post-Harvest (October 2013)**	**Fifth Post-Harvest (October 2014)**
A	702	520	573	595	672
B	201	64.4	55.2	86.5	82.4
C	227	171	216	162	**279**
D	315	264	178	95.0	119
E	372	224	297	277	319
F	340	191	227	179	212
G	384	220	109	123	143
H	864	529	**969**	592	**875**
I	1,004	313	407	528	717
J (upstream)	583	186	274	230	443
J (downstream)	469	236	326	260	383

Cleanup criteria = 140 mg/kg