START 3

Superfund Technical Assessment and Response Team 3 – Region 8

United States
Environmental Protection Agency
Contract No. EP-W-05-050

PHASE II – ANALYTICAL RESULTS REPORT
FOR TARGETED BROWNFIELDS ASSESSMENT

LARAMIE YTTRIUM PLANT (Including Portions of the Midwest/Standard Oil Refinery)
Laramie, Albany County, Wyoming

TDD No. 1204-04

October 29, 2012

URS
OPERATING SERVICES, INC.

In association with:
Garry Struthers Associates, Inc.
LT Environmental, Inc.
OTIE
TechLaw, Inc.
Tetra Tech EMI

LARAMIE YTTRIUM PLANT TBA PHASE II ARR

LARAMIE YTTRIUM PLANT
(Including Portions of the Midwest/Standard Oil Refinery)
Laramie, Albany County, Wyoming

EPA Contract No. EP-W-05-050
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Prepared By:
Jen Patureau
Chemist

URS Operating Services, Inc.
999 18th Street, Suite 900
Denver, CO 80202-2409

Approved: _____ Date: _____
William Rothenmeyer, Site Assessment Manager, EPA, Region 8

Approved: Charles W. Baker Date: 10/29/12
Charles W. Baker, START 3 Program Manager, UOS

Approved: Jen Patureau Date: 10/29/12
Jen Patureau, Chemist, START 3, UOS

DISTRIBUTION LIST

U.S. ENVIRONMENTAL PROTECTION AGENCY

William Rothenmeyer (2 copies)	Site Assessment Manager, EPA Region 8

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URS OPERATING SERVICES, INC.

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ANALYTICAL RESULTS REPORT
for
PHASE II ENVIRONMENTAL SITE ASSESSMENT

LARAMIE YTTRIUM PLANT TBA
(Including portions of the Midwest/Standard Oil Refinery)
Laramie, Albany County, Wyoming

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APPENDICES

1.0 INTRODUCTION

This document is submitted in accordance with the task elements specified in Technical Direction Document (TDD) 1204-04 dated April 4, 2012, issued to URS Operating Services, Inc. (UOS) Superfund Technical Assessment and Response Team 3 (START) in Region 8 of the U.S. Environmental Protection Agency (EPA). The purpose of this TDD is to perform a Targeted Brownfields Assessment (TBA) at the Laramie Yttrium Plant property in Laramie, Albany County, Wyoming. The scope of services included providing an updated Phase I report, developing a Field Sampling Plan, performing a Phase II Environmental Site Assessment (ESA) to investigate and delineate areas of contamination located on the property, outlining cleanup options with associated cost estimates in a final Phase II Analytical Results Report (ARR), and submitting a Property Profile Form (PPF).

The Laramie Rivers Conservation District (LRCD) has requested assistance from the EPA with characterizing environmental conditions at the Laramie Yttrium Plant property in Laramie, Albany County, Wyoming (Figure 1). The LRCD has proposed redeveloping the property as an office building with teaching gardens and an arboretum. This Phase II ARR includes the analytical results for samples collected on the property from June 4 through June 7, 2012 (Figure 2).

Field samples collected from the property included surface soil, subsurface soil, groundwater, investigation-derived waste water and soil, and air monitoring filter cassettes. Surface soil samples collected from grid area locations across the site were analyzed for semi-volatile organic compounds (SVOCs) with polycyclic aromatic hydrocarbons (PAHs) by selective ion monitoring (SIM). Surface soil samples were collected at a greater sample density from sub-grid location A (Figure 3) and were analyzed for metals only. These samples were analyzed onsite in zip-top polypropylene bags or in situ by X-Ray Fluorescence (XRF), and confirmation samples were laboratory-analyzed for target analyte list (TAL) total metals. Subsurface soil samples in sub-grid locations B and C (Figures 4 and 5) were also analyzed in situ for metals by XRF with confirmation samples analyzed for TAL total metals. All metals laboratory confirmation samples were prepared in a controlled environment prior to submission.

Groundwater samples were analyzed for volatile organic compounds (VOCs), SVOCs, gasoline range organics (GRO), diesel range organics (DRO), TAL total metals, and total organic carbon (TOC). UOS personnel used a truck-mounted direct-push Power Probe® to penetrate and core the soil at the property for collection of all subsurface soil samples and shallow groundwater samples. Investigation-derived waste water and soil were analyzed for VOCs, SVOCs, DRO, GRO, and TAL total metals. Waste water was also analyzed for TOC, and waste soil was analyzed by Toxicity Characteristic Leaching Procedure

(TCLP) for the Resource Conservation and Recovery Act (RCRA) 8 metals. Air filter samples were analyzed by Asbestos Hazard Emergency Response Act (AHERA) transmission electron microscopy (TEM) method for asbestos fibers.

Soil and water samples were shipped via FedEx to CT Laboratories, LLC in Baraboo, Wisconsin for VOC, SVOC/PAH, DRO, GRO, TAL total metals, TCLP metals, and TOC analysis. Filter samples were hand-delivered to TechLaw, Inc., EPA Environmental Services Assistance Team (ESAT) Region 8 Laboratory in Golden, Colorado for AHERA TEM analysis. This ARR is intended to be used in conjunction with the Laramie Yttrium Plant TBA Phase II Field Sampling Plan (FSP).

1.1 PURPOSE

The purpose of this Phase II ESA was to gather sufficient environmental data to address the potential recognized environmental conditions and additional environmental concerns identified in the Phase I assessment (UOS 2012a) with respect to the proposed uses of the property by the LRCD. The original objectives of this Phase II ESA were to:

- Install six monitoring wells on the property and conduct one round of groundwater sampling for VOCs, SVOCs, DRO, GRO, TAL total metals, and TOC;
- Determine the extent of PAHs in surface soil across the property, and statistically analyze any discovered contaminants for toxicological impact;
- Determine the extent of metals contamination in sub-grid location A (Figure 2) and associated removal costs; and
- Sample subsurface soil in sub-grid locations B and C (Figure 2) for TAL metals to determine the source of groundwater metals contamination at former sampling locations YPGW06 and YPGW15.

1.2 DETAILED SCOPE OF SERVICES

The scope of services for this Phase II includes environmental sampling and reporting requirements that support the TBA Recipient's desire to develop the property as an office building with teaching garden and arboretum.

The scope of services for this Phase II ESA is in compliance with ASTM International (ASTM) E1903-97, Standard Guide for Environmental Site Assessments: Phase II Environmental Site

Assessment Process (ASTM 2011). This scope of services may be modified by EPA as more information regarding property conditions becomes available.

1.3 SIGNIFICANT ASSUMPTIONS, LIMITATIONS, AND EXCEPTIONS

The LRCD has provided a TBA application and historical reports on the Laramie Yttrium Plant and surrounding properties from which background information was taken. Assumptions for the Phase I ESA were made using these documents as a guide to describe potential contamination. The Phase II sampling plan for this property was prepared based on information obtained from the updated Phase I assessment (UOS 2012a), related resources, and site reconnaissance. No access limitations were found during the Phase II ESA.

1.4 DEVIATIONS

Notable deviations from the surface soil portion of the field sampling plan include submitting sieved soil samples for XRF metals confirmation analysis, instead of grab samples. This was done in order to obtain better correlation between XRF and laboratory results, and also to more appropriately assess the toxicological risk associated with respirable particulates in the soil.

Deviations from the subsurface soil sampling plan include sampling in strategic locations to locate contaminants consistent with the migration of groundwater, rather than a standardized grid formation around former sampling locations YPGW06 and YPGW15. The area upgradient of former sample location YPGW06 was partially inaccessible due to a large mound of soil and concrete debris. Three subsurface soil locations were investigated in the most appropriate and accessible areas of this vicinity.

2.0 BACKGROUND INFORMATION

2.1 LOCATION AND LEGAL DESCRIPTION

The Yttrium Plant property is located in Laramie, Albany County, Wyoming (Figure 1). The Yttrium Plant property covers approximately 5.62 acres, including the new parcel of land to the east. The address is 971 North Cedar Street, Laramie, Wyoming, 82072, and the property location is shown in Figure 1. The legal description of the property is the SE quarter of Section 29, T. 16 N., R. 73 W. (U.S. Geological Survey [USGS] 1963, Wyoming Department of Transportation

[WYDOT] 2009). The geographic coordinates of the property are 41° 19′ 17.4″ north latitude and 105° 35′ 55.68″ west longitude (EDR 2012).

2.2 PROPERTY AND VICINITY GENERAL CHARACTERISTICS

The 5.62-acre Laramie Yttrium Plant property and adjacent properties were all originally part of the Midwest and Standard Oil refineries. The Laramie Yttrium Plant property includes two large rows of concrete still supports constructed by the refinery in 1920. The supports are connected to an underground ventilation system, the remains of which are evidenced by four bricked "manholes" (Nickle 2011). These structures are currently in a dilapidated state, with protruding rebar, debris, and extreme vandalism. The remainder of the property contains some localized piles of debris, drums of unidentified contents, and access to the adjacent neighborhood via a gap in the boundary fence on the south side (Figure 2).

The property does not have an operational water or sewage system, although it had a water system at the time of its construction in 1920 (Nickle 2011).

Photographs of the property are included in Appendix A.

2.3 HISTORICAL USE OF THE PROPERTY

The Laramie Yttrium Plant property was originally part of the Midwest and Standard Oil refineries, owned by British Petroleum (BP)/Amoco. The Midwest and Standard Oil refineries began construction in September of 1919 and April of 1920, respectively. Due to the overlapping dates of construction for the two adjacent refineries, it is not clear which of the two contained the property, although a map contemporary with the time of construction depicts the majority of the property's ruins on the parcel owned by Standard Oil. By 1926, both plants were being operated by Midwest under management by John F. Cullen (WYDOT 2009). The refinery was operational from 1921 until 1932.

The existing concrete ruins on the property were originally supports for a system of refinery stills and ovens, used to fractionate distillates taken from the Midwest refinery. The petroleum was distilled into various constituents using a series of ovens with increasing temperatures to obtain oils with different boiling points. Products manufactured by the Laramie refinery include gasoline, kerosene, furnace oil, distillate, fuel oil, and various grades of road oils which were shipped to Salt Lake City via the adjacent rail line (WYDOT 2009).

The still supports on the property were constructed in at least three different phases. Those on the southeast side of the property were built earliest, of unreinforced concrete. The supports on the southwest side were built afterwards, and constructed with a softer concrete and rebar reinforcement. The supports around which the large green building was later built are the newest, and are made of a stronger concrete. These were connected underground by a set of ventilation tunnels, which routed hot air from the stills to a set of four small smokestacks. The locations of these stacks are still visible on the property as open, brick-lined holes near the support structures (Nickle 2011).

After the refinery closed in 1932, the structures on the property were kept intact and a night guard was stationed on the property in the event of reopening. The property was sold to Dewey and Mildred Burris on April 8, 1940, and Dewey Burris sold his parcel to United States Yttrium, Inc. on October 1, 1956. The green three-story building on the Yttrium Plant property was constructed in 1956 by the Spiegelberg Lumber Company of Laramie. This building incorporates some of the original reinforced concrete walls. The tall central component was constructed to be an elevator shaft, although the elevator was never installed. U.S. Yttrium, Inc. used this property as a pilot plant for processing and refining yttrium ore. Originally, the ore was processed in the building located centrally on the property, until the operation was moved over to the larger green building. No commercial product was ever produced at this property, although ore was stored in a small "bunker-like" building to the north of the green building, which has since been removed (WYDOT 2009, RETEC 2004).

In 1972, Hubert Nickle bought the property from Howard Carroll. Since that time, it has been leased to several businesses, including Heggie Logging; Jeff Wagner, who used it as a car paint and body shop; and Fred Pier, who used the property to store trucks and solid waste-collecting material (WYDOT 2009). The property has been abandoned for approximately the last 20 years (Nickle 2011).

2.4 DESCRIPTIONS OF STRUCTURES, ROADS, AND OTHER SITE IMPROVEMENTS

The Laramie Yttrium Plant property is located on North Cedar Street in Laramie, Wyoming. This road was constructed after the refinery property was established in 1919. The largest building on the property has a second and third story, which were built onto the original reinforced concrete

still supports in 1956. This building was constructed in 1956 by U.S. Yttrium, Inc. as a pilot plant to process and refine yttrium ore (WYDOT 2009).

2.5 CURRENT USES OF THE ADJOINING PROPERTIES

The property directly across North Cedar Street to the west of the Laramie Yttrium Plant property was previously part of the Midwest/Standard Oil Refinery. It is now an open space owned by BP/Amoco, which has been remediated with 10 inches of topsoil due to asbestos contamination. The remediation was performed as part of an effort to develop the property into a park space (LRCD 2011). There are no structures on this property. To the north of the Yttrium Plant property, there is an open field, followed by an enclosed storage facility. The property directly to the east is an operational concrete processing plant, followed by a railyard which was previously used to transport products from the refinery. The southern boundary of the Laramie Yttrium Plant property is directly adjacent to a residential neighborhood, an alley of which is open to the property.

2.6 SITE CHARACTERISTICS

2.6.1 Geological Setting

The Laramie Yttrium Plant property is located within the Laramie structural basin. The basin is bounded on the west by the Medicine Bow Mountains, on the east by the Laramie Range, and on the south by the Front Range (Casper Aquifer Protection Plan [CAPP] 2002). The area is heavily faulted with both normal and reverse faults trending northwest to southeast.

2.6.2 Geology

The property is underlain by alluvial floodplain deposits from the Laramie River. The deposits are composed of interlayered sands and gravels. Alluvium is typically 20 to 30 feet thick in the area and extends along the Laramie River for about 0.5 mile east of the property, 12 miles west and south of the property, and approximately 30 miles north of the property (URS 1994).

Beneath the alluvium lie three major rock units. At the surface is the Satanka Shale, followed by the Casper Formation, followed by the lowermost unit, the Sherman Granite.

The Satanka Shale is Permian in age and unconformably overlies the Casper Formation. It consists mainly of red shale with interbedded siltstone and sandstone layers and is approximately 250 to 320 feet thick in the area. The lower 20 feet has several thin red and white sandstone beds. These beds are similar to those found in the Casper Formation. The Satanka Shale is exposed along the western margin of the Laramie Range, near the eastern city limits of Laramie (CAPP 2002).

The Pennsylvanian-Permian Casper Formation unconformably overlies the Fountain Formation (a less than 50 feet thick layer of irregularly distributed arkosic sandstone, with minor amounts of siltstone) where present or the Precambrian basement rocks where the Fountain is absent. It comprises marine and eolian sandstones, interbedded with marine limestone and minor amounts of shale (CAPP 2002).

The bedrock unit is the Sherman Granite and lies about 800 to 1,000 feet below ground surface (bgs) at the property. It is Precambrian in age and consists of coarsely crystalline igneous rocks (CAPP 2002).

2.6.3 Hydrogeology

There is an unconfined water table aquifer in the alluvial material underlying the property, which was found in the previous Phase II site assessment to be 4.9 to 7.95 feet bgs (UOS 2011). The alluvial deposits are expected to be highly permeable and are assigned a hydraulic conductivity of approximately 10^{-2} to 10^{-4} centimeters per second (cm/sec) (USGS 1987). The fractured sandstone of the Casper Aquifer is the principal water-bearing unit in the area. The Casper Aquifer is under artesian pressure in the Laramie area and is recharged to the east in the foothills of the Laramie Range (URS 1994). Wells drawing water from the Casper Aquifer can be up to 1,500 feet deep west of the property, and the hydraulic conductivity of the aquifer is estimated to be between 10^{-4} to 10^{-6} cm/sec (URS 1994, USGS 1987).

Groundwater typically flows in a northwesterly direction toward the Laramie River. Taken in its entirety, the Satanka Shale is a regional confining layer overlying the Casper Aquifer. However, permeable sandstones in the Satanka Shale provide water to many domestic and stock wells in the Laramie area. Approximately 300 feet of interbedded shale, siltstone, and sandstone isolates the Casper Aquifer from overlying aquifers,

including permeable beds within the Satanka Shale. The faulting discussed above causes a high level of interconnectivity between the rock units in the area. Because of this, groundwater can easily and quickly travel to greater distances (CAPP 2002).

Sixteen temporary groundwater monitoring wells were installed during the October 2011 Phase II site assessment, with depths to groundwater ranging from 4.9 to 7.95 feet bgs. During the June 2012 Phase II site assessment, six additional groundwater monitoring wells were installed on the property, with depth to water at all locations at approximately 6 feet bgs. Additional survey data acquired in July 2012 indicated that these levels more precisely range from 5.78 to 7.82 feet bgs in the summer (Appendix G).

2.6.4 Hydrology

The Laramie Yttrium Property is essentially flat. Local drainage is through ditches that lead to the west toward the Laramie River. The Laramie River is located approximately 0.25 mile to the west of the site. The Union Pacific Railroad yard is immediately east of the site and has been raised approximately 3 feet above the local ground surface. Groundwater flows through culverts under the tracks northwest towards the site, and then drains to the Laramie River (URS 1994).

The average annual flow rate of the Laramie River between 1973 and 2006, as measured near Bosler, Wyoming (approximately 18 miles downstream from the site), is 147.9 cubic feet per second (USGS 2011).

2.6.5 Meteorology

The Laramie Yttrium Plant property is located in a semiarid climate zone. The mean annual precipitation is 11.16 inches (NOAA 2011). The net annual precipitation as calculated from precipitation and evapotranspiration data obtained from the database is 5.1 inches (University of Delaware 1986). The 2-year, 24-hour rainfall event for this area is 1.5 inches (Dunne and Leopold 1978).

3.0 PROJECT DATA QUALITY OBJECTIVES

The EPA Data Quality Objectives (DQO) process is a seven-step systematic planning approach to develop acceptance or performance criteria for EPA-funded projects. The seven steps of the DQO process are:

Step 1 State the Problem;
Step 2 Identify the Decision;
Step 3 Identify Inputs to the Decision;
Step 4 Define the Study Boundaries;
Step 5 Develop a Decision Rule;
Step 6 Specify Limits on Decision Errors; and
Step 7 Optimize the Design for Obtaining Data.

UOS developed these DQOs based on information provided by the EPA, the LRCD, and research to compile the Phase I report on this property. The approved Phase II Field Sampling Plan (FSP) contains a complete step-by-step explanation of the DQO process for this property (UOS 2012b).

The five questions identified in the DQO process to be answered by this investigation were:

1. What is the source and extent of metals contamination found in groundwater on the north side of the property?
2. What is the extent of existing metals contamination in surface soil on the central western portion of the property (previous sample location YPSS09)?
3. Are existing PAH concentrations in surface soil throughout the property a threat to human health?
4. What are the cleanup options available to remediate the property satisfactorily for its planned use?
5. Will trace concentrations of asbestos found in surface soil throughout the property require special health and safety precautions during remediation?

Data review determined that sufficient data of usable quality were collected to answer the five questions identified in the DQO process. Data review summaries are presented in Appendix C.

4.0 SAMPLING ACTIVITIES AND LOCATIONS

START conducted sampling activities in accordance with the approved FSP on June 4 through 6, 2011. The sampling area consisted of the full 5.62 acres of the property. During the August 2011 Phase I site reconnaissance, a Ludlum Model 12 instrument with a 44-9 probe for alpha, beta, and gamma radiation detection was used to screen the entire property. The highest site readings were found to be less than the action level of 3 times background. All subsurface soil samples collected during the June 2012 Phase II sampling event were also screened with the Ludlum Model 12, with all readings significantly less than 3 times background levels.

4.1 SURFACE SOIL SAMPLING

4.1.1 XRF Samples

A total of 50 surface soil samples from sub-grid location A were collected from 0 to 6 inches bgs. Samples were collected with stainless steel scoops, placed into zip-top polypropylene bags and homogenized for onsite XRF analysis. Eleven additional *in situ* surface soil screening XRF readings were also collected in the vicinity of this area to determine the extent of localized surface soil metals contamination (Figure 3).

Eighteen bagged surface soil samples from sub-grid location A were prepared in a controlled environment to more accurately assess the concentration of respirable metals within the sample. Samples were heated in individual aluminum tins and sieved with a 60-mesh screen. Sample contents were then placed into a polyethylene XRF cup and covered with mylar film for XRF analysis.

4.1.2 Laboratory Samples

Thirteen prepared surface soil samples and one prepared surface soil duplicate sample were submitted for TAL total metals confirmation analysis. These samples were submitted in XRF cups with no additional preparation.

Thirty surface soil samples and two duplicates were collected in a grid throughout the property for SVOC/PAH analysis by SIM. Samples were collected from 0 to 6 inches bgs with stainless steel scoops, then placed in 4-ounce (oz) glass jars. All surface soil samples were sent to CT Laboratories, LLC via FedEx under UOS chain-of-custody procedures.

Photographs are included in Appendix A, and sample locations are shown in Figure 2.

4.2 SUBSURFACE SOIL SAMPLING

4.2.1 XRF Samples

Three subsurface soil boring locations near sub-grid location B and five subsurface soil boring locations near sub-grid location C were analyzed *in situ* by XRF at 1-foot intervals. Subsurface sample locations were chosen in order to delineate metals contamination in groundwater at former locations YPGW06 and YPGW15. One *in situ* XRF reading was collected at a 12-inch depth in sub-grid location A, to determine the depth of metals contamination. A total of 23 *in situ* XRF readings were collected. Four subsurface soil samples were collected into zip-top bags with dedicated polyethylene scoops for controlled environment preparation in the same manner as described in Section 4.1.1.

4.2.2 Laboratory Samples

Two prepared subsurface soil samples were submitted in XRF cups for TAL total metals confirmation analysis. All subsurface soil samples were sent to CT Laboratories, LLC via FedEx under UOS chain-of-custody procedures.

Photographs are included in Appendix A, and sample locations are shown in Figure 2.

4.3 GROUNDWATER SAMPLING

A Powerprobe® was used to hydraulically push a coring device to install six groundwater monitoring wells on the Laramie Yttrium Plant property. The locations were determined based on overall access and geographical representation of the site. The wells were constructed with 2-inch polyvinyl chloride (PVC) casing and screen. Depth to groundwater for all six sample locations was approximately 6 feet bgs. All six wells were installed to a depth of 12 feet bgs, with screen from 2 to 12 feet bgs. A total of six samples and one duplicate sample were collected from the six installed groundwater monitoring wells. Groundwater well construction details, water levels, and water quality data collected onsite can be found in Table 3.

Groundwater was extracted using a dedicated bailer at each sample location. Before sampling each well, water quality parameters were monitored with a Horiba U-52 multi-parameter meter

until readings stabilized to within 10 percent, and at least 3 times the well casing volume were allowed to purge. For each groundwater sample, six 40-mL volatile organic (VOA) vials preserved with hydrochloric acid were filled for VOC and GRO analysis. Four 1-liter amber bottles were filled for SVOC and DRO analyses. One 500-mL polyethylene bottle preserved with nitric acid was filled for TAL total metals analysis. One 500-mL polyethylene bottle preserved with sulfuric acid was filled for TOC analysis. Upon sampling each groundwater monitoring well, sample containers were labeled and placed in coolers with ice for preservation. All samples were sent to CT Laboratories, LLC for their respective analyses under UOS chain-of-custody procedures.

GPS data and photographs were collected at each sample location. Photographs are included in Appendix A, and sample locations are shown in Figure 2.

4.4 ASBESTOS AIR MONITORING

An SKC AirChek XR5000 personal sampling pump was used to collect air monitoring filter samples for asbestos analysis. One 0.8-µm mixed cellulose ester (MCE) filter cassette sample was collected over an 8-hour period on each June 5, 2012 and June 6, 2012. These were analyzed by AHERA TEM method for asbestos fibers.

4.5 INVESTIGATION-DERIVED WASTE CHARACTERIZATION

Purge water from all groundwater monitoring wells was combined and containerized in a 55-gallon drum compliant with Department of Transportation (DOT) specifications. Water within the drum was sampled with a peristaltic pump for the full suite of property groundwater analyses, as described in Section 4.3. Extraneous subsurface soil generated from soil borings was containerized in a 5-gallon bucket with a lid. This soil was homogenized, and six 4-oz sample jars were filled for VOC, SVOC, DRO, GRO, TAL total metals, and TCLP RCRA 8 metals analyses.

5.0 DATA QUALITY ASSESSMENT

5.1 FIELD DATA QUALITY ASSESSMENT

All applicable Technical Standard Operating Procedures (TSOPs) were followed as prescribed in the approved FSP (UOS 2012b).

Two field replicate soil samples were collected, and the comparison of the results indicates acceptable quality overall. Four analytes were found to have relative percent differences (RPD) above 35 percent, which is likely attributed to very low concentrations of analytes found in the sample. In all four cases, analyte concentrations for both samples were less than 1 part per million (ppm). One field duplicate water sample was also collected, and the comparison of the results indicates acceptable quality for all analytical methods except metals and DRO. The RPDs were above 20 percent for 11 metals analytes, which is likely due to the non-homogenous nature of the sample. RPDs for the soil and water duplicate samples are presented in Tables A and B, Section 5.2.3.

One trip blank, LYGW08, was shipped with the VOC and GRO samples. The trip blank had no detections for VOC. Analytical results of the trip blank are presented in Table 7.

All appropriate documentation including the log book, photo documentation, sample locations, sample handling, and chain-of-custody procedures were followed in the field. Appendix B includes laboratory sample results, Appendix C includes internal data reviews of the sample results, and Appendix D includes XRF data.

5.2 DATA QUALITY INDICATORS

A data quality review for project data was conducted by the project manager to determine data quality and usability. Additionally, all analytical data were reviewed by a UOS chemist. The project data quality review included:

- Quality assessment and quality control (QA/QC) review of field-generated data and observations;
- Evaluation of QC samples including trip blanks, field replicates, and matrix spike laboratory control samples to assess the quality of the field activities and laboratory procedures;
- Assessment of the quality of data measured and generated in terms of accuracy, precision, and representativeness; and
- Summary of the usability of the data, based upon the assessment of data conducted during the previous steps.

5.2.1 Bias

Bias is systematic or persistent distortion of a measurement process that causes errors in one direction. The extent of bias was determined by an evaluation of laboratory initial calibration/continuing calibration verification, laboratory control spike/laboratory control spike duplicates, blank spikes, matrix spike/matrix spike duplicate (MS/MSD), and method blanks. Laboratory data reviews indicate that, based on laboratory blank contamination and check sample interference, water samples may be biased low for some metals analytes, including arsenic, lead, and thallium. Matrix interference indicates mercury in water samples should be considered an estimated value. Data reviews are included in Appendix C.

5.2.2 Sensitivity

Sensitivity generally refers to the capability of a method or instrument to discriminate between small differences in analyte concentration and is generally discussed as detection limits. In most cases, reporting limits of the laboratory methods are below the range of the Wyoming Voluntary Remediation Program (VRP) residential soil cleanup levels that were used to evaluate this property. The exception to this includes SVOC/PAH compounds in soil samples that required dilution due to matrix interference. If Wyoming VRP migrations to groundwater (MGW) cleanup levels are used to evaluate this property, additional reporting limits for soil SVOC analytes would be included in this exception.

XRF

The XRF detection limit is below Wyoming VRP residential soil cleanup levels for all metals analytes except arsenic. In addition, the validation process for prepared and sieved XRF samples raises the arsenic reporting limit to 10 percent of the lead value in cases where arsenic is detected at concentrations less than 10 percent of lead concentration. This is because lead L alpha (L_α) and arsenic K alpha (K_α) spectral peaks read by the instrument are very similar in wavelength and, therefore, a large lead peak can mask the arsenic peak entirely. The XRF instrument uses algorithmic correction and secondary spectral peaks to obtain concentration values in this situation. This quality check is an effort to ensure metals concentrations generated by XRF are legitimate for those elements

that can interfere with each other. Validated XRF data are summarized in Table 16, with complete results and Form Is included in Appendix D.

5.2.3 Precision

Precision is the measure of agreement among repeated measurements of the same property under identical, or substantially similar, conditions and is expressed as the RPD between the sample pairs. Three replicate soil samples and one duplicate water sample were collected from this property in order to determine precision. The laboratory also conducts duplicate analysis on select samples.

Two of the three soil field duplicates had one or more RPDs greater than the 35 percent criteria set by the CLP National Functional Guidelines (NFG) for data review (EPA CLP 2008). The variation in percent difference is likely attributed to low concentrations of analytes in the sample. In all four analytes with RPD exceedances, concentrations for both samples was less than 1 ppm.

The groundwater field duplicate indicates acceptable quality for all analytical results except metals and DRO. RPDs were above 20 percent for 11 metals analytes, which may be due to low concentrations of analytes in some cases, or sediment present in the water matrix. Many RPDs for the soil and water duplicate samples are presented in Tables A and B, below:

TABLE A
Relative Percent Differences in Duplicate Soil Samples
Results in milligrams per kilogram (mg/kg) parts per million (ppm)

Analyte			
Metals	**LYSOAA01**	**LYSOAA01D**	**RPD (%)**
Aluminum	6,550	6,750	3
Antimony	2	2.1	5
Arsenic	7.8	7.9	1
Barium	240	242	1
Beryllium	0.42	0.43	2
Cadmium	1.9	2	5
Calcium	20,600	21,400	4
Chromium	17.5	17.5	0

TABLE A
Relative Percent Differences in Duplicate Soil Samples
Results in milligrams per kilogram (mg/kg) parts per million (ppm)

Analyte			
Cobalt	5.2	5.2	0
Copper	31.1	31.6	2
Iron	24,100	24,600	2
Lead	523	555	6
Magnesium	3,590	3,690	3
Manganese	348	358	3
Mercury	0.27	0.39	**36**
Nickel	19.4	19.9	3
Potassium	2078	2070	0.39
Sodium	280.4	283.3	1
Vanadium	28	28.2	1
Zinc	193	198	3
SVOCs	**LYSOA05***	**LYSOA06***	**RPD (%)**
2-Methylnaphthalene	0.22	0.22	0
Anthracene	0.11	0.1	10
Benzo(a)anthracene	0.39	0.39	0
Benzo(a)pyrene	0.38	0.4	5
Benzo(b)fluoranthene	0.26	0.26	0
Benzo(g,h,i)perylene	0.29	0.46	**45**
Benzo(k)fluoranthene	0.035	0.062	**56**
Chrysene	0.57	0.53	7
Dibenzo(a,h)anthracene	0.13	0.14	7
Fluoranthene	0.22	0.21	5
Indeno(1,2,3-cd)pyrene	0.29	0.47	**47**
Naphthalene	0.18	0.16	12
Phenanthrene	1.2	1.1	9
Pyrene	1.2	1.1	9
SVOCs	**LYSOD05***	**LYSOD06***	**RPD (%)**
2-Methylnaphthalene	0.12	0.13	8
Anthracene	0.061	0.074	19
Benzo(a)anthracene	0.27	0.19	35

TABLE A
Relative Percent Differences in Duplicate Soil Samples
Results in milligrams per kilogram (mg/kg) parts per million (ppm)

Analyte			
Benzo(a)pyrene	0.25	0.27	8
Benzo(b)fluoranthene	0.29	0.4	32
Benzo(g,h,i)perylene	0.14	0.16	13
Benzo(k)fluoranthene	0.076	0.078	3
Chrysene	0.32	0.42	27
Dibenzo(a,h)anthracene	0.086	0.076	12
Fluoranthene	0.28	0.34	19
Indeno(1,2,3-cd)pyrene	0.12	0.16	29
Naphthalene	0.078	0.084	7
Phenanthrene	0.64	0.76	17
Pyrene	0.64	0.71	10

* Sample diluted to obtain results, due to matrix background interference

TABLE B
Relative Percent Differences in Duplicate Groundwater Samples
Results in micrograms per liter (µg/L) parts per billion (ppb)

Analyte	**LYMW03**	**LYMW07**	**RPD (%)**
Metals			
Aluminum	10,600	21,800	**69**
Barium	99.4	300	**100**
Beryllium	1.6	1.3	**21**
Cadmium	1.1	1.5	**31**
Calcium	304,000	285,000	6.5
Chromium	28.5	47.5	**50**
Cobalt	10.1	13.9	**32**
Copper	17.3	72.2	**123**
Iron	44,900	70,500	**44**
Lead	22.7	51.9	**78**
Magnesium	289,000	281,000	3
Manganese	2,980	3,370	12
Nickel	20.4	25	20
Potassium	7.48	10.2	**31**

TABLE B
Relative Percent Differences in Duplicate Groundwater Samples
Results in micrograms per liter (µg/L) parts per billion (ppb)

Analyte	LYMW03	LYMW07	RPD (%)
Sodium	299	250	18
Vanadium	43.7	68.1	**44**
Zinc	130	152	16
Volatile Organic Compounds			
Methyl tert-butyl ether	3.7	4	7.8
Semi-volatile Organic Compounds			
1-Methylnaphthalene	0.09	0.092	2.2
2-Methylnaphthalene	0.089	0.1	12
Acenaphthene	0.43	0.39	9.8
Acenaphthylene	0.095	0.094	1.1
Anthracene	0.47	0.48	2.1
Benzo(a)anthracene	0.12	0.11	8.7
Benzo(a)pyrene	0.05	0.052	3.9
Benzo(b)fluoranthene	0.022	0.022	0.0
Benzo(g,h,i)perylene	0.054	0.053	1.9
Chrysene	0.21	0.21	0.0
Fluoranthene	0.056	0.072	25
Fluorene	0.67	0.63	6.2
Naphthalene	0.17	0.18	5.7
Pyrene	1	1.1	9.5
Diesel Range Organics			
Diesel Range Organics	2,400	5,600	**80**

5.2.4 Representativeness

Representativeness is the measure of the degree to which data accurately and precisely represent a characteristic of a population parameter, variations at a sampling point, a process condition, or an environmental condition. Representativeness encompasses both the degree to which measurements reflect the actual concentration, and the degree to which sampling units reflect the population they represent. Representativeness was addressed by adherence to TSOPs for sampling procedures, field and laboratory QA/QC

procedures, collection of appropriate sample material, homogenization methods, analytical methods, and sample preparation.

5.2.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system. The actual percentage of completeness is less important than the effect of completeness on the data set. All samples were collected as planned.

5.2.6 Comparability

Comparability is the qualitative term that expresses the confidence that two data sets can contribute to common interpretation and analysis and is used to describe how well samples within a data set, as well as two independent data sets, are interchangeable. Comparability was addressed by a data usability review comparing the results of field observations and laboratory analyses. Data were found to be comparable across data sets.

XRF Comparability

All samples were collected in the same manner by START under the same FSP (UOS 2012b) and, therefore, XRF and laboratory sample data events for the set are internally comparable. A linear regression model for lead results in the two analytical data sets was constructed, resulting in an r^2 value of 0.992 (Figure A). Any data sets demonstrating an r^2 value of 0.85 to 1.0 is considered a definitive data quality level (EPA 1998), meaning the sets show statistically similar results. XRF instruments are characteristically more accurate when analyzing mid-range levels of metals (i.e., about 100 to 1,000 ppm), which is consistent with this data set. XRF results near the Wyoming VRP cleanup level of 400 ppm for lead in residential soils can, therefore, be considered highly reliable.

TABLE C
XRF and Laboratory Lead Results
Concentrations in milligrams per kilogram (mg/kg) parts per million (ppm)

	Lead	
Sample ID	**XRF**	**Lab**
LYSOAA01	**610**	**523**
LYSOAA01D	**601**	**555**
LYSOAA02	**1077**	**1030**

TABLE C
XRF and Laboratory Lead Results
Concentrations in milligrams per kilogram (mg/kg) parts per million (ppm)

Sample ID	Lead	
	XRF	**Lab**
LYSOAA03	**1672**	**1610**
LYSOAA05	**891**	**761**
LYSOAB01	**569**	**515**
LYSOAB02	**828**	**778**
LYSOAB03	**2234**	**2140**
LYSOAC03	**962**	**957**
LYSOAD02	**529**	**518**
LYSOAD03	**1510**	**1280**
LYSOAE02	**663**	**550**
LYSOAE03	**432**	354
LYSOAE05	250	218
LYSSB0303	16	12.7
LYSSC0101	81	71

BOLD Result exceeds Wyoming VRP lead cleanup level for residential soil of 400 ppm

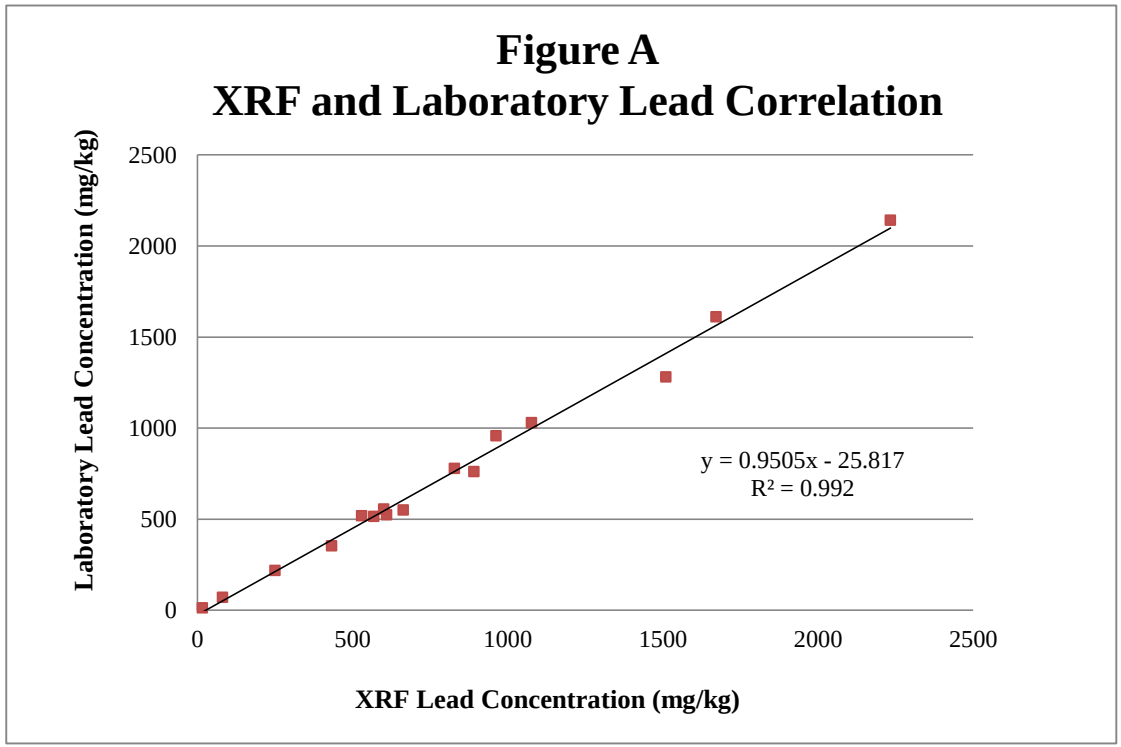


Figure A
XRF and Laboratory Lead Correlation
Laboratory Lead Concentration (mg/kg)
2500
2000
1500
1000
500
0
0
500
1000
1500
2000
2500
y = 0.9505x - 25.817
R² = 0.992
XRF Lead Concentration (mg/kg)

6.0 ANALYTICAL RESULTS

Analytical results for soil and groundwater samples are presented in Tables 4 through 11, along with Wyoming VRP Cleanup Levels for groundwater, residential soil, and soil MGW screening levels. Analytical results for investigation-derived waste are presented in Tables 12 and 13, and results for air monitoring samples are presented in Table 14.

The laboratory analytical methods used for collected samples at the property are as follows:

- VOC – EPA SW-846 Method 8260;
- SVOC/PAH by SIM – EPA SW-846 Method 8270C;
- DRO – EPA SW-846 Method 8015M;
- GRO – EPA SW-846 Method 8015M;
- TAL Total Metals – EPA SW-846 Method 6010B;
- TOC – EPA SW-846 Method 9060A;
- TCLP RCRA 8 Metals – EPA SW-846 Method 1311; and
- Asbestos – AHERA TEM Method.

In total, 30 surface soil samples were collected from the Laramie Yttrium Plant property for SVOC/PAH analysis. Ninety-three onsite and *in situ* XRF readings were collected from surface and subsurface soils during the Phase II site assessment. Twenty-two surface and subsurface soil samples were prepared in a controlled environment and reanalyzed by XRF. Of these, 13 surface soil and 2 subsurface soil samples were sent for TAL total metals laboratory confirmation analysis. Results are provided in Tables 4 and 6. Surface soil sample locations and results that exceed guidance levels are detailed below and depicted in Figure 3.

Seven groundwater samples were submitted for VOC, SVOC, DRO, GRO, TAL total metals, and TOC analyses, including one duplicate sample. One trip blank water sample was submitted as a QC measure for VOC sample transport. Results can be found in Tables 3 and 7 through 11.

Investigation-derived waste water was sampled and submitted for VOC, SVOC, DRO, GRO, TAL total metals, and TOC analyses. Investigation-derived waste soil was sampled and submitted for VOC, SVOC, DRO, GRO, TAL total metals, and TCLP RCRA 8 metals analyses.

Further discussion on compounds that exceed guidance levels appears in Section 7.0.

6.1 VOLATILE ORGANIC COMPOUND SAMPLE RESULTS

Laboratory results for groundwater samples indicated the presence of 13 VOC analytes, though all were far below Wyoming VRP cleanup levels. Analytical results for VOCs in groundwater can be found in Table 7.

6.2 SEMI-VOLATILE ORGANIC COMPOUND SAMPLE RESULTS

Twenty-two SVOC analytes were detected in groundwater samples. One analyte was detected at a concentration equivalent to the Wyoming VRP cleanup level. LYMW03 was found to have a concentration of benzo(a)anthracene of 0.12 micrograms per liter (µg/L), which is essentially equal to the Wyoming VRP cleanup level of 0.117 µg/L. LYMW07 was a duplicate sample of LYMW03, and was found to have a benzo(a)anthracene concentration of 0.11 µg/L. All other analytes were detected in concentrations below Wyoming VRP cleanup levels. Analytical results for SVOCs in groundwater can be found in Table 8.

Laboratory results for SVOCs in surface soil indicate that the one analyte equivalent to the Wyoming VRP water cleanup level exceeded the soil MGW cleanup level. Benzo(a)anthracene was found in concentrations ranging from 0.022 to 5.4 ppm, with 28 of 30 samples exceeding the VRP MGW cleanup level of 0.014 ppm. Four additional PAH compounds exceed the VRP cleanup levels for residential soil. Exceedances for these compounds are also found throughout the property. Benzo(a)pyrene was found in concentrations ranging from 0.019 to 4.8 ppm, with all 30 samples exceeding the VRP cleanup level of 0.015 ppm. Benzo (b)fluoranthene ranged from 0.034 to 2.7 ppm, with 20 samples exceeding the VRP cleanup level of 0.15 ppm. Dibenzo(a,h)anthracene was found in concentrations ranging from 0.008 to 1.5 ppm, with 26 samples exceeding the VRP cleanup level of 0.015 ppm. Indeno(1,2,3-cd)perylene ranged from 0.008 to 5.9 ppm, with 17 samples exceeding the VRP cleanup level of 0.15 ppm.

Analytical results for SVOCs/PAHs in surface soil can be found in Table 5. Four sample locations were found to have significantly higher concentrations of PAH analytes, and are shown in Figure 6.

6.3 DIESEL RANGE ORGANICS SAMPLE RESULTS

DRO results for groundwater samples ranged from no detection to 5,600 µg/L. The highest detected concentration was found in sample LYMW07, a duplicate of LYMW03, although

LYMW03 was only found to have a DRO concentration of 2,400 µg/L. These concentrations are well below the 10,000 µg/L Wyoming VRP cleanup level for DRO. Groundwater DRO results are presented in Table 9.

6.4 GASOLINE RANGE ORGANICS SAMPLE RESULTS

Analytical results for GRO in groundwater samples ranged from no detection to 560 µg/L. This is far below the Wyoming VRP water cleanup level of 7,300 µg/L. Analytical results are presented in Table 10.

6.5 TOTAL METALS SAMPLE RESULTS

6.5.1 XRF Results

Surface soils in sub-grid A analyzed *in situ* by XRF indicated concentrations of lead exceeding the Wyoming VRP residential soil cleanup level of 400 ppm in 13 of 62 sampled 5 by 5-foot grid squares (Figure 3). Prepared, sieved, and validated sample results from this location indicate that seventeen samples from the 5 by 5-foot grid squares have lead exceeding the 400 ppm VRP cleanup level. No manganese results exceeded the VRP cleanup level of 1,800 ppm in *in situ* or sieved and validated XRF samples. Iron results for *in situ* samples indicate seven sub-grid A sample locations exceed the VRP cleanup level of 55,000 ppm. Prepared and sieved XRF samples indicate that eight samples exceeded the cleanup level of 55,000 ppm, with six of these results consistent with the *in situ* exceedances. Raw XRF results for *in situ* samples in sub-grid A ranged from no detection to 234 ppm arsenic. Prepared raw XRF sample results range from 3 to 46 ppm arsenic. All validated arsenic results for samples collected in this area were assigned a U qualifier for being less than 10 percent of the corresponding lead result, though raw XRF results compared with laboratory confirmation results suggest the occurrence of exceedances above the Wyoming VRP cleanup level of 0.39 ppm is legitimate. No additional validation qualifiers were assigned for surface soil samples.

No subsurface soils in sub-grids A, B, and C were found to have lead concentrations above the VRP cleanup level for residential soil. Concentrations ranged from 6 to 117 ppm in 35 *in situ* samples, and from 12 to 178 ppm for the 4 prepared and sieved samples. The lead result for LYSSC0303, 12 ppm, was assigned a J qualifier in the

validation process for being between the XRF instrument's detection limit and reporting limit for the analyte.

Raw XRF analytical results are summarized in Table 15 and presented in full in Appendix D. Validated XRF results are summarized in Table 16 and presented in full in Appendix D. Raw data in Table 15 and Appendix D have not been validated and should be used only for guidance and screening purposes.

6.5.2 Laboratory Results

Laboratory results for metals in groundwater indicate Wyoming VRP cleanup level exceedances for seven analytes. These include arsenic, cobalt, iron, lead, manganese, mercury, and thallium. The arsenic groundwater cleanup level of 10 µg/L was exceeded only in LYMW07, which was a duplicate of LYMW03. The large discrepancy in arsenic concentrations (21.4 and 8.9 J µg/L, respectively) is inconclusive, and may indicate inadequate precision in the duplicate sample set. The cobalt cleanup level of 10.9 µg/L was exceeded in samples LYMW02 and LYMW07, which had concentrations of 15.2 and 13.9 µg/L, respectively. Again, LYMW03 had a cobalt concentration below VRP cleanup levels, so the exceedance in LYMW07 is inconclusive. Four groundwater samples were found to have iron concentrations greater than the Wyoming VRP cleanup level of 25,500 µg/L. Samples LYMW02, LYMW03, and LYMW04 and LYMW06 had concentrations ranging from 29,500 to 57,800 µg/L. Lead was detected in concentrations exceeding the VRP cleanup level of 15 µg/L in all samples but LYMW01. Concentrations for lead ranged from 6.9 to 40.3 µg/L. Manganese was detected in concentrations exceeding the VRP cleanup level of 50 µg/L in all six groundwater samples, with results ranging from 514 to 5,390 µg/L. Mercury was detected in concentrations above the VRP cleanup level of 2 µg/L in sample LYMW06. This sample was found to have a mercury concentration of 19.1 µg/L. Thallium was detected in two samples above the VRP cleanup level of 2 µg/L. Samples LYMW02 and LYMW06 had thallium concentrations of 3.3 J and 3.5 J, respectively. It should be noted that both of these analytical results were assigned a J qualifier for being below the analytical method reporting limit.

Laboratory results for metals in sub-grid A surface soil confirmation samples indicate that of the seven contaminants affecting groundwater (above), five exceeded Wyoming

VRP MGW standards. Lead was present in concentrations from 218 to 2,140 ppm in surface soil confirmation samples, with 12 of 14 samples exceeding the 400 ppm cleanup level. Currently, no MGW cleanup level exists for lead. Iron concentrations exceeded the Wyoming VRP MGW cleanup level of 640 ppm in all 14 samples, ranging from 21,700 to 66,300 ppm. Sample LYSOAE02 was found to have the highest iron concentration, and the only exceedance for the 55,000 ppm Wyoming VRP residential soil cleanup level. Arsenic was detected from 7.2 to 19.7 ppm in surface soil samples, exceeding Wyoming VRP MGW and residential soil cleanup levels in all 14 surface soil samples. Cobalt, manganese, and mercury concentrations exceeded Wyoming VRP MGW standards for all 14 surface soil samples, though none exceeded residential soil cleanup levels. Cobalt ranged from 5.2 to 19 ppm, exceeding the MGW cleanup level of 0.49 ppm. Manganese concentrations ranged from 348 to 1150 ppm, exceeding the MGW standard of 57 ppm. Mercury concentrations ranged from 0.049 to 0.39 ppm, exceeding the MGW cleanup level of 0.033 ppm. Analytical results for metals in surface soil samples are presented in Table 4.

Subsurface soil confirmation samples ranged from 12.7 to 71 ppm in lead concentration, far below the Wyoming VRP cleanup level for residential soil. Five analytes affecting groundwater contamination exceeded the Wyoming VRP MGW cleanup levels. Arsenic was the only analyte that exceeded the VRP MGW and residential soil cleanup level in subsurface soil samples, with results ranging from 3.7 to 4.6 ppm. Cobalt, iron, manganese, and mercury concentrations exceeded Wyoming VRP MGW standards for both samples, though none exceeded residential soil cleanup levels. Cobalt concentrations ranged from 4.7 to 5.9 ppm, iron concentrations ranged from 12,500 to 13,800 ppm, manganese concentrations ranged from 240 to 385 ppm, and mercury concentrations ranged from 0.068 to 0.11 ppm. Analytical results for metals in subsurface soil are presented in Table 6.

6.6 INVESTIGATION-DERIVED WASTE RESULTS

Analytical results for investigation-derived soil and groundwater waste indicate that both are considered non-hazardous by RCRA standards and would not require disposal at a Subtitle C landfill. No TCLP volatile or semi-volatile compounds were detected for soil or groundwater samples, and all detections for metals were far below TCLP regulatory levels (Tables 12 and 13). It is, therefore, likely that soil contained on the Laramie Yttrium Plant property may be disposed

of at a standard municipal landfill, and may require additional analysis upon landfill request. Waste water at the site may be managed as nonhazardous waste in accordance with state regulations. Investigation-derived soil and groundwater waste must be reanalyzed upon the accumulation of any additional volume prior to disposal.

6.7 AIR MONITORING FILTER RESULTS

During the Phase II sampling event, an SKC AirChek XR5000 personal sampling pump was used to collect filter samples for airborne asbestos fibers. One 0.8-micrometer (µm) MCE filter cassette sample was collected over an 8-hour period on each June 5, 2012 and June 6, 2012. These were analyzed by AHERA TEM method for asbestos fibers. The AHERA TEM is generally used for asbestos abatement clearance, and clearance levels are based on the average of a set of five samples. The average result for the two filter samples collected is 52 structures per square millimeter (s/mm^2), lower than the AHERA clearance level of $70 s/mm^2$.

Although the AHERA clearance level is not fully comparable to a sample set of two, results do indicate the presence of airborne asbestos fibers on the property. It should also be noted that this analytical method is not an Occupational Safety and Health Administration (OSHA)-approved analytical method for asbestos exposure. It may be necessary to use an OSHA-approved method to determine the exposure of individuals during remediation activities. Personal protective equipment (PPE) or air monitoring may be required at the property during remediation activities until OSHA compliance can be demonstrated.

7.0 CONCLUSIONS

Based on analytical results, several contaminants have been identified as being present on site. Analytical results for arsenic exceeded VRP residential cleanup levels for all surface and subsurface soil samples collected. In addition, lead concentrations exceeded the VRP cleanup level in 17 sub-grid A surface soil samples collected. Iron was detected above the VRP cleanup level in one surface soil sample. PAHs were detected in all 30 surface soil samples. Arsenic, cobalt, iron, lead, manganese, mercury and thallium were detected at concentrations in excess of the Wyoming VRP cleanup standards for groundwater samples. Asbestos fibers were detected in air monitoring samples collected on the property. An expanded discussion on sample results is provided below.

Arsenic levels in excess of the Wyoming VRP cleanup level of 0.39 ppm were observed in all 15 laboratory-submitted surface soil samples and the duplicate sample, ranging from 7.2 to 19.7 ppm.

Subsurface soil samples had arsenic concentrations ranging from 3.7 to 4.6 ppm. The USGS reports that the average geometric mean for arsenic concentrations in the western U.S. is 5.5 ppm with a standard deviation of 1.98 (USGS 1984). Arsenic values in the Laramie area of the study were in the range of <0.1 to 4.1 ppm. In this USGS study, the total observed range of arsenic values was between 0.10 and 97 ppm. Twelve surface soil samples had arsenic concentrations above 7.48 ppm, the high end of observed concentration range for the western U.S. Locations for these samples are consistent with elevated lead concentrations in sub-grid location A. Subsurface soil arsenic levels are consistent with levels found in the Laramie study area, and are likely naturally occurring and not indicative of environmental concern.

The XRF lead concentration in 17 surface soil samples in sub-grid location A exceeds the Wyoming VRP cleanup level of 400 ppm, with laboratory confirmation concentrations ranging from 515 to 2,140 ppm. The source of elevated lead levels in this location is unknown. Surface soil in the area of highest metals concentration (LYSOAE01/LYSOAD01) is visibly discolored (Figure 3, Appendix A Photos 8 and 9).

Iron concentrations greater than 25,500 µg/L were found in four of six groundwater samples. Lead was found in concentrations exceeding VRP cleanup levels in five groundwater samples. In addition, LYMW02 was found to have concentrations of cobalt exceeding VRP cleanup levels. A mercury concentration greater than 2 µg/L was found at location LYMW06. Manganese concentrations exceeding 50 µg/L were found in all six groundwater samples. Arsenic was detected in LYMW07, though this result is inconclusive due to a much lower concentration with a J qualifier in the duplicate sample. Thallium detections above the VRP cleanup level were found in two groundwater samples, though both were assigned J qualifiers for being below reporting limits. Contaminants found at locations LYMW03 and LYMW05 may be the result of on-site migration due to the direction of groundwater flow. An updated potentiometric map was generated, using surveyor data generated at the property on July 2, 2012 (Figure 7, Appendix G). Groundwater at the property is shallow, unconfined water, which is not a potable water source. Although Wyoming DEQ statutes specify groundwater must be cleaned to drinking water standards, drinking water contamination is not a concern for the intended use of the property. Remedy selection will be based upon Wyoming DEQ evaluation with the LRCD.

Five PAH compounds were detected in concentrations above Wyoming VRP residential standards in the SVOC analysis for 30 surface soil samples. These five compounds included benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. These compounds are byproducts from the combustion of fossil fuels such as coal, which is consistent with the history of the property as a refinery. The property contains visible burned debris throughout. The presence of PAH compounds may also be attributed to the property's proximity to a rail yard. A statistical analysis

of these analytes was conducted to assess the toxicological risk of these analytes in an industrial site, which is the intended use by the LRCD. The analysis consisted of a single-tailed Student's t-test to establish a 95 percent confidence interval for each analyte. Results are presented in Table 17, and indicate property concentrations for all analytes except benzo(a)pyrene are below EPA Regional Screening Levels (RSLs) for industrial soil.

8.0 RECOMMENDATIONS

8.1 CLEANUP CONSIDERATIONS

Based on the results and conclusions listed above, cleanup of the property debris and burn zones may be required. Although arsenic may be evaluated as a suitable background limit, five PAH compounds exceeded residential guidance levels for surface soil on the property. Of these, benzo(a)pyrene is the only PAH compound that exceeds the EPA RSL for industrial soil. Further evaluation of property PAH levels as related to ambient PAH levels in the Laramie area may be a worthwhile pursuit in order to assess the practicality of remediation.

Excavation of DRO-contaminated soils at former sample location YPSS03 and metals-contaminated soils at sub-location A may be necessary, depending on intended future use of the property. Surface soil excavation may alleviate contamination of subsurface soil and groundwater present in these locations.

The containers of stored materials in leaking drums and in the main green building found to be Department of Transportation (DOT) 3 flammable/combustible during the previous Phase II will need to be disposed of appropriately by a certified waste disposal facility. Waste petroleum materials in the liquid phase may potentially be recycled by fuel blending. This process is an economic alternative to incineration for organic waste streams containing greater than 5,000 British Thermal Units (BTUs) per pound. Organic sludge is safely blended into a pumpable slurry for use in cement kilns; in effort to reduce consumption of coal, oil, and fossil fuel (Clean Harbors 2012).

Soil and groundwater environmental concerns addressed in Section 7.0 may be resolved by capping portions of the property with an asphalt layer or layer of clean fill. A non-permeable surface may allow the use of the land without remediation due to the limiting of potential exposure and contaminant migration. Applying clean fill and planting native grasses in areas of concern is another remediation option. Installation of vapor intrusion barriers is recommended

where proposed building structures will be located. Due to the property's proximity to a 500-year flood zone, the LRCD may wish to elevate future building structures.

The presence of widespread contamination throughout the surrounding area, evident by consistent contamination in monitoring wells on the property, makes bio-remediation options for the property challenging. Installation of a Phosphate-Induced Metal Stabilization (PIMS) hydroxyapatite barrier may alleviate some soluble metals on the property, though this option may not be suitable for all metals contaminants of concern. This remedial method is somewhat costly, but would last a few decades. Phyto-remedial options for DRO contamination at the site include planting thirsty trees such as cottonwoods or poplars, though the trees would be dormant for half of the year. Chemical treatment of monitoring wells on the property may serve to enhance bio-remediation. These remedial measures may be effective for alleviating some contamination on the Laramie Yttrium Plant property itself, but will not address residual upgradient and downgradient source contamination. The above options may be further limited spatially and chronologically by the intended construction of a highway through the property, projected to occur in 2017.

In general, minimal disturbance of subsurface contaminants at the property is required. The LRCD is advised to contact the Wyoming VRP to discuss project objectives and plans before acquiring bid requests.

Air monitoring results indicate that airborne asbestos fibers are present on the property during activities causing light to moderate disturbance of surface soils. Additional air monitoring is recommended to establish property safety standards during remediation work.

8.2 DISCLAIMERS

This cost estimate has been prepared based on certain assumptions made by UOS (see Section 8.3.2) which substantially affect the conclusions and recommendations of this document. These assumptions, although thought to be reasonable and appropriate, may not prove to be true in the future. The conclusions and recommendations of UOS are conditional upon these assumptions.

The cost estimates provided were obtained at a point in time and do not take into account changes in economy or pricing by service providers. All cost estimates include a 20 percent contingency for the entire job. Regardless, prospective contractors and their respective bids should be solicited appropriately in accordance with the LRCD procurement guidelines.

8.3 CLEANUP ACTIONS

8.3.1 Hazardous Waste Container Disposal

Stored hazardous materials in leaking drums and containers in the main green building will need to be disposed of by a waste disposal facility working under a Part B permit for management of RCRA-regulated hazardous waste. The cost estimate is based on disposal by incineration or recycling by fuel blending of approximately eight drums of DOT 3 flammable/combustible material onsite. The estimated cost for disposal by incineration combined with fuel blending is $4,321.66 (Table 18).

8.3.2 DRO and Metals Contaminated Soil Abatement

An approximately 30 by 30-foot area around sample location YPGW03 was found to have DRO in concentrations exceeding Wyoming VRP cleanup levels. The cost estimate for DRO-contaminated soil was prepared assuming a necessary excavation area of 900 square feet and a depth of 6 inches. Contaminated soil may be disposed of by incineration, along with non-bulk DRO containers. Confirmation sampling should be conducted on the cell floor and walls in all excavated areas.

Additional costs were included for excavation of metals-contaminated soils at sub-grid location A. The cost estimate for metals-contaminated soil was prepared assuming a necessary excavation area of 425 square feet and a depth of 6 inches. A post-excavation assessment should be conducted with XRF analysis to ensure all metals-contaminated soil at this location is removed. In addition, a soil sample should be submitted from the excavated soil for metals TCLP analysis. Soil disposal should occur at an appropriate landfill (municipal or Subtitle C) pending results of TCLP analysis. If no additional excavation at the property is necessary, the total cost for removing DRO- and metals-contaminated soils with confirmation sampling and backfill of clean soil will be approximately $62,347.64.

Cost estimations above are based on the following assumptions:

- An excavation depth of 6 inches was used in determining the volume of DRO- and metals-contaminated soil to be removed;

- DRO-contaminated soil will be packaged into a segregated roll-off dumpster and taken to an incineration facility;
- Metals-contaminated soil will be packaged into a segregated roll-off dumpster and taken to an appropriate landfill for disposal pending TCLP analysis;
- A swell factor of 1.2 was used for the expansion of soil during excavation;
- Fill material will be trucked from a distance of 15 miles;
- A contingency of 20 percent is used.

A detailed cost estimate can be found in Table 18.

9.0 LIST OF REFERENCES

ASTM International (formerly American Society for Testing and Materials) (ASTM). 2011. Standard Guide for Environmental Site Assessments: Phase II Environmental Site Assessment Process. ASTM Designation: E 1903-11.

Casper Aquifer Protection Plan (CAPP). 2002. City of Laramie, WY.

Clean Harbors. 2012. Waste Disposal and Recycling: Fuel Blending. http://www.cleanharbors.com/browse_by_service/waste_disposal_and_recycling/fuel_blending.html

Dunne, T. and L.B. Leopold. 1978. "Water and Environmental Planning." W. H. Freeman and Company, San Francisco.

Environmental Data Resources, Inc. (EDR). 2012. Radius Map™ Report with GeoCheck®. May 3, 2012.

Laramie Rivers Conservation District (LRCD). 2011. Targeted Brownfields Assessment Application. July 2011.

Nickle, Hubert (Nickle). Current owner of the Yttrium Plant property. Personal communication. August 24, 2011.

National Oceanic and Atmospheric Administration (NOAA). 2011. "Climatography of the United States No. 81." Accessed on September 26, 2011.

The RETEC Group, Inc. (RETEC). 2004. "Summary of Corrective Measures and Existing Conditions Report." August 31, 2004.

U.S. Environmental Protection Agency (EPA). 1998. Environmental Technology Verification Report: Field Portable X-Ray Fluorescence Analyzer, Niton XL Spectrum Analyzer. March 1998.

U.S. Environmental Protection Agency Contract Laboratory Program (EPA CLP). 2008. National Functional Guidelines for Organic and Inorganic Data Review. June 2008.

U.S. Geological Survey (USGS). 1963 (Photorevised 1978). 7.5 Minute Topographic Map Quadrangles, Laramie, Wyoming.

U.S. Geological Survey (USGS). 1984. Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States. USGS Professional Paper 1270. Washington D.C.

U.S. Geological Survey (USGS). 1987. "Basic Ground-Water Hydrology." Water-Supply Paper 2220. Prepared by Ralph C. Heath.

U.S. Geological Survey (USGS) 2011. USGS Surface-Water Annual Statistics for Wyoming. USGS Site Number 06661585 Laramie River Near Bosler, WY. http://waterdata.usgs.gov

University of Delaware, Center for Climate Research, Department of Geography. 1986. Terrestrial Water Budget Data Archive; Version 1.01, compiled by C. J. Willmott and C. M. Rowe.

URS Corporation (URS). 1994. Preliminary Assessment of the Laramie Gas Company, Laramie, Wyoming. June 24, 1994.

URS Operating Services, Inc. (UOS). 2011. Yttrium Plant Phase II ARR. December 2011.

URS Operating Services, Inc. (UOS). 2012a. Laramie Yttrium Plant TBA Phase I ESA. May 2012.

URS Operating Services, Inc. (UOS). 2012b. Laramie Yttrium Plant TBA Phase II Field Sampling Plan. May 2012.

Wyoming Department of Transportation (WYDOT). 2009. "Report of Historical Investigations" for the Midwest/Standard Oil Refinery. November 2009.

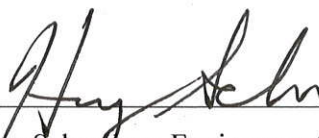
10.0 ENVIRONMENTAL PROFESSIONAL'S QUALIFICATIONS, STATEMENT, AND SIGNATURES

This work was conducted by an environmental professional as specified in Section 7.5.1 of E 1527-05 and defined pursuant to 40 CFR.10 (ASTM 2005).

Henry Schmelzer has a Baccalaureate or higher degree from an accredited institution of higher education in a discipline of engineering or science and the equivalent of twenty-five (25) years of full-time relevant experience such as participation in the performance of all appropriate inquiries investigations, environmental site assessments or other site investigations including environmental analyses, investigations, and remediation which involve the understanding of surface and subsurface environmental conditions and the processes used to evaluate these conditions and for which professional judgment was used to develop opinions regarding conditions indicative of releases or threatened releases (see §312.1(c)) to the subject property. He remains current in his field through participation in continuing education or other activities.

Under the supervision of environmental professional, Henry Schmelzer, Jen Patureau assisted in the conduct of this all appropriate inquiry. Jen Patureau has a Baccalaureate or higher degree from an accredited institution of higher education in a discipline of engineering or science and the equivalent of 4 years of full-time relevant experience.

We declare that, to the best of our professional knowledge and belief, we meet the definition of environmental professionals as defined in §312.10 of 40 CFR 312. We have the specific qualifications based on education, training, and experience to assess a property of the nature, history, and setting of the subject property. We have developed and performed all appropriate inquiry in conformance with the standards and practices set forth in 40 CFR Part 312.

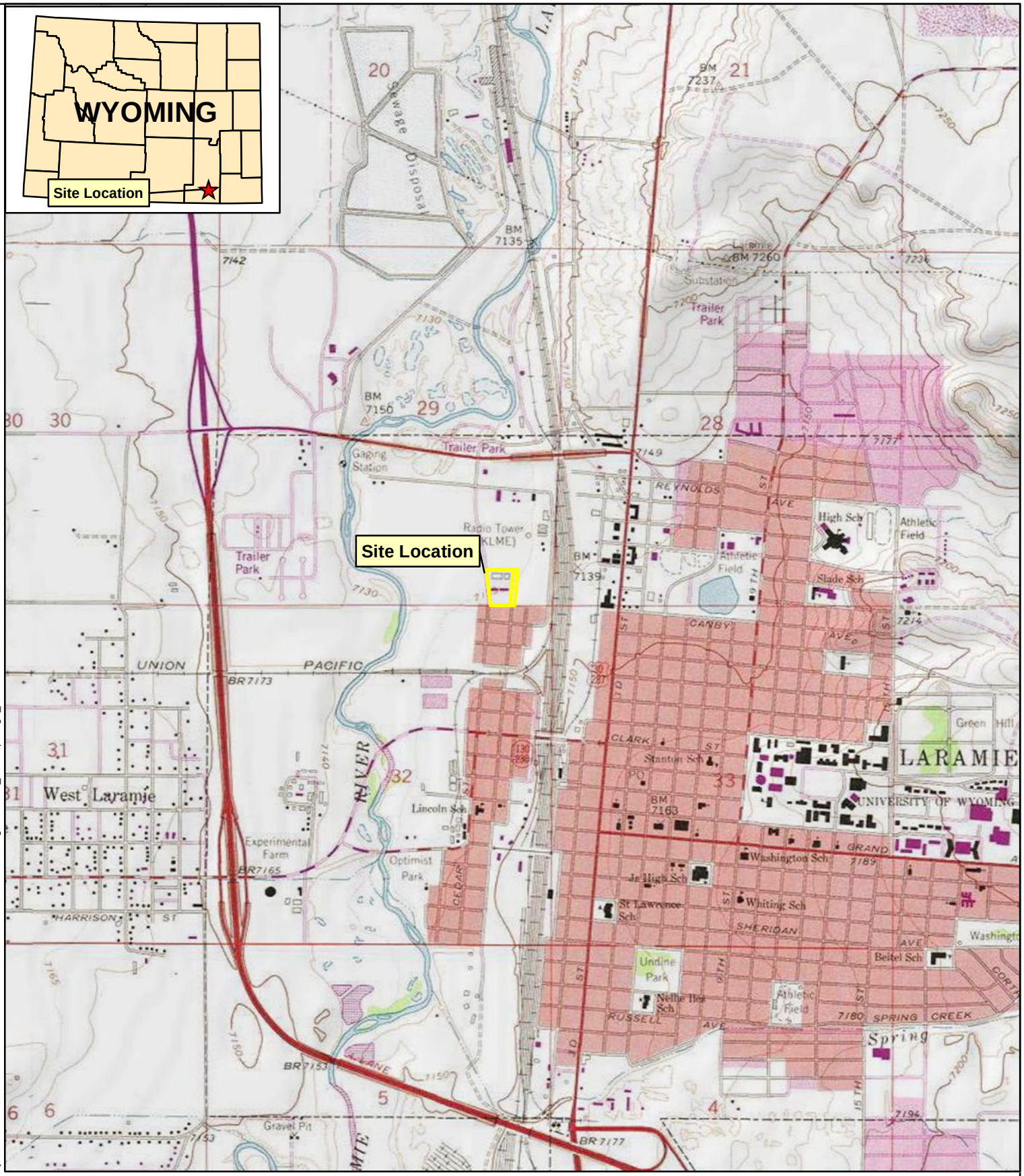


Date: 10/29/12

Henry Schmelzer, Environmental Scientist, Project Manager

Date: 10/29/12

Jen Patureau, Chemist



Projection System:
NAD 1983 UTM Zone 13N

1 inch Page Size: 8.5 x 11

1 in = 2,000 feet

0 0.25 0.5 Miles

N W E S

TDD Title: **Yttrium Plant**

Figure: 1

Figure Title: Site Location Map

TDD County: Albany TDD: 1204-04

TDD State: WY Date: 10/2012

Sources:
USTopo

URS OPERATING SERVICES

Author: Alex Mahrou Date/Time: Monday, October 29, 2012 1:30:41 PM File: T:\START3\Laramie Yttrium Plant\gis\Phase II_Arc\Maps\Fig1_SiteLoc.mxd

Subgrid Location B

Subgrid Location C

LYMW06

LYMW05

LYMW04

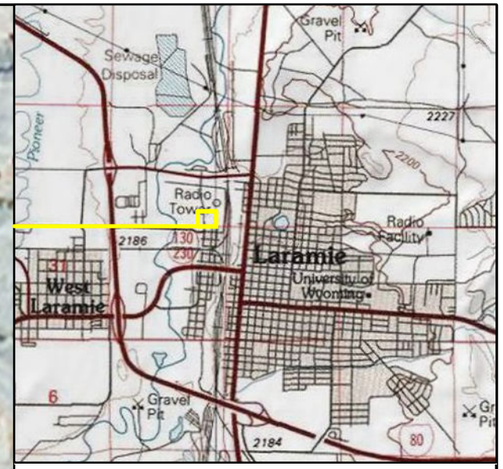
N Cedar St

Subgrid Location A

LYMW03

LYMW02

LYMW01



Legend

- PAH Surface Soil
- Groundwater Wells
- Metals delineation subsurface soil
- Metals delineation surface soil
- 100' by 100' grid cells
- Site Boundary

N
W E
S

0 25 50 100 Feet

TDD Title: **Yttrium Plant**

Figure Title: Sample Location Map

Figure No. 2

TDD State: WY

TDD County: Albany

TDD: 1204-04

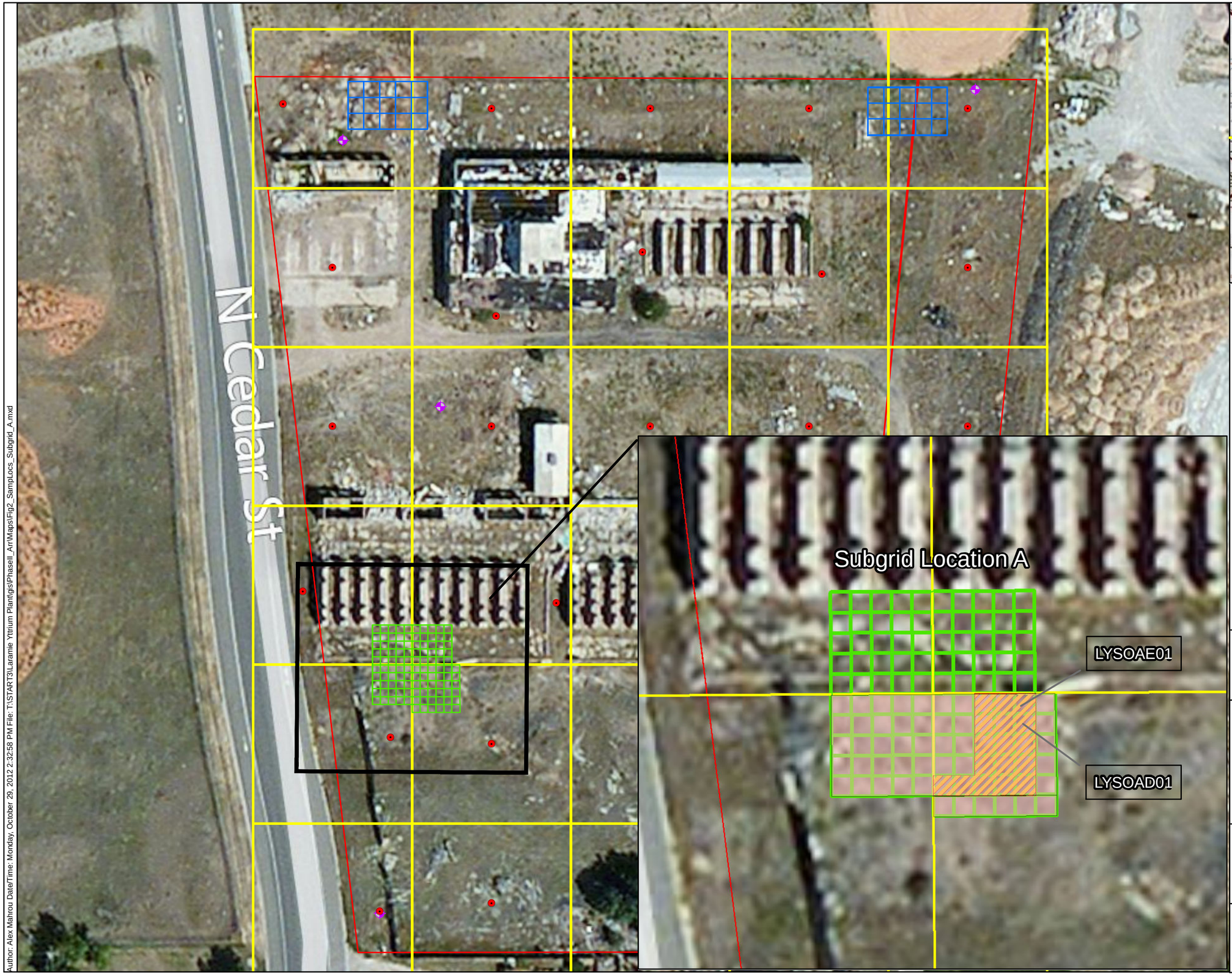
Date: 10/2012

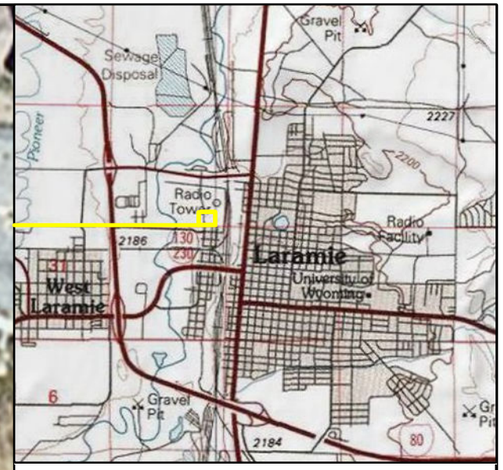
Base Data Source: GPS Observations, Esri World Imagery
Datum/Projection: NAD 1983 UTM Zone 13N
Page Size: 11x17

URS OPERATING SERVICES

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Author: Alex Mahrou Date/Time: Monday, October 29, 2012 2:32:23 PM File: T:\START3\Laramie Yttrium Plant\gis\PhaseII_ArcMaps\Fig2_SampLocs_s0.mxd





Legend

- PAH Surface Soil
- Groundwater Wells
- Metals delineation subsurface soil
- Metals delineation surface soil
- 100' by 100' grid cells
- Site Boundary
- Surface soil sample locations
- Area exceeding Wyoming VRP cleanup level for residential soil

N / W / E / S

0 25 50 100 Feet

TDD Title: **Yttrium Plant**

Figure Title: Sub-grid Location A XRF Results

Figure No. 3

TDD State: WY TDD: 1204-04

TDD County: Albany Date: 10/2012

Base Data Source: GPS Observations, Esri World Imagery
Datum/Projection: NAD 1983 UTM Zone 13N
Page Size: 11x17

URS OPERATING SERVICES

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Author: Alex Mahrou Date/Time: Monday, October 29, 2012 2:32:58 PM File: T:\START3\Laramie Yttrium Plant\gis\PhaseII_Art\Maps\Fig2_SampLocs_Subgrid_A.mxd

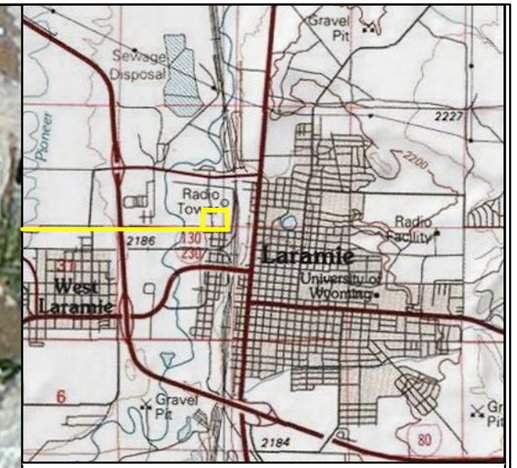
N Cedar St

Sub-grid Location B

LYSSB01

LYSSB02

LYSSB03



Legend

- Groundwater Wells
- Metals delineation subsurface soil
- Metals delineation surface soil
- 100' by 100' grid cells
- Site Boundary

Matrix

- Subsurface Soil Locations

N W E S

0 25 50 100 Feet

TDD Title: **Yttrium Plant**

Figure Title: Sub-grid Location B

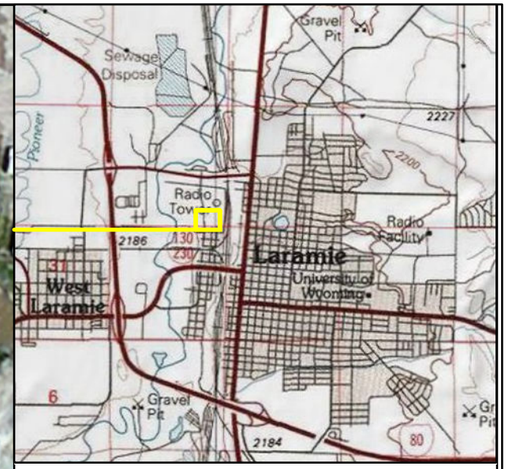
Figure No. 4

TDD State: WY TDD: 1204-04

TDD County: Albany Date: 10/2012

Base Data Source: GPS Observations, Esri World Imagery
Datum/Projection: NAD 1983 UTM Zone 13N
Page Size: 11x17

URS OPERATING SERVICES



Legend

- Groundwater Wells
- Metals delineation subsurface soil
- Metals delineation surface soil
- 100' by 100' grid cells
- Site Boundary

Matrix

- Subsurface Soil Locations

N W E S

0 25 50 100 Feet

TDD Title: **Yttrium Plant**

Figure Title: Sub-grid Location C

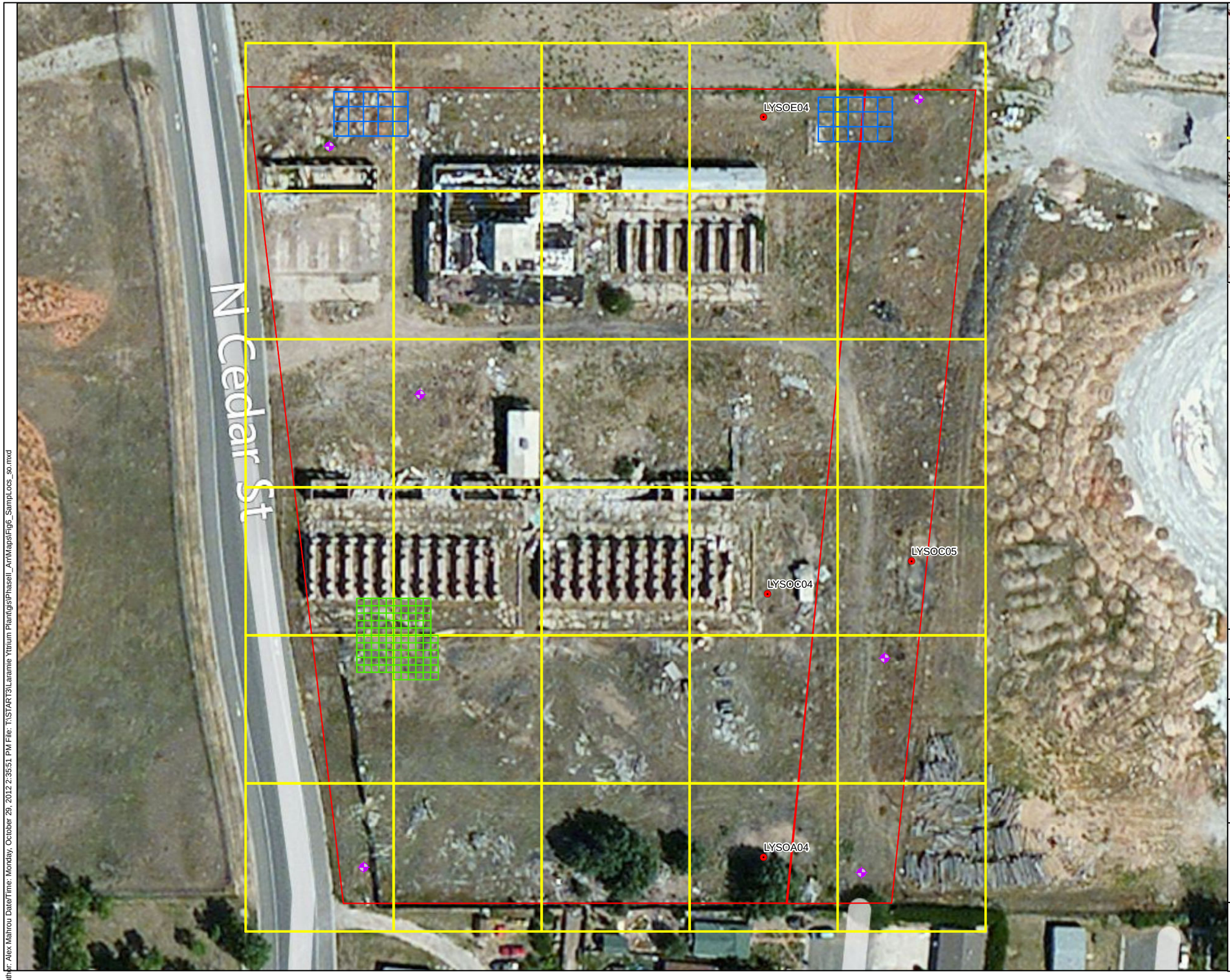
Figure No. 5

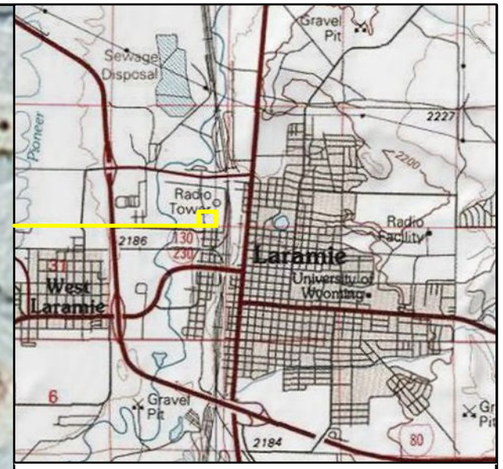
TDD State: WY TDD: 1204-04

TDD County: Albany Date: 10/2012

Base Data Source: GPS Observations, Esri World Imagery
Datum/Projection: WGS 1984 Web Mercator Auxiliary Sphere
Page Size: 11x17

URS OPERATING SERVICES





Legend

- PAH Surface Soil
- Groundwater Wells
- Metals delineation subsurface soil
- Metals delineation surface soil
- 100' by 100' grid cells
- Site Boundary

N
W E
S

0 25 50 100 Feet

TDD Title: **Yttrium Plant**

Figure Title: Surface Soil Sample Locations With Highest PAH Concentrations

Figure No. 6

TDD State: WY

TDD: 1204-04

TDD County: Albany

Date: 10/2012

Base Data Source: GPS Observations, Esri World Imagery
Datum/Projection: NAD 1983 UTM Zone 13N
Page Size: 11x17

URS OPERATING SERVICES

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Author: Alex Mahrou Date/Time: Monday, October 29, 2012 2:35:51 PM File: T:\START3\Laramie Yttrium Plant\gis\PhaseII_ArcMaps\Fig6_SampLocs_so.mxd

LYMW06
Potentiometric
(ft): 7132.52

LYMW05
Potentiometric
(ft): 7132.4

LYMW04
Potentiometric
(ft): 7132.11

LYMW03
Potentiometric
(ft): 7132.69

LYMW02
Potentiometric
(ft): 7132.46

LYMW01
Potentiometric
(ft): 7132.74

GW Survey Locations (Collected July 02, 2012)

Potentiometric Heights

NAVD88 (ft)

- 7,131.401855 - 7,131.63039
- 7,131.630391 - 7,131.774041
- 7,131.774042 - 7,131.878514
- 7,131.878515 - 7,131.982987
- 7,131.982988 - 7,132.08746
- 7,132.087461 - 7,132.204992
- 7,132.204993 - 7,132.329054
- 7,132.329055 - 7,132.459645
- 7,132.459646 - 7,132.603295
- 7,132.603296 - 7,132.779594
- 7,132.779595 - 7,133.066895

Projection System:
GCS North American 1983

1 inch = 70 feet

Page Size: 11x17

N
W E
S

Feet
0 37.5 75 150

TDD Title: **Laramie Yttrium Plant**
Figure: 7

Figure Title: Potentiometric Map July 2012
TDD County: ALBANY TDD:1204-04
TDD State: WY Date:10/2012

Sources:

DigitalGlobe .5 Meter BW Imagery 7-13-2010
July 2012 Survey

URS OPERATING SERVICES

Author: Alex Mahrou Date/Time: Monday, October 29, 2012 2:37:12 PM File: T:\START3\Laramie Yttrium Plant\gis\map's\Fig7_Potentiometric.mxd

TABLE 1
Sample Locations and Rationale

Sample Matrix	Sample ID	Location	Rationale
Surface Soil	LYSOA01-LYSOF05 (30 samples; LYSOA04 and LYSOC05 are MS/MSD)	Grid plots throughout property	To assess extent and toxicological risk of PAHs in surface soil.
	LYSOAA01-LYSOAE10 (50 samples), LYSOAA0105SE-LYSOAE0105E (12 samples)	Sub-grid location A	To delineate localized surface soil metals contamination.
	LYSOAA01D	Duplicate of LYSOAA01	To document the precision of sample collection and preparation procedures and laboratory analyses.
	LYSOA06	Duplicate of LYSOA05	To document the precision of sample collection procedures and laboratory analyses.
	LYSOD06	Duplicate of LYSOD05	To document the precision of sample collection procedures and laboratory analyses.
Subsurface Soil	LYSOAD0112	Sub-grid location A	To investigate depth of localized metals contamination.
	LYSSB0101-LYSSB0307 (8 samples)	Sub-grid location B	To investigate source of metals in groundwater.
	LYSSC0101-LYSSC0507 (22 samples)	Sub-grid location C	To investigate source of metals in groundwater.
Groundwater	LYMW01	Southeast corner of property	Determine contamination at property boundary over seasonal groundwater fluctuations.
	LYMW02	Southwest corner of property	Determine contamination at property boundary over seasonal groundwater fluctuations.
	LYMW03	East boundary of property	Determine contamination at property boundary over seasonal groundwater fluctuations.
	LYMW04 (MS/MSD)	Centrally located on property	Determine contamination within property over seasonal groundwater fluctuations.
	LTMW05	Northeast corner of property	Determine contamination at property boundary over seasonal groundwater fluctuations.
	LYMW06	Northwest corner of property	Determine contamination at property boundary over seasonal groundwater fluctuations.

TABLE 1
Sample Locations and Rationale

Sample Matrix	Sample ID	Location	Rationale
Groundwater, cont.	LYMW07	Duplicate of LYMW03	To document the precision of sample collection procedures and laboratory analyses.
	LYMW08	Trip Blank (VOC analysis only)	To document potential for contamination due to volatile nature of constituents during transport.
Filter	LYF01, LYF02	Throughout property	Determine presence of airborne asbestos fibers.
Waste Soil	LYSSWC01	Sub-grid locations B and C	Characterize soil generated during sample event.
Waste Water	LYGWWC01	Monitoring well locations	Characterize water generated during sample event.

TABLE 2
Location, Depth, Analyses, and Types of Samples Collected

Sample ID	Analyses	Sample Matrix	Sample Depth
LYSOAA01-LYSOAE10 (50 samples), LYSOAA0105SE-LYSOAE0105E (12 samples)	XRF Total Metals	Surface Soil	0-6 inches
LYSOA01-LYSOF05 (30 samples; LYSOA04 and LYSOC05 are MS/MSD)	SVOC/PAH by SIM	Surface Soil	0-6 inches
LYSOAD0112	XRF Total Metals	Subsurface Soil	12 inches
LYSSB0101-LYSSB0307	XRF Total Metals	Subsurface Soil	1-7 feet bgs
LYSSC0101-LYSSC0507	XRF Total Metals	Subsurface Soil	1-8 feet bgs
LYMW01	VOCs, SVOCs, DRO, GRO, TAL Total Metals, TOC	Groundwater	6.15 feet bgs
LYMW02	VOCs, SVOCs, DRO, GRO, TAL Total Metals, TOC	Groundwater	6.63 feet bgs
LYMW03	VOCs, SVOCs, DRO, GRO, TAL Total Metals, TOC	Groundwater	5.42 feet bgs
LYMW04 (MS/MSD)	VOCs, SVOCs, DRO, GRO, TAL Total Metals, TOC	Groundwater	7.77 feet bgs
LYMW05	VOCs, SVOCs, DRO, GRO, TAL Total Metals, TOC	Groundwater	6.34 feet bgs
LYMW06	VOCs, SVOCs, DRO, GRO, TAL Total Metals, TOC	Groundwater	7.2 feet bgs
LYMW07 (Duplicate)	VOCs, SVOCs, DRO, GRO, TAL Total Metals, TOC	Groundwater	5.42 feet bgs
LYMW08 (Trip Blank)	VOCs	Water	NA
LYF01, LYF02	AHERA TEM	Filter	NA
LYSSWC01	VOCs, SVOCs, DRO, GRO, TAL Total Metals, TCLP RCRA Metals	Subsurface Soil	0-8 feet bgs
LYGWWC01	VOCs, SVOCs, DRO, GRO, TAL Total Metals, TOC	Groundwater	5.42 to 7.77 feet bgs

TABLE 3
Field and Laboratory Water Quality Parameters and Well Construction Details

Parameter	Units	Sample ID					
		LYMW01	LYMW02	LYMW03	LYMW04	LYMW05	LYMW06
Temperature	°C	10.26	8.99	9.84	9.08	8.71	8.79
pH	NA	6.80	7.14	6.88	6.90	7.10	6.91
Oxygen Reduction Potential	mV	-8	33	-125	-90	-88	-99
Conductivity	mS/cm	3.15	3.08	3.61	3.25	5.09	3.58
Turbidity*	NTU	-	-	-	-	-	169
Dissolved Oxygen	mg/L	2.99	3.55	1.52	0.90	1.60	2.12
Total Organic Carbon†	mg/L	18	13	28	21 M	13	26
Well Construction Details							
Total Well Depth	feet bgs	12	12	12	12	12	12
Screen Depth	feet bgs	2.0-12	2.0-12	2.0-12	2.0-12	2.0-12	2.0-12
Sand Depth	feet bgs	1.9-6	1.9-8	1.5-8	1.9-9.5	1.9-6	1.9-8
Bentonite Depth	feet bgs	1.9-0.5	0.5-1.9	0.5-1.5	0.5-1.9	0.5-1.9	0.5-1.9
Slough from Borehole installation	feet bgs	6.0-12	8.0-12	8.0-12	9.5-12	6.0-12	8.0-12

*Most samples collected were above the instrument's detection range of 0 to 800 NTU.
M Matrix Spike and/or Matrix Spike Duplicate recovery outside acceptance limits.
°C Degrees Celsius
NA Not Applicable
mV Millivolts
mS/cm Millisiemens per centimeter
NTU Nephelometric turbidity units
mg/L Milligrams per liter
† Laboratory analysis

TABLE 4
Laboratory Confirmation Results for Metals in Surface and Subsurface Soil
Concentrations in milligrams per kilogram (mg/kg) parts per million (ppm)

Analyte	CAS Number	WY VRP Cleanup Level (mg/kg)		Sample ID													
		Residential Soil	Migration to Groundwater	LYSO AA01	LYSO AA01D	LYSO AA02	LYSO AA03	LYSO AA05	LYSO AB01	LYSO AB02	LYSO AB03	LYSO AC03	LYSO AD02	LYSO AD03	LYSO AE02	LYSO AE03	LYSO AE05
Aluminum	7429-90-5	77000	55000	6550	6750	7080	6750	7440	6810	7150	7340	8210	11100	7860	3920	7690	7960
Antimony	7440-36-0	31	0.66	2	2.1	2	2.4	6	1.9	1.7	2.2	2.4	2.7	2.7	5.3	2.9	1.8
Arsenic*	7440-38-2	0.39	0.0013	**7.8**	**7.9**	**9.2**	**9.2**	**7.2**	**7.9**	**8.8**	**12.4**	**9.2**	**14.2**	**10.2**	**19.7**	**11**	**9.4**
Barium	7440-39-3	15000	300	240	242	354	549	280	226	347	575	466	270	563	87	197	168
Beryllium	7440-41-7	-	-	0.42	0.43	0.43	0.5	0.4	0.36	0.53	0.54	0.57	0.82	0.61	0.11	0.35	0.33
Cadmium	7440-43-9	70	1.4	1.9	2	3.1	4.6	23.8	4.8	2.9	3.5	2.5	3.4	2.1	0.68	3.1	1.2
Calcium	7440-70-2	-	-	20600	21400	24100	21400	21000	23400	25600	22600	28400	8760	25000	16900	19200	40000
Chromium	7440-47-3	-	-	17.5	17.5	20.2	22.9	64.2	28.6	21.2	27.4	21	26.8	22.9	21.8	24.3	21.9
Cobalt*	7440-48-4	23	0.49	**5.2**	**5.2**	**5.8**	**5.4**	**7.9**	**6.2**	**6.1**	**6.6**	**6.5**	**19**	**6.6**	**6.8**	**11.8**	**7**
Copper	7440-50-8	3100	51	31.1	31.6	50.4	66.2	54	42.5	59.7	101	61.6	92.3	85.7	73.5	58.8	39.9
Iron	7439-89-6	55000	640	**24100**	**24600**	**26500**	**25900**	**21700**	**24900**	**24500**	**32300**	**27200**	**48200**	**29200**	**66300**	**39100**	**31800**
Lead	7439-92-1	400	-	**523**	**555**	**1030**	**1610**	**761**	**515**	**778**	**2140**	**957**	**518**	**1280**	**550**	354	218
Magnesium	7439-95-4	-	-	3590	3690	3770	3580	4510	3490	3690	4430	4630	2250	5790	1430	4330	6840
Manganese*	7439-96-5	1800	57	**348**	**358**	**427**	**465**	**405**	**412**	**426**	**500**	**459**	**1150**	**500**	**393**	**490**	**421**
Mercury*	7439-97-6	6.7	0.033	**0.27 M**	**0.39**	**0.37**	**0.32**	**0.37**	**0.13**	**0.077**	**0.063**	**0.049**	**0.16**	**0.055**	**0.36**	**0.31**	**0.28**
Nickel	7440-02-0	1600	48	19.4	19.9	15.4	15.9	20.2	15.6	16.3	23.8	18.5	57.4	20.6	21	33.9	23
Potassium	7440-09-7	-	-	2078	2070	1967	1458	2167	1982	2049	1629	2138	1283	1635	902.8	1421	1574
Silver	7440-22-4	390	1.6	0.17 U	0.15 U	0.14 U	0.14 U	0.17 U	0.15 U	0.12 U	0.15 U	0.15 U	0.16 U	0.21 J	0.16 U	0.15 U	0.16 U
Sodium	7440-23-5	-	-	280.4	283.3	218.3	232.2	168.6	213.6	229.2	425	275	341.5	541.3	372.6	433.3	294.4
Vanadium	7440-62-2	390	180	28	28.2	26.4	23.6	27.6	25.5	25.6	26	29.4	25.5	26.8	13.8	25.8	27.2
Zinc	7440-66-6	23000	680	193	198	489	810	334	282	444	1200	778	398	1020	64.7	339	173

U Analyte not detected above method detection limit (MDL).
J Analyte detected above MDL but not above reporting limit (RL). Numerical value should be considered an estimate.
M Matrix spike and/or Matrix Spike Duplicate recovery outside acceptance limits.
BOLD Analyte exceeds one or more WY VRP cleanup levels.
* Analyte is a contaminant found above WY VRP groundwater cleanup levels and therefore compared to soil Migration to Groundwater Cleanup Level.

TABLE 5
Laboratory Results for SVOCs in Surface Soil
Concentrations in milligrams per kilogram (mg/kg) parts per million (ppm)

Analyte	CAS Number	WY VRP Cleanup Level (mg/kg)		Sample ID												
		Residential Soil	Migration to Groundwater	LYSOA01	LYSOA02	LYSOA03	LYSOA04	LYSOA05	LYSOA06	LYSOB01	LYSOB02	LYSOB03	LYSOB04	LYSOB05	LYSOC01	LYSOC02
2,6-Dinitrotoluene	606-20-2	61	0.034	0.13 U,V	0.25 U,V	0.25 U,V	0.24 U,V	0.26 U,V	0.26 U,V	0.24 U,V	0.24 U,V	0.24 U,V	0.24 U,V	4 V	0.25 U,V	0.25 U,V
2-Methylnaphthalene	91-57-6	-	-	0.12 V	0.22 V	0.098 V	0.47 V	0.22 V	0.22 V	0.21 V	0.11 V	0.18 V	0.26 V	0.11 V	0.017 J,V	0.09 V
Acenaphthene	83-32-9	3400	27	0.0084 V	0.012 J,V	0.0074 J,V	0.019 V	0.011 J,V	0.0098 J,V	0.015 V	0.009 J,V	0.02 V	0.021 V	0.0071 J,V	0.0041 U,V	0.0042 U,V
Acenaphthylene	208-96-8	-	-	0.017 V	0.041 V	0.0063 U,V	0.0081 J,V	0.0066 J,V	0.0066 J,V	0.006 U,V	0.006 U,V	0.006 U,V	0.012 J,V	0.0061 U,V	0.0061 U,V	0.0062 U,V
Anthracene	120-12-7	17000	450	0.057 V	0.1 V	0.095 V	0.29 V	0.11 V	0.1 V	0.18 V	0.079 V	0.15 V	0.17 V	0.065 V	0.0051 U,V	0.028 V
Benzo(a)anthracene*	56-55-3	0.15	0.014	**0.14 V**	**0.33 V**	**0.43 V**	**1.4 V**	**0.39 V**	**0.39 V**	**0.44 V**	0.005 U,V	**0.5 V**	**0.37 V**	**0.23 V**	**0.033 V**	**0.077 V**
Benzo(a)pyrene	50-32-8	0.015	0.0046	**0.2 V**	**0.81 V**	**0.59 V**	**1.2 V**	**0.38 V**	**0.4 V**	**0.56 V**	**0.18 V**	**0.47 V**	**0.49 V**	**0.28 V**	**0.018 J,V**	**0.078 V**
Benzo(b)fluoranthene	205-99-2	0.15	0.047	**0.28 V**	**0.74 V**	**0.29 V**	**0.84 V**	**0.26 V**	**0.26 V**	**0.3 V**	**0.26 V**	**0.29 V**	**0.36 V**	**0.23 V**	0.034 V	0.076 V
Benzo(g,h,i)perylene	191-24-2	-	-	0.11 V	0.8 V	0.84 V	1.4 V	0.29 V	0.46 V	0.65 V	0.12 V	0.42 V	0.46 V	0.25 V	0.0092 J,V	0.038 V
Benzo(k)fluoranthene	207-08-9	1.5	0.46	0.1 V	0.17 V	0.041 V	0.13 V	0.035 V	0.062 V	0.09 V	0.073 V	0.1 V	0.11 V	0.043 V	0.012 J,V	0.028 V
Butylbenzyl phthalate	85-68-7	260	0.67	0.38 U,V	0.77 U,V	0.77 U,V	0.74 U,V	0.8 U,V	0.8 U,V	0.73 U,V	0.73 U,V	0.73 U,V	0.74 U,V	0.74 U,V	0.75 U,V	0.76 U,V
Carbazole	86-74-8	-	-	0.15 U,V	0.3 U,V	0.3 U,V	0.28 U,V	0.31 U,V	0.31 U,V	0.28 U,V	0.28 U,V	0.28 U,V	0.28 U,V	0.28 U,V	0.29 U,V	0.29 U,V
Chrysene	218-01-9	15	1.4	0.3 V	0.6 V	0.49 V	2.1 V	0.57 V	0.53 V	0.7 V	0.48 V	0.62 V	0.85 V	0.33 V	0.039 V	0.11 V
Dibenzo(a,h)anthracene	53-70-3	0.015	0.015	**0.056 V**	**0.54 V**	**0.19 V**	**0.39 V**	**0.13 V**	**0.14 V**	**0.13 V**	**0.038 V**	**0.11 V**	**0.12 V**	**0.092 V**	0.0061 U,V	**0.016 J,V**
Dibenzofuran	132-64-9	-	-	0.13 U,V	0.25 U,V	0.25 U,V	0.24 U,V	0.26 U,V	0.26 U,V	0.24 U,V	0.24 U,V	0.24 U,V	0.24 U,V	0.24 U,V	0.25 U,V	0.25 U,V
Fluoranthene	206-44-0	2300	210	0.26 V	0.46 V	0.14 V	0.52 V	0.22 V	0.21 V	0.23 V	0.23 V	0.3 V	0.38 V	0.17 V	0.046 V	0.076 V
Fluorene	86-73-7	2300	33	0.0073 J,V	0.013 J,V	0.0063 J,V	0.02 V	0.0077 J,V	0.0055 J,V	0.009 J,V	0.005 U,V	0.007 J,V	0.016 J,V	0.005 U,V	0.0051 U,V	0.0052 U,V
Indeno(1,2,3-cd)pyrene	193-39-5	0.15	0.16	0.11 V	**0.81 V**	**0.86 V**	**1.4 V**	**0.29 V**	**0.47 V**	**0.66 V**	0.13 V	**0.43 V**	**0.47 V**	**0.25 V**	0.0072 U,V	0.034 V
Naphthalene	91-20-3	3.9	0.00055	0.34 V	0.88 V	0.052 V	0.21 V	0.18 V	0.16 V	0.14 V	0.061 V	0.1 V	0.28 V	0.097 V	0.013 J,V	0.07 V
Phenanthrene	85-01-8	-	-	0.62 V	1 V	0.87 V	4.8 M,V	1.2 V	1.1 V	1.9 V	0.7 V	1.7 V	1.8 V	0.66 V	0.039 V	0.25 V
Pyrene	129-00-0	1700	150	0.53 V	0.95 V	1.1 V	4 M,V	1.2 V	1.1 V	1.6 V	0.72 V	1.4 V	1.6 V	0.67 V	0.052 V	0.23 V
Pyridine	110-86-1	78	0.0097	0.2 U,V	0.41 U,V	0.41 U,V	0.39 U,M,V	0.43 U,V	0.43 U,V	0.39 U,V	0.39 U,V	0.39 U,V	0.4 U,V	0.39 U,V	0.4 U,V	0.4 U,V

U Analyte not detected above method detection limit (MDL).
J Analyte detected above MDL but not above reporting limit (RL). Numerical value should be considered an estimate.
M Matrix Spike and/or Matrix Spike Duplicate recovery outside acceptance limits.
V Quantitation or reporting limit raised due to dilution for matrix background interference.
Y Replicate/duplicate precision outside acceptance limits.
BOLD Analyte exceeds one or more WY VRP cleanup levels.
* Analyte is a contaminant found above WY VRP groundwater cleanup levels and therefore compared to soil Migration to Groundwater Cleanup Level.

TABLE 5 (cont.)
Laboratory Results for SVOCs in Surface Soil
Concentrations in milligrams per kilogram (mg/kg) parts per million (ppm)

Analyte	CAS Number	WY VRP Cleanup Level (mg/kg)		Sample ID												
		Residential Soil	Migration to Groundwater	LYSOC03	LYSOC04	LYSOC05	LYSOD01	LYSOD02	LYSOD03	LYSOD04	LYSOD05	LYSOD06	LYSOE01	LYSOE02	LYSOE03	LYSOE04
2,6-Dinitrotoluene	606-20-2	61	0.034	0.24 U,V	0.24 U,V	1.2 U	0.24 U,V	0.24 U,V	0.24 U,V	0.25 U,V	0.24 U,V	0.24 U,V	3.5 V	0.25 U,V	0.24 U,V	0.25 U,V
2-Methylnaphthalene	91-57-6	-	-	0.93 V	1.2 V	4.5	0.022 V	0.013 J,V	0.11 V	0.43 V	0.12 V	0.13 V	0.024 V	0.32 V	0.18 V	0.2 V
Acenaphthene	83-32-9	3400	27	0.013 J,V	0.098 ,V	0.15	0.004 U,V	0.004 U,V	0.0041 U,V	0.0041 U,V	0.0071 J,V	0.01 J,V	0.004 U,V	0.025 V	0.009 J,V	0.25 V
Acenaphthylene	208-96-8	-	-	0.023 V	0.006 J,V	0.03 U	0.0061 U,V	0.006 U,V	0.0061 U,V	0.012 J,V	0.016 J,V	0.023 V	0.006 U,V	0.0062 U,V	0.006 U,V	0.016 J,V
Anthracene	120-12-7	17000	450	0.14 V	1 V	1.8	0.0051 U,V	0.005 U,V	0.011 J,V	0.072 V	0.061 V	0.074 V	0.053 V	0.16 V	0.057 V	0.4 V
Benzo(a)anthracene*	56-55-3	0.15	0.014	**0.26 V**	**2.7 V**	**5.4 M**	**0.022 V**	**0.057 V**	**0.051 V**	**0.064 V**	**0.27 V**	**0.19 V**	**0.028 V**	**0.58 V**	**0.3 V**	**2 V**
Benzo(a)pyrene	50-32-8	0.015	0.0046	**0.52 V**	**2.4 V**	**4.8**	**0.019 V**	**0.048 V**	**0.063 V**	0.14 V	**0.25 V**	**0.27 V**	**0.038 V**	**0.8 V**	**0.52 V**	**1.9 V**
Benzo(b)fluoranthene	205-99-2	0.15	0.047	**0.51 V**	**1 V**	**2.7**	0.03 V	0.08 V	0.073 V	0.12 V	**0.29 V**	**0.4 V**	0.073 V	**0.74 V**	**0.39 V**	**0.46 V**
Benzo(g,h,i)perylene	191-24-2	-	-	0.52 V	2.4 V	5.9 M	0.01 J,V	0.011 J,V	0.025 V	0.1 V	0.14 V	0.16 V	0.019 J,V	0.92 V	0.8 V	1.2 V
Benzo(k)fluoranthene	207-08-9	1.5	0.46	0.092 V	0.11 V	0.53	0.011 J,V	0.022 ,V	0.029 V	0.038 V	0.076 V	0.078 V	0.016 J,V	0.15 V	0.083 V	2.3 V
Butylbenzyl phthalate	85-68-7	260	0.67	0.74 U,V	0.73 U,V	3.7 U	0.74 U,V	0.73 U,V	1.1 J,V	0.75 U,V	0.74 U,V	0.73 U,V	0.73 U,V	0.75 U,V	0.73 U,V	0.9 J,V
Carbazole	86-74-8	-	-	0.28 U,V	0.28 U,V	1.4 U,Y	0.28 U,V	0.28 U,V	0.28 U,V	0.29 U,V	0.29 U,V	0.28 U,V	0.28 U,V	0.29 U,V	0.28 U,V	0.31 J,V
Chrysene	218-01-9	15	1.4	0.68 V	3.2 V	8.2 M	0.034 V	0.072 V	0.062 V	0.18 V	0.32 V	0.42 V	0.068 V	0.64 V	0.3 V	2 V
Dibenzo(a,h)anthracene	53-70-3	0.015	0.015	**0.13 V**	**0.35 V**	**1.5 M**	0.0061 U,V	0.008 J,V	**0.035 V**	**0.068 V**	**0.086 V**	**0.076 V**	0.008 J,V	**0.51 V**	**0.47 V**	**0.7 V**
Dibenzofuran	132-64-9	-	-	0.24 U,V	0.26 J,V	1.2 U	0.24 U,V	0.24 U,V	0.24 U,V	0.25 U,V	0.24 U,V	0.24 U,V	0.24 U,V	0.25 U,V	0.24 U,V	0.25 U,V
Fluoranthene	206-44-0	2300	210	0.39 V	0.72 V	2.3	0.028 V	0.074 V	0.055 V	0.085 V	0.28 V	0.34 V	0.066 V	0.34 V	0.14 V	3.2 V
Fluorene	86-73-7	2300	33	0.01 J,V	0.081 V	0.11	0.0051 U,V	0.005 U,V	0.0051 U,V	0.0051 J,V	0.0051 U,V	0.0091 J,V	0.005 U,V	0.021 V	0.012 J,V	0.15 V
Indeno(1,2,3-cd)pyrene	193-39-5	0.15	0.16	**0.52 V**	**2.5 V**	**5.9 M**	0.0081 J,V	0.008 J,V	0.028 V	0.094 V	0.12 V	0.16 V	0.018 J,V	**0.92 V**	**0.8 V**	**1.2 V**
Naphthalene	91-20-3	3.9	0.00055	0.74 V	0.19 V	0.88	0.011 J,V	0.006 J,V	0.066 V	0.23 V	0.078 V	0.084 V	0.01 J,V	0.12 V	0.08 V	0.27 V
Phenanthrene	85-01-8	-	-	1.5 V	11 V	23 M	0.037 V	0.048 V	0.07 V	0.52 V	0.64 V	0.76 V	0.039 V	0.99 V	0.36 V	2.6 V
Pyrene	129-00-0	1700	150	1.4 V	7.8 V	19 M	0.047 V	0.089 V	0.086 V	0.4 V	0.64 V	0.71 V	0.076 V	1.1 V	0.34 V	3.6 V
Pyridine	110-86-1	78	0.0097	0.4 U,V	0.39 U,V	2 U,M	0.39 U,V	0.39 U,V	0.4 U,V	0.4 U,V	0.4 U,V	0.39 U,V	0.44 J,V	0.4 U,V	0.39 U,V	0.4 U,V

U Analyte not detected above method detection limit (MDL).
J Analyte detected above MDL but not above reporting limit (RL). Numerical value should be considered an estimate.
M Matrix Spike and/or Matrix Spike Duplicate recovery outside acceptance limits.
V Quantitation or reporting limit raised due to dilution for matrix background interference.
Y Replicate/duplicate precision outside acceptance limits.
BOLD Analyte exceeds one or more WY VRP cleanup levels.
* Analyte is a contaminant found above WY VRP groundwater cleanup levels and therefore compared to soil Migration to Groundwater Cleanup Level.

TABLE 5 (cont.)
Laboratory Results for SVOCs in Surface Soil
Concentrations in milligrams per kilogram (mg/kg) parts per million (ppm)

Analyte	CAS Number	WY VRP Cleanup Level (mg/kg)		Sample ID					
		Residential Soil	Migration to Groundwater	LYSOE05	LYSOF01	LYSOF02	LYSOF03	LYSOF04	LYSOF05
2,6-Dinitrotoluene	606-20-2	61	0.034	0.25 U,V	0.24 U,V	0.24 U,V	0.24 U,V	0.24 U,V	0.25 U,V
2-Methylnaphthalene	91-57-6	-	-	0.32 V	0.02 V	0.051 V	0.071 V	0.083 V	0.098 V
Acenaphthene	83-32-9	3400	27	0.0096 J,V	0.004 U,V	0.004 U,V	0.0041 U,V	0.004 U,V	0.0042 U,V
Acenaphthylene	208-96-8	-	-	0.017 J,V	0.0061 U,V	0.006 U,V	0.0061 U,V	0.006 U,V	0.0073 J,V
Anthracene	120-12-7	17000	450	0.04 V	0.0051 U,V	0.028 V	0.032 V	0.015 J,V	0.019 V
Benzo(a)anthracene*	56-55-3	0.15	0.014	**0.13 V**	**0.028 V**	**0.15 V**	0.0051 U,V	**0.059 V**	**0.07 V**
Benzo(a)pyrene	50-32-8	0.015	0.0046	**0.21 V**	**0.028 V**	**0.41 V**	**0.08 V**	**0.046 V**	**0.039 V**
Benzo(b)fluoranthene	205-99-2	0.15	0.047	**0.3 V**	0.038 V	**0.71 V**	0.085 V	0.076 V	0.092 V
Benzo(g,h,i)perylene	191-24-2	-	-	0.25 V	0.017 J,V	0.43 V	0.13 V	0.079 V	0.042 V
Benzo(k)fluoranthene	207-08-9	1.5	0.46	0.039 V	0.01 J,V	0.11 V	0.021 V	0.016 J,V	0.024 V
Butylbenzyl phthalate	85-68-7	260	0.67	0.77 U,V	0.74 U,V	0.74 U,V	0.74 U,V	0.73 U,V	0.76 U,V
Carbazole	86-74-8	-	-	0.3 U,V	0.28 U,V	0.28 U,V	0.28 U,V	0.28 U,V	0.29 U,V
Chrysene	218-01-9	15	1.4	0.25 V	0.044 V	0.26 V	0.1 V	0.095 V	0.13 V
Dibenzo(a,h)anthracene	53-70-3	0.015	0.015	**0.18 V**	0.0061 U,V	**0.079 V**	**0.047 V**	**0.016 J,V**	0.01 J,V
Dibenzofuran	132-64-9	-	-	0.25 U,V	0.24 U,V	0.24 U,V	0.24 U,V	0.24 U,V	0.25 U,V
Fluoranthene	206-44-0	2300	210	0.28 V	0.038 V	0.23 V	0.048 V	0.044 V	0.12 V
Fluorene	86-73-7	2300	33	0.0074 J,V	0.0051 U,V	0.005 U,V	0.0051 U,V	0.005 U,V	0.0052 U,V
Indeno(1,2,3-cd)pyrene	193-39-5	0.15	0.16	**0.22 V**	0.016 J,V	**0.41 V**	0.12 V	0.069 V	0.032 V
Naphthalene	91-20-3	3.9	0.00055	0.45 V	0.0091 J,V	0.048 V	0.041 V	0.045 V	0.2 V
Phenanthrene	85-01-8	-	-	0.43 V	0.041 V	0.21 V	0.2 V	0.13 V	0.2 V
Pyrene	129-00-0	1700	150	0.43 V	0.073 V	0.36 V	0.21 V	0.12 V	0.19 V
Pyridine	110-86-1	78	0.0097	0.41 U,V	0.39 U,V	0.39 U,V	0.4 U,V	0.39 U,V	0.41 U,V

U Analyte not detected above method detection limit (MDL).
J Analyte detected above MDL but not above reporting limit (RL). Numerical value should be considered an estimate.
M Matrix Spike and/or Matrix Spike Duplicate recovery outside acceptance limits.
V Quantitation or reporting limit raised due to dilution for matrix background interference.
Y Replicate/duplicate precision outside acceptance limits.
BOLD Analyte exceeds one or more WY VRP cleanup levels.
* Analyte is a contaminant found above WY VRP groundwater cleanup levels and therefore compared to soil Migration to Groundwater Cleanup Level.

TABLE 6
Laboratory Confirmation Results for Metals in Subsurface Soil
Concentrations in milligrams per kilogram (mg/kg) parts per million (ppm)

Analyte	CAS Number	WY VRP Cleanup Level (mg/kg)		Sample ID	
		Residential Soil	Migration to Groundwater	LYSSB0303	LYSSC0101
Aluminum	7429-90-5	77000	55000	9000	7460
Antimony	7440-36-0	31	0.66	0.15 U	0.43 J
Arsenic*	7440-38-2	0.39	0.0013	**3.7**	**4.6**
Barium	7440-39-3	15000	300	134	205
Beryllium	7440-41-7	-	-	0.48	0.43
Cadmium	7440-43-9	70	1.4	0.49	0.64
Calcium	7440-70-2	-	-	21700	21300
Chromium	7440-47-3	-	-	15.6	12.5
Cobalt*	7440-48-4	23	0.49	**5.9**	**4.7**
Copper	7440-50-8	3100	51	12.8	24.6
Iron	7439-89-6	55000	640	**13800**	**12500**
Lead	7439-92-1	400	-	12.7	71
Magnesium	7439-95-4	-	-	7280	4690
Manganese*	7439-96-5	1800	57	**385**	**240**
Mercury*	7439-97-6	6.7	0.033	**0.068**	**0.11**
Nickel	7440-02-0	1600	48	11.2	9.6
Potassium	7440-09-7	-	-	1892	1895
Silver	7440-22-4	390	1.6	0.14 U	0.15 U
Sodium	7440-23-5	-	-	555.8	143.9
Vanadium	7440-62-2	390	180	26.1	23.7
Zinc	7440-66-6	23000	680	48.5	76.9

U Analyte not detected above method detection limit (MDL).
J Analyte detected above MDL but not above reporting limit (RL). Numerical value should be considered an estimate.
BOLD Analyte exceeds one or more WY VRP benchmarks.
* Analyte is a contaminant found above WY VRP groundwater cleanup levels and therefore compared to soil Migration to Groundwater Cleanup Level.

TABLE 7
Laboratory Results for VOCs in Groundwater
Concentrations in micrograms per liter (µg/L) parts per billion (ppb)

Analyte	CAS Number	WY VRP Cleanup Level (µg/L)	Sample ID							
			LYMW01	LYMW02	LYMW03	LYMW04	LYMW05	LYMW06	LYMW07*	LYMW08†
1,2,4-Trimethylbenzene	95-63-6	365	0.4 U	0.4 U	0.4 U	9.6 M,Y	0.4 U	0.4 U	0.4 U	0.4 U
1,3,5-Trimethylbenzene	108-67-8	1820	0.4 U	0.4 U	0.4 U	1.6	0.4 U	0.4 U	0.4 U	0.4 U
Bromodichloromethane	75-27-4	80	0.3 U	0.3 U	0.3 U	0.6 J	0.3 U	0.3 U	0.3 U	0.3 U
cis-1,2-Dichloroethene	156-59-2	70	0.3 U	0.3 U	0.3 U	0.3 U	1.3	0.3 U	0.3 U	0.3 U
Ethylbenzene	100-41-4	700	0.3 U	0.3 U	0.3 U	0.35 J	0.3 U	0.3 U	0.3 U	0.3 U
Isopropylbenzene	98-82-8	3600	0.3 U	0.3 U	0.3 U	2	0.3 U	0.34 J	0.3 U	0.3 U
m,p-Xylenes	1330-20-7	10000	0.6 U	0.6 U	0.6 U	1 J	0.6 U	0.6 U	0.6 U	0.6 U
Methyl tert-butyl ether	1634-04-4	47.3	3.5	0.46 J	3.7	2.6	3.5	2.6	4	0.4 U
Naphthalene‡	91-20-3	729	0.3 U	0.3 U	0.48 J	2.8	0.3 U	0.34 J	0.58 J	0.3 U
n-Butylbenzene	104-51-8	-	0.4 U	0.4 U	0.4 U	2.7	0.4 U	0.4 U	0.4 U	0.4 U
n-Propylbenzene	103-65-1	-	0.4 U	0.4 U	0.4 U	1.5	0.4 U	0.4 U	0.4 U	0.4 U
p-Isopropyltoluene	99-87-6	-	0.4 U	0.4 U	0.4 U	1.8	0.4 U	0.4 U	0.4 U	0.4 U
sec-Butylbenzene	135-98-8	-	0.3 U	0.3 U	0.3 U	1.3	0.3 U	0.31 J	0.3 U	0.3 U
Trichloroethene	79-01-6	5	0.5 U	0.5 U	0.5 U	0.5 U	2.4	0.5 U	0.5 U	0.5 U

U Analyte not detected above method detection limit (MDL).
J Analyte detected above MDL but not above reporting limit (RL). Numerical value should be considered an estimate.
M Matrix Spike and/or Matrix Spike Duplicate recovery outside acceptance limits.
Y Replicate/duplicate precision outside acceptance limits.
* Duplicate of LYMW03.
† Trip Blank.‡ Compound is found on analyte list for SW-846 Methods 8260 and 8270.

TABLE 8
Laboratory Results for SVOCs in Groundwater
Concentrations in micrograms per liter (µg/L) parts per billion (ppb)

Analyte	CAS Number	WY VRP Cleanup Level (µg/L)	Sample ID						
			LYMW01	LYMW02	LYMW03	LYMW04	LYMW05	LYMW06	LYMW07*
1-Methylnaphthalene	90-12-0	-	0.003 U	0.003 U	0.09	36	0.0031 U	0.05	0.092
2-Methylnaphthalene	91-57-6	-	0.003 U	0.003 U	0.089	1.6	0.0031 U	0.039	0.1
Acenaphthene	83-32-9	2190	0.015	0.003 U	0.43	1.7	0.0031 U	0.056	0.39
Acenaphthylene	208-96-8	-	0.006 J	0.002 U	0.095	0.64	0.002 U	0.002 U	0.094
Anthracene	120-12-7	10900	0.067	0.002 U	0.47	0.51	0.002 U	0.051	0.48
Benzo(a)anthracene	56-55-3	0.117	0.018	0.003 U	**0.12**	0.016	0.0031 U	0.0031 U	0.11
Benzo(a)pyrene	50-32-8	0.2	0.004 U	0.004 U	0.05	0.004 U	0.0041 U	0.0041 U	0.052
Benzo(b)fluoranthene	205-99-2	0.117	0.004 U	0.004 U	0.022	0.004 U	0.0041 U	0.0041 U	0.022
Benzo(g,h,i)perylene	191-24-2	-	0.005 U	0.005 U	0.054	0.005 J	0.0051 U	0.0051 U	0.053
Bis(2-ethylhexyl) phthalate	117-81-7	6	4.3 B	0.75 U	0.77 U	0.75 U	0.77 U	0.77 U	0.76 U
Chrysene	218-01-9	11.7	0.041	0.004 U	0.21	0.017	0.0041 U	0.0041 U	0.21
Dibenzo(a,h)anthracene	53-70-3	0.0117	0.004 U	0.004 U	0.0041 U	0.004 U	0.0041 U	0.0041 U	0.004 J
Dibenzofuran	132-64-9	-	0.26 U	0.26 U	0.27 U	1.3	0.27 U	0.27 U	0.26 U
Diethyl phthalate	84-66-2	29200	0.37 J	0.28 U	0.29 U	0.28 U	0.29 U	0.29 U	0.28 U
Di-n-butyl phthalate	84-74-2	3650	0.41 J	0.22 U	0.23 J	0.22 U	0.22 U	0.27 J	0.62 J
Di-n-octyl phthalate	117-84-0	-	0.16 U	0.16 U	0.16 U	0.61	0.16 U	0.16 U	0.16 U
Fluoranthene	206-44-0	1460	0.028	0.003 U	0.056	0.015	0.0031 U	0.0031 U	0.072
Fluorene	86-73-7	1460	0.007 J	0.002 U	0.67	3.2	0.002 U	0.036	0.63
Indeno(1,2,3-cd)pyrene	193-39-5	0.117	0.004 U	0.005 J	0.013 J	0.004 U	0.0041 U	0.0041 U	0.013 J
Naphthalene†	91-20-3	729	0.003 U	0.003 U	0.17	3.6	0.0031 U	0.23	0.18

TABLE 8
Laboratory Results for SVOCs in Groundwater
Concentrations in micrograms per liter (µg/L) parts per billion (ppb)

Analyte	CAS Number	WY VRP Cleanup Level (µg/L)	Sample ID						
			LYMW01	LYMW02	LYMW03	LYMW04	LYMW05	LYMW06	LYMW07*
Phenanthrene	85-01-8	-	0.007 J	0.003 U	0.0031 U	2.3	0.0031 U	0.0031 U	0.003 U
Pyrene	129-00-0	1090	0.45	0.003 U	1	0.22	0.0031 U	0.019	1.1

U Analyte not detected above method detection limit (MDL).
J Analyte detected above MDL but not above reporting limit (RL). Numerical value should be considered an estimate.
B Analyte detected in the associated method blank.
BOLD Analyte exceeds one or more WY VRP cleanup levels.
***** Duplicate of LYMW03.
† Compound is found on analyte list for EPA SW-846 Methods 8260 and 8270.

TABLE 9
Diesel Range Organics Results for Groundwater Samples
Results in micrograms per Liter (µg/L) parts per billion (ppb)

Analyte	CAS Number	WY VRP Water Cleanup Level (µg/L)	Sample ID						
			LYMW01	LYMW02	LYMW03	LYMW04	LYMW05	LYMW06	LYMW07*
Diesel Range Organics	STL00143	10,000	460	44 U	2400	3300	46 U	1700	5600

U Analyte not detected above method detection limit (MDL).
* Duplicate of LYMW03.

TABLE 10
Gasoline Range Organics Results for Groundwater Samples
Results in micrograms per Liter (µg/L) parts per billion (ppb)

Analyte	CAS Number	WY VRP Water Cleanup Level (µg/L)	Sample ID						
			LYMW01	LYMW02	LYMW03	LYMW04	LYMW05	LYMW06	LYMW07*
Gasoline Range Organics	8006-61-9	7,300	30 U	30 U	84 J	560	30 U	79 J	89 J

U Analyte not detected above method detection limit (MDL).
J Analyte detected above MDL but below reporting limit (RL). Numerical value should be considered an estimate.
* Duplicate of LYMW03.

TABLE 11
Laboratory Results for Metals in Groundwater
Concentrations in micrograms per liter (µg/L) parts per billion (ppb)

Analyte	CAS Number	WY VRP Cleanup Level (µg/L)	Sample ID						
			LYMW01	LYMW02	LYMW03	LYMW04	LYMW05	LYMW06	LYMW07*
Aluminum	7429-90-5	36500	5090	21000	10600	11600 M	8830	5010	21800
Arsenic	7440-38-2	10	4 U	9.3 J	8.9 J	4.8 J	7.8 J	4 U	**21.4**
Barium	7440-39-3	2000	64	359	99.4	149	106	107	300
Beryllium	7440-41-7	4	0.26 J	2.7	1.6	0.8	1.7	0.56	1.3
Cadmium	7440-43-9	5	0.3 U	1.3	1.1	0.3 U	1.6	0.41 J	1.5
Calcium	7440-70-2	-	294000	232000	304000	239000	346000	294000	285000
Chromium	7440-47-3	-	14.4	56.3	28.5	23.7	23.9	14.7	47.5
Cobalt	7440-48-4	10.9	3.8	**15.2**	10.1	9.4	10.1	3.5	**13.9**
Copper	7440-50-8	1300	17.5	88.2	17.3	760 M	23.9	22.8	72.2
Iron	7439-89-6	25500	8910	**57800**	**44900**	**38200 M**	18100	**29500**	**70500**
Lead	7439-92-1	15	6.9	**33.2**	**22.7**	**16.7**	**19.6**	**40.3**	**51.9**
Magnesium	7439-95-4	-	240000	217000	289000	182000 M	303000	252000	281000
Manganese	7439-96-5	50	**514**	**5390**	**2980**	**1460**	**524**	**5120**	**3370**
Mercury	7439-97-6	2	0.016 U	0.016 U	0.08	0.016 U	0.04 J	**19.1**	0.04 J
Nickel	7440-02-0	729	8.8	34.7	20.4	14.2	20.2	9.1	25
Potassium	7440-009-7	-	.00628	.00782	.00748	.00703	.00903	.00639	.0102
Selenium	7782-49-2	50	4.1 J	4.9 J	3.5 J	3.3 J	5.3 J	6.8 J	3.7 J
Sodium	7440-23-5	-	0.208	0.259	0.299	0.255 Y	0.368	0.281	0.250
Thallium	7440-28-0	2	2.5 U	**3.3 J**	2.5 U	2.5 U,M	2.5 U	**3.5 J**	2.5 U

TABLE 11
Laboratory Results for Metals in Groundwater
Concentrations in micrograms per liter (µg/L) parts per billion (ppb)

Analyte	CAS Number	WY VRP Cleanup Level (µg/L)	Sample ID						
			LYMW01	LYMW02	LYMW03	LYMW04	LYMW05	LYMW06	LYMW07*
Vanadium	7440-62-2	255	12.3	123	43.7	44.1	58.1	34.3	68.1
Zinc	7440-66-6	5000	49.7	204	130	70.1	114	72.3	152

U Analyte not detected above method detection limit (MDL).
J Analyte detected above MDL but not above reporting limit (RL). Numerical value should be considered an estimate.
M Matrix Spike and/or Matrix Spike Duplicate recovery outside acceptance limits.
Y Replicate/duplicate precision outside acceptance limits.
BOLD Analyte exceeds one or more WY VRP cleanup levels.
***** Duplicate of LYMW03.

TABLE 12
Laboratory Results for Investigation-Derived Soil
Results in milligrams per kilogram (mg/kg) and
milligrams per liter (mg/L) parts per million (ppm)

Analyte	CAS Number	TCLP Regulatory Limit	LYSSWC01
Metals (mg/kg)			
Aluminum	7429-90-5	-	9840 M
Antimony	7440-36-0	-	0.94
Arsenic	7440-38-2	-	3
Barium	7440-39-3	-	144
Beryllium	7440-41-7	-	0.66
Cadmium	7440-43-9	-	0.47
Calcium	7440-70-2	-	15100
Chromium	7440-47-3	-	19.3
Cobalt	7440-48-4	-	6.8
Copper	7440-50-8	-	13.9
Iron	7439-89-6	-	16900 M
Lead	7439-92-1	-	10.9
Magnesium	7439-95-4	-	6660
Manganese	7439-96-5	-	209
Mercury	7439-97-6	-	1.1 M
Nickel	7440-02-0	-	12.5
Potassium	7440-009-7	-	1182
Sodium	7440-23-5	-	497.7
Vanadium	7440-62-2	-	31.6
Zinc	7440-66-6	-	61.9
TCLP (mg/L)			
Barium	7440-39-3	100	0.37
Cadmium	7440-43-9	1	0.0015 Y
Chromium	7440-47-3	5	0.0046 B
Selenium	7782-49-2	1	0.022 B
Volatile Organic Compounds (mg/kg)			
1,2,4-Trimethylbenzene	95-63-6	-	3.6
1,3,5-Trimethylbenzene	108-67-8	-	1.1
m,p-Xylenes	1330-20-7	-	3.1

TABLE 12
Laboratory Results for Investigation-Derived Soil
Results in milligrams per kilogram (mg/kg) and
milligrams per liter (mg/L) parts per million (ppm)

Analyte	CAS Number	TCLP Regulatory Limit	LYSSWC01
Naphthalene	91-20-3	-	8.3
n-Butylbenzene	104-51-8	-	0.6 J
o-Xylene	95-47-6	-	0.99 Y
p-Isopropyltoluene	99-87-6	-	0.38 J
Toluene	108-88-3	-	0.43 J
Semi-volatile Organic Compounds (mg/kg)			
2-Methylnaphthalene	91-57-6	-	0.32 V
Acenaphthene	83-32-9	-	0.055 V
Anthracene	120-12-7	-	0.1 V
Benzo(a)anthracene	56-55-3	-	0.3 V
Benzo(a)pyrene	50-32-8	-	0.37 V
Benzo(b)fluoranthene	205-99-2	-	0.29 V
Benzo(g,h,i)perylene	191-24-2	-	0.52 V
Benzo(k)fluoranthene	207-08-9	-	0.04 V
Chrysene	218-01-9	-	0.33 V
Dibenzo(a,h)anthracene	53-70-3	-	0.3 V
Fluoranthene	206-44-0	-	0.11 V
Fluorene	86-73-7	-	0.096 V
Indeno(1,2,3-cd)pyrene	193-39-5	-	0.47 V
Naphthalene	91-20-3	-	0.051 V
Phenanthrene	85-01-8	-	0.47 V
Pyrene	129-00-0	-	0.91 V
Petroleum Products (mg/kg)			
Gasoline Range Organics	8006-61-9	-	430
Diesel Range Organics	STL00143	-	1500 M

J Analyte detected above MDL but not above reporting limit (RL). Numerical value should be considered an estimate.
B Analyte detected in the associated method blank.
M Matrix spike and/or Matrix Spike Duplicate recovery outside acceptance limits.
V Quantitation or reporting limit raised due to dilution for matrix background interference.
Y Replicate/duplicate precision outside acceptance limits.

TABLE 13
Laboratory Results for Investigation-Derived Water
Concentrations in micrograms per liter (µg/L) parts per billion (ppb)

Analyte	CAS Number	TCLP Regulatory Limit	LYGWWC01
Metals			
Aluminum	7429-90-5	-	1970
Barium	7440-39-3	100000	69.6
Beryllium	7440-41-7	-	0.29 J
Calcium	7440-70-2	-	277000
Chromium	7440-47-3	5000	5
Cobalt	7440-48-4	-	1.7 J
Copper	7440-50-8	-	33.4
Iron	7439-89-6	-	6080
Lead	7439-92-1	5000	4.8
Magnesium	7439-95-4	-	256000
Manganese	7439-96-5	-	1970
Mercury	7439-97-6	200	1.1
Nickel	7440-02-0	-	5.1
Potassium	7440-009-7	-	0.00675
Selenium	7782-49-2	1000	4.1 J
Sodium	7440-23-5	-	0.241
Vanadium	7440-62-2	-	6.1
Zinc	7440-66-6	-	17.4
Volatile Organic Compounds			
1,2,4-Trimethylbenzene	95-63-6	-	3.3
1,3,5-Trimethylbenzene	108-67-8	-	0.67 J
Isopropylbenzene	98-82-8	-	0.56 J
Methyl tert-butyl ether	1634-04-4	-	2.1
Naphthalene	91-20-3	-	1.1
n-Butylbenzene	104-51-8	-	0.95 J
n-Propylbenzene	103-65-1	-	0.57 J
p-Isopropyltoluene	99-87-6	-	0.65 J
sec-Butylbenzene	135-98-8	-	0.35 J

TABLE 13
Laboratory Results for Investigation-Derived Water
Concentrations in micrograms per liter (µg/L) parts per billion (ppb)

Analyte	CAS Number	TCLP Regulatory Limit	LYGWWC01
Semi-volatile Organic Compounds			
1-Methylnaphthalene	90-12-0	-	6.1
2-Methylnaphthalene	91-57-6	-	0.28
Acenaphthene	83-32-9	-	0.37
Acenaphthylene	208-96-8	-	0.13
Anthracene	120-12-7	-	0.13
Dibenzofuran	132-64-9	-	0.34 J
Fluorene	86-73-7	-	0.7
Naphthalene	91-20-3	-	0.66
Phenanthrene	85-01-8	-	0.33
Pyrene	129-00-0	-	0.13
Petroleum Products			
Gasoline Range Organics	8006-61-9	-	120
Diesel Range Organics	STL00143	-	1000

J Analyte detected above MDL but not above reporting limit (RL). Numerical value should be considered an estimate.

TABLE 14
Laboratory Results for Asbestos Fibers on Filter Samples

Parameter	AHERA Clearance Level	Sample ID	
		LYF01	LYF02
Total AHERA Structures	-	51	23
Loading on Filter (s/mm^2)	70 (avg)	84	20
Air Volume Sampled (L)	-	155	166
Air Concentration (s/cc)	-	0.52	0.11

TABLE 15
In Situ and Sieved Raw XRF Results for Surface and Subsurface Soil
Results in milligrams per kilogram (mg/kg) parts per million (ppm)

			XRF Results (ppm)																	
			In Situ		Sieved		In Situ		Sieved		In Situ		Sieved		In Situ		Sieved		In Situ		Sieved	
Sample ID	Location	Depth	Mn	Mn Error	Mn	Mn Error	Fe	Fe Error	Fe	Fe Error	Co	Co Error	Co	Co Error	As	As Error	As	As Error	Pb	Pb Error	Pb	Pb Error
LYSOAA01	Sub-grid location A	0-6 inches	392	19	572	12	32119	226	46131	179	280	38	430	26	17	5	13	3	387	6	610	4
LYSOAA02	Sub-grid location A	0-6 inches	411	20	613	13	35532	258	47915	189	316	42	451	27	15	5	13	4	530	8	1077	7
LYSOAA03	Sub-grid location A	0-6 inches	402	20	662	13	33616	245	45656	180	353	41	468	27	40	7	18	5	836	10	1672	9
LYSOAA04	Sub-grid location A	0-6 inches	478	21	577	12	33846	247	43589	170	309	41	360	26	20	5	20	3	357	6	625	5
LYSOAA05	Sub-grid location A	0-6 inches	554	24	566	12	54502	407	37304	147	586	56	323	23	30	6	23	4	505	8	891	6
LYSOAA06	Sub-grid location A	0-6 inches	345	18	-	-	23916	179	-	-	179	34	-	-	9	3	-	-	97	3	-	-
LYSOAA07	Sub-grid location A	0-6 inches	411	19	-	-	25977	195	-	-	237	36	-	-	17	3	-	-	153	4	-	-
LYSOAA08	Sub-grid location A	0-6 inches	436	19	-	-	20426	154	-	-	93	30	-	-	9	2	-	-	83	3	-	-
LYSOAA09	Sub-grid location A	0-6 inches	305	17	-	-	17073	133	-	-	97	28	-	-	7	2	-	-	73	3	-	-
LYSOAA10	Sub-grid location A	0-6 inches	315	17	-	-	16709	129	-	-	125	28	-	-	10	2	-	-	78	3	-	-
LYSOAB01	Sub-grid location A	0-6 inches	398	20	604	13	24577	196	46955	181	99	36	297	26	239	14	22	3	3170	27	569	4
LYSOAB02	Sub-grid location A	0-6 inches	510	21	639	13	29551	218	43228	170	233	38	359	26	4	6	25	4	567	8	828	5
LYSOAB03	Sub-grid location A	0-6 inches	598	24	741	14	51974	380	60172	237	512	53	496	31	61	9	23	6	1369	14	2234	11
LYSOAB04	Sub-grid location A	0-6 inches	393	19	-	-	25913	194	-	-	211	36	-	-	10	3	-	-	122	4	-	-
LYSOAB05	Sub-grid location A	0-6 inches	354	18	-	-	23859	179	-	-	216	34	-	-	11	3	-	-	114	3	-	-
LYSOAB06	Sub-grid location A	0-6 inches	266	16	-	-	16588	130	-	-	120	28	-	-	6	2	-	-	57	3	-	-
LYSOAB07	Sub-grid location A	0-6 inches	377	18	-	-	21012	162	-	-	185	32	-	-	8	3	-	-	135	4	-	-
LYSOAB08	Sub-grid location A	0-6 inches	363	18	-	-	23848	177	-	-	188	34	-	-	4	3	-	-	113	3	-	-
LYSOAB09	Sub-grid location A	0-6 inches	326	17	-	-	19272	148	-	-	190	30	-	-	5	2	-	-	71	3	-	-
LYSOAB10	Sub-grid location A	0-6 inches	343	18	-	-	21418	162	-	-	199	32	-	-	8	2	-	-	74	3	-	-
LYSOAC01	Sub-grid location A	0-6 inches	622	23	871	15	60100	401	81282	307	400	52	612	35	29	5	32	3	408	6	598	5
LYSOAC02	Sub-grid location A	0-6 inches	678	23	903	15	48096	329	64810	250	312	47	437	31	26	5	21	3	474	7	695	5
LYSOAC03	Sub-grid location A	0-6 inches	587	24	609	13	43164	320	45645	180	383	48	316	26	21	7	13	4	753	10	962	6
LYSOAC04	Sub-grid location A	0-6 inches	419	19	-	-	28051	202	-	-	191	36	-	-	13	3	-	-	134	4	-	-
LYSOAC05	Sub-grid location A	0-6 inches	347	17	-	-	20781	156	-	-	125	31	-	-	10	2	-	-	93	3	-	-
LYSOAC06	Sub-grid location A	0-6 inches	281	17	-	-	26801	197	-	-	208	36	-	-	10	2	-	-	89	3	-	-
LYSOAC07	Sub-grid location A	0-6 inches	354	18	-	-	25088	183	-	-	290	34	-	-	13	2	-	-	75	3	-	-
LYSOAC08	Sub-grid location A	0-6 inches	409	19	-	-	24160	180	-	-	202	34	-	-	10	3	-	-	106	3	-	-
LYSOAC09	Sub-grid location A	0-6 inches	328	17	-	-	19532	146	-	-	179	30	-	-	6	2	-	-	85	3	-	-

TABLE 15
In Situ and Sieved Raw XRF Results for Surface and Subsurface Soil
Results in milligrams per kilogram (mg/kg) parts per million (ppm)

Sample ID	Location	Depth	XRF Results (ppm)																	
			In Situ		Sieved		In Situ		Sieved		In Situ		Sieved		In Situ		Sieved		In Situ		Sieved	
			Mn	Mn Error	Mn	Mn Error	Fe	Fe Error	Fe	Fe Error	Co	Co Error	Co	Co Error	As	As Error	As	As Error	Pb	Pb Error	Pb	Pb Error
LYSOAC10	Sub-grid location A	0-6 inches	376	18	-	-	20109	151	-	-	227	31	-	-	10	2	-	-	83	3	-	-
LYSOAD01	Sub-grid location A	0-6 inches	414	21	623	16	110262	694	166772	651	927	70	929	53	-64	8	37	4	1413	13	667	5
LYSOAD02	Sub-grid location A	0-6 inches	1410	33	1703	21	72368	498	92312	357	487	60	566	38	35	5	26	3	397	7	529	4
LYSOAD03	Sub-grid location A	0-6 inches	561	25	654	13	59303	437	51483	203	845	59	406	28	52	8	3	5	1085	12	1510	8
LYSOAD04	Sub-grid location A	0-6 inches	334	19	-	-	50474	347	-	-	291	49	-	-	13	3	-	-	124	4	-	-
LYSOAD05	Sub-grid location A	0-6 inches	312	18	-	-	42309	299	-	-	216	45	-	-	14	3	-	-	91	3	-	-
LYSOAD06	Sub-grid location A	0-6 inches	541	21	-	-	37909	269	-	-	218	42	-	-	15	3	-	-	146	4	-	-
LYSOAD07	Sub-grid location A	0-6 inches	332	18	-	-	23743	179	-	-	236	34	-	-	10	3	-	-	109	3	-	-
LYSOAD08	Sub-grid location A	0-6 inches	392	18	-	-	23274	174	-	-	204	33	-	-	9	2	-	-	91	3	-	-
LYSOAD09	Sub-grid location A	0-6 inches	326	17	-	-	22003	162	-	-	224	32	-	-	10	3	-	-	109	3	-	-
LYSOAD10	Sub-grid location A	0-6 inches	372	18	-	-	23401	173	-	-	169	33	-	-	8	2	-	-	71	3	-	-
LYSOAE01	Sub-grid location A	0-6 inches	352	21	513	15	114680	737	156375	609	1180	73	972	51	51	7	34	4	799	10	607	5
LYSOAE02	Sub-grid location A	0-6 inches	323	21	520	15	107810	707	134280	524	827	71	816	47	78	7	46	4	823	10	663	5
LYSOAE03	Sub-grid location A	0-6 inches	389	21	744	15	71293	498	74782	294	436	60	395	35	2	5	21	3	374	6	432	4
LYSOAE04	Sub-grid location A	0-6 inches	392	20	-	-	40814	294	-	-	176	45	-	-	16	3	-	-	148	4	-	-
LYSOAE05	Sub-grid location A	0-6 inches	311	18	576	13	29272	216	53670	215	233	38	370	29	32	5	15	2	363	6	250	3
LYSOAE06	Sub-grid location A	0-6 inches	362	19	-	-	37022	261	-	-	236	42	-	-	13	3	-	-	108	3	-	-
LYSOAE07	Sub-grid location A	0-6 inches	380	19	-	-	20499	161	-	-	99	32	-	-	11	3	-	-	96	3	-	-
LYSOAE08	Sub-grid location A	0-6 inches	451	20	-	-	27632	205	-	-	168	36	-	-	7	3	-	-	108	3	-	-
LYSOAE09	Sub-grid location A	0-6 inches	345	18	-	-	25822	189	-	-	298	35	-	-	12	2	-	-	85	3	-	-
LYSOAE10	Sub-grid location A	0-6 inches	316	17	-	-	17460	134	-	-	128	28	-	-	12	2	-	-	75	3	-	-
LYSOAA0505	5 feet south of LYSOAA05	0-6 inches	296	18	-	-	25048	194	-	-	245	36	-	-	19	3	-	-	139	4	-	-
LYSOAA0405	5 feet south of LYSOAA04	0-6 inches	310	24	-	-	28720	285	-	-	109	49	-	-	20	5	-	-	219	6	-	-
LYSOAA0205	5 feet south of LYSOAA03	0-6 inches	223	16	-	-	12380	114	-	-	7	26	-	-	15	3	-	-	121	4	-	-
LYSOAA0305	5 feet south of LYSOAA02	0-6 inches	145	13	-	-	8160	74	-	-	-21	19	-	-	11	2	-	-	56	2	-	-
LYSOAA0105	5 feet south of LYSOAA01	0-6 inches	305	19	-	-	30228	240	-	-	256	42	-	-	18	4	-	-	266	6	-	-
LYSOAA0105SE	5 feet southeast of LYSOAA01	0-6 inches	341	22	-	-	21837	207	-	-	13	39	-	-	9	5	-	-	294	7	-	-
LYSOAA0105E	5 feet east of LYSOAA01	0-6 inches	326	21	-	-	29116	256	-	-	208	45	-	-	11	4	-	-	156	5	-	-

TABLE 15
In Situ and Sieved Raw XRF Results for Surface and Subsurface Soil
Results in milligrams per kilogram (mg/kg) parts per million (ppm)

Sample ID	Location	Depth	XRF Results (ppm)																	
			In Situ		Sieved		In Situ		Sieved		In Situ		Sieved		In Situ		Sieved		In Situ		Sieved	
			Mn	Mn Error	Mn	Mn Error	Fe	Fe Error	Fe	Fe Error	Co	Co Error	Co	Co Error	As	As Error	As	As Error	Pb	Pb Error	Pb	Pb Error
LYSOAB0105E	5 feet east of LYSOAB01	0-6 inches	168	17	-	-	17571	165	-	-	106	34	-	-	6	3	-	-	112	4	-	-
LYSOAC0105E	5 feet east of LYSOAC01	0-6 inches	237	19	-	-	25124	220	-	-	104	40	-	-	26	3	-	-	119	4	-	-
LYSOAD0105E	5 feet east of LYSOAD01	0-6 inches	587	23	-	-	22673	185	-	-	83	35	-	-	13	3	-	-	86	3	-	-
LYSOAE0105E	5 feet east of LYSOAE01	0-6 inches	191	21	-	-	41953	385	-	-	245	58	-	-	17	5	-	-	288	7	-	-
LYSOAD0112	LYSOAD01	1 foot bgs	340	25	-	-	62033	538	-	-	385	68	-	-	20	5	-	-	309	7	-	-
LYSSC0101	Sub-grid C; borehole 1	1 foot bgs	285	17	375	10	23935	183	27730	112	330	35	272	20	8	2	12	1	43	3	81	2
LYSSC0102	Sub-grid C; borehole 1	2 feet bgs	253	17	-	-	17582	143	-	-	133	30	-	-	6	2	-	-	29	2	-	-
LYSSC0103	Sub-grid C; borehole 1	3 feet bgs	368	20	-	-	26654	212	-	-	181	38	-	-	7	2	-	-	20	2	-	-
LYSSC0104	Sub-grid C; borehole 1	4 feet bgs	1220	31	-	-	39651	292	-	-	499	46	-	-	15	2	-	-	9	2	-	-
LYSSC0105	Sub-grid C; borehole 1	5 feet bgs	179	15	-	-	18504	149	-	-	160	31	-	-	4	1	-	-	6	2	-	-
LYSSC0106	Sub-grid C; borehole 1	6 feet bgs	275	16	-	-	34819	236	-	-	382	39	-	-	9	1	-	-	7	2	-	-
LYSSC0201	Sub-grid C; borehole 2	1 foot bgs	295	17	-	-	22276	171	-	-	200	33	-	-	11	2	-	-	54	3	-	-
LYSSC0205	Sub-grid C; borehole 2	5 feet bgs	285	18	-	-	19480	164	-	-	168	33	-	-	13	2	-	-	50	3	-	-
LYSSC0206	Sub-grid C; borehole 2	6 feet bgs	257	20	-	-	31914	267	-	-	392	46	-	-	7	2	-	-	8	2	-	-
LYSSC0207	Sub-grid C; borehole 2	7 feet bgs	194	14	-	-	13610	105	-	-	87	24	-	-	6	1	-	-	10	2	-	-
LYSSC0208	Sub-grid C; borehole 2	8 feet bgs	155	13	-	-	15502	116	-	-	147	26	-	-	6	1	-	-	10	2	-	-
LYSSC0301	Sub-grid C; borehole 3	1 foot bgs	29	9	-	-	7152	62	-	-	44	17	-	-	1	1	-	-	13	2	-	-
LYSSC0303	Sub-grid C; borehole 3	3 feet bgs	216	16	291	9	23438	184	25967	105	189	35	170	19	9	2	6	1	13	2	12	1
LYSSC0306	Sub-grid C; borehole 3	6 feet bgs	542	21	-	-	23720	178	-	-	202	34	-	-	4	2	-	-	14	2	-	-
LYSSC0307	Sub-grid C; borehole 3	7 feet bgs	307	18	-	-	33136	241	-	-	349	41	-	-	7	1	-	-	6	2	-	-
LYSSC0308	Sub-grid C; borehole 3	8 feet bgs	118	12	-	-	12847	100	-	-	174	24	-	-	1	1	-	-	11	2	-	-
LYSSC0401	Sub-grid C; Borehole 4	1 foot bgs	311	18	-	-	15271	130	-	-	74	28	-	-	5	2	-	-	25	2	-	-
LYSSC0405	Sub-grid C; Borehole 4	5 feet bgs	114	11	-	-	11996	91	-	-	152	22	-	-	3	2	-	-	97	3	-	-
LYSSC0501	Sub-grid C; borehole 5	1 foot bgs	427	20	-	-	27785	213	-	-	286	38	-	-	8	2	-	-	18	2	-	-
LYSSC0505	Sub-grid C; borehole 5	5 feet bgs	296	18	-	-	23067	181	-	-	247	35	-	-	7	2	-	-	14	2	-	-
LYSSC0506	Sub-grid C; borehole 5	6 feet bgs	373	18	-	-	21852	167	-	-	248	33	-	-	5	2	-	-	14	2	-	-
LYSSC0507	Sub-grid C; borehole 5	7 feet bgs	157	13	-	-	9551	80	-	-	51	20	-	-	5	1	-	-	15	2	-	-
LYSSB0101	Sub-grid B; borehole 1	1 foot bgs	547	21	592	12	25772	195	40064	159	191	36	359	25	9	3	11	2	117	4	178	2
LYSSB0201	Sub-grid B; borehole 2	1 foot bgs	238	17	-	-	18795	157	-	-	193	32	-	-	4	2	-	-	14	2	-	-

TABLE 15
In Situ and Sieved Raw XRF Results for Surface and Subsurface Soil
Results in milligrams per kilogram (mg/kg) parts per million (ppm)

Sample ID	Location	Depth	XRF Results (ppm)																	
			In Situ		Sieved		In Situ		Sieved		In Situ		Sieved		In Situ		Sieved		In Situ		Sieved	
			Mn	Mn Error	Mn	Mn Error	Fe	Fe Error	Fe	Fe Error	Co	Co Error	Co	Co Error	As	As Error	As	As Error	Pb	Pb Error	Pb	Pb Error
LYSSB0205	Sub-grid B; borehole 2	5 feet bgs	228	15	-	-	14610	117	-	-	147	26	-	-	5	1	-	-	15	2	-	-
LYSSB0302	Sub-grid B; borehole 3	2 feet bgs	465	20	-	-	26886	197	-	-	296	36	-	-	9	2	-	-	76	3	-	-
LYSSB0303	Sub-grid B; borehole 3	3 feet bgs	289	17	531	11	19004	148	26799	108	235	31	230	20	5	2	9	1	18	2	16	1
LYSSB0304	Sub-grid B; borehole 3	4 feet bgs	187	16	-	-	18746	157	-	-	178	32	-	-	8	2	-	-	13	2	-	-
LYSSB0305	Sub-grid B; borehole 3	5 feet bgs	94	12	-	-	6972	69	-	-	-12	18	-	-	1	1	-	-	15	2	-	-
LYSSB0306	Sub-grid B; borehole 3	6 feet bgs	135	13	-	-	13830	113	-	-	-4	25	-	-	7	1	-	-	8	2	-	-
LYSSB0307	Sub-grid B; borehole 3	7 feet bgs	146	15	-	-	18990	162	-	-	92	33	-	-	5	2	-	-	9	2	-	-

*Raw XRF data should be used for guidance and screening purposes only.

TABLE 16
Validated XRF Results
Concentrations in milligrams per kilogram (mg/kg) parts per million (ppm)

Sample ID	Location	Depth	Manganese	MnQ	MnDL	MnRL	Iron	FeQ	FeDL	FeRL	Cobalt	CoQ	CoDL	CoRL	Arsenic	AsQ	AsDL	AsRL	Lead	PbQ	PbDL	PbRL
LYSOAA01	Sub-grid location A	0-6 inches	572		23	76.8	46131		954	3180	430		61.1	204	61	U	2.36	7.87	610		4.04	13.5
LYSOAA01D	Sub-grid location A	0-6 inches	552		23	76.8	46667		954	3180	434		61.1	204	60.1	U	2.36	7.87	601		4.04	13.5
LYSOAA02	Sub-grid location A	0-6 inches	613		23	76.8	47915		954	3180	451		61.1	204	107.7	U	2.36	7.87	1077		4.04	13.5
LYSOAA03	Sub-grid location A	0-6 inches	662		23	76.8	45656		954	3180	468		61.1	204	167.2	U	2.36	7.87	1672		4.04	13.5
LYSOAA04	Sub-grid location A	0-6 inches	577		23	76.8	43589		954	3180	360		61.1	204	62.5	U	2.36	7.87	625		4.04	13.5
LYSOAA05	Sub-grid location A	0-6 inches	566		23	76.8	37304		954	3180	323		61.1	204	89.1	U	2.36	7.87	891		4.04	13.5
LYSOAB01	Sub-grid location A	0-6 inches	604		23	76.8	46955		954	3180	297		61.1	204	56.9	U	2.36	7.87	569		4.04	13.5
LYSOAB02	Sub-grid location A	0-6 inches	639		23	76.8	43228		954	3180	359		61.1	204	82.8	U	2.36	7.87	828		4.04	13.5
LYSOAB03	Sub-grid location A	0-6 inches	741		23	76.8	60172		954	3180	496		61.1	204	223.4	U	2.36	7.87	2234		4.04	13.5
LYSOAC01	Sub-grid location A	0-6 inches	871		23	76.8	81282		954	3180	612		61.1	204	59.8	U	2.36	7.87	598		4.04	13.5
LYSOAC02	Sub-grid location A	0-6 inches	903		23	76.8	64810		954	3180	437		61.1	204	69.5	U	2.36	7.87	695		4.04	13.5
LYSOAC03	Sub-grid location A	0-6 inches	609		23	76.8	45645		954	3180	316		61.1	204	96.2	U	2.36	7.87	962		4.04	13.5
LYSOAD01	Sub-grid location A	0-6 inches	623		23	76.8	166772		954	3180	929		61.1	204	66.7	U	2.36	7.87	667		4.04	13.5
LYSOAD02	Sub-grid location A	0-6 inches	1703		23	76.8	92312		954	3180	566		61.1	204	52.9	U	2.36	7.87	529		4.04	13.5
LYSOAD03	Sub-grid location A	0-6 inches	654		23	76.8	51483		954	3180	406		61.1	204	151	U	2.36	7.87	1510		4.04	13.5
LYSOAE01	Sub-grid location A	0-6 inches	513		23	76.8	156375		954	3180	972		61.1	204	60.7	U	2.36	7.87	607		4.04	13.5
LYSOAE02	Sub-grid location A	0-6 inches	520		23	76.8	134280		954	3180	816		61.1	204	66.3	U	2.36	7.87	663		4.04	13.5
LYSOAE03	Sub-grid location A	0-6 inches	744		23	76.8	74782		954	3180	395		61.1	204	43.2	U	2.36	7.87	432		4.04	13.5
LYSOAE05	Sub-grid location A	0-6 inches	576		23	76.8	53670		954	3180	370		61.1	204	25	U	2.36	7.87	250		4.04	13.5
LYSSB0101	Sub-grid B; borehole 1	1 foot bgs	592		23	76.8	40064		954	3180	359		61.1	204	17.8	U	2.36	7.87	178		4.04	13.5
LYSSB0303	Sub-grid B; borehole 3	3 feet bgs	531		23	76.8	26799		954	3180	230		61.1	204	9		2.36	7.87	16		4.04	13.5
LYSSC0101	Sub-grid C; borehole 1	1 foot bgs	375		23	76.8	27730		954	3180	272		61.1	204	12		2.36	7.87	81		4.04	13.5
LYSSC0303	Sub-grid C; borehole 3	3 feet bgs	291		23	76.8	25967		954	3180	170	J	61.1	204	6	J	2.36	7.87	12	J	4.04	13.5
LYSSC0303D	Sub-grid C; borehole 3	3 feet bgs	327		23	76.8	27235		954	3180	120	J	61.1	204	8		2.36	7.87	10	J	4.04	13.5

Q XRF Qualifier
DL XRF Detection Limit
RL XRF Reporting Limit
U with associated numerical value As concentration is less than 10% of Pb concentration
J Analyte detected above the DL, but not above the RL

TABLE 17
Statistical Analysis for PAHs in Surface Soil
Concentrations in milligrams per kilogram (mg/kg) parts per million (ppm)

	Analyte						
Statistical Elements	**Benzo(a) anthracene**	**Benzo(a) pyrene**	**Benzo(b) fluoranthene**	**Benzo(g,h,i) perylene**	**Benzo(k) fluoranthene**	**Dibenzo(a,h) anthracene**	**Indeno(1,2,3-cd) pyrene**
alpha	0.1	0.1	0.1	0.1	0.1	0.1	0.1
n	30	30	30	30	30	30	30
Mean	0.55	0.59	0.39	0.61	0.16	0.20	0.61
Standard Deviation	1.1	0.96	0.51	1.1	0.42	0.31	1.1
95% Confidence - Single Tailed	0.34	0.30	0.16	0.35	0.13	0.10	0.35
95% confident that soil average is below:	0.89	0.89	0.55	0.96	0.29	0.30	0.97
95% confident that soil average is above:	0.21	0.29	0.23	0.26	0.028	0.11	0.26
Minimum	0.0050	0.019	0.030	0.0092	0.010	0.0061	0.0072
Maximum	5.4	4.8	2.7	5.9	2.3	1.5	5.900
Screening Level							
EPA RSL for Industrial Soil	2.1	**0.21**	2.1	-	21	0.21	2.1

BOLD 95% confident that average analyte concentration in soil at property exceeds screening level

TABLE 18
Preliminary Cost Estimate for Removal of Hazardous Materials and DRO- and Metals-Contaminated Soil

Line Item (RS Means)	Item Description	Quantity	Unit	Crew	Daily Output	Hours	Factor	Unit Costs In Dollars			Total	Total w/ O&P	Item Total
								Labor	Equip	Mtrls			
	MOBILIZATION AND SITE PREPARATION												
1.54.36.50.0100	Mobilization of dozer, backhoe, >150 HP	1	EA	B-34K	3	2.667	1	$81.50	$207.00	N/A	$288.50	$354.00	**$354.00**
Heavy Equip. Operator	Mob 1 equipment operator, heavy (backhoe, dozer)	1	HR	N/A	N/A	1	1	$44.52	N/A	N/A	$44.52	$70.33	**$70.33**
Light Equip. Operator	Mob 1 equipment operators, light (water truck drivers / laborers)	2	HR	N/A	N/A	1	1	$35.10	N/A	N/A	$34.85	$53.37	**$106.74**
01.56.26.50.0200	Temp. Fencing, chain-link, rented	200	LF	N/A	400	0.04	1	$1.21	N/A	$1.21	$3.00	$3.85	**$770.00**
01.31.13.20.0200	Removal manager, average (preparation)	1	HR	N/A	N/A	20	1	$46.25	N/A	$0.00	$46.25	$71.87	**$1,437.40**
	Excavator Rental, weekly rate; contractor estimate	1	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$1,229.00	$1,229.00	$1,229.00
	Roll-off drop fee; contractor estimate	1	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$1,000.00	$1,000.00	**$1,000.00**
													$4,967.47
	DISPOSAL OF HAZARDOUS MATERIALS CONTAINERS												
	55-gallon drum, FB1; contractor estimate	5	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$125.00	$125.00	**$625.00**
	5-gallon bucket, FB1; contractor estimate	2	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$125.00	$125.00	**$250.00**
	16-gallon drum, A22K; contractor estimate	1	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$125.00	$125.00	**$125.00**
	55-gallon drum, A22K; contractor estimate	1	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$250.00	$250.00	**$250.00**
	20-gallon drum, A22K; contractor estimate	2	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$200.00	$200.00	**$400.00**
	1-gallon bucket, CPB; contractor estimate	1	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$50.00	$50.00	**$50.00**
	Lab-pack; contractor estimate	6	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$157.50	$157.50	**$945.00**
	Transportation, non-bulk; contractor estimate	12	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$35.00	$35.00	**$420.00**
	Subtotal												**$3,065.00**
	Fuel charge, 17.5%; contractor estimate	1	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	17.5%	17.5%	**$536.38**
													$3,601.38
	EXCAVATION OF CONTAMINATED SOIL (DRO)												
31.23.16.42.5500	Excavating, backhoe, 3.5CY	16.67	BCY	B-12D	2800	0.006	1	$0.20	$0.83	N/A	$1.03	$1.23	**$20.50**
01.31.13.20.0200	Removal manager, average	1	HR	N/A	N/A	20	1	$46.25	N/A	$0.00	$46.25	$71.87	**$1,437.40**
Heavy Equip. Operator	Equipment operator, heavy (backhoe)	1	HR	N/A	N/A	20	1	$44.52	N/A	N/A	$44.52	$70.33	**$1,406.60**
Light Equip. Operator	Equipment operator, light (water truck driver/laborer)	2	HR	N/A	N/A	20	1	$35.10	N/A	N/A	$34.85	$53.37	**$2,134.80**
01.54.33.40.6950	Dust suppression - water truck, 6,000 gal, off-highway, 1 truck for site dust suppression	0.5	WK	N/A	N/A	N/A	1	$765.00	$2,290.00	$0.00	$6,875.00	$966.80	**$483.40**
	Water for dust suppression - 1 load every 4 hours (6,000 gal/load), 1 truck	30,000	GAL	N/A	N/A	N/A	1	N/A	N/A	$0.00252	$0.00252	$0.00252	**$75.60**
													$5,558.30

TABLE 18
Preliminary Cost Estimate for Removal of Hazardous Materials and DRO- and Metals-Contaminated Soil

Line Item (RS Means)	Item Description	Quantity	Unit	Crew	Daily Output	Hours	Factor	Unit Costs In Dollars			Total	Total w/ O&P	Item Total
								Labor	Equip	Mtrls			
	DISPOSAL OF CONTAMINATED SOIL (DRO)												
	Disposal, bulk CCRK; contractor estimate	18.9	TON	N/A	N/A	N/A	1	N/A	N/A	N/A	$680.00	$680.00	**$12,852.00**
	Roll-off dump fee; contractor estimate	1	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$1,100.00	$1,100.00	**$1,100.00**
	Roll-off liner; contractor estimate	1	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$68.00	$68.00	**$68.00**
	Washout; contractor estimate	1	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$256.00	$256.00	**$256.00**
	Demurrage; contractor estimate	4	HR	N/A	N/A	N/A	1	N/A	N/A	N/A	$105.00	$105.00	**$420.00**
	Subtotal												**$14,696.00**
	Fuel charge, 17.5%; contractor estimate	1	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	17.5%	17.5%	**$2,571.80**
													$17,267.80
	EXCAVATION OF CONTAMINATED SOIL (METALS)												
31.23.16.42.5500	Excavating, backhoe, 3.5CY	7.87	BCY	B-12D	2800	0.006	1	$0.20	$0.83	N/A	$1.03	$1.23	**$9.68**
01.31.13.20.0200	Removal manager, average	1	HR	N/A	N/A	8	1	$46.25	N/A	$0.00	$46.25	$71.87	**$574.96**
Heavy Equip. Operator	Equipment operator, heavy (backhoe)	1	HR	N/A	N/A	8	1	$44.52	N/A	N/A	$44.52	$70.33	**$562.64**
Light Equip. Operator	Equipment operator, light (water truck driver/laborer)	2	HR	N/A	N/A	8	1	$35.10	N/A	N/A	$34.85	$53.37	**$853.92**
01.54.33.40.6950	Dust suppression - water truck, 6,000 gal, off-highway, 1 truck for site dust suppression	0.5	WK	N/A	N/A	N/A	1	$765.00	$2,290.00	$0.00	$6,875.00	$966.80	**$483.40**
	Water for dust suppression - 1 load every 4 hours (6,000 gal/load), 1 truck	15,000	GAL	N/A	N/A	N/A	1	N/A	N/A	$0.00252	$0.00252	$0.00252	**$37.80**
													$2,522.40
	DISPOSAL OF CONTAMINATED SOIL (METALS)												
	Disposal, bulk CCS; contractor estimate (minimum)	15	TON	N/A	N/A	N/A	1	N/A	N/A	N/A	$180.00	$180.00	**$2,700.00**
	Roll-off dump fee; contractor estimate	1	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$1,100.00	$1,100.00	**$1,100.00**
	Roll-off liner; contractor estimate	1	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$68.00	$68.00	**$68.00**
	Washout; contractor estimate	1	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$256.00	$256.00	**$256.00**
	Demurrage; contractor estimate	3	HR	N/A	N/A	N/A	1	N/A	N/A	N/A	$105.00	$105.00	**$420.00**
	Adams County Haz Fee; contractor estimate	15	TON	N/A	N/A	N/A	1	N/A	N/A	N/A	$6.94	$6.94	**$104.10**
	Adams County Fee, 2%; contractor estimate	1	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	2%	2%	**$54.00**
	Subtotal												**$4,702.10**
	Fuel charge, 17.5%; contractor estimate	1	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	17.5%	17.5%	**$822.87**
													$5,524.97

TABLE 18
Preliminary Cost Estimate for Removal of Hazardous Materials and DRO- and Metals-Contaminated Soil

Line Item (RS Means)	Item Description	Quantity	Unit	Crew	Daily Output	Hours	Factor	Unit Costs In Dollars			Total	Total w/ O&P	Item Total
								Labor	Equip	Mtrls			
	REPLACE CLEAN SOIL												
31.23.23.13.1300	Dozer, backfilling, up to 300' haul, no compaction	29.45	LCY	B-10B	1200	0.01	1	$0.37	$0.88	$0.00	$1.26	$1.54	**$45.35**
31.23.23.20.9100	Hauling, 18 CY truck, 45 MPH, 30 mile cycle	29.45	LCY	B-34I	144	0.056	1	$1.91	$4.59	N/A	$6.50	$7.95	**$234.13**
31.23.23.16.0200	Fill material, sand, dead, or bank	29.45	LCY	N/A	150	N/A	1	$5.25	$1.90	$10.00	$17.15	$21.14	**$622.57**
01.54.33.40.6950	Dust suppression - water truck, 6,000 gal, off-highway, 1 truck for site dust suppression	1	WK	N/A	N/A	N/A	1	$765.00	$2,290.00	$0.00	$6,875.00	$966.80	**$966.80**
01.31.13.20.0200	Removal manager, average	1	HR	N/A	N/A	20	1	$46.25	N/A	$0.00	$46.25	$71.87	**$1,437.40**
Heavy Equip. Operator	Equipment operator, heavy (dozer)	1	HR	N/A	N/A	20	1	$44.52	N/A	N/A	$44.52	$70.33	**$1,406.60**
Light Equip. Operator	Equipment operators, light (water truck)	2	HR	N/A	N/A	20	1	$35.10	N/A	N/A	$35.10	$55.45	**$1,109.00**
	Water for dust suppression - 1 load every 4 hours (6,000 gal/load), 1 truck	30,000	GAL	N/A	N/A	N/A	1	N/A	N/A	$0.00252	$0.00252	$0.00252	**$75.60**
													$5,897.45
	DEMOBILIZATION												
1.54.36.50.0100	Demobilization of Dozer, Loader, >150 HP	1	EA	B-34K	3	2.667	1	$81.50	$207.00	N/A	$288.50	$354.00	**$354.00**
Heavy Equip. Operator	Demob 1 equipment operators, heavy (backhoe, dozer)	1	HR	N/A	N/A	2	1	$44.52	N/A	N/A	$44.52	$70.33	**$140.66**
Light Equip. Operator	Demob 2 equipment operators, light (water truck drivers / laborers)	2	HR	N/A	N/A	1	1	$35.10	N/A	N/A	$34.85	$53.37	**$106.74**
01.31.13.20.0200	Removal manager, average (demob)	1	HR	N/A	N/A	10	1	$46.25	N/A	$0.00	$46.25	$71.87	**$718.70**
													$1,320.10
	ENVIRONMENTAL MONITORING												
01.31.13.20.0100	Safety engineer, soil and air sample collection.	40	HR	N/A	N/A	40	1	$21.60	N/A	N/A	$21.60	$33.75	**$1,350.00**
	Air monitoring equipment rental (DataRAM), 1 instruments; rental rate	2	WK	N/A	N/A	N/A	2	N/A	$560.00	N/A	$560.00	$560.00	**$1,120.00**
	TCLP analysis; laboratory rate	1	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$70.00	$70.00	**$70.00**
	TCLP extraction; laboratory rate	1	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$40.00	$40.00	**$40.00**
	DRO confirmation analysis; laboratory rate	2	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$40.00	$40.00	**$80.00**
	Metals confirmation analysis; laboratory rate	2	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$90.00	$90.00	**$180.00**
	Asbestos filter analysis; laboratory rate	2	EA	N/A	N/A	N/A	1	N/A	N/A	N/A	$7.00	$7.00	**$14.00**
													$2,854.00

TABLE 18
Preliminary Cost Estimate for Removal of Hazardous Materials and DRO- and Metals-Contaminated Soil

Line Item (RS Means)	Item Description	Quantity	Unit	Crew	Daily Output	Hours	Factor	Unit Costs In Dollars			Total	Total w/ O&P	Item Total
								Labor	Equip	Mtrls			
	FIELD EXPENSES												
01.52.13.20.1250	Equipment storage trailer, monthly only	1	MO	N/A	N/A	N/A	1	N/A	$73.50	N/A	$73.50	$80.50	**$80.50**
02.82.13.45.0100	Environmental Technician, straight time, hourly rate	1	HR	N/A	N/A	8	1	$34.77	N/A	N/A	$34.77	$38.25	**$306.00**
	21,000 gallon water storage tank, steel	1	MO	N/A	N/A	N/A	1	N/A	$1,200.00	N/A	$1,200.00	$1,200.00	**$1,200.00**
	Truck, 4X4, 3/4 ton, 1 trucks; rental rate	2	WK	N/A	N/A	N/A	1	N/A	$428.00	N/A	$428.00	$428.00	**$856.00**
													$2,442.50
SITE TOTAL													**$51,956.37**
CONTINGENCY (20%)													$10,391.27
GRAND TOTAL													**$62,347.64**

See Section 8 of the report for explanations and assumptions used in calculations
Source: RSMeans, 2012. Building Construction Cost Data. https://meanscostworks.com/