Former Acme Power Plant
VRP #58.220
PS #0807

EPA Site Assessment
Grant BF96845801

Site Assessment
Final Report

Prepared for:

Wyoming Department of
Environmental Quality

U.S. Environmental Protection
Agency, Region 8

WWC ENGINEERING

September 2021

SITE ASSESSMENT FINAL REPORT
FORMER ACME POWER PLANT VRP #58.220 (PS #0807)
EPA SITE ASSESSMENT GRANT BF96845801

Prepared for:	Voluntary Remediation Program Solid and Hazardous Waste Division Wyoming Department of Environmental Quality 200 West 17th Street, 2nd Floor Cheyenne, WY 82002
Prepared by:	WWC Engineering 1849 Terra Avenue Sheridan, WY 82801 (307) 672-0761
Principal Author:	Loren Ruttinger, P.E., Project Manager
Reviewed by:	Jack Fritz, P.E., Director of Operations

LOREN M. RUTTINGER
15709
Date 04/30/2021

WWC ENGINEERING
Serving the Rocky Mountain region since 1980.
www.wwcengineering.com

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF APPENDICES

TABLE OF CONTENTS (Continued)

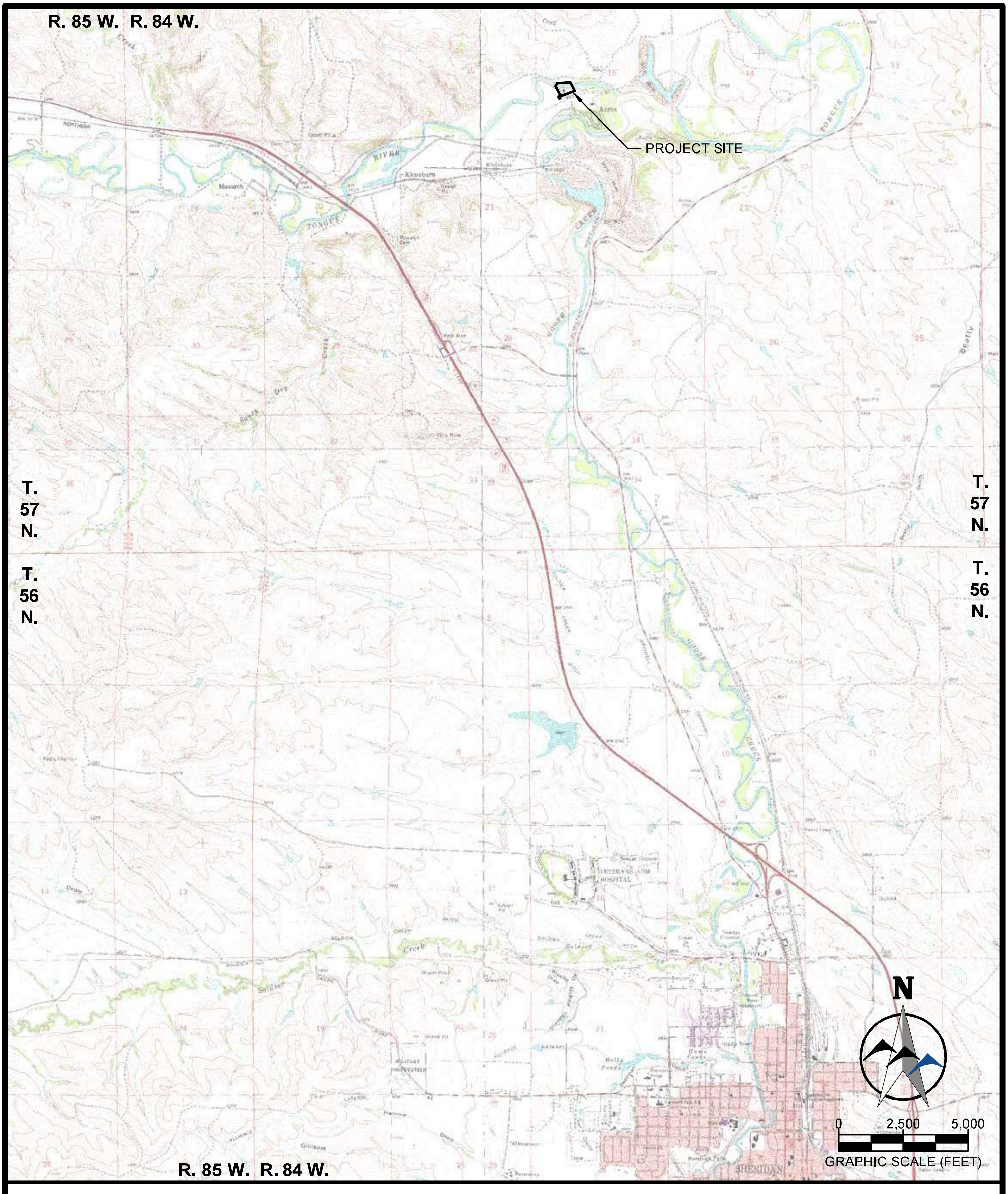
1.0 SITE SUMMARY

The Former Acme Power Plant site (the Site) is a 5.8-acre parcel of land located at 165 Acme Road in Acme, Sheridan County, Wyoming, approximately 10 miles north of Sheridan, Wyoming. The Site is owned by the Sheridan County Conservation District (the Owner). Figure 1 shows the location of the Site in relation to Sheridan. The Site is located in Township 57 North, Range 84 West, Section 15, North ½ of the Southwest ¼ (Sheridan County Parcel 57841530000333). The Tongue River passes through the northern portion of the Site. The Tongue River is a perennial tributary to the Yellowstone River. Adjacent lands are owned by the Padlock Ranch Company. Nearby lands are owned by Big Horn Coal Company (care of Lighthouse Resources, LLC), Sheridan-Johnson Rural Electrification Association, and the State of Wyoming. This Site Assessment involves the portion of the 5.8-acre Site south of the Tongue River, referred to as the Study Area (shown on Figure 2).

The Site was the location of the historical coal-fired Acme Power Plant (the Plant). The Plant was constructed in 1910 and operated from March 1911 to August 23, 1976. The Plant derived its coal from nearby mines and its water source from the Tongue River. As early as 1912, the Plant provided power to the neighboring mines and coal camps, the City of Sheridan, and the Sheridan Railway Company. The Sheridan County Electric Company owned and operated the Plant from 1910 until 1947, when it sold the Plant to Montana-Dakota Utilities (MDU). MDU upgraded the steam turbines in the Plant in 1947 and again in 1952. In 1973, the U.S. Environmental Protection Agency (EPA) informed MDU that the Plant did not meet air quality standards and would either need to be upgraded or shut down. MDU chose to shut down the Plant. EPA agreed to a slow-phase shutdown, and the Plant completed final operations on August 23, 1976.

MDU sold the Plant to Carl Weissman and Sons for metal salvage. The Plant sat mostly idle until 1984 when Perkins Power purchased it with the intention of operating it again and using the Plant's steam to heat a 2-acre greenhouse for growing lettuce hydroponically. This planned use, along with several other proposed Plant use options, did not materialize during the 1980s and early 1990s. Several deed transfers occurred in the early 1990s. In 2000, salvage rights were assigned to a private individual, and ownership of the Plant was transferred to Diversified Resources. In 2008, the Site was approved for auto salvage operations and disposal by the Sheridan Board of County Commissioners. In October 2015 through January 2017, the Sheridan Community Land Trust worked through issues involving property ownership of the Site. After applying to the EPA Targeted Brownfield Assessment Program in June 2016, the Sheridan County Conservation District assumed ownership of the Site in June 2017.

EPA tasked Weston Solutions, Inc. (Weston) with a Phase I Environmental Site Assessment (ESA), which was completed in January 2017. The Phase I ESA recommended conducting a Phase II ESA, conducting asbestos-containing materials (ACM) surveys,



DESIGNED BY: WWC ENGINEERING

FIGURE 1. PROJECT SITE IN RELATION TO SHERIDAN, WYOMING

DESIGNED BY: WWC ENGINEERING

FIGURE 2. SITE ASSESSMENT STUDY AREA

\\wwc.local\work\Sheridan\WDEQ\19018\Task_04\SHEETS\LOC_GENERAL_FIGS.dwg 10/19/2021 3:25:55 PM dave johnson lead-based paint (LBP) surveys, polychlorinated biphenyl (PCB)-containing equipment surveys, and drum characterization to verify contents of drums (Weston 2017a). Weston completed a Phase II ESA focusing on media outside the buildings (i.e., soil, groundwater, surface water, and sediments) (Weston 2017b) and a Phase II ESA focusing on hazardous building materials (i.e., ACM, LBP, PCBs, mold, etc.) in October 2017 (Weston 2017c). The Site was entered into the Wyoming Department of Environmental Quality/Voluntary Remediation Program (WDEQ/VRP) in January 2018. WWC Engineering (WWC) was contracted in June 2018 to supervise preliminary environmental cleanup activities termed “Site Stabilization.”

Table 1 chronologically summarizes previous Site investigations and Site Stabilization. Weston prepared the Phase I ESA and Phase II ESAs for the Site in January 2017 and October 2017, respectively. The work commenced after the Owner applied to the EPA Targeted Brownfield Assessment Program. WWC supervised Site Stabilization field activities from October 2018 through January 2019 to remove immediate human health and environmental hazards. The following subsections further describe the Site investigations and environmental cleanup.

1.1 Phase I ESA for the Former Acme Power Plant

The Phase I ESA for the Former Acme Power Plant identified the possibility of ACM, LBP, and other environmental hazards at the Site, due to the age and use of the buildings. The Phase I ESA documented six recognized environmental conditions (RECs) in connection with the Site (Weston 2017a):

- Stained surface soils and stressed vegetation
- Multiple drum storage areas with drums of unknown contents
- Previous undocumented activities that may have included car crushing and battery recycling
- Transformer spill of PCB-containing oil
- Coal ash pile
- Historical coal-fired power plant operations

The Phase I ESA also revealed evidence of two non-scope considerations in connection with the Site:

- The potential for ACM, LBP, mercury-containing thermostat switches and light fixtures, and PCB-containing equipment
- The presence of mold

The Phase I ESA recommendations included conducting a Phase II ESA to investigate potential contamination of surface soils, subsurface soils, sediments, and

Table 1. Summary of Previous Site Investigations and Site Stabilization

Date	Investigation	Summary of Results
2017	Phase I ESA	Six recognized environmental conditions and two non-scope considerations were found in connection to the property. Recommendations included conducting a Phase II ESA, conducting ACM, LBP, mercury, and PCB surveys, and conducting drum characterization (Weston 2017a).
2017	Phase II ESA	Surface soil contaminants of concern (COCs) included diesel range organics (DRO), oil range organics (ORO), PCBs, heavy metals, polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs). Subsurface soil COCs included iron, two VOCs (tetrachloroethene [PCE] and benzene), and PAHs. Groundwater COCs included one VOC (PCE), a pesticide (hexachlorobenzene), and six metals. Tongue River sediment COCs included DRO, ORO, and four metals. Although metals were reported in the coal ash pile, it was deemed unlikely that leachate from the coal ash pile would impact groundwater above regulatory standards. DRO, ORO, PCBs, PAHs, and metals were identified as COCs sourced from within the Plant. Approximately 67 drums were identified. Of 33 sampled drums, 30 contained used oil (Weston 2017b).
2017	Phase II ESA for Hazardous Building Materials	ACM was identified in the Plant, Barn, Maintenance Shop, Little House, and exterior soils. LBP was identified in the Plant, Barn, Maintenance Shop, Trailer, and Little House. Potential PCB-containing ballasts were identified in the Barn and Maintenance Shop. Five transformers were believed to have PCBs present. PCBs were also assumed present in lubrication oils and grease of coal delivery system, compressed air lines, boilers, ash handling systems, and switch gears. One mercury thermostat switch was observed in the Trailer. Mold was encountered throughout the Plant and Barn (Weston 2017c).
2018-2019	Site Stabilization	Site Stabilization field activities occurred from October 2018-January 2019. Bulk and loose ACM were removed from the Site. ACM included materials in original packaging/boxes/buckets as well as any obvious bulk asbestos. Approximately 60 cubic yards of bulk and loose ACM were removed from outside buildings and from within the Barn, Maintenance Shop, Little House, and Plant. ACM removed from the Site were friable and nonfriable. Site Stabilization did not include abatement of ACM. Site Stabilization included staging, screening, sampling, characterizing, and properly disposing of 51 drums, 23 of which had RCRA 8 metals concentrations that classified the drums as hazardous waste. All 51 drums were incinerated. Miscellaneous containers such as 5-gallon buckets and various containers 1 gallon or less were collected, characterized, and disposed of accordingly. Containers with residual contents were disposed with the drums. Empty containers were disposed at the Sheridan City Landfill. Potential PCB contamination sampling and delineation were conducted, including water samples, sediment samples, building material samples (concrete and brick), and wipe samples of equipment surfaces. Site security measures were completed. These measures included boarding entrances into the Plant and hanging signs on doors to the Plant and the Site perimeter fence to alert of the asbestos danger onsite.

groundwater; conducting ACM and LBP surveys; conducting surveys to determine the presence of potential mercury and PCB-containing equipment; and conducting drum characterization activities to verify drum contents prior to disposal.

1.2 Phase II ESA for the Former Acme Power Plant

The Phase II ESA identified a number of exceedances of cleanup standards at the Site. COCs were categorized as primary or secondary COCs based on the concentration of contaminants. COCs were assessed in surface soils, subsurface soils, groundwater, Tongue River sediments, the coal ash pile, building sediments, and the drums with unknown contents. The findings are summarized below (Weston 2017b).

1.2.1 Surface Soils

Contamination was identified in surface soils (0 to 1 foot below ground surface) across the Site. The following conclusions were made based on the results:

- The primary COCs identified in surface soils across the Site include DRO, ORO, Aroclor 1260 (a PCB), lead, and two PAHs (benzo[a]pyrene and benzo[b]fluoranthene).
- The secondary COCs included five metals (arsenic, antimony, copper, iron, and manganese), four PAHs (benzo[a]anthracene, bis[2-ethylhexyl]phthalate, dibenzo[a,h]anthracene, and indeno[1,2,3-cd]pyrene), two VOCs (benzene and PCE), and one herbicide (pentachlorophenol [PCP]).
- Sample results confirmed that surface soil staining near the drums is petroleum related.
- The highest concentrations of Arochlor 1260 were found along the southern portion of the Site. The source of PCB contamination in the southern portion of the Site is not known; however, it is possible that PCB oil was spilled at the Site and impacted soils were the result of tracking by vehicles. The two surface soil samples collected within the former substation were both non-detect for all PCB analytes.
- Broken battery debris was identified in multiple areas west of the Plant.
- PCE was detected above the WDEQ/VRP Migration to Groundwater cleanup level (CUL) at one location only; however, PCE was detected below regulatory standards in multiple locations west of the Plant.

1.2.2 Subsurface Soils

Subsurface soil investigations revealed that the vertical extent of contamination that exceeds EPA and WDEQ standards is limited to the top few feet, in general. The following conclusions were reached following the subsurface investigation:

- Only iron and PCE were considered primary COCs, since these were the only two analytes detected above regulatory standards in groundwater samples.

- Benzo(a)pyrene, benzo(b)fluoranthene, and benzene were considered secondary COCs. Benzo(a)pyrene and benzo(b)fluoranthene were vertically delineated above the smear zone and were not leaching to groundwater. Although benzene was detected above the WDEQ/VRP Migration to Groundwater CUL in multiple locations directly above the smear zone, it was not detected in any groundwater samples.
- Although low-level detections were reported for total petroleum hydrocarbon (TPH) ranges in all subsurface soil samples, no results were above WDEQ/VRP Residential Soil or Migration to Groundwater CULs.
- Of the five PCE detections above WDEQ/VRP Migration to Groundwater CULs, all were identified west of the Plant. Some detections above standards were directly above the smear zone. Concentrations exceeding groundwater CULs were detected downgradient of subsurface soil exceedances.
- PCBs were non-detect in all subsurface soil samples except for low-level detections of Aroclor 1260 in one location.
- Iron results exceeded the WDEQ/VRP Migration to Groundwater CUL in all subsurface soil samples.

1.2.3 Groundwater

Impacts to groundwater were identified at the Site; however, not all contaminant sources were identified. The exceedances of the PCE groundwater CUL are considered the primary concern to groundwater. The following conclusions were reached following the groundwater investigation:

- PCE, hexachlorobenzene (fungicide for crop seeds banned in 1966), and six metals (aluminum, arsenic, cobalt, iron, lead, and manganese) were determined to be COCs for groundwater at the Site; however, hexachlorobenzene, aluminum, and cobalt were not detected at elevated concentrations in soils.
- Of the ten samples collected, only three exceeded CULs other than metals.
- Manganese was detected above the WDEQ/VRP groundwater CUL in eight of the ten samples collected.
- PCBs were not detected in any groundwater samples.
- Low-level TPH ranges were detected in five samples; however, concentrations were well below CULs.
- Of the six metals that exceed regulatory benchmarks (aluminum, arsenic, cobalt, iron, lead, and manganese), only arsenic and lead have EPA maximum contaminant levels (MCLs).
- Other than an elevated result for iron in one subsurface soil sample directly above the smear zone, a source leaching metal contaminants into groundwater was not identified in the subsurface investigation.

- Though detections were reported for almost all metal analytes in each sample, the COC exceedances were at substantially higher concentrations in downgradient locations.
- Hexachlorobenzene was not detected in any surface or subsurface soil samples. Due to the upgradient location of the groundwater sample with hexachlorobenzene and no detections of hexachlorobenzene in Site soils, the source of hexachlorobenzene may be offsite or was not encountered during investigations.
- PCE was detected throughout the soil column in the area west of the Plant. PCE was found in the groundwater upgradient of the Plant at a very low concentration. The PCE exceedances in groundwater downgradient of the Plant and PCE detected in building sediment samples indicate the source of PCE may be located within the Plant.
- No sheens or light nonaqueous phase liquid (LNAPL) were observed when purging groundwater or collecting samples from temporary wells.

1.2.4 Tongue River Sediments

Tongue River sediments were sampled at the Site on both the north and south banks. The results of sediment sampling are summarized as follows:

- The upgradient sediment sample relative to the Plant and coal ash pile was used to determine the 3x upgradient sample concentration comparison values.
- Evaluation of Tongue River sediment results identified DRO, ORO, and four metals (arsenic, copper, lead, and nickel) as the primary COCs potentially sourced from the Plant or the coal ash pile.
- Concentrations of gasoline-range organics (GRO), DRO, and/or ORO exceeding 3x the upgradient levels were reported in all sediment samples collected; however, all values were low-level concentrations except for one location and its duplicate.
- PCBs were not detected in any of the sediment samples collected from the north or south banks.
- **Tongue River south bank:** Most impacts reported were adjacent to the Plant. Of particular interest are the elevated DRO and ORO concentrations along with five metals (arsenic, copper, lead, nickel, and mercury). Of the seven COCs identified in sediment, DRO, ORO, and three of the metals (arsenic, copper, and lead) were identified as COCs sourced in soil and groundwater samples collected from the area of the Plant. These are the primary COCs.
- **Tongue River north bank:** For the three samples collected from the north bank, all TPH concentrations were very low and not considered to be sourced from the coal ash pile or from the Plant. The only analyte of concern is nickel.

When compared to sample concentrations collected directly from the coal ash pile, it is possible the elevated nickel is sourced from the coal ash pile.

1.2.5 Coal Ash Pile

The results of coal ash pile sampling are summarized as follows:

- No evidence of radioactive material above background levels was observed.
- No EPA or WDEQ/VRP residential benchmarks were exceeded by any sample results.
- Though the WDEQ/VRP Migration to Groundwater CULs were exceeded by eight metal analytes total in all samples collected from the coal ash pile, results of the synthetic precipitation leaching procedure (SPLP) analysis did not report any exceedances above groundwater EPA MCLs or WDEQ/VRP CULs. This indicates that any leachate from the coal ash pile would not impact groundwater above regulatory standards.
- When comparing coal ash pile results to sediment results along the north bank of the Tongue River, nickel concentrations in both samples appear to be elevated. Due to the proximity of the coal ash pile, the coal ash pile may be the source of nickel impacts in the sediment.

1.2.6 Building Sediments

Building sediment samples were collected as a general indicator of potential contaminants previously used within the Plant. The following summarized the conclusions of sediment sampling:

- DRO, ORO, PCBs, PAHs, and metals are considered primary COCs associated with the Site that are sourced from within the Plant.
- The elevated concentrations of DRO, ORO, and PAHs are likely attributed to fuel, lubricants, and oil used in equipment and machinery in the Plant.
- The elevated levels of Aroclor 1260 (a PCB typically used in equipment before 1950) are likely sourced from PCB-containing oil used in equipment and machinery at the Plant such as compressors, fuel systems, hydraulic systems, turbines, etc.
- The sources for arsenic, cadmium, copper, and lead are not known, but are possibly due to coal ash generated and handled, chemicals stored at the Plant (e.g., weed control), and/or windblown surface soil deposits of exterior soils.
- Although PCE concentrations did not exceed CULs within the building sediments, the detection of PCE is of note as it indicates the possibility of PCE use within the Plant operations such as in cleaning solvents for equipment and parts. If PCE was used inside the Plant, another source area contributing to the PCE exceedance in downgradient groundwater samples could be associated with the Plant.

1.2.7 Drums with Unknown Contents

The results of the hazard classification of drums with unknown contents are summarized as follows:

- Four waste streams could be generated.
- Approximately 67 drums were identified. Results for 30 of the 33 drums accessible for screening indicated used motor oil was the unknown content.
- Multiple drums onsite were inaccessible.
- Although none of the drums sampled contained chlorinated/halogenated compounds, it is possible that PCE compounds and/or other waste streams are present in the inaccessible drums or had been contained, but subsequently released, by the empty drums at the Site.

1.3 Phase II ESA for the Former Acme Power Plant Hazardous Building Materials

Hazardous building materials were analyzed between May 31 and June 4, 2017. Results of the hazardous building materials Phase II ESA are summarized as follows (Weston 2017c):

- Five buildings at the Site were assessed for ACM: Plant, Maintenance Shop, Little House, Trailer, and Barn. The locations of these buildings are depicted on Figure 2. Additionally, surface soil samples were collected to test for the presence of asbestos fibers in surface soils. ACM is present throughout the Plant, as well as in the Barn, Maintenance Shop, and Little House. The presence of trace asbestos fibers in surface soils outside the Plant door indicates friable asbestos fibers are migrating beyond the walls of the Plant. ACM is a COC at the Site.
- Five buildings at the Site were assessed for LBP: Plant, Maintenance Shop, Little House, Trailer, and Barn. Based on the X-ray fluorescence (XRF) readings, elevated lead concentrations are present on door components, window components, walls, and/or trim in all five buildings at the Site. Although there were positive readings on building exterior surfaces, no bare soils were present around the locations of the readings. Therefore, lead impacts to surface soils were not evaluated. LBP is a COC at the Site.
- Potential PCB-containing ballasts were identified only in the Barn and Maintenance Shop. None of the light fixtures observed in the buildings appeared to be leaking fluids. Additionally, five transformers which are currently leaking, or have previously leaked, are believed to have PCBs present as indicated by sediment sample results in the Phase II ESA (Weston 2017b). PCBs are also assumed to be present in lubrication oils and grease of the coal delivery system, compressed air lines, boilers, ash handling systems, and switch gears (GEI 2000). PCBs are a COC at the Site.
- One mercury thermostat switch was observed in the Trailer. Mercury is a COC at the Site.

- Mold was encountered throughout the Plant and in the Barn. Mold is a COC at the Site.

1.4 Former Acme Power Plant Site Stabilization

WWC was contracted by WDEQ/VRP in June 2018 to lead Site Stabilization. The primary purpose of Site Stabilization was to remove hazards that could present immediate risk to human health or the environment during the future site assessment and cleanup activities. The Site Stabilization scope of work (SOW) included interviews and research to understand historical operations and activities at the Site, removal of bulk and loose ACM, characterization and removal of drums with unknown contents, and sampling and delineation of potential PCB contamination. The initial site visit occurred on August 30, 2018. During the initial site visit, the project team found many miscellaneous containers such as 5-gallon buckets with unknown contents and household chemicals around the Site. Also, there was evidence of trespassing and security concerns. Thus, the project team determined that site security measures would be beneficial for public safety, including signage and boarding doorways. WDEQ/VRP approved modification of the SOW to include disposing of the miscellaneous containers and improving Site security (WWC 2019a).

1.4.1 Historical Research and Interviews

WWC conducted research and interviews to understand historical operations and activities at the Site. Research primarily consisted of reviewing historical records and photographs. Interviews included a former Big Horn Coal Company Landman, a former MDU meter reader and lineman, a consultant of Perkins Power who evaluated the Plant for startup in 1988, and a former MDU lineman.

Research of historical photographs included images from the construction of the Plant in 1910 to final operations in the 1970s. The photographs showed locations of historical electrical equipment no longer in the Plant or at the Site that likely contained PCB oils. Additionally, photographs showed operations or Site conditions that could direct Site Assessment sampling locations. For example, Photograph H-1 in Appendix H of the QAPP shows stressed vegetation southeast of the Plant (WWC 2019b). Stressed vegetation could be indicative of a building, roadway, or railway footprint or of potential chemical contamination. Without knowing what activity caused stress to the vegetation, soil sampling was designed to investigate whether residual contamination is present in that area.

Interviews during Site Stabilization also produced useful information for Site Assessment. Several sources verified that a variety of materials were accepted at the Site as trash or for auto, battery, or transformer recycling. Two individuals who worked for MDU while the Plant was still in operation recalled that the Plant was kept very clean and the grounds were maintained. This indicates that much of the soil staining and trash around the Site was a result of salvage or other operations after 1976 when MDU sold the Plant. One former MDU employee recalled that MDU salvaged the transformers from the substation when the Plant closed. The transformers were hauled to Sheridan. This could explain the lack of PCB contamination in surface soils near the substation (discussed in Section 1.2.1). The same MDU employee visited the Site regularly during line patrols from 1976-2003. He recalled Carl Weissman and Sons stockpiling used car batteries (4-5 feet high), transformers, and drums on the south side of the Plant. These items were brought in from offsite and were not residual materials from historical Plant operations. The former MDU employee recalled that the soils on the south side of the Plant “looked like a garage floor because of the oil staining.” Although the Phase II ESA did not find detections of PCB oils in the surface soils near the substation, PCBs (Aroclor 1260) were detected on the south side of the Plant. The Phase II ESA noted that the source was unknown, and the assumption was that vehicle tracking from the substation caused the contamination. Due to the former MDU employee interview, it is assumed that the PCB contamination in surface soils in this area is from the transformer recycling activities conducted by Carl Weissman and Sons. PCBs are considered a COC in the area south of the Plant. Site Assessment was designed to conduct biased sampling in this area.

1.4.2 Bulk and Loose Asbestos-Containing Materials

The Site Stabilization SOW included removal of bulk and loose ACM at the Site. Bulk and loose ACM was defined as:

> *Asbestos, and asbestos-containing materials, in and around original packaging/boxes, as well as any obvious bulk asbestos in and around the immediate area. This task does not include asbestos abatement of the buildings and equipment where asbestos is present.*

WWC utilized the Phase II ESA for Hazardous Building Materials (Weston 2017c) to target bulk and loose ACM at the Site. Table 2 summarizes the ACM removed during Site Stabilization. As shown in Table 2, miscellaneous materials were targeted outside. These included a tote of friable pipe insulation, friable and nonfriable packing/gaskets, and nonfriable roofing tar and materials. Additionally, friable pipe and boiler insulation are present in the Plant. Bulk ACMs were targeted inside the Plant, primarily including materials that had not been installed and remained in storage in original packaging. The approximate quantities targeted in the Plant are summarized in Table 2. A total of 60 cubic yards of ACM were transported and disposed at a Category II Landfill in Miles City, Montana (WWC 2019a).

Doors and windows were open prior to Site Stabilization. During Site Stabilization, windows were closed, and doors were boarded. However, broken Plant windows remain open. Openings in the Plant have provided pathways for wind, animals,

Table 2. Summary of Bulk and Loose ACM Removed during Site Stabilization

Identified ACM	Location	Estimated Quantity	Condition
Miscellaneous Outside (Picked October 5 and November 1, 2018)			
Tote of pipe insulation	Southwest of Plant	1 box	Friable
Packing/gaskets	Outside buildings	Unknown	Variable
Roofing tar and materials	Outside buildings	Unknown	Nonfriable
Barn (Picked October 29, 2018)			
Pipe insulation	Main level and loft	2 boxes	Friable
Fiberboard	Loft	80 square feet	Nonfriable
Manhole gaskets	Main level	14 rolls	Nonfriable
Maintenance Shop (Picked October 29, 2018)			
Asbestoline and Fireite	Loft	2 gallons	Nonfriable
Brake pads	Main level	3 pads	Nonfriable
Covering	Main level	5 linear feet	Nonfriable
Packing/gaskets	Main level	8 rolls and 3 gaskets	Nonfriable
Little House (Picked October 29, 2018)			
Johns Manville insulation	Main level	1 roll	Friable
Plant (Picked October 5 through November 1, 2018)			
Pipe insulation	Storage loft	20 cubic yards	Friable
Pipe and boiler insulation	1952 boiler room catwalks	20 cubic yards	Friable

or trespassers to transport asbestos fibers from the Plant. Due to the presence of bulk and loose ACM outside the Plant and the presence of pathways for fiber migration, activity-based sampling (ABS) for asbestos in soil was conducted during Site Assessment. The results of ABS are discussed in Section 2.5, and the ABS report is provided in Appendix A.

1.4.3 Drums with Unknown Contents

Drums with unknown contents were scattered throughout the Site. Figure D-3 of the Sampling and Analysis Plan (SAP) shows the approximate locations where drums were located before they were staged, characterized, and removed during Site Stabilization (WWC 2019b). The drums were placed in overpacks and then transported to a staging area west of the Plant. The drums were screened and sampled in the staging area. A total of 51 drums had liquid contents that required field screening and sampling. Field screening and laboratory analysis verified that all 51 drums contained used motor oil. Analysis of the drums revealed hazardous concentrations of RCRA metals in 23 of the 51 drums. Once laboratory analyses of samples were complete, the drums were labeled, transported offsite, and disposed of according to the hazard characterization of each drum. All wastes in the drums were incinerated for energy recovery in a cement kiln at Systech Environmental Corporation in Fredonia, Kansas (WWC 2019a).

During Site Stabilization, soil staining was observed near some locations where drums had been stored. Photographs E-2 and E-3 of the SAP show soil staining on the north side of the Plant next to the 1947 boiler room where most drums had been stored.

Figure D-3 of the SAP shows the photograph locations in relation to the Plant (WWC 2019b). The photographs show the condition of soil on October 11-12, 2018 when the drums had been moved to the staging area.

During Site Assessment, biased sampling was conducted in the area on the north side of the Plant near the drum storage area. Due to approximately half of the drums of used oil having hazardous concentrations of RCRA metals, metals as well as petroleum hydrocarbons are considered COCs in the former drum storage areas.

1.4.4 Miscellaneous Containers

Miscellaneous small containers (5-gallon buckets and various containers approximately 1 gallon or less) were scatter throughout the Site outside and inside the buildings. During Site Stabilization, the miscellaneous containers were gathered and sorted at the drum staging area. The containers were placed within a 10-foot by 20-foot portable secondary containment berm. When field screening indicated that the contents in the container were the same as those in the drums (i.e., used motor oil), the contents from the small containers were emptied into a drum of the same waste stream to consolidate containers. When small containers were emptied into drums, samples were collected from the drums for laboratory analysis after the small containers were emptied. Not all waste streams in the miscellaneous small containers could be emptied into a drum. Twelve other waste streams were identified and sorted. These waste streams included the following:

- Paint and related materials (non-processable)
- Grease
- Caustic potash
- Herbicides
- Aerosols
- Petroleum contaminated soil
- Inorganic acid
- Bleach
- Inorganic base
- Oxidizing solid
- PCB oil (>500 ppm)
- PCB light ballasts

The 12 waste streams were sorted into respective containers and hauled offsite. All wastes except for the PCB wastes were accepted by Clean Harbors Environmental Services in Kimball, Nebraska. A 5-gallon bucket with PCB oil was sent to the Clean

Harbors facility in Aragonite, Utah. The PCB light ballasts were sent to Region 8 Enviro LLC in Commerce City, Colorado (WWC 2019a).

During Site Stabilization, releases and staining were observed particularly from 5-gallon buckets near the southeast entrance of the Plant. Photograph H-4 of the SAP shows the condition of 5-gallon buckets containing used motor oil during the initial site visit on August 30, 2018. The approximate location of Photograph H-4 is shown on Figure D-3 of the SAP (WWC 2019b).

Although the 5-gallon buckets were located on a concrete slab, petroleum hydrocarbon contamination appears to have migrated to neighboring soils. The area near the southeast entrance of the Plant was a focus of biased sampling during Site Assessment. Due to hazardous concentrations of RCRA metals in approximately half of the drums with used motor oil, metals as well as petroleum hydrocarbons are considered COCs in areas where 5-gallon buckets released used motor oil.

1.4.5 PCB Contamination Sampling and Delineation

Historical power plant operations typically utilized PCB-containing oil or grease for a variety of equipment and applications. Typical power plant equipment and machinery with PCB oils included transformers, compressors, fuel systems, hydraulic systems, turbines, lubrication oils and grease of coal delivery systems, compressed air lines, boilers, ash handling systems, and switch gears (GEI 2000). During Site Stabilization, building materials (concrete and brick), water, sediment, and surfaces of remaining equipment in the Plant were sampled for the presence of PCB oils. Most of the PCB sampling and delineation for Site Stabilization was conducted within the Plant, but some sampling occurred outside the Plant, which was the focus of the Site Assessment under PS #0807. Sampling and delineation of PCBs outside the Plant included some equipment and concrete pads beneath the substation. Aroclor 1254 was detected on a wipe sample of grease on a headgate motor that controlled water flow between the Tongue River and the tunnel beneath the Plant (VTO103025W) (WWC 2019a). The motor is shown in Photograph H-5 of the SAP (WWC 2019b). Aroclor 1254 was also detected on a wipe sample of oil residue on the side of a switch beneath the substation (VTO1031D5W). The switch is shown in Photograph H-6 of the SAP (WWC 2019b). Aroclor 1260 was detected in concrete samples from three slabs on the east side of the Plant near the substation (VTO103140C, VTO103143C, and VTO103144C). Photographs H-7, H-8, and H-9 of the SAP depict these PCB sampling locations, respectively (WWC 2019b).

Considering the detections of PCBs in equipment and concrete outside of the Plant, PCBs were considered a COC in soil, sediment, and surface water during Site Assessment.

1.5 Additional Observations

During Site Stabilization field activities and water rights research (WWC was contracted separately by the Owner to complete water rights research), additional observations were made that provided information regarding COCs, impacted media, and migration pathways relevant to Site Assessment.

1.5.1 Melted Lead

During the ACM pick for Site Stabilization on October 5, 2018, WWC encountered lead on surface soils that apparently had been melted during historical battery recycling activities. This lead may be a contributing factor to elevated concentrations of lead in soils discovered during the Phase II ESA investigations (Weston 2017b). Photographs H-10 and H-11 of the SAP show examples of melted lead discovered by WWC during the ACM pick west of the Plant. Figure D-3 of the SAP depicts the approximate location where the lead in Photographs H-10 and H-11 was discovered (WWC 2019b). The lead encountered was containerized and disposed of with other hazardous wastes during Site Stabilization.

During Site Assessment, lead was considered a COC because of the presence of melted lead accumulations on the surface. Accumulations of lead could have provided contamination sources to surface and subsurface soils, sediments, and surface water.

1.5.2 Sheridan County Electric Tunnel Water Right

WWC was contracted separately by the Owner to research the water rights associated with the Plant. One of the water rights associated with the Plant is a non-consumptive right for the Sheridan County Electric Tunnel (Wyoming State Engineer's Office [SEO] Permit P5059.0E). The Sheridan County Electric Tunnel was used to divert water from the Tongue River to condense steam from Plant operations. All cooling water was returned to the river through the tunnel, which has an inlet and outlet. A tunnel and pump plan and cross section (shown as Exhibit H-1 in Appendix H of the QAPP) were part of the P5059.0E permit (WWC 2019b). Two condensers and two pump intake locations are shown on the plan. During PCB sampling and delineation, two water samples were obtained from what was assumed to be a sump (VTO102907SW and VTO1029D1SW) (WWC 2019a). Based on the tunnel and pump plan, what had been assumed to be a sump was a pump intake location. Photograph H-12 in Appendix H of the QAPP shows the 16-inch centrifugal pump intake (Exhibit H-1) where samples VTO102907SW and VTO1029D1SW were obtained. Photograph H-13 shows the other assumed pump intake location for the two 10-inch centrifugal pumps (Exhibit H-1) (WWC 2019b). PCBs were not detected in samples VTO102907SW and VTO1029D1SW. However, PCBs were detected in sediment samples obtained in the basement of the

Plant (VTO102902S, VTO102905S, VTO102906S, VTO102908S, VTO1029D2S, and VTO102909S) (WWC 2019a).

The pump intake locations provide pathways to the tunnel, which, in turn, provides a pathway to the Tongue River. As noted by the Phase II ESA, the basement of the Plant seasonally floods (Weston 2017b). Seasonal flooding of the basement is likely the cause of PCB detections in sediment throughout the Plant (i.e., flooding likely spreads sediment and contamination throughout the basement). Additionally, the tunnel provides a pathway for contamination to exit the Plant when the water recedes. In May 2019, WWC was onsite for the Owner's water rights research. WWC inspected the headgate at the mouth of the tunnel and observed a potential sheen on the water behind the headgate as shown in Photograph H-14 of the QAPP (WWC 2019b). Because of the low water level behind the headgate, WWC also observed the top of the tunnel opening, shown in Photograph H-15 of the QAPP (WWC 2019b).

Since the tunnel provides a pathway for surface water, groundwater, and sediments to be impacted by contamination within the Plant, the water behind the headgate provided an important surface water sampling location during Site Assessment.

2.0 SITE ASSESSMENT

The PS #0807 Site Assessment included sampling and analysis of soils (surface and subsurface), groundwater, surface water, and sediment. The purpose of sampling and analysis was to delineate the nature and extent of contamination, complete an ecological risk assessment, and develop remedial alternatives. Also included in the PS #0807 SOW was ABS for asbestos in soils. The ABS report is included in Appendix A. The assessment of soils, groundwater, surface water, and sediment were completed by WWC of Sheridan, Wyoming. WWC subcontracted American Engineering Testing (AET) of Sheridan, Wyoming to drill using a direct-push rig for soil sampling. AET was also subcontracted to use an auger rig to installation of monitor wells. Sampling was conducted according to the project-specific Quality Assurance Project Plan (QAPP) for EPA Site Assessment Grant BF96845801 and the project-specific SAP (WWC 2019b). Applicable portions of the QAPP and SAP were prepared for consistency with guidance in Fact Sheet #29 (WDEQ/VRP 2018a) and Fact Sheet #28 for Data Quality Objectives (DQOs) (WDEQ/VRP 2007). Standard Operating Procedures (SOPs) for work practices and sampling activities were provided in Appendix E of the QAPP.

2.1 Soils (Surface and Subsurface) Sampling and Analysis

COCs were detected in both surface and subsurface soils during Phase II ESA sampling. Detections were greater in surface soils (0-1 foot) and the upper few feet of subsurface soils (greater than 1 foot). WDEQ/VRP soil CULs have been developed for the upper 12 feet of soil. Drilling and soil sampling at each borehole were planned to terminate at 12 feet below ground surface (bgs); however, due to shallow groundwater near the Plant, the phreatic zone and groundwater were encountered at less than 12 feet bgs at several soil sampling locations. At these locations, sampling was terminated at the capillary fringe. The borehole logs with termination depths are provided in Appendix B.

Sampling of surface and subsurface soil utilized a direct-push truck-mounted drill rig. Direct-push drill rigs containerize soils in borehole-specific clear plastic tubes. Using the direct-push drill rig reduced the risk of contamination between boreholes; decontamination is not as time-consuming. The advantages of direct-push drill rigs include less disturbed (nearly in-situ) soil samples, fewer soil cuttings to dispose as investigation-derived waste (IDW), less time to drill shallow boreholes, greater maneuverability of the rig in tight locations, and full soil profiles that facilitate more accurate soil logging than from auger rig cuttings. All boreholes were logged noting soil physical characteristics (i.e., soil type, color, texture, moisture, and transitions), observed environmental conditions (i.e., odor, staining, and field screening results), and depth to water (if encountered). The borehole logs are provided in Appendix B.

A combination of biased boreholes and grids were used. Three discrete samples were collected from biased boreholes and two from boreholes in grids. These discrete samples represent two or three depths in each borehole to map the extent of contamination. The discrete samples for each borehole were collected from the following depths:

1. 0-1 foot bgs (surface soil)
2. 1-foot interval for which field screening indicated the presence of contamination either due to staining, odor, or VOC readings using a photoionization detector (PID) OR 2-3 feet bgs if field screening did not indicate the presence of contamination
3. 11-12 feet bgs OR the 1-foot interval directly above the capillary fringe, whichever was encountered first

Biased sampling targeted areas where staining was apparent or historical activities were known to have caused contamination. The process for selecting biased sampling locations is provided in the SAP (WWC 2019b). Three discrete samples were collected from each biased borehole. The Phase II ESA sample results indicated that detections of COCs decreased near the edges of the Site and farther from the Plant. To efficiently assess the entire Study Area, grid sampling was utilized near its edges. Grid samples are considered representative of an entire grid. The maximum allowable grid size is 0.20 acre. Therefore, grids sized under 0.20 acre were placed near the edges of the Study Area. As stated in Fact Sheet #9, a minimum of 10 sample locations are required for a statistical analysis for comparison to CULs (WDEQ/VRP 2016a). If less than 10 sample locations are collected, statistical analysis cannot be used; instead, direct comparison of results to CULs is necessary. The boreholes were drilled at approximately the centroid of each grid. Due to less contamination expected in grids, a different sampling approach was used versus biased sampling. Within each grid, two 1-foot discrete samples were collected instead of three. The samples were generally collected from 0-1 foot bgs (surface soil) and the 1-foot interval directly above the capillary fringe.

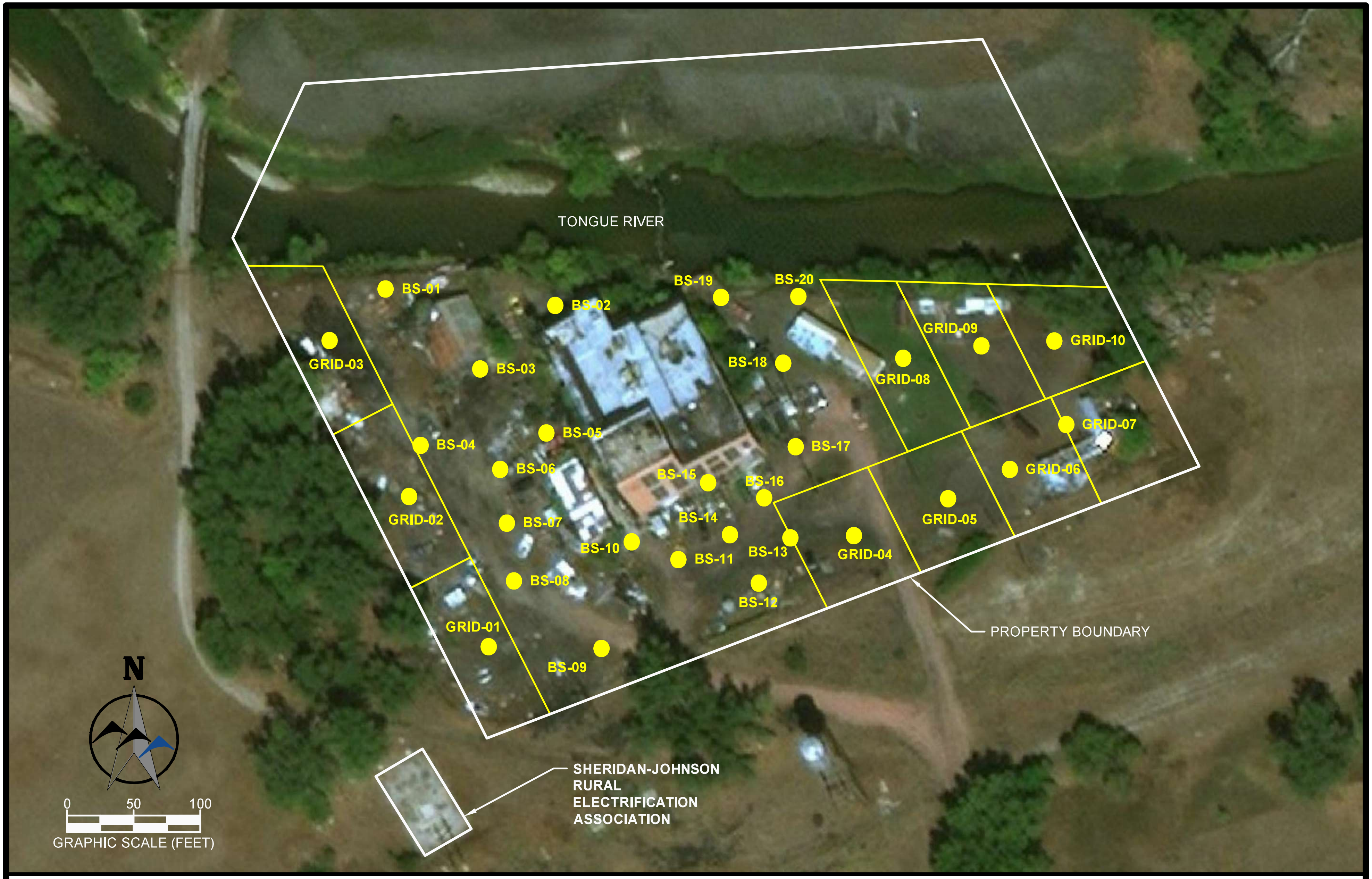
As described in Section 2.2.4, a single undisturbed soil sample was collected from each monitor well location in the saturated zone of soils (the alluvial aquifer). Three of the samples were saved and analyzed for permeability (hydraulic conductivity) to compare to slug test results from the same wells. The undisturbed samples were collected from approximately the center of the saturated zone between 13-15 feet bgs. Samples were collected in California tube samplers.

Sample locations and depths were documented on the borehole logs provided in Appendix B. The unique names, date and time collected, sampler, and requested analyses were recorded on the chain-of-custody forms (provided with the laboratory analyses in Appendix C). The surface and subsurface soil sample names consisted of the following 12-digit format:

XXXXXXXXXXXX

Space 1	Division letter code with V = VRP
Spaces 2 and 3	Initials (first and last) of the person who collected the sample (e.g., Loren Ruttinger was coded as LR)
Spaces 4 through 7	Month and day sample was collected (e.g., sample collected on September 16 was coded as 0916)
Space 8	Sample type (e.g., B for biased sample or G for grid sample)
Space 9 and 10	Sample location number (e.g., sample location 06 was coded as 06)
Space 11 and 12	Bottom depth of sampling interval (e.g., a 3-4 feet bgs sampling interval was coded as 04)

The locations of biased soil sample locations and grid sample locations are shown on Figure 3. The coordinates of these sampling locations, the sampling intervals, and the sample names are summarized in Table 3. The borehole locations were surveyed to the nearest foot using survey-grade GPS following completion of drilling.



NOTE: SAMPLE LOCATION NOMENCLATURE WAS ABBREVIATED WITHOUT "ACME-" AT THE BEGINNING OF EACH NAME.

DESIGNED BY: WWC ENGINEERING

FIGURE 3. SURFACE AND SUBSURFACE SOIL SAMPLING LOCATIONS

Table 3. Soil Borehole Summary

Borehole	Northing WY83EC (ft)	Easting WY83EC (ft)	Sampled Depth Intervals (ft bgs)	Analytical Sample Names
ACME-BS-01	1936571	1401595	0-1	VLR0918B0101
			5-6	VLR0918B0106
			11-12	VLR0918B0112
ACME-BS-02	1936559	1401722	0-1	VLR0916B0201
			8-9	VLR0916B0209
			10-11	VLR0916B0211
ACME-BS-03	1936511	1401666	0-1	VLR0918B0301
			6-7	VLR0918B0307
			11-12	VLR0918B0312
ACME-BS-04	1936454	1401621	0-1	VLR0918B0401
			5-6	VLR0918B0406
			11-12	VLR0918B0412
ACME-BS-05	1936463	1401716	0-1	VLR0918B0501
			9-10	VLR0918B0510
			11-12	VLR0918B0512
ACME-BS-06	1936436	1401681	0-1	VLR0916B0601
			4-5	VLR0916B0605
			11-12	VLR0916B0612
ACME-BS-07	1936396	1401686	0-1	VLR0918B0701
			9-10	VLR0918B0710
			11-12	VLR0918B0712
ACME-BS-08	1936352	1401692	0-1	VLR0919B0801
			9-10	VLR0919B0810
			11-12	VLR0919B0812

Table 3. Soil Borehole Summary (Continued)

Borehole	Northing WY83EC (ft)	Easting WY83EC (ft)	Sampled Depth Intervals (ft bgs)	Analytical Sample Names
ACME-BS-09	1936302	1401757	0-1	VLR0919B0901
			3-4	VLR0919B0904
			10-11	VLR0919B0911
ACME-BS-10	1936381	1401780	0-1	VLR0919B1001
			4-5	VLR0919B1005
			11-12	VLR0919B1012
ACME-BS-11	1936368	1401815	0-1	VLR0919B1101
			4-5	VLR0919B1105
			10-11	VLR0919B1111
ACME-BS-12	1936351	1401875	0-1	VLR0919B1201
			4-5	VLR0919B1205
			10-11	VLR0919B1211
ACME-BS-13	1936385	1401899	0-1	VLR0919B1301
			4-5	VLR0919B1305
			10-11	VLR0919B1311
ACME-BS-14	1936387	1401853	0-1	VLR0917B1401
			4-5	VLR0917B1405
			11-12	VLR0917B1412
ACME-BS-15	1936426	1401837	0-1	VLR0919B1501
			5-6	VLR0919B1506
			11-12	VLR0919B1512
ACME-BS-16	1936414	1401879	0-1	VLR0919B1601
			4-5	VLR0919B1605
			9-10	VLR0919B1610
ACME-BS-17	1936453	1401903	0-1	VLR0917B1701
			4-5	VLR0917B1705
			10-11	VLR0917B1711

Table 3. Soil Borehole Summary (Continued)

Borehole	Northing WY83EC (ft)	Easting WY83EC (ft)	Sampled Depth Intervals (ft bgs)	Analytical Sample Names
ACME-BS-18	1936515	1401893	0-1	VLR0917B1801
			3-4	VLR0917B1804
			10-11	VLR0917B1811
ACME-BS-19	1936565	1401847	0-1	VLR0919B1901
			6-7	VLR0919B1907
			9-10	VLR0919B1910
ACME-BS-20	1936566	1401905	0-1	VLR0917B2001
			5-6	VLR0917B2006
			10-11	VLR0917B2011
ACME-GRID-01	1936303	1401673	0-1	VLR0916G0101
			5-6	VLR0916G0106
ACME-GRID-02	1936415	1401613	0-1	VLR0918G0201
			11-12	VLR0918G0212
ACME-GRID-03	1936532	1401553	0-1	VLR0916G0301
			5-6	VLR0916G0306
ACME-GRID-04	1936386	1401946	0-1	VLR0918G0401
			10-11	VLR0918G0411
ACME-GRID-05	1936414	1402017	0-1	VLR0918G0501
			10-11	VLR0918G0511
ACME-GRID-06	1936436	1402063	0-1	VLR0917G0601
			10-11	VLR0917G0611
ACME-GRID-07	1936469	1402106	0-1	VLR0917G0701
			8-9	VLR0917G0709
ACME-GRID-08	1936519	1401983	0-1	VLR0918G0801
			10-11	VLR0918G0811

Table 3. Soil Borehole Summary (Continued)

Borehole	Northing WY83EC (ft)	Easting WY83EC (ft)	Sampled Depth Intervals (ft bgs)	Analytical Sample Names
ACME-GRID-09	1936529	1402042	0-1	VLR0917G0901
			10-11	VLR0917G0911
ACME-GRID-10	1936532	1402097	0-1	VLR0917G1001
			9-10	VLR0917G1010
Total Surface and Subsurface Soil Samples				**80**

Each soil sample was analyzed using the EPA methods in Table 4. As noted in the table, only surface soils (0-1 foot bgs) were analyzed for EPA 8151A pentachlorophenol due to the expense of the method for one analyte and the limited source of PCP as an herbicide potentially applied to the surface. During the Phase II ESA, PCP was detected only in surface soils. The reasoning for each analysis is summarized in Table 4.

Quality control samples were collected to ensure the integrity of samples. Field quality control samples for soils included trip blanks and field equipment rinsate blanks. Trip blanks are samples of analyte-free media that travel from the laboratory to the sampling site and are then returned to the laboratory. Trip blanks were prepared at a frequency of one per day of sampling during which samples were collected for VOCs. Since every borehole was sampled for VOCs, a trip blank was necessary for every day of soil sampling. Trip blank nomenclature followed this 12-digit format:

XXXXXXXXXXXX

Space 1	Division letter code with V = VRP
Spaces 2 and 3	Initials (first and last) of the person who collected the sample (Loren Ruttinger was coded as LR)
Spaces 4 through 7	Month and day sample was collected (e.g., sample collected on September 16 was coded as 0916)
Space 8	Sample type (e.g., T for trip blank)
Spaces 9 and 10	Sample matrix (e.g., SO for soil)
Space 11 and 12	Trip blank number (e.g., third trip blank was coded as 03)

Field equipment rinsate blanks were collected at a rate of one per day per sampler per sampling technique when the sampling method utilized reusable equipment. An analyte-free medium (deionized water) was used to rinse sampling

Table 4. Soil Analysis Methods and Reasoning

EPA Method	Location	Reasoning for Analysis
EPA 8015M DRO+ORO	Surface and subsurface	DRO and ORO were previously identified as COCs in surface soils. Staining has been observed on soils in drum storage areas.
EPA 8015M GRO	Surface and subsurface	Low-level concentrations were previously detected in Tongue River sediments, which could have originated from soils.
EPA 8270 SVOCs	Surface and subsurface	Hexachlorobenzene (fungicide for crop seeds) was previously detected in upgradient groundwater samples. The source is unknown.
EPA 8270 SIM PAHs	Surface and subsurface	Six PAHs were previously identified as COCs in surface and subsurface soils.
EPA 8260 VOCs	Surface and subsurface	Benzene and PCE were previously identified as COCs in surface and subsurface soils.
EPA 8082 PCBs	Surface and subsurface	PCBs were previously identified as COCs in surface soils. Detections of PCBs were found in subsurface soils.
EPA 6010 Metals	Surface and subsurface	Metals were previously identified as COCs in surface and subsurface soils as well as sediments.
EPA 7471B Mercury	Surface and subsurface	Metals were previously identified as COCs in surface and subsurface soils as well as sediments.
EPA 8151A Pentachlorophenol (only)	Surface (only)	PCP is an herbicide previously detected in surface soils only. Due to typical surface application of herbicides and expense of method, only surface soils were analyzed.

equipment after completion of decontamination and prior to sampling at another location. Rinsate sample nomenclature followed this 12-digit format:

XXXXXXXXXXXX

Space 1	Division letter code with V = VRP
Spaces 2 and 3	Initials (first and last) of the person who collected the sample (Loren Ruttinger was coded as LR)
Spaces 4 through 7	Month and day sample was collected (e.g., sample collected on September 16 was coded as 0916)
Space 8	Sample type (e.g., R for rinsate blank)
Spaces 9 and 10	Sample matrix (e.g., SO for soil)

Space 11 and 12	Rinsate blank number (e.g., third rinsate blank was coded as 03)

Because field equipment rinsates were a different medium than soil (water), a separate trip blank was required for rinsate samples. This had not been specified in the SAP (WWC 2019b). The nomenclature followed this 13-digit format:

XXXXXXXXXXXXX

Space 1	Division letter code with V = VRP
Spaces 2 and 3	Initials (first and last) of the person who collected the sample (Loren Ruttinger was coded as LR)
Spaces 4 through 7	Month and day sample was collected (e.g., sample collected on September 16 was coded as 0916)
Spaces 8 and 9	Sample type (e.g., TR for trip blank for rinsate samples)
Spaces 10 and 11	Sample matrix (e.g., SO for soil)
Space 12 and 13	Trip blank number (e.g., third trip blank for rinsate was coded as 03)

As stated in the WDEQ/VRP QAPP, soils are inherently heterogeneous and are subject to natural variations in composition and texture (WDEQ/VRP 2018b). It is typically not possible to isolate the effects of sampling technique and laboratory procedures from natural soil heterogeneity. Therefore, field duplicates were not collected for soil/solid evaluations. Table 5 summarizes the results of the soil sampling quality control samples. Section 4.0 discusses the analysis of quality control samples. Appendix C provides the analytical results for the quality control samples.

2.1.1 Deviations from the Sampling and Analysis Plan

During field sampling, several deviations were made from the SAP (WWC 2019b). These deviations are summarized as follows:

1. The SAP was written to collect one sample from each grid sampling location. In the SAP, discrete intervals in each grid sampling location were to be combined into one composite sample. Instead, two discrete samples were collected from each grid sampling location. The discrete intervals were generally collected from the surface and the interval directly above groundwater. This deviation from the SAP was made at the request of the WDEQ/VRP project manager in the field.

Table 5. Soil Quality Control Samples

Sample Name	Date	Quality Control Sample Type	Detections or Sample Notes
VLR0916TSO01	09/16/2019	Trip Blank	Detection of methylene chloride below the reporting limit (J flag)
VLR0916RSO01	09/16/2019	Field Equipment Rinsate Blank	Detection of iron below the reporting limit (J flag)
VLR0916TRSO01	09/16/2019	Rinsate Trip Blank	No detections
VLR0917TSO02	09/17/2019	Trip Blank	Detection of methylene chloride below the reporting limit (J flag)
VLR0917RSO02	09/17/2019	Field Equipment Rinsate Blank	Detections of iron and manganese greater than migration to groundwater CULs, but less than residential CULs
VLR0917TRSO02	09/17/2019	Rinsate Trip Blank	No detections
VLR0918TSO03	09/18/2019	Trip Blank	Detection of methylene chloride below the reporting limit (J flag)
VLR0918RSO03	09/18/2019	Field Equipment Rinsate Blank	Detections of iron and methylene chloride greater than migration to groundwater CULs, but less than residential CULs
VLR0918TRSO03	09/18/2019	Rinsate Trip Blank	No detections
VLR0919TSO04	09/19/2019	Trip Blank	Detection of methylene chloride below the reporting limit (J flag)
VLR0919RSO04	09/19/2019	Field Equipment Rinsate Blank	Detections of iron and methylene chloride below the reporting limits (J flags)
VLR0919TRSO04	09/19/2019	Rinsate Trip Blank	No detections

2. Due to the increase in grid soil samples, four biased sample locations were removed to maintain the project budget. This reduced biased sampling locations from 24 to 20. This is reflected on Figure 3.
3. Due to field sampler error, the location in the SAP called out as ACME-GRID-03 was documented as ACME-GRID-01 on the sample labels. Therefore, the ACME-GRID-01 and ACME-GRID-03 locations were switched from those originally specified in the SAP. This is depicted on Figure 3.

4. The SAP specified that one trip blank would be collected per day of sampling. Since a rinsate sample was also required per day and rinsate samples were a different medium than the soil (water versus solid), separate trip blanks containing deionized water were utilized for rinsate sample trip blanks and unopened VOC vials were used as trip blanks for soil.
5. Grid sample locations were adjusted from the centroid of the grid due to debris preventing drilling at the centroid. The sampling locations within each grid are shown on Figure 3.

2.1.2 Analytical Results and COC Analysis

The surface and subsurface soil analytical results are provided in Appendix C. A summary of all soil analytical results compared to WDEQ/VRP CULs is also provided in Appendix C. The analytical results were processed through a seven-step screening procedure consistent with WDEQ/VRP Fact Sheet #20 (WDEQ/VRP 2019) and the EPA Region 8 guidance document "Evaluating and Identifying Contaminants of Concern for Human Health" (EPA 1994). The seven-step screening procedure included:

1. Determining if the contaminant is an essential nutrient
2. Determining if the contaminant exceeds background concentrations
3. Calculating the detection frequency
4. Evaluating persistence, mobility, and bioaccumulation
5. Determining if concentrations exceed health and technology-based numerical criteria (WDEQ/VRP CULs or EPA screening levels)
6. Researching if there is historical evidence of the compound at the site
7. Completing toxicity concentration screening

The seven-step screening procedure for contaminants is depicted in Figure 4. The complete discussion of the screening procedure for surface and subsurface soils is provided in Appendix D. Following completion of the screening procedure, COCs in surface and subsurface soils were determined. These are listed in Table 6. Once the final list of COCs was developed, each analyte was reviewed for detections above WDEQ/VRP CULs and analytical laboratory method detection limits (MDLs). The numbers of detections are listed in Table 6. Those COCs with detections above WDEQ/VRP CULs were used to develop the nature and extent figures in Appendix E. The COCs listed with no detections above the laboratory MDLs may not be present onsite and may only be COCs because the laboratory MDLs are higher than CULs or EPA regional screening levels (RSLs). Therefore, only COCs with detections above CULs or RSLs and laboratory MDLs are shown on the nature and extent figures. As shown in Figures E-1

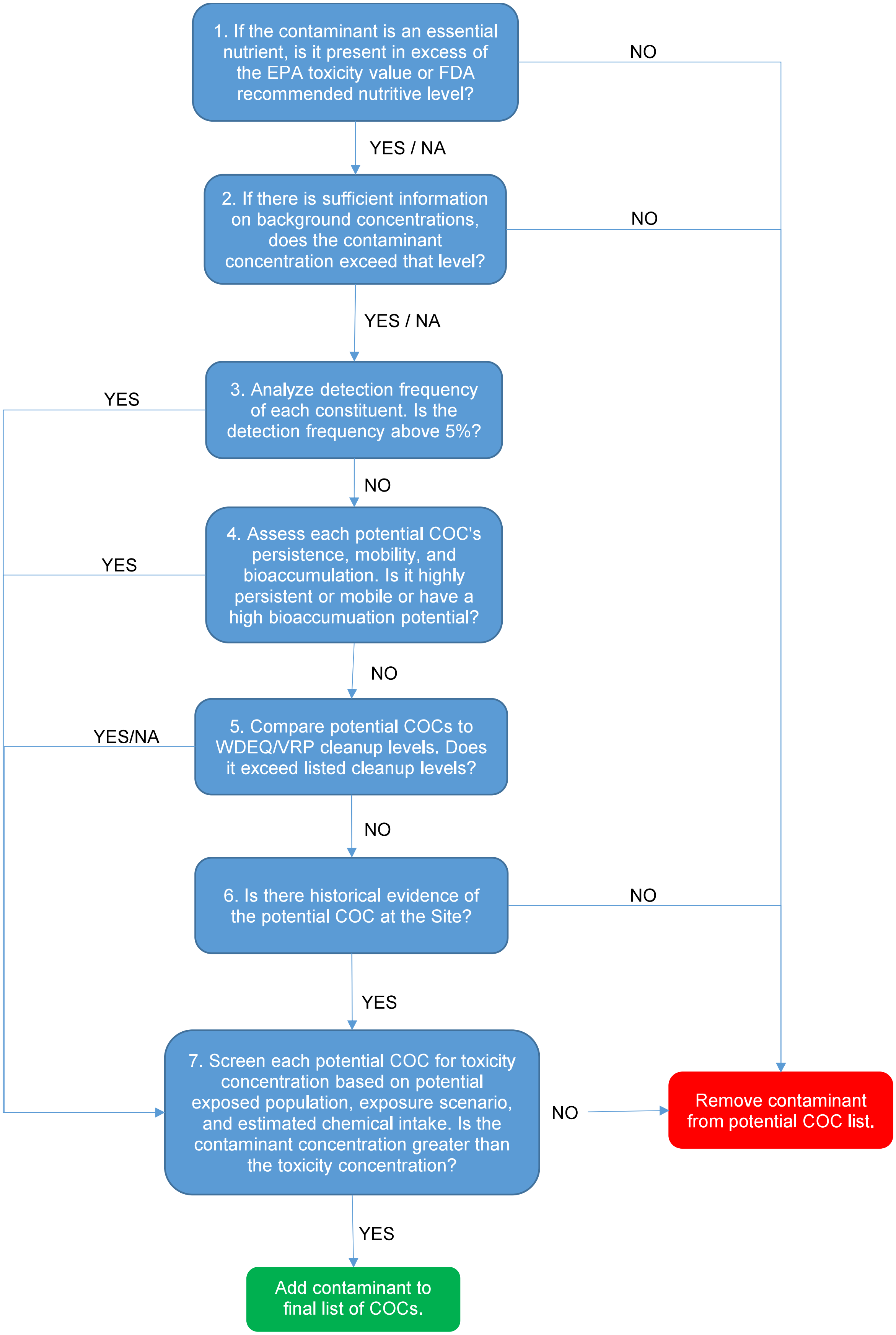


FIGURE 4. CONTAMINANT OF CONCERN SCREENING PROCESS

Table 6. COCs in Surface and Subsurface Soil

Analyte	CAS Number	WDEQ/VRP Migration to Groundwater Cleanup Level (mg/kg)	WDEQ/VRP Residential Soil Cleanup Level (mg/kg)	RSL (mg/kg)	EPC (mg/kg)	Detections Above Pace MDL	Detections Above WDEQ Cleanup Level
1,2,3-Trichloropropane	96-18-4	--	--	0.005	0.008	0	0
1,2-Dibromo-3-chloropropane	96-12-8	--	--	0.005	0.008	0	0
Arsenic	7440-38-2	12.0[1]	12.0[1]	0.623	7.995	80	8
Lead	7439-92-1	32.0[1]	400	13.50	78.43	80	23
N-Nitrosodimethylamine	62-75-9	--	--	0.002	0.078	0	0
N-Nitroso-di-n-propylamine	621-64-7	0.00000287	0.078	0.071	0.292	0	0
PCB, Total	1336-36-3	--	--	0.204	0.240	41	8
PCB-1260 (Aroclor 1260)	11096-82-5	0.1750	0.24	0.216	0.234	38	7

[1] Statewide background concentrations for select metals (WDEQ/VRP 2015)

through E-4 of Appendix E, most of the contamination above CULs and RSLs is in the surface soil interval (0-1 ft bgs). The analytes that are COCs with detections above CULs and RSLs are:

- Arsenic
- Lead
- PCB-1260 (Aroclor 1260)
- PCB, Total

Table 7 lists potential COCs with no comparable WDEQ/VRP CULs or EPA RSLs. Nature and extent figures were not developed for these potential COCs since there are no established CULs or RSLs. The analytes listed as potential COCs with detections above laboratory MDLs are:

- 1,1-Dichloropropene
- 3-Nitroaniline
- 4-Nitrophenol
- Acenaphthylene
- Benzo(g,h,i)perylene
- Carbazole
- Motor Oil Range Organics (C24-C36)
- Phenanthrene
- p-Isopropyltoluene
- Sodium

It should be noted that sodium is considered an essential nutrient; however, an EPA reference dose for sodium could not be determined to compare to the calculated average daily dose (ADD). Therefore, sodium was retained as a potential COC, though it is unlikely to be a harmful constituent.

2.1.3 Data Gaps

Based upon the results of soil sampling, review of the data, the COC analysis, and the nature and extent of COCs, WWC identified the following potential data gaps:

- Soil background samples could be collected offsite to determine natural concentrations of analytes such as arsenic and sodium. Background samples could be used to establish a site-specific baseline.

- Analytes identified as COCs but without detections above the analytical laboratory MDLs could require additional assessment if laboratory analyses with MDLs lower than the RSLs are available. However, those analytes with no detections above MDLs in 80 soil samples may be unlikely to exist onsite.
- In those instances where a COC was identified in a grid (such as ACME-GRID-06), the entire grid is considered contaminated. Remediation of the entire grid may be required. Refined site assessment could be desired in contaminated grid cells to limit the extents of remediation.
- Potential COCs with no comparable RSLs or CULs may require additional evaluation to determine if the calculated exposure point concentration (EPC) could be a hazard to human or environmental health.

Table 7. Potential COCs in Surface and Subsurface Soil without Comparable RSLs

Analyte	CAS Number	EPC (mg/kg)	Detections Above MDL
1,1-Dichloropropene	563-58-6	0.001	1
1,3-Dichlorobenzene	541-73-1	0.003	0
2,2-Dichloropropane	594-20-7	0.001	0
2-Nitrophenol	88-75-5	0.078	0
3-Nitroaniline	99-09-2	0.070	2
4-Bromophenylphenyl ether	101-55-3	0.076	0
4-Chlorophenylphenyl ether	7005-72-3	0.079	0
4-Nitrophenol	100-02-7	0.130	2
Acenaphthylene	208-96-8	0.022	37
Benzo(g,h,i)perylene	191-24-2	0.047	56
Carbazole	86-74-8	0.057	6
cis-1,3-Dichloropropene	10061-01-5	0.001	0
Dimethylphthalate	131-11-3	0.087	0
Motor Oil Range (C24-C36)	--	1,455	80
Phenanthrene	85-01-8	0.151	65
p-Isopropyltoluene	99-87-6	0.004	7
Sodium[1]	7440-23-5	1,405	80
trans-1,3-Dichloropropene	10061-02-6	0.002	0

[1] Sodium is an essential nutrient without an EPA reference dose.

2.2 Groundwater Sampling and Analysis

Since COCs were detected in groundwater during Phase II ESA sampling (Weston 2017b), Site Assessment included sampling and analysis of groundwater. Groundwater sampling required installation of monitor wells. Ten monitor wells were installed in select boreholes after soil sampling. Whereas soil sampling terminated at the depths specified in Table 3 (12 feet bgs or the capillary fringe, whichever was encountered first), drilling continued into the saturated zone to complete monitor well installation. As discussed in Section 1.2.3, PCE and hexachlorobenzene were determined to be COCs for groundwater during the Phase II ESA. PCE and hexachlorobenzene have specific gravities greater than 1.0. PCE has low solubility and hexachlorobenzene is insoluble in water. Therefore, higher concentrations of these COCs may be found near bedrock. The temporary monitor wells used for sampling groundwater in the Phase II ESA did not extend to bedrock, but monitor wells installed for Site Assessment were completed into bedrock. Insoluble liquids with specific gravities greater than 1.0 can behave as dense nonaqueous phase liquids (DNAPLs). DNAPLs can migrate along the dip of bedrock rather than migrating with the groundwater gradient (which may not trend in the same direction). Therefore, to sample for the presence of DNAPLs, wells were completed at least 1.5 feet into bedrock to create traps for DNAPLs. A typical well construction diagram is shown in Figure 5. The wells were installed using an auger rig, which accommodated drilling through alluvial gravels and into the bedrock.

The locations of monitor wells in relation to the Study Area are shown on Figure 6. Table 8 provides the surveyed coordinates of the wells and the constructed total depths. The soil borehole in which the monitor well was constructed is also listed in Table 8. The well construction summaries for the ten monitor wells are provided in Appendix F. Special care was made to avoid drilling through relatively impermeable bedrock into an underlying water-bearing interval, which could provide a pathway for DNAPLs to migrate to underlying intervals. The well screen was installed to extend approximately 3 feet above the potentiometric surface at the time of drilling to account for seasonal fluctuations. This allows potential light nonaqueous phase liquids (LNAPLs) to enter the well during high groundwater. LNAPLs were not observed during groundwater sampling for the Phase II ESA (Weston 2017b) or during Site Assessment. Regardless, well construction allows for monitoring of LNAPLs. The well construction summaries in Appendix F show the measured static water level at the time of well development with respect to the constructed screened interval.

The contours and dip of the bedrock were estimated from the monitor well drilling. The depth to bedrock from the ground surface was logged during drilling. Surveying the top of casing and ground elevation at each well provided a datum to calculate the approximate elevation of the top of bedrock. Figure 7 shows the approximate contours

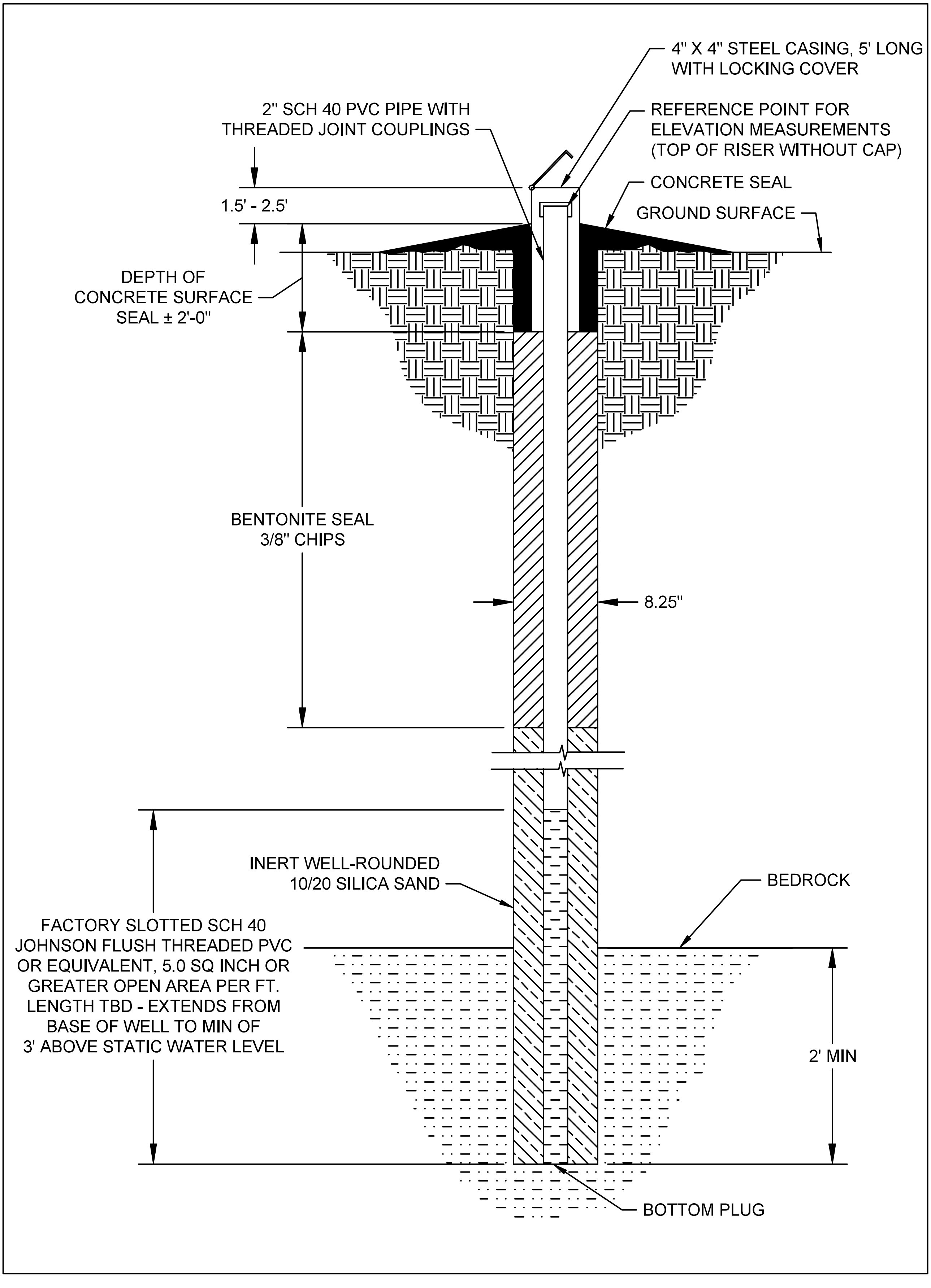


FIGURE 5. TYPICAL MONITOR WELL CONSTRUCTION DIAGRAM

DESIGNED BY: WWC ENGINEERING

FIGURE 6. GROUNDWATER MONITOR WELL LOCATIONS

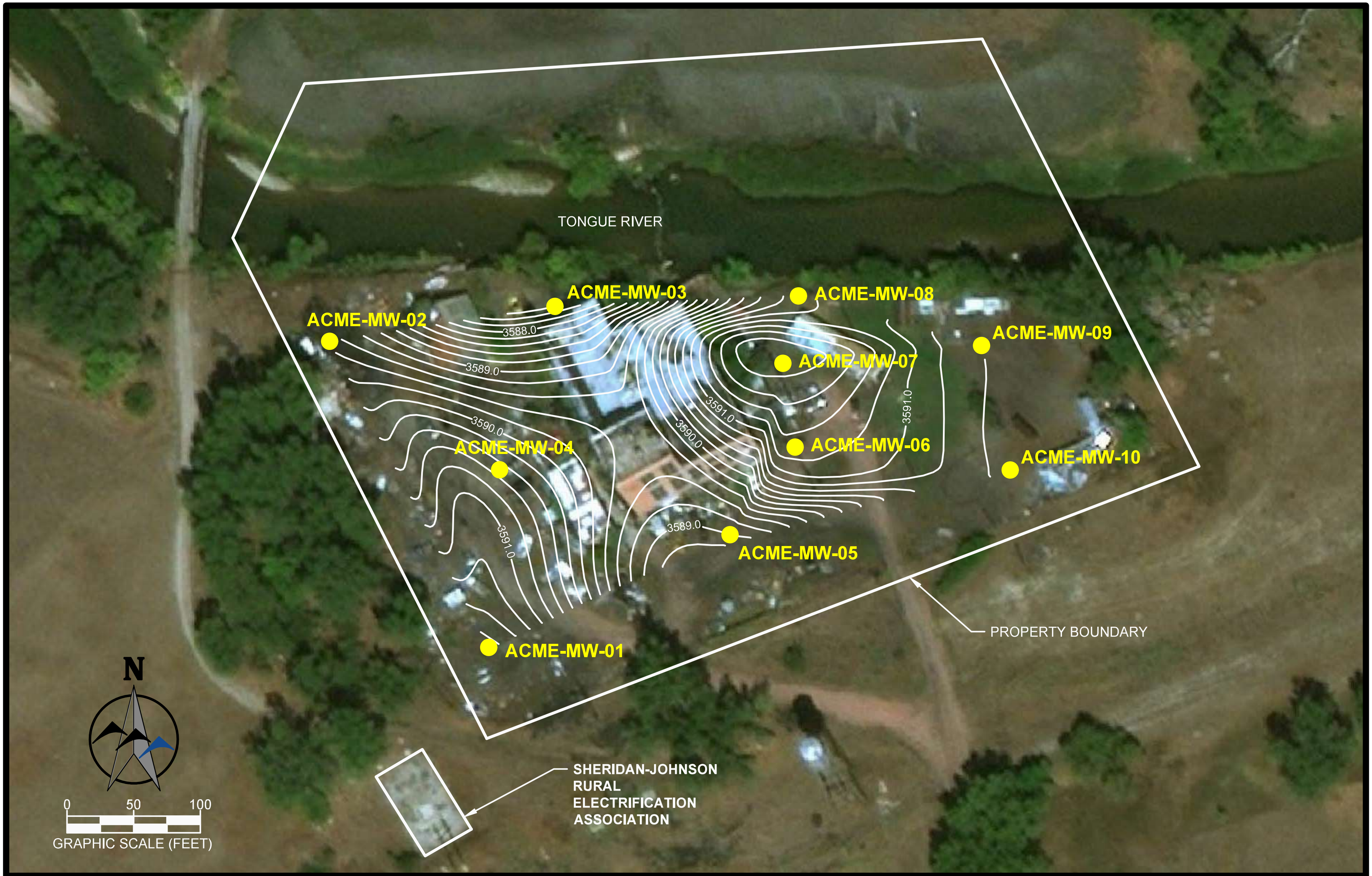
K:\Sheridan\WDEQ\19018\Task_04\SHEETS\GROUNDWATER_WELL_LOCATIONS.dwg 8/1/2021 4:19:59 PM loren ruttinger

Table 8. Monitor Well Summary

Monitor Well	Northing WY83EC (ft)	Easting WY83EC (ft)	Top of Casing (ft amsl)	Total Depth (ft bgs)	Corresponding Soil Borehole	Analytical Sample Names
ACME-MW-01	1936303.5	1401673.5	3612.7	20.0	ACME-GRID-01	VLR0923MW011 VLR1210MW012 VLR0324MW013 VLR0616MW014
ACME-MW-02	1936532.0	1401553.2	3613.4	22.7	ACME-GRID-03	VLR0923MW021 VLR1210MW022 VLR0324MW023 VLR0616MW024
ACME-MW-03	1936558.2	1401722.1	3611.4	23.0	ACME-BS-02	VLR0925MW031 VLR1212MW032 VLR0326MW033 VLR0617MW034
ACME-MW-04	1936435.8	1401680.6	3614.3	22.5	ACME-BS-06	VLR0925MW041 VLR1212MW042 VRF0326MW043 VLR0617MW044
ACME-MW-05	1936387.1	1401853.5	3611.5	21.5	ACME-BS-14	VLR0925MW051 VLR1212MW052 VRF0325MW053 VLR0617MW054
ACME-MW-06	1936452.7	1401902.2	3610.0	17.5	ACME-BS-17	VLR0925MW061 VLR1211MW062 VRF0325MW063 VLR0617MW064

Table 8. Monitor Well Summary (Continued)

Monitor Well	Northing WY83EC (ft)	Easting WY83EC (ft)	Top of Casing (ft amsl)	Total Depth (ft bgs)	Corresponding Soil Borehole	Analytical Sample Names
ACME-MW-07	1936515.5	1401893.1	3609.9	18.0	ACME-BS-18	VLR0924MW071 VLR1211MW072 VRF0325MW073 VLR0617MW074
ACME-MW-08	1936566.1	1401904.8	3609.4	18.0	ACME-BS-20	VLR0924MW081 VLR1211MW082 VRF0325MW083 VLR0616MW084
ACME-MW-09	1936528.8	1402042.1	3609.1	18.0	ACME-GRID-09	VLR0924MW091 VLR1211MW092 VLR0324MW093 VLR0616MW094
ACME-MW-10	1936435.6	1402063.6	3609.0	18.0	ACME-GRID-06	VLR0924MW101 VLR1210MW102 VLR0324MW103 VLR0616MW104



DESIGNED BY: WWC ENGINEERING

FIGURE 7. TOPOGRAPHIC SURFACE OF BEDROCK

of the bedrock. The contours show that west of the Plant, the bedrock generally dips north or northeast toward the Tongue River. East of the Plant, The bedrock dips more to the east. Dips in bedrock could provide pathways for DNAPLs to migrate.

Once the monitor wells were constructed, they were developed using a bailer and a low-flow pump. At least ten casing volumes were purged from each well according to the SOP provided in Appendix E of the QAPP (WWC 2019b). The well development details are provided on the well construction summaries provided in Appendix F. Ten casing volumes were not developed from wells that that recharged slowly, including ACME-MW-05 and ACME-MW-06. Ten casing volumes were not fully developed from ACME-MW-09 due to loss of a bailer down the well during development. The bailer was recovered at the sampling event the following week in September 2019.

The first groundwater sampling event was not initiated until at least 24 hours after development and until the potentiometric surface had re-equilibrated to the static water level. Static water levels were measured before pumping for well purging began. Groundwater samples were collected using low-flow sampling methods that caused less than 0.33 foot of drawdown. At least three casing volumes were purged from wells before sampling.

Field equipment was calibrated before each sampling event. Calibration results were recorded on the calibration forms provided in Appendix G. Serial numbers of equipment were recorded on the calibration forms. Before samples were collected, field parameters were measured and observed to stabilize within three successive readings. Field readings were recorded on the groundwater sampling forms provided in Appendix H. The guidelines for stable water quality field parameters are as follows (WDEQ 2018a):

- ±3% for temperature
- ±0.1 for pH
- ±3% for specific electrical conductance (SEC)
- ±10 mV for redox potential (ORP)
- ±10% for dissolved oxygen (DO) for values greater than 0.5 mg/L; if three consecutive DO values are less than 0.5 mg/L, the values may be considered stable
- ±10% for turbidity if greater than 5 Nephelometric Turbidity Units (NTUs); if three consecutive turbidity values are less than 5 NTU, the values may be considered stable

Once the field readings had stabilized, laboratory-supplied containers were filled (as applicable) directly from the low-flow sampling pump without use of an intermediate container in the following order:

1. VOCs
2. SVOCs
3. Pesticides
4. Inorganics
5. Other unfiltered samples

Proper VOC sampling minimized aeration when filling sample bottles. The vials were filled with no visible headspace when inverted. If air bubbles were present after the sample was collected, the sample was collected again in a new bottle. Effervescence was not observed in any samples.

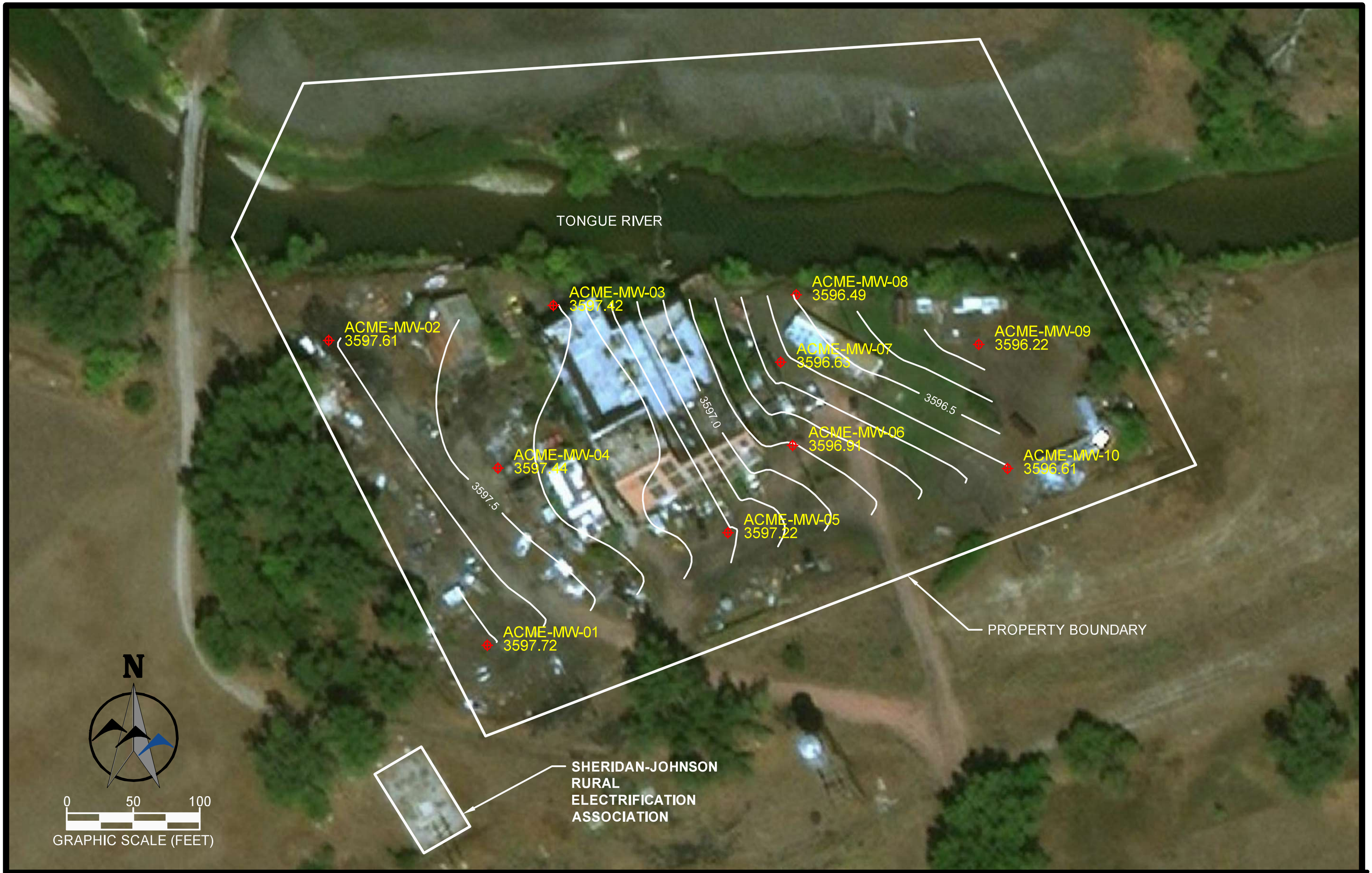
All development and purge waters were contained in drums until laboratory results were returned. Upon request by WDEQ, purge water was transported and disposed offsite at an appropriate facility by Beartooth Environmental, Inc. (Beartooth) of Billings, MT. IDW disposal is discussed in Section 6.0.

Sample locations, field parameters, and observations were documented on the groundwater sampling forms provided in Appendix H. The unique names, date and time collected, sampler, and requested analyses were recorded on the chain-of-custody forms provided with the laboratory analytical results in Appendix I. The groundwater sample names consisted of the following 12-digit format (samples collected from each monitor well are summarized in Table 8):

XXXXXXXXXXXX

Space 1	Division letter code with V = VRP
Spaces 2 and 3	Initials (first and last) of the person who collected the sample (e.g., Loren Ruttinger was coded as LR)
Spaces 4 through 7	Month and day sample was collected (e.g., sample collected on September 23 was coded as 0923)
Spaces 8 through 11	Monitor well number (e.g., MW03 for ACME-MW-03)
Space 12	Quarter number (e.g., second quarter of sampling was coded as 2)

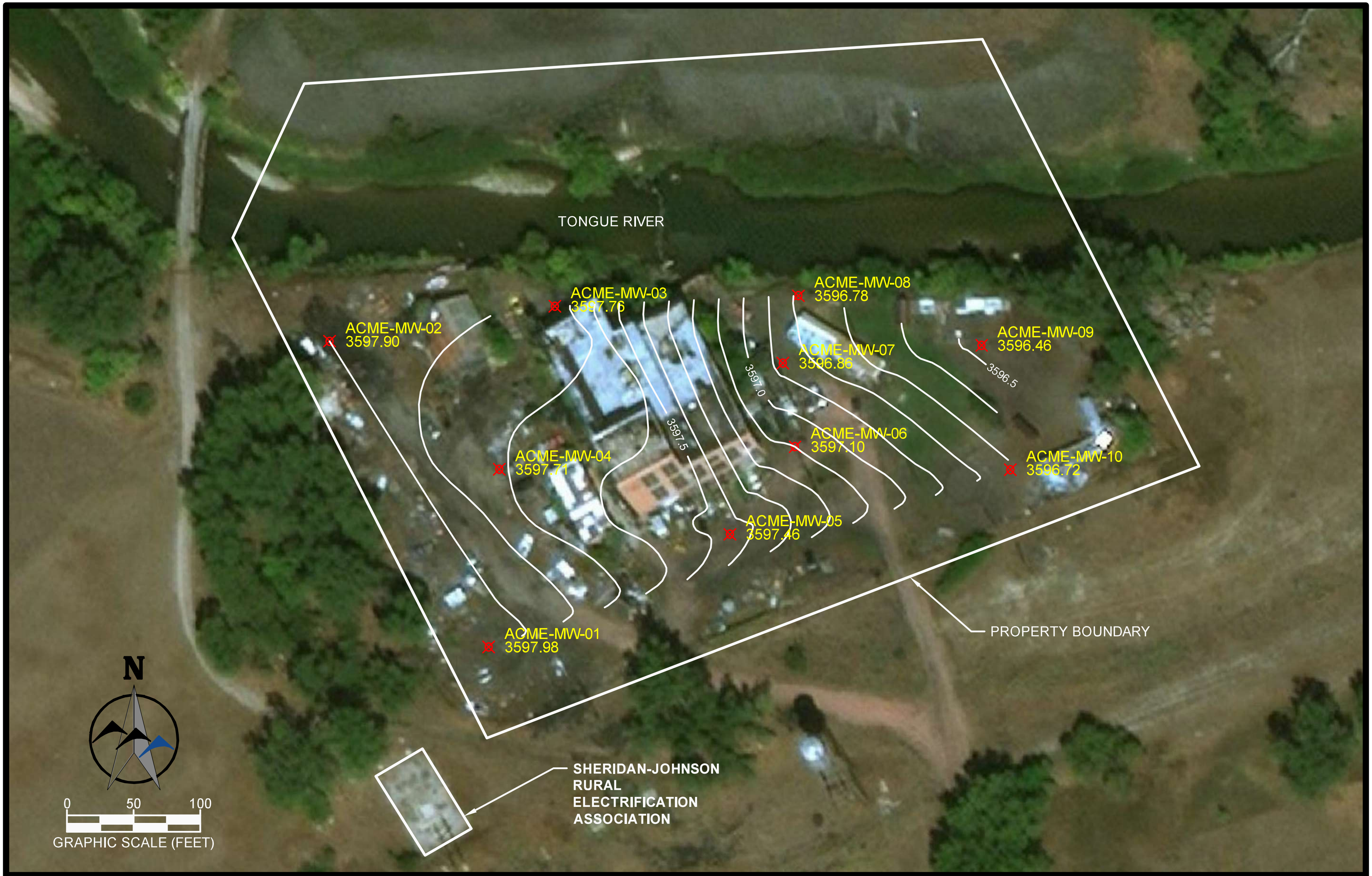
Approximate potentiometric contours were developed for each of the four quarters of groundwater sampling. See Figures 8 through 11. Groundwater sampling occurred quarterly during four consecutive quarters to account for seasonal fluctuations.



DESIGNED BY: WWC ENGINEERING

FIGURE 8. SEPTEMBER 2019 POTENTIOMETRIC SURFACE

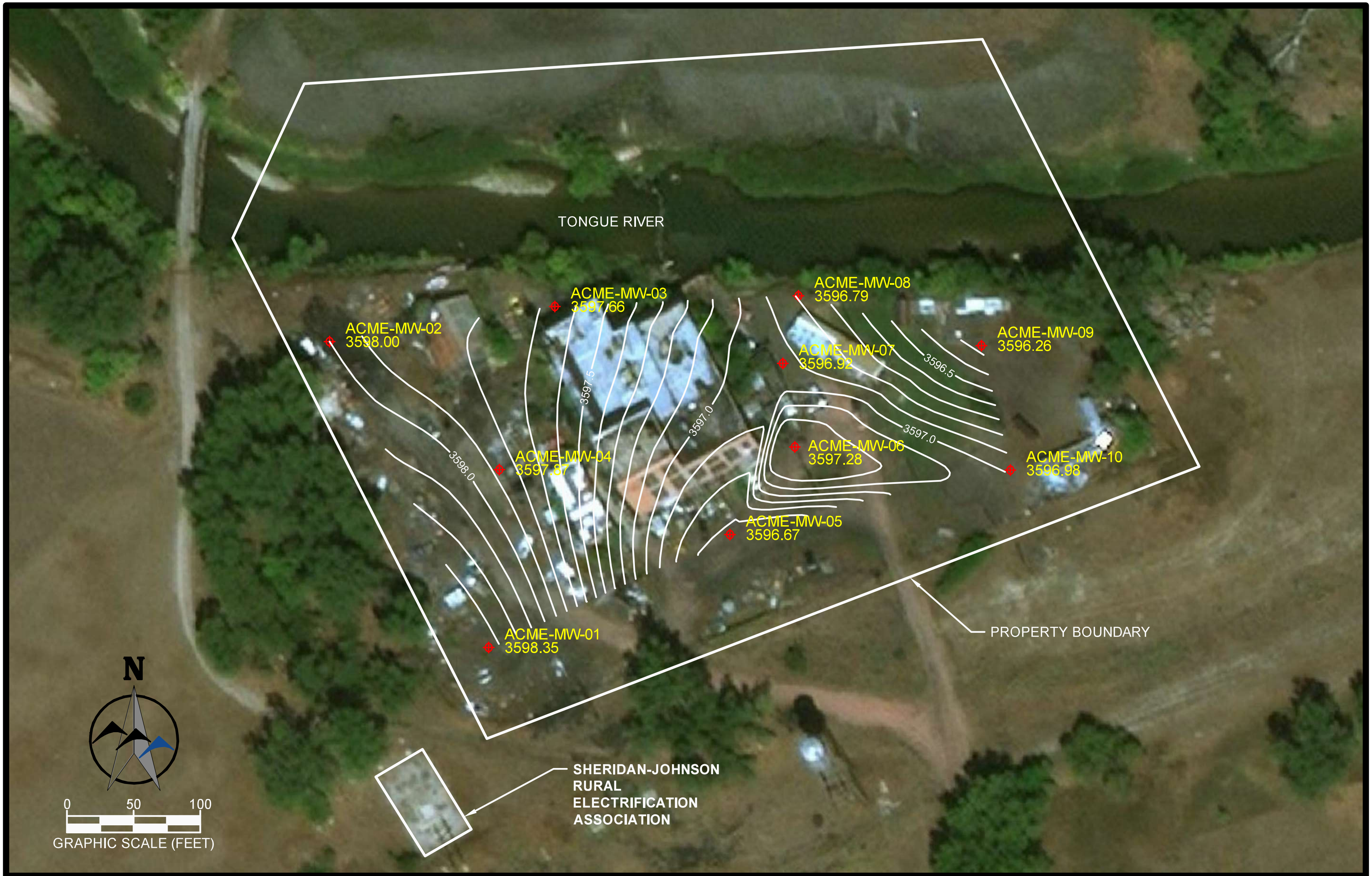
K:\Sheridan\WDEQ\19018\Task_04\SHEETS\POT_SURF_SEPT_2019_COC_EXTENTS.dwg 8/1/2021 4:40:58 PM loren ruttinger



DESIGNED BY: WWC ENGINEERING

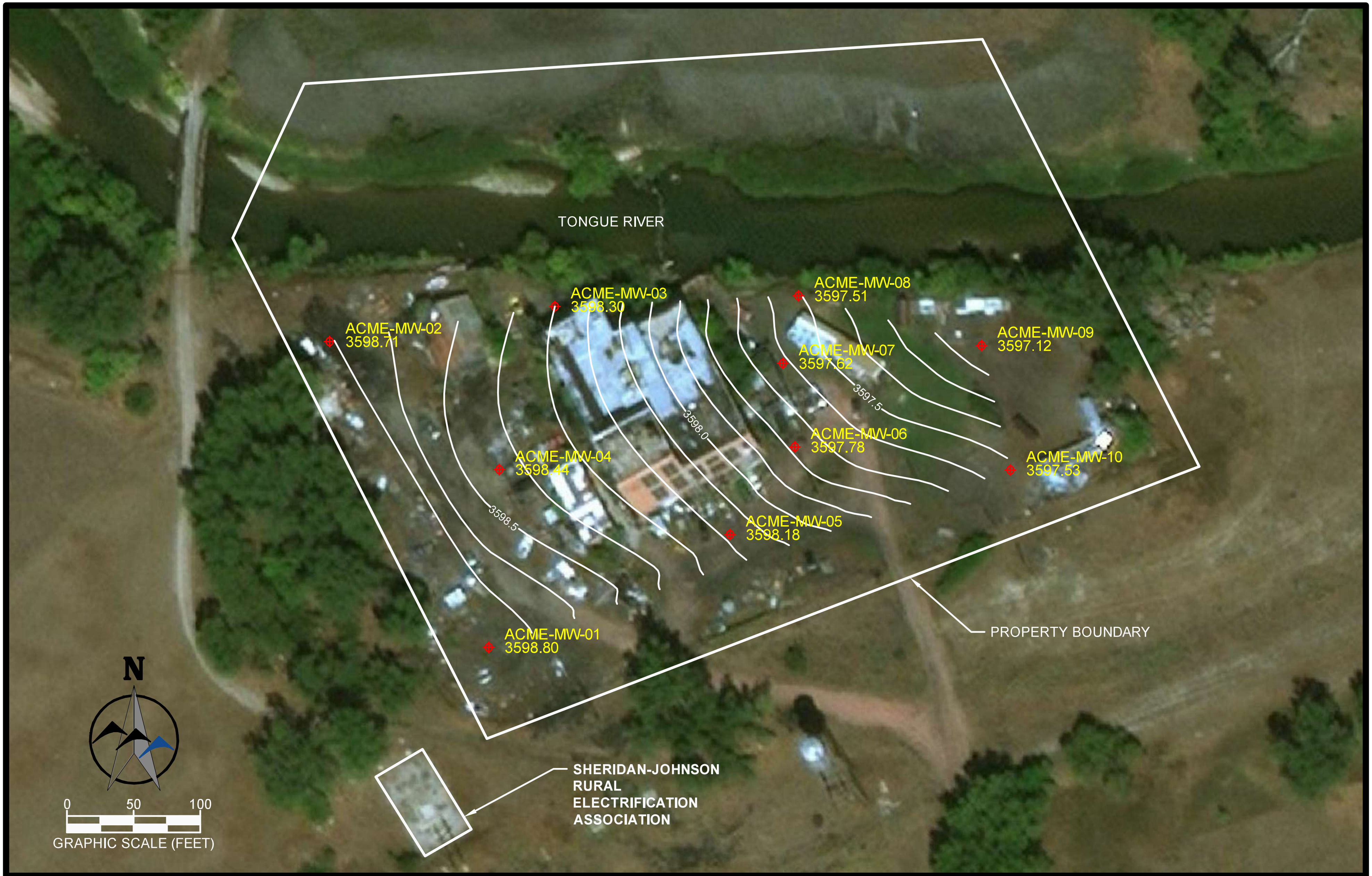
FIGURE 9. DECEMBER 2019 POTENTIOMETRIC SURFACE

K:\Sheridan\WDEQ\19018\Task_04\SHEETS\POT_SURF_DEC_2019_COC_EXTENTS.dwg 8/1/2021 4:52:26 PM loren ruttinger



DESIGNED BY: WWC ENGINEERING

FIGURE 10. MARCH 2020 POTENTIOMETRIC SURFACE



DESIGNED BY: WWC ENGINEERING

FIGURE 11. JUNE 2020 POTENTIOMETRIC SURFACE

K:\Sheridan\WDEQ\19018\Task_04\SHEETS\POT_SURF_JUNE_2020_COC_EXTENTS.dwg 8/1/2021 5:02:20 PM loren ruttinger

Each groundwater sample was analyzed using the EPA methods listed in Table 9. Groundwater was analyzed for the same parameters as soil except that method EPA 8151A for PCP was not used. During the Phase II ESA, PCP was detected only in surface soils; therefore, groundwater was not analyzed for PCP because it was assumed to be unlikely that PCP would migrate to groundwater. The reasoning for each analysis is included in Table 9.

Table 9. Groundwater Analysis Methods and Reasoning

EPA Method	Reasoning for Analysis
EPA 8015M DRO+ORO	Low-level TPH concentrations below CULs were previously detected in groundwater samples. DRO and ORO were identified as COCs in surface soils
EPA 8015M GRO	Low-level TPH concentrations below CULs were previously detected in groundwater samples
EPA 8270 SVOCs	Hexachlorobenzene (fungicide for crop seeds) was previously detected in upgradient groundwater samples
EPA 8270 SIM PAHs	Two PAHs were previously identified as COCs in subsurface soils. Groundwater was sampled for indications of migration to groundwater
EPA 8260 VOCs	PCE was previously identified as a COC in groundwater
EPA 8082 PCBs	PCBs were not previously detected in groundwater samples. However, PCBs were previously identified as COCs in surface soils and were detected in subsurface soils
EPA 6020 Metals	Six metals were previously identified as COCs in groundwater
EPA 7470A Mercury	Six metals were previously identified as COCs in groundwater

Field quality control samples included trip blanks, field equipment rinsate blanks, and field duplicates. Trip blanks were prepared and analyzed at a frequency of one per day of sampling during which samples were collected for VOCs. Since every monitor well was sampled for VOCs, a trip blank was necessary for every day of groundwater sampling. Trip blank nomenclature followed this 12-digit format:

XXXXXXXXXXXX

Space 1	Division letter code with V = VRP
Spaces 2 and 3	Initials (first and last) of the person who collected the sample (e.g., Loren Ruttinger was coded as LR)

Spaces 4 through 7	Month and day sample was collected (e.g., sample collected on September 23 was coded as 0923)
Space 8	Sample type (e.g., T for trip blank)
Spaces 9 and 10	Sample matrix (e.g., GW for groundwater)
Space 11 and 12	Trip blank number (e.g., third trip blank was coded as 03)

Field equipment rinsate blanks were collected at a rate of one per day per sampler per sampling technique when the sampling method utilized reusable equipment. New tubing was utilized at each well for each sampling event. However, field instruments and tubing weights are reusable and were used at multiple wells. Therefore, rinsate blanks were collected. Each day of sampling, one well was sampled at a time with one pump utilizing the same sampling techniques by a primary sampler, even if an assistant was onsite to support the primary sampler; therefore, one rinsate sample was collected per day of groundwater sampling. Rinsate sample nomenclature followed this 12-digit format:

XXXXXXXXXXXX

Space 1	Division letter code with V = VRP
Spaces 2 and 3	Initials (first and last) of the person who collected the sample (e.g., Loren Ruttinger was coded as LR)
Spaces 4 through 7	Month and day the sample was collected (e.g., sample collected on September 23 was coded as 0923)
Space 8	Sample type (e.g., R for rinsate blank)
Spaces 9 and 10	Sample matrix (e.g., GW for groundwater)
Space 11 and 12	Rinsate blank number (e.g., third rinsate blank was coded as 03)

As stated in the WDEQ/VRP QAPP, field duplicates should be collected for groundwater at a rate of 1 per 20 samples, or 1 per sampling event when less than 20 total groundwater samples are collected (WDEQ/VRP 2018b). Therefore, one duplicate groundwater sample was collected per sampling event per quarter. Field duplicates are used to assess the degree of variability due to sampling technique and laboratory procedures by evaluating samples obtained from the same medium at the same location collected sequentially. Field duplicates received unique sample identification numbers to ensure the identity of the samples were blind to the analytical laboratory. The locations of duplicates were documented on the groundwater sampling forms provided in Appendix H. Field duplicate sample nomenclature followed this 12-digit format:

XXXXXXXXXXXX

Space 1	Division letter code with V = VRP
Spaces 2 and 3	Initials (first and last) of the person who collected the sample (e.g., Loren Ruttinger was coded as LR)
Spaces 4 through 7	Month and day sample was collected (e.g., sample collected on September 25 was coded as 0925)
Space 8	Sample type (e.g., D for duplicate)
Spaces 9 and 10	Sample matrix (e.g., GW for groundwater)
Space 11 and 12	Duplicate number (e.g., third duplicate was coded as 03)

Table 10 summarizes the quality control samples collected for groundwater. Section 4.0 discusses the analysis of quality control samples. Appendix I provides the analytical results for the groundwater quality control samples.

2.2.1 Deviations from the Sampling and Analysis Plan

There were no deviations from the SAP in groundwater sampling and analysis other than slight coordinate changes in wells from the planned locations.

2.2.2 Analytical Results and COC Analysis

The groundwater analytical results for all four quarters are provided in Appendix I. A summary of all groundwater analytical results compared to WDEQ/VRP CULs is also provided in Appendix I. The analytical results were processed through a seven-step screening procedure consistent with WDEQ/VRP Fact Sheet #20 (WDEQ/VRP 2019) and the EPA Region 8 guidance document “Evaluating and Identifying Contaminants of Concern for Human Health” (EPA 1994). The seven-step screening procedure included:

1. Determining if the contaminant is an essential nutrient
2. Determining if the contaminant exceeds background concentrations
3. Calculating the detection frequency
4. Evaluating persistence, mobility, and bioaccumulation
5. Determining if concentrations exceed health and technology-based numerical criteria (WDEQ/VRP CULs or EPA screening levels)
6. Researching if there is historical evidence of the compound at the site
7. Completing toxicity concentration screening

Table 10. Groundwater Quality Control Samples

Sample Name	Date	Quality Control Sample Type	Detections or Sample Notes
VLR0923RGW01	09/23/2019	Field Equipment Rinsate Blank	Detections of acenaphthene, acenaphthylene, calcium, copper, phenanthrene below the reporting limit (J flags)
VLR0924RGW02	09/24/2019	Field Equipment Rinsate Blank	Detections of calcium, magnesium, and phenanthrene below the reporting limit (J flags)
VLR0925RGW03	09/25/2019	Field Equipment Rinsate Blank	Detection of phenanthrene below the reporting limit (J flag)
VLR1210RGW04	12/10/2019	Field Equipment Rinsate Blank	Detections of barium, magnesium, and sodium below the reporting limits (J flags)
VLR1211RGW05	12/11/2019	Field Equipment Rinsate Blank	Detections of calcium, chromium, magnesium, and sodium below the reporting limits (J flags)
VLR1212RGW06	12/12/2019	Field Equipment Rinsate Blank	Detections of anthracene, calcium, chromium, and magnesium below the reporting limits (J flags)
VLR0324RGW07	03/24/2020	Field Equipment Rinsate Blank	Detections of bromodichloromethane, calcium, diesel range organics, manganese, motor oil range, and toluene below the reporting limits (J flags) and detection of chloroform
VRF0325RGW08	03/25/2020	Field Equipment Rinsate Blank	Detection of chloroform and detection of toluene below the reporting limit (J flag)
VRF0326RGW09	03/26/2020	Field Equipment Rinsate Blank	Detections of calcium and naphthalene below the reporting limits (J flags)
VLR0616RGW10	06/16/2020	Field Equipment Rinsate Blank	Detections of chromium, toluene, and zinc below the reporting limits (J flags) and detection of naphthalene
VLR0617RGW11	06/17/2020	Field Equipment Rinsate Blank	Detections of chromium, magnesium, naphthalene, toluene, and zinc below the reporting limits (J flags)

Table 10. Groundwater Quality Control Samples (Continued)

Sample Name	Date	Quality Control Sample Type	Detections or Sample Notes
VLR0923TGW01	09/23/2019	Trip Blank	No detections
VLR0924TGW02	09/24/2019	Trip Blank	No detections
VLR0925TGW03	09/25/2019	Trip Blank	No detections
VLR1210TGW04	12/10/2019	Trip Blank	Detection of toluene below the reporting limit (J flag)
VLR1211TGW05	12/11/2019	Trip Blank	No detections
VLR1212TGW06	12/12/2019	Trip Blank	Detection of toluene below the reporting limit (J flag)
VLR0324TGW07	03/24/2020	Trip Blank	No detections
VRF0325TGW08	03/25/2020	Trip Blank	Detection of tetrachloroethene above CULs and detection of trichloroethene below the reporting limit (J flag)
VRF0326TGW09	03/26/2020	Trip Blank	No detections
VLR0616TGW10	06/16/2020	Trip Blank	No detections
VLR0617TGW11	06/17/2020	Trip Blank	No detections
VLR0925DGW01	09/25/2019	Groundwater Duplicate	Duplicate of VLR0925MW041 from ACME-MW-04
VLR1212DGW02	12/12/2019	Groundwater Duplicate	Duplicate of VLR1212MW032 from ACME-MW-03
VRF0325DGW03	03/25/2020	Groundwater Duplicate	Duplicate of VRF0325MW053 from ACME-MW-05
VLR0617DGW04	06/17/2020	Groundwater Duplicate	Duplicate of VLR0617MW044 from ACME-MW-04

The seven-step screening procedure for contaminants is depicted in Figure 4. The complete discussion of the screening procedure for groundwater is provided in Appendix J. Following completion of the screening procedure, COCs in groundwater were determined. These are summarized in Table 11. Once the final list of COCs was developed, each analyte was reviewed for detections above WDEQ/VRP CULs and analytical MDLs. The numbers of detections are listed in Table 11. There were no groundwater COCs with detections above the MDLs. Therefore, the nature and extent figures were not developed for groundwater COCs. The COCs listed in Table 11 are likely a result of laboratory MDLs higher than CULs and RSLs. The COCs listed with no detections above the laboratory MDLs may not be present onsite, although one of them (hexachlorobenzene) was determined to be a COC in the Phase II ESA (Weston 2017b).

Table 11. COCs in Groundwater

Analyte	CAS Number	WDEQ/VRP Water Cleanup Level (µg/L)	RSL (µg/L)	EPC (µg/L)	Detections Above MDL
1,2,3-Trichloropropane	96-18-4	--	0.008	0.355	0
1,2-Dibromo-3-chloropropane	96-12-8	--	0.200	1.627	0
1,2-Dibromoethane (EDB)	106-93-4	--	0.050	0.310	0
1,2-Diphenylhydrazine	122-66-7	--	0.112	1.715	0
3,3’-Dichlorobenzidine	91-94-1	0.199	0.199	2.031	0
4,6-Dinitro-2-methylphenol	534-52-1	--	2.667	2.831	0
Allyl chloride	107-05-1	--	0.730	1.657	0
Bis(2-Chloroethyl) ether	111-44-4	0.0816	0.082	1.440	0
Hexachlorobenzene[1]	118-74-1	1.00	1.000	1.200	0
N-Nitrosodimethylamine	62-75-9	--	0.018	1.040	0
N-Nitroso-di-n-propylamine	621-64-7	0.0128	0.013	1.418	0
Pentachlorophenol	87-86-5	1.0	1.000	5.809	0
Tetrachloroethene[2]	127-18-4	5.00	5.000	2.829	8

[1] Identified as COC in Phase II ESA (Weston 2017b)

[2] Retained as a COC at request of WDEQ/VRP. Although the site-wide EPC was calculated below the CUL, isolated locations of contamination above CULs were identified.

Table 12 lists potential COCs with no comparable WDEQ/VRP CULs or EPA RSLs. Nature and extent figures were not developed for these potential COCs since there are no established CULs or RSLs. The analytes listed as potential COCs with one or more detections above laboratory MDLs are:

Table 12. Potential COCs in Groundwater without Comparable RSLs

Analyte	CAS Number	EPC (µg/L)	Detections Above MDL
1,1-Dichloropropene	563-58-6	0.171	0
1,3-Dichlorobenzene	541-73-1	0.306	0
2,2-Dichloropropane	594-20-7	0.159	0
2-Nitrophenol	88-75-5	1.500	0
3-Nitroaniline	99-09-2	2.931	0
4-Bromophenylphenyl ether	101-55-3	1.318	0
4-Chlorophenylphenyl ether	7005-72-3	0.946	0
4-Nitrophenol	100-02-7	3.989	0
Acenaphthylene	208-96-8	0.010	0
Benzo(g,h,i)perylene	191-24-2	0.010	1
Carbazole	86-74-8	1.421	0
cis-1,3-Dichloropropene	10061-01-5	0.232	0
Dichlorofluoromethane	75-43-4	0.159	0
Dimethylphthalate	131-11-3	1.431	0
Motor Oil Range (C24-C36)	--	56.6	2
PCB-1262 (Aroclor 1262)	37324-23-5	0.036	0
PCB-1268 (Aroclor 1268)	11100-14-4	0.045	0
Phenanthrene	85-01-8	0.012	15
p-Isopropyltoluene	99-87-6	0.239	0
Sodium[1]	7440-23-5	32,683	40
trans-1,3-Dichloropropene	10061-02-6	0.169	0

[1] Sodium is an essential nutrient without an EPA reference dose.

- Benzo(g,h,i)perylene
- Motor Oil Range Organics (C24-C36)
- Phenanthrene
- Sodium

It should be noted that sodium is considered an essential nutrient; however, an EPA reference dose for sodium could not be determined to compare to the calculated ADD. Therefore, sodium was retained as a potential COC, though it is unlikely to be a harmful constituent.

Even though PCE was eliminated in the COC screening process in Step 7 for groundwater because the calculated site-wide EPC was lower than the CUL/RSL, several discrete groundwater samples were collected from monitor wells ACME-MW-04, ACME-MW-05, and ACME-MW-06 with concentrations of PCE exceeding WDEQ/VRP CULs. These isolated locations and occurrences of contamination, or “hotspots,” have been depicted on Figures K-1 through K-4 of Appendix K. The figures depict the nature and extents of PCE contamination in September 2019, December 2019, March 2020, and June 2020, respectively. As shown by these figures, The PCE contamination appears to remain in the vicinity of ACME-MW-04, ACME-MW-05, and ACME-MW-06 regardless of the time of year and groundwater stage. As shown in Figure 7, the bedrock contours appear to decline from ACME-MW-04 to ACME-MW-05. Though the concentrations of PCE are not high enough to truly behave as DNAPL, PCE contamination may be following the natural gradient of bedrock.

2.2.3 Data Gaps

Based upon the results of groundwater sampling, review of the data, the COC analysis, and the nature and extent of COCs, WWC identified the following potential data gaps following site assessment:

- Groundwater background samples could be collected offsite to determine natural concentrations of analytes such as sodium, iron, and manganese. Background samples could be used to establish a site-specific baseline.
- Analytes identified as COCs but without detections above the analytical laboratory MDLs could require additional assessment if laboratory analyses with MDLs lower than the RSLs are available. However, those analytes with no detections above MDLs in 40 groundwater samples may be unlikely to exist onsite.
- Potential COCs with no comparable RSLs or CULs may require additional evaluation to determine if the calculated EPC could be a hazard to human or environmental health.

2.2.4 Hydraulic Properties of the Alluvial Aquifer

Site Assessment included analyses of the hydraulic properties of the alluvial aquifer. These analyses encompassed static water level measurements, continuous hydrographs, slug tests, and soil hydraulic conductivity tests. Water level measurements were used to determine the potentiometric surface and groundwater gradient at the Site. The static water level was measured with a flat-tape water level meter, which is accurate to approximately 0.01 foot. Flat-tape water level meters are self-contained and battery-operated units that signal a buzzer when the tape encounters water. This type of water level meter is appropriate, since the monitor wells were free from obstructions such as pumps. Additionally, Heron Instruments dipperLog TOUGH titanium groundwater data loggers were placed in five of the wells (ACME-MW-03, ACME-MW-04, ACME-MW-05, ACME-MW-07, and ACME-MW-09). The data loggers recorded pressure head and water temperature hourly. A site-specific barLog was used to measure barometric pressure, which was used to correct the pressure head readings from the groundwater data loggers. The depths of the groundwater data loggers below the top of casing were measured and the surveyed casing elevations used to determine respective elevations of the data loggers. The hourly readings were graphed to develop continuous hydrographs for the five wells, which are provided in Appendix L. Flat-tape (e-line) water level measurements are also graphed on the hydrographs to compare the e-line readings to the data logger readings. There is discrepancy between one e-line reading and the data logger hydrograph for ACME-MW-05 during June 2020. Since the hydrograph appears to be consistent, it is assumed that the e-line reading may have been recorded incorrectly by the field sampler. Continuous water level measurements were collected from December 2019 through July 2021. As shown by the hydrographs, approximately 2.0 to 2.5 feet of seasonal groundwater level fluctuation is common at the Site.

Also plotted on the hydrographs in Appendix L are the elevations of the well screen and the elevation of bedrock at each well. These elevations show the relationship of groundwater fluctuations to the well screen and bedrock. The wells were constructed to ensure that if LNAPLs are present at the Site, the well screen would always extend above the potentiometric surface to allow LNAPLs into the well for sampling. As shown by the hydrographs, the water level in all five wells with data loggers never rose above the top of the well screen. The wells were also constructed with screen into the bedrock to allow DNAPLs to enter in the event DNAPLs flow along the bedrock surface. As shown by the bedrock and well screen elevations, the well screens of all wells were completed at least 1 foot into bedrock.

In addition to water level measurements, slug tests (falling-head type) were performed to determine aquifer hydraulic characteristics. The tests provide data for estimation of groundwater movement, most notably the hydraulic conductivity of the aquifer. Though not as accurate as pump tests, slug tests are more practical for contaminated sites where groundwater must be containerized. The Bouwer and Rice (1976) methodology was used to perform slug tests at ACME-MW-02, ACME-MW-03, ACME-MW-04, ACME-MW-06, ACME-MW-07, and ACME-MW-08. The slug test analyses and slug test field forms are provided in Appendix M. The results of the slug tests are summarized in Table 13. Additionally, three constant head permeability tests (ASTM D2434) were completed using in-situ soil samples collected in California tubes from ACME-MW-02, ACME-MW-03, and ACME-MW-08 to compare results to the slug tests. The three constant head permeability tests completed by AET are included in Appendix N. As shown in Table 13, the hydraulic conductivity measurements from the slug and permeability tests ranged from approximately 38.4 to 283.5 ft/day. These values are typical of fine to coarse sand and fine to coarse gravel, which were encountered during drilling (refer to the borehole logs in Appendix B) and are typical Tongue River alluvial materials. This indicates that contamination in groundwater could be relatively mobile.

Table 13. Summary of Aquifer Hydraulic Conductivity

Monitor Well	**Slug Test Hydraulic Conductivity (ft/day)**	**Laboratory Constant Head Permeability (ft/day)**	**Typical Aquifer Material Type***
ACME-MW-02	106.6	133.2	Fine to coarse sand
ACME-MW-03	38.9	90.7	Fine to coarse sand
ACME-MW-04	38.4	Not Tested	Fine to coarse sand
ACME-MW-06	281.4	Not Tested	Fine to coarse gravel
ACME-MW-07	155.1	Not Tested	Fine to coarse gravel
ACME-MW-08	39.9	283.5	Fine to coarse sand

*Driscoll 1986

2.3 Surface Water and Cooling Tunnel Sampling and Analysis

Surface water samples were not collected for the Phase II ESA. As shown on Figure 2, the Study Area is adjacent to the Tongue River. COCs in soil and groundwater could impact the Tongue River via runoff transporting contamination from surface soils toward the river or via groundwater transport. Due to the COCs present in soils and groundwater, surface water was sampled during Site Assessment.

Surface water was collected directly from the Tongue River using a peristaltic pump with disposable tubing specific to each sampling location and event. Sample bottles were filled by continuous flow from the peristaltic pump.

ACME-SW-01 was just upstream (west) of the Study Area near the bridge, and ACME-SW-03 was within and near the downstream (eastern) edge of the Study Area.

Water was also sampled within the cooling water tunnel on the north side of the Plant (ACME-SW-02). This sampling location was used to detect potential contaminant transport from the cooling tunnel to the river. Upon completion of Site Assessment, it was determined that ACME-SW-02 is not representative of surface water quality within the Tongue River and was analyzed separately from the two river sampling locations.

Field equipment was calibrated before each sampling event. The calibration forms for each quarterly sampling event are provided in Appendix G. Before the surface water samples were collected, field parameters were measured and recorded on the surface water sampling forms provided in Appendix O. The field readings for surface water included the following consistent with WDEQ guidance (WDEQ 2018a):

- pH
- Specific electrical conductance (SEC)
- Temperature
- Turbidity
- Dissolved oxygen (DO)
- Redox potential (ORP)

Laboratory-supplied containers were filled (as applicable) in the following order:

1. VOCs
2. SVOCs
3. Pesticides
4. Inorganics
5. Other unfiltered samples
6. Filtered samples

To properly sample VOCs, aeration was minimized when filling sample bottles. The vials were filled with no visible headspace when inverted. Sample locations, field parameters, and observations were documented on the surface water sampling forms provided in Appendix O. The unique names, date, and time collected, sampler, and requested analyses were recorded on the chain-of-custody forms. The chain-of-custody forms are provided with the laboratory analytical results in Appendix P. The surface water sample names consisted of the following 12-digit format:

XXXXXXXXXXXX

Space 1	Division letter code with V = VRP

Spaces 2 and 3	Initials (first and last) of the person who collected the sample (e.g., Loren Ruttinger was coded as LR)
Spaces 4 through 7	Month and day sample was collected (e.g., sample collected on September 23 was coded as 0923)
Spaces 8 through 11	Surface water sampling location (e.g., SW02 for ACME-SW-02)
Space 12	Quarter number (e.g., second quarter of sampling was coded as 2)

The surface water sampling locations are shown on Figure 12. The coordinates of the surface water sampling locations and the surface water samples collected at each location are provided in Table 14. The three sampling locations were surveyed following establishment of the sampling sites. Surface water sampling occurred quarterly during four consecutive quarters under the PS #0807 SOW. Sampling during four consecutive quarters accounted for seasonal fluctuations. Each surface water sample and cooling tunnel sample was analyzed using the EPA methods listed in Table 15. Surface water was analyzed for the same parameters as groundwater.

Field quality control samples for surface water sampling included trip blanks and field equipment rinsate blanks. Trip blanks were prepared at a frequency of one per day of sampling during which samples are collected for VOCs. Since surface water was sampled for VOCs, a trip blank was necessary for every day of sampling. Surface water samples were collected during one day per sampling event; therefore, one trip blank was prepared per quarterly sampling event. Trip blank nomenclature followed this 12-digit format:

XXXXXXXXXXXX

Space 1	Division letter code with V = VRP
Spaces 2 and 3	Initials (first and last) of the person who collected the sample (e.g., Loren Ruttinger was coded as LR)
Spaces 4 through 7	Month and day sample was collected (e.g., sample collected on September 23 was coded as 0923)
Space 8	Sample type (e.g., T for trip blank)
Spaces 9 and 10	Sample matrix (e.g., SW for surface water)
Space 11 and 12	Trip blank number (e.g., third trip blank was coded as 03)

DESIGNED BY: WWC ENGINEERING

FIGURE 12. SURFACE WATER AND COOLING TUNNEL SAMPLING LOCATIONS

K:\Sheridan\WDEQ\19018\Task_04\SHEETS\SW_PUBLIC.dwg 11/9/2021 9:07:37 AM loren ruttinger

Table 14. Surface Water and Cooling Tunnel Sampling Locations

Surface Water Sampling Location	Northing WY83EC (ft)	Easting WY83EC (ft)	Quarter Date Sampled	Analytical Sample Names
ACME-SW-01	1936606	1401455	First Quarter 09/26/2019	VLR0926SW011
			Second Quarter 12/09/2019	VLR1209SW012
			Third Quarter 03/23/2020	VLR0323SW013
			Fourth Quarter 06/15/2020	VLR0615SW014
ACME-SW-02	1936558	1401780	First Quarter 09/26/2019	VLR0926SW021
			Second Quarter 12/09/2019	VLR1209SW022
			Third Quarter Not Sampled	Frozen 3rd Quarter, Not Sampled
			Fourth Quarter 06/15/2020	VLR0615SW024
ACME-SW-03	1936587	1402073	First Quarter 09/26/2019	VLR0926SW031
			Second Quarter 12/09/2019	VLR1209SW032
			Third Quarter 03/23/2020	VLR0323SW033
			Fourth Quarter 06/15/2020	VLR0615SW034
Total Surface Water Samples				**11**

Table 15. Surface Water and Cooling Tunnel Analysis Methods and Reasoning

EPA Method	Reasoning for Analysis
EPA 8015M DRO+ORO	Comparison of analyte concentrations to groundwater and soils analyses
EPA 8015M GRO	Comparison of analyte concentrations to groundwater and soils analyses
EPA 8270 SVOCs	Comparison of analyte concentrations to groundwater and soils analyses
EPA 8270 SIM PAHs	Comparison of analyte concentrations to groundwater and soils analyses
EPA 8260 VOCs	Comparison of analyte concentrations to groundwater and soils analyses
EPA 8082 PCBs	Comparison of analyte concentrations to groundwater and soils analyses
EPA 6020 Metals	Comparison of analyte concentrations to groundwater and soils analyses
EPA 7470A Mercury	Comparison of analyte concentrations to groundwater and soils analyses

Field equipment rinsate blanks were collected at a rate of one per day per sampler per sampling technique when the sampling method utilized reusable equipment. One sampler sampled surface water over one day per quarter; therefore, one rinsate sample was collected per quarter. Rinsate sample nomenclature followed this 12-digit format:

XXXXXXXXXXXX

Space 1	Division letter code with V = VRP
Spaces 2 and 3	Initials (first and last) of the person who collected the sample (e.g., Loren Ruttinger was coded as LR)
Spaces 4 through 7	Month and day sample was collected (e.g., sample collected on September 23 was coded as 0923)
Space 8	Sample type (e.g., R for rinsate blank)

Spaces 9 and 10	Sample matrix (e.g., SW for surface water)
Space 11 and 12	Rinsate blank number (e.g., third rinsate blank was coded as 03)

Field duplicates are not typically collected for surface water due to the variability of a flowing stream. Duplicates were not collected from the surface water sampling locations during Site Assessment. Table 16 summarizes the quality control samples collected for surface water. Section 4.0 discusses the analysis of quality control samples. Appendix P provides the analytical results for the surface water quality control samples.

2.3.1 Deviations from the Sampling and Analysis Plan

Minimal deviations from the surface water SAP occurred during Site Assessment. The SAP provided the opportunity for either a beaker or a peristaltic pump to be used to collect samples. To minimize transport from one container to another and to minimize cross-contamination, a peristaltic pump with new tubing was used at all sampling locations to fill sample containers directly from the pump tubing.

One of the planned samples was not collected. In March 2020, the water in the cooling tunnel at ACME-SW-02 was frozen, and the ice could not be broken to collect a sample. Therefore, a third quarter sample from ACME-SW-02 was not collected.

2.3.2 Analytical Results and COC Analysis

The surface water and cooling tunnel analytical results for all four quarters are provided in Appendix P. A summary of all surface water and cooling tunnel analytical results compared to WDEQ/VRP CULs is also provided in Appendix P. The analytical results were processed through a seven-step screening procedure consistent with WDEQ/VRP Fact Sheet #20 (WDEQ/VRP 2019) and the EPA Region 8 guidance document "Evaluating and Identifying Contaminants of Concern for Human Health" (EPA 1994). The seven-step screening procedure included:

1. Determining if the contaminant is an essential nutrient
2. Determining if the contaminant exceeds background concentrations
3. Calculating the detection frequency
4. Evaluating persistence, mobility, and bioaccumulation
5. Determining if concentrations exceed health and technology-based numerical criteria (WDEQ/VRP CULs or EPA screening levels)
6. Researching if there is historical evidence of the compound at the site
7. Completing toxicity concentration screening

Table 16. Surface Water Quality Control Samples

Sample Name	Date	Quality Control Sample Type	Detections or Sample Notes
VLR0926RSW01	09/26/2019	Field Equipment Rinsate Blank	Detections of chromium and zinc below the reporting limits (J flags)
VLR1209RSW02	12/09/2019	Field Equipment Rinsate Blank	Detections of calcium and sodium below the reporting limits (J flags)
VLR0323RSW03	03/23/2020	Field Equipment Rinsate Blank	Detection of bromodichloromethane, chromium, diesel range organics, motor oil range organics, and toluene below the reporting limits (J flag) and detection of chloroform above the reporting limit
VLR0615RSW04	06/15/2020	Field Equipment Rinsate Blank	Detections of 1,2,3-trichlorobenzene, barium, calcium, copper, iron, lead, magnesium, manganese, naphthalene, potassium, sodium, and toluene below the reporting limits (J flags) and detections of chloroform, chromium, nickel, and zinc above the reporting limits
VLR0926TSW01	09/26/2019	Trip Blank	No detections
VLR1209TSW02	12/09/2019	Trip Blank	No detections
VLR0323TSW03	03/23/2020	Trip Blank	No detections
VLR0615TSW04	06/15/2020	Trip Blank	No detections

The seven-step screening procedure for contaminants is depicted in Figure 4. The complete discussion of the screening procedure for surface water and cooling tunnel samples is provided in Appendix Q. Following completion of the screening procedure, COCs in surface water (Tongue River) and cooling tunnel water were determined separately. These are summarized in Table 17. Once the final list of COCs was developed, each analyte was reviewed for detections above WDEQ/VRP CULs and analytical laboratory MDLs. The numbers of detections of each COC are listed in Table 17. Those COCs with detections above WDEQ/VRP CULs were used to develop the nature and extent figure (Figure 12). The COCs listed with no detections above the laboratory MDLs may not be present onsite and may only be COCs because the laboratory MDLs are not lower than CULs or EPA RSLs. Therefore, only COCs with detections above CULs or RSLs and laboratory MDLs were shown on the nature and extent figure (Figure 12). Both detected COCs were in the samples from ACME-SW-02 (the cooling tunnel). Due to this, the nature and extents figure is limited to highlighting the ACME-SW-02 sample location. The analytes that are COCs with detections above CULs and RSLs in the cooling tunnel are:

- Tetrachloroethene (PCE)
- Trichloroethene (TCE)

Table 18 lists potential COCs with no comparable WDEQ/VRP CULs or EPA RSLs. Nature and extent figures were not developed for these potential COCs since there are no established CULs or RSLs. The analytes listed as potential COCs with detections above laboratory MDLs in surface water are:

- Motor Oil Range Organics (C24-C36)
- Phenanthrene
- Sodium

The analytes listed as potential COCs with detections above laboratory MDLs in the cooling tunnel are also:

- Motor Oil Range Organics (C24-C36)
- Phenanthrene
- Sodium

Table 17. COCs in Surface Water and the Cooling Tunnel

Analyte	CAS Number	WDEQ/VRP Water Cleanup Level (µg/L)	RSL (µg/L)	EPC (µg/L)	Detections Above MDL	Detections Above WDEQ Cleanup Levels
Surface Water (Tongue River)						
1,1,2,2-Tetrachloroethane	79-34-5	0.449	0.076	0.450	0	--
1,2,3-Trichloropropane	96-18-4	0.00075	0.008	0.510	0	--
1,2-Dibromo-3-chloropropane	96-12-8	--	0.200	3.30	0	--
1,2-Dibromoethane (EDB)	106-93-4	--	0.050	0.480	0	--
1,2-Diphenylhydrazine	122-66-7	--	0.078	1.700	0	--
3,3’-Dichlorobenzidine	91-94-1	0.199	0.130	2.10	0	--
4,6-Dinitro-2-methylphenol	534-52-1	--	1.50	2.90	0	--
Allyl chloride	107-05-1	--	0.730	1.900	0	--
Bis(2-Chloroethyl) ether	111-44-4	0.0816	0.014	1.500	0	--
Hexachlorobenzene	118-74-1	1.00	1.00	1.200	0	--
N-Nitrosodimethylamine	62-75-9	--	0.00011	1.100	0	--
N-Nitroso-di-n-propylamine	621-64-7	0.0128	0.011	1.400	0	--
Pentachlorophenol	87-86-5	1.00	1.00	5.80	0	--
Cooling Tunnel						
1,1,2,2-Tetrachloroethane	79-34-5	0.449	0.076	0.450	0	--
1,2,3-Trichloropropane	96-18-4	0.00075	0.008	0.510	0	--
1,2-Dibromo-3-chloropropane	96-12-8	--	0.200	3.30	0	--

Table 17. COCs in Surface Water and the Cooling Tunnel (Continued)

Analyte	CAS Number	WDEQ/VRP Water Cleanup Level (µg/L)	RSL (µg/L)	EPC (µg/L)	Detections Above MDL	Detections Above WDEQ Cleanup Levels
Cooling Tunnel						
1,2-Dibromoethane (EDB)	106-93-4	--	0.050	0.480	0	--
1,2-Diphenylhydrazine	122-66-7	--	0.078	1.700	0	--
3,3’-Dichlorobenzidine	91-94-1	0.199	0.130	2.10	0	--
4,6-Dinitro-2-methylphenol	534-52-1	--	1.50	2.90	0	--
Allyl chloride	107-05-1	--	0.730	1.900	0	--
Bis(2-Chloroethyl) ether	111-44-4	0.0816	0.014	1.500	0	--
Hexachlorobenzene	118-74-1	1.00	1.00	1.200	0	--
N-Nitrosodimethylamine	62-75-9	--	0.00011	1.100	0	--
N-Nitroso-di-n-propylamine	621-64-7	0.0128	0.011	1.400	0	--
Pentachlorophenol	87-86-5	1.00	1.00	5.80	0	--
Tetrachloroethene (PCE)	127-18-4	5.00	5.00	557.0	3	3
Trichloroethene (TCE)	79-01-6	5.00	5.00	7.40	3	1

It should be noted that sodium is considered an essential nutrient; however, an EPA reference dose for sodium could not be determined to compare to the calculated ADD. Therefore, sodium was retained as a potential COC, though it is unlikely to be a harmful constituent.

As discussed in Section 12.0, a surface water and groundwater interaction study was completed to better understand the relationship between the cooling tunnel, the Tongue River, and groundwater. Based upon the potentiometric surface and the chemical constituents in the water from the cooling tunnel (ACME-SW-02), the water in the cooling tunnel is likely in communication with groundwater. This explains the detections of iron, manganese, and PCE in the cooling tunnel. As shown by the groundwater "hotspot" figures in Appendix K, PCE was detected upgradient of the cooling tunnel. This may indicate that the source of PCE contamination is from the western side of the Plant and that PCE is migrating toward the cooling tunnel. The PCE contamination may have accumulated in the cooling tunnel. While the water in the cooling tunnel is likely groundwater, the tunnel provides a pathway for contamination to reach the Tongue River during high water stages.

2.3.3 Data Gaps

Based upon the results of surface water sampling, review of the data, the COC analysis, and the nature and extent of COCs, WWC identified the following potential data gaps following Site Assessment:

- One surface water sample was not collected in March 2020 due to frozen water preventing sampling from the cooling tunnel (ACME-SW-02). The lack of this sample is a quarterly chemical data gap. Regardless of this data gap, the water in the cooling tunnel was adequately characterized. The inability to sample the water in the cooling tunnel during the winter quarter demonstrates that water early in the year is typically frozen and cannot mobilize from the tunnel.
- Analytes identified as COCs but without detections above the analytical laboratory MDLs could require additional assessment if laboratory analyses with MDLs lower than the RSLs are available. However, those analytes with no detections above MDLs in 11 surface water samples may be unlikely to exist onsite.

Table 18. Potential COCs in Surface Water and the Cooling Tunnel without Comparable RSLs

Analyte	CAS Number	EPC (µg/L)	Detections Above MDL
Surface Water (Tongue River)			
1,1-Dichloropropene	563-58-6	0.400	0
1,3-Dichlorobenzene	541-73-1	0.390	0
2,2-Dichloropropane	594-20-7	0.340	0
2-Nitrophenol	88-75-5	1.500	0
3-Nitroaniline	99-09-2	3.00	0
4-Bromophenylphenyl ether	101-55-3	1.300	0
4-Chlorophenylphenyl ether	7005-72-3	0.960	0
4-Nitrophenol	100-02-7	4.10	0
Acenaphthylene	208-96-8	0.010	0
Benzo(g,h,i)perylene	191-24-2	0.010	0
Carbazole	86-74-8	1.500	0
cis-1,3-Dichloropropene	10061-01-5	0.410	0
Dichlorofluoromethane	75-43-4	0.280	0
Dimethylphthalate	131-11-3	1.500	0
Motor Oil Range (C24-C36)	--	210.0	4
PCB-1262 (Aroclor 1262)	37324-23-5	0.036	0
PCB-1268 (Aroclor 1268)	11100-14-4	0.045	0
Phenanthrene	85-01-8	0.010	1
p-Isopropyltoluene	99-87-6	0.300	0
Sodium[1]	7440-23-5	56,200	8
trans-1,3-Dichloropropene	10061-02-6	0.360	0
Cooling Tunnel			
1,1-Dichloropropene	563-58-6	0.400	0
1,3-Dichlorobenzene	541-73-1	0.390	0
2,2-Dichloropropane	594-20-7	0.340	0

Table 18. Potential COCs in Surface Water and the Cooling Tunnel without Comparable RSLs (Continued)

Analyte	**CAS Number**	**EPC (µg/L)**	**Detections Above MDL**
Cooling Tunnel			
2-Nitrophenol	88-75-5	1.500	0
3-Nitroaniline	99-09-2	3.00	0
4-Bromophenylphenyl ether	101-55-3	1.300	0
4-Chlorophenylphenyl ether	7005-72-3	0.950	0
4-Nitrophenol	100-02-7	4.00	0
Acenaphthylene	208-96-8	0.010	0
Benzo(g,h,i)perylene	191-24-2	0.010	0
Carbazole	86-74-8	1.400	0
cis-1,3-Dichloropropene	10061-01-5	0.410	0
Dichlorofluoromethane	75-43-4	0.280	0
Dimethylphthalate	131-11-3	1.500	0
Motor Oil Range (C24-C36)	--	210.0	2
PCB-1262 (Aroclor 1262)	37324-23-5	0.036	0
PCB-1268 (Aroclor 1268)	11100-14-4	0.045	0
Phenanthrene	85-01-8	0.008	1
p-Isopropyltoluene	99-87-6	0.300	0
Sodium[1]	7440-23-5	56,200	3
trans-1,3-Dichloropropene	10061-02-6	0.360	0

[1] Sodium is an essential nutrient without an EPA reference dose.

- Potential COCs with no comparable RSLs or CULs may require additional evaluation to determine if the calculated EPC could be a hazard to human or environmental health.

2.4 River Sediment Sampling and Analysis

Tongue River sediments and building sediments were analyzed for the Phase II ESA. Evaluation of Tongue River sediment results in the Phase II ESA identified DRO, ORO, and four metals (arsenic, copper, lead, and nickel) as the primary COCs potentially sourced from the Plant or the coal ash pile. Due to detections of COCs in

Tongue River sediments, additional analysis of river sediments was completed during Site Assessment.

Sampling of river sediment occurred near the low- and high-water lines along the southern bank of the Tongue River. The river sediment sample locations are shown on Figure 13. The locations correlate to surface water sampling locations and near sediment sampling locations that exceeded CULs during the Phase II ESA (Weston 2017b). The coordinates of these sampling locations are provided in Table 19.

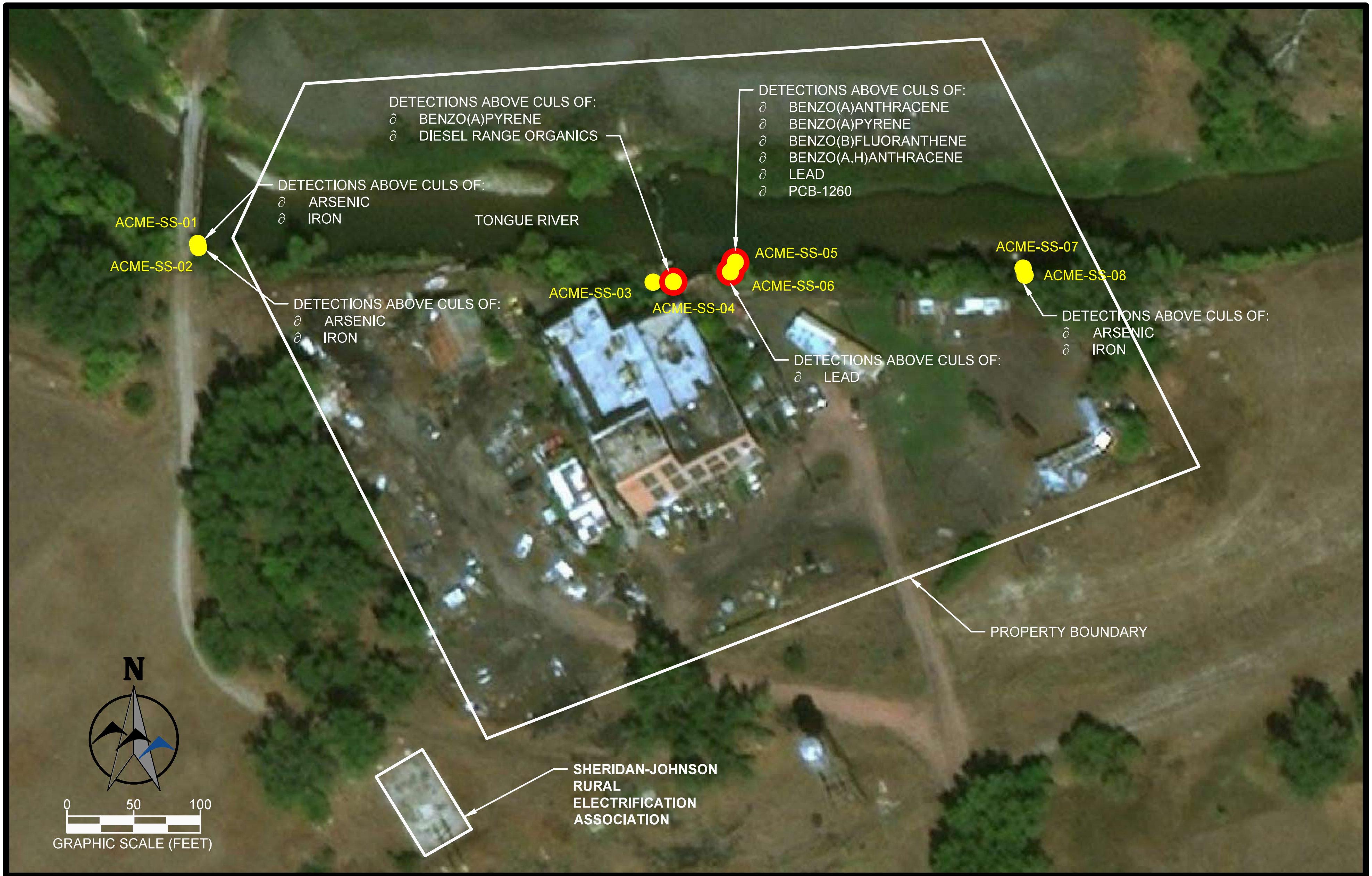
Sediments were sampled when water levels were low in the early fall (October 2019), but before the river froze over. Sediments were collected using disposable scoops. One scoop was used at each sampling location. During sampling, it was determined that sediments were relatively shallow; therefore, intervals deeper than 0 to 4 inches were not sampled in favor of sampling sediments at different elevations along the south riverbank.

Sample locations and depths were documented on the sampling logs provided in Appendix R. The unique names, date and time collected, sampler, and requested analyses were recorded on the chain-of-custody form provided with the analytical results in Appendix S. The sediment sample names consisted of the following 13-digit format:

XXXXXXXXXXXXX

Space 1	Division letter code with V = VRP
Spaces 2 and 3	Initials (first and last) of the person who collected the sample (e.g., Loren Ruttinger was coded as LR)
Spaces 4 through 7	Month and day sample was collected (e.g., sample collected on October 25 was coded as 1025)
Spaces 8 and 9	Sample type (e.g., SS for sediment sample)
Spaces 10 and 11	Sample location number (e.g., sample location 03 was coded as 03)
Space 12 and 13	Sampling interval (e.g., a 0-4 inches sampling interval was coded as 04)

Each sediment sample was analyzed using the EPA methods listed in Table 20. Sediments were analyzed for the same parameters as surface water.



DESIGNED BY: WWC ENGINEERING

FIGURE 13. RIVER SEDIMENT SAMPLE LOCATIONS

Table 19. River Sediment Sampling Locations

Sediment Sample Location	Northing WY83EC (ft)	Easting WY83EC (ft)	Sample Depth (inches)	Analytical Sample Names
ACME-SS-01	1936605	1401454	0-4	VLR1025SS0104
ACME-SS-02	1936602	1401455	0-4	VLR1025SS0204
ACME-SS-03	1936576	1401796	0-4	VLR1025SS0304
ACME-SS-04	1936577	1401811	0-4	VLR1025SS0404
ACME-SS-05	1936591	1401857	0-4	VLR1025SS0504
ACME-SS-06	1936584	1401854	0-4	VLR1025SS0604
ACME-SS-07	1936587	1402073	0-4	VLR1025SS0704
ACME-SS-08	1936581	1402075	0-4	VLR1025SS0804
Total River Sediment Samples				**8**

Field quality control samples included one trip blank. Since sediment sampling locations were sampled for VOCs over one day, one trip blank was necessary for the single day of sediment sampling. Trip blank nomenclature followed this 12-digit format:

XXXXXXXXXXXX

Space 1	Division letter code with V = VRP
Spaces 2 and 3	Initials (first and last) of the person who collected the sample (e.g., Loren Ruttinger was coded as LR)
Spaces 4 through 7	Month and day sample was collected (e.g., sample collected on October 25 was coded as 1025)
Space 8	Sample type (e.g., T for trip blank)
Spaces 9 and 10	Sample matrix (e.g., SS for sediment)
Space 11 and 12	Trip blank number (e.g., first trip blank was coded as 01)

Table 20. River Sediment Analysis Methods and Reasoning

EPA Method	Reasoning for Analysis
EPA 8015M DRO+ORO	Comparison of analyte concentrations to surface water and soils analyses
EPA 8015M GRO	Comparison of analyte concentrations to surface water and soils analyses
EPA 8270 SVOCs	Comparison of analyte concentrations to surface water and soils analyses
EPA 8270 SIM PAHs	Comparison of analyte concentrations to surface water and soils analyses
EPA 8260 VOCs	Comparison of analyte concentrations to surface water and soils analyses
EPA 8082 PCBs	Comparison of analyte concentrations to surface water and soils analyses
EPA 6010 Metals	Comparison of analyte concentrations to surface water and soils analyses
EPA 7471B Mercury	Comparison of analyte concentrations to surface water and soils analyses
EPA 8151A Pentachlorophenol (only)	Comparison of analyte concentrations to surface water and soils analyses

Field equipment rinsate blanks are typically collected at a rate of one per day per sampler per sampling technique when the sampling method utilizes reusable equipment. Since disposable scoops were used to sample sediments and sediments were placed directly into sample containers, a rinsate sample was not deemed necessary.

As stated in the WDEQ/VRP QAPP, soils are inherently heterogeneous and are subject to natural variations in composition and texture. It is typically not possible to isolate the effects of sampling technique and laboratory procedures from natural soil heterogeneity (WDEQ/VRP 2018b). Therefore, a field duplicate was not collected for river sediment evaluations.

Table 21 summarizes the quality control samples collected for river sediment. Section 4.0 discusses the analysis of quality control samples. Appendix S provides the analytical results for the river sediment quality control samples.

Table 21. River Sediment Quality Control Samples

Sample Name	Date	Quality Control Sample Type	Detections or Sample Notes
VLR1025TSS01	10/22/2019	Trip Blank	Detection of methylene chloride below the reporting limit (J flag)

2.4.1 Deviations from the Sampling and Analysis Plan

River sediment sampling deviated slightly from the SAP. Sediment samples were collected from 0-4 inches along the bank of the Tongue River. Deeper samples (4-8 inches were not collected). Samples were collected near the low-water line and the high-water line along the southern bank of the Tongue River rather than beneath the water surface.

2.4.2 Analytical Results and COC Analysis

The river sediment analytical results are provided in Appendix S. A summary of all river sediment analytical results compared to WDEQ/VRP CULs is also provided in Appendix S. The analytical results were processed through a seven-step screening procedure consistent with WDEQ/VRP Fact Sheet #20 (WDEQ/VRP 2019) and the EPA Region 8 guidance document "Evaluating and Identifying Contaminants of Concern for Human Health" (EPA 1994). The seven-step screening procedure included:

1. Determining if the contaminant is an essential nutrient
2. Determining if the contaminant exceeds background concentrations
3. Calculating the detection frequency
4. Evaluating persistence, mobility, and bioaccumulation
5. Determining if concentrations exceed health and technology-based numerical criteria (WDEQ/VRP CULs or EPA screening levels)
6. Researching if there is historical evidence of the compound at the site
7. Completing toxicity concentration screening

The seven-step screening procedure for contaminants is depicted in Figure 4. The complete discussion of the screening procedure for river sediments is provided in Appendix T. Following completion of the screening procedure, COCs in river sediments were determined. These are summarized in Table 22. Once the final list of COCs was developed, each analyte was reviewed for detections above WDEQ/VRP CULs and analytical laboratory MDLs. The numbers of detections are listed in Table 22. Twelve of the 24 COCs had no detections above the MDLs, indicating the MDLs were too high. Those COCs with detections above WDEQ/VRP CULs were used to develop the nature and extent figure (Figure 13). The COCs listed with no detections above the laboratory MDLs may not be present onsite and may only be COCs because the laboratory MDLs are not lower than CULs or EPA RSLs. Therefore, only COCs with detections above CULs or RSLs and laboratory MDLs were shown on the nature and extent figure (Figure 13). As shown in Figure 13, the COCs were primarily detected in ACME-SS-04, ACME-SS-05, and ACME-SS-06. Arsenic and iron were detected above CULs in ACME-SS-01, ACME-SS-02,

Table 22. COCs in River Sediment

Analyte	CAS Number	WDEQ/VRP Migration to Groundwater Cleanup Level (mg/kg)	WDEQ/VRP Residential Soil Cleanup Level (mg/kg)	RSL (mg/kg)	EPA Consensus-Based PEC[2] (mg/kg)	EPC (mg/kg)	Detections Above MDL	Detections Above WDEQ Cleanup Level
1,2,3-Trichloropropane	96-18-4	--	--	0.005	--	0.009	0	--
1,2-Dibromo-3-chloropropane	96-12-8	--	--	0.005	--	0.009	0	--
1,2-Diphenylhydrazine	122-66-7	--	--	0.618	--	3.12	0	--
2,4-Dinitrotoluene	121-14-2	0.0197	1.70	1.590	--	3.24	0	--
2,6-Dinitrotoluene	606-20-2	0.00897	0.36	0.330	--	3.37	0	--
4,6-Dinitro-2-methylphenol	534-52-1	--	--	4.93	--	25.2	0	--
4-Chloroaniline	106-47-8	0.0355	2.7	2.47	--	6.78	0	--
Arsenic	7440-38-2	12.0[1]	12.0[1]	0.623	33.0	15.9	8	3
Benzo(a)anthracene	56-55-3	0.35	1.1	1.080	1.050	1.85	5	1
Benzo(a)pyrene	50-32-8	0.204	0.11	0.110	1.450	1.45	8	3
Benzo(b)fluoranthene	205-99-2	1.1	1.1	1.100	--	2.98	5	1
bis(2-Chloroethyl) ether	111-44-4	0.0000176	0.23	0.196	--	4.10	0	--
Dibenz(a,h)anthracene	53-70-3	0.34	0.11	0.110	--	0.321	2	1
Diesel Range Organics	--	--	2,300	2,300	--	10,400	8	1
Hexachlorobenzene	118-74-1	0.0552	0.21	0.184	--	4.15	0	--
Hexachloroethane	67-72-1	0.0044	1.8	1.510	--	3.31	0	--
Iron	7439-92-6	7.59	55,000	54,800	--	120,000	8	3
Lead	7439-92-1	32.0[1]	400	13.50	128	57.7	8	2
N-Nitrosodimethylamine	62-75-9	--	--	0.002	--	3.12	0	--
N-Nitroso-di-n-propylamine	621-64-7	0.00000287	0.078	0.071	--	11.6	0	--
PCB, Total	1336-36-3	--	--	0.204	0.676	0.289	5	--
PCB-1260 (Aroclor 1260)	11096-82-5	0.1750	0.24	0.216	--	0.289	5	1
Phenanthrene	85-01-8	--	--	--	1.170	4.71	6	--
Thallium	7440-28-0	0.1426	0.78	0.782	--	1.4	4	--

[1] Statewide background concentrations for select metals (WDEQ/VRP 2015)

[2] Probable Effect Concentration

and ACME-SS-08; however, these sample locations are not highlighted in Figure 13. The detections of arsenic and iron may be naturally occurring since ACME-SS-01 and ACME-SS-02 are offsite and upstream. The analytes that are COCs with detections above CULs or RSLs are:

- Arsenic
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Dibenz(a,h)anthracene
- Diesel Range Organics
- Iron
- Lead
- PCB-1260 (Aroclor 1260)
- Phenanthrene

Table 23 lists potential COCs with no comparable WDEQ/VRP CULs or EPA RSLs. Nature and extent figures were not developed for these potential COCs since there are no established CULs or RSLs. The analytes listed as potential COCs with detections above laboratory MDLs are:

- Acenaphthylene
- Benzo(g,h,i)perylene
- Carbazole
- Motor Oil Range Organics (C24-C36)
- Sodium

It should be noted that sodium is considered an essential nutrient; however, an EPA reference dose for sodium could not be determined to compare to the calculated ADD. Therefore, sodium was retained as a potential COC, though it is unlikely to be a harmful constituent.

The results of the river sediment sampling demonstrated that limited sampling restricts the COC screening process from calculating an EPC and results in a more extensive list of COCs. Additionally, the high MDLs contributed to additional COCs without detections. The river sediment sampling also demonstrated that like surface and subsurface soils, contamination in the Study Area is typically shallow and localized.

Table 23. Potential COCs in River Sediment without Comparable RSLs

Analyte	CAS Number	EPC (mg/kg)	Detections Above Pace MDL
1,1-Dichloropropene	563-58-6	0.001	0
1,3-Dichlorobenzene	541-73-1	0.003	0
2,2-Dichloropropane	594-20-7	0.001	0
2-Nitrophenol	88-75-5	3.10	0
3-Nitroaniline	99-09-2	2.78	0
4-Bromophenylphenyl ether	101-55-3	3.03	0
4-Chlorophenylphenyl ether	7005-72-3	3.16	0
4-Nitrophenol	100-02-7	4.94	0
Acenaphthylene	208-96-8	0.375	3
Benzo(g,h,i)perylene	191-24-2	1.020	3
Carbazole	86-74-8	2.11	1
cis-1,3-Dichloropropene	10061-01-5	0.001	0
Dichlorofluoromethane	75-43-4	0.002	0
Dimethylphthalate	131-11-3	3.46	0
Motor Oil Range (C24-C36)	N/A	15,800	8
p-Isopropyltoluene	99-87-6	0.004	0
Sodium[1]	7440-23-5	1450	8
trans-1,3-Dichloropropene	10061-02-6	0.003	0

[1] Sodium is an essential nutrient without an EPA reference dose.

2.4.3 Data Gaps

Based on the results of river sediment sampling, review of the data, the COC analysis, and the nature and extent of COCs, WWC identified the following potential data gaps:

- Additional river sediment background samples could be collected offsite to determine natural concentrations of analytes such as arsenic, iron, and sodium. Background samples could be used to establish a site-specific baseline.
- Analytes identified as COCs but without detections above the analytical laboratory MDLs could require additional assessment if laboratory analyses with

MDLs lower than the RSLs are available. Those analytes with no detections above MDLs in all samples may be unlikely to exist onsite.

- Additional assessment along the riverbank may be required to determine the full extents of contamination.
- Potential COCs with no comparable RSLs or CULs may require additional evaluation to determine if the detected concentrations could be a hazard to human or environmental health.

2.5 Activity-Based Sampling for Asbestos in Soils

ABS sampling for asbestos in soils was completed by WWC and Y Environmental in August 2019. The ABS utilized two scenarios (generic raking and weed whacking) in three grids within the Study Area. Asbestos structures were detected on cassettes in all three grids. The results of ABS were used to calculate the risk of developing lung cancer at the Site due to exposure to asbestos. The risk calculations determined there may be an unacceptable risk to workers at the Site without respiratory protection. The calculations also determined there is a significant risk of developing lung cancer by long-term residents of the Site. Asbestos in soils is considered a COC at the Site. The full ABS report is provided in Appendix A.

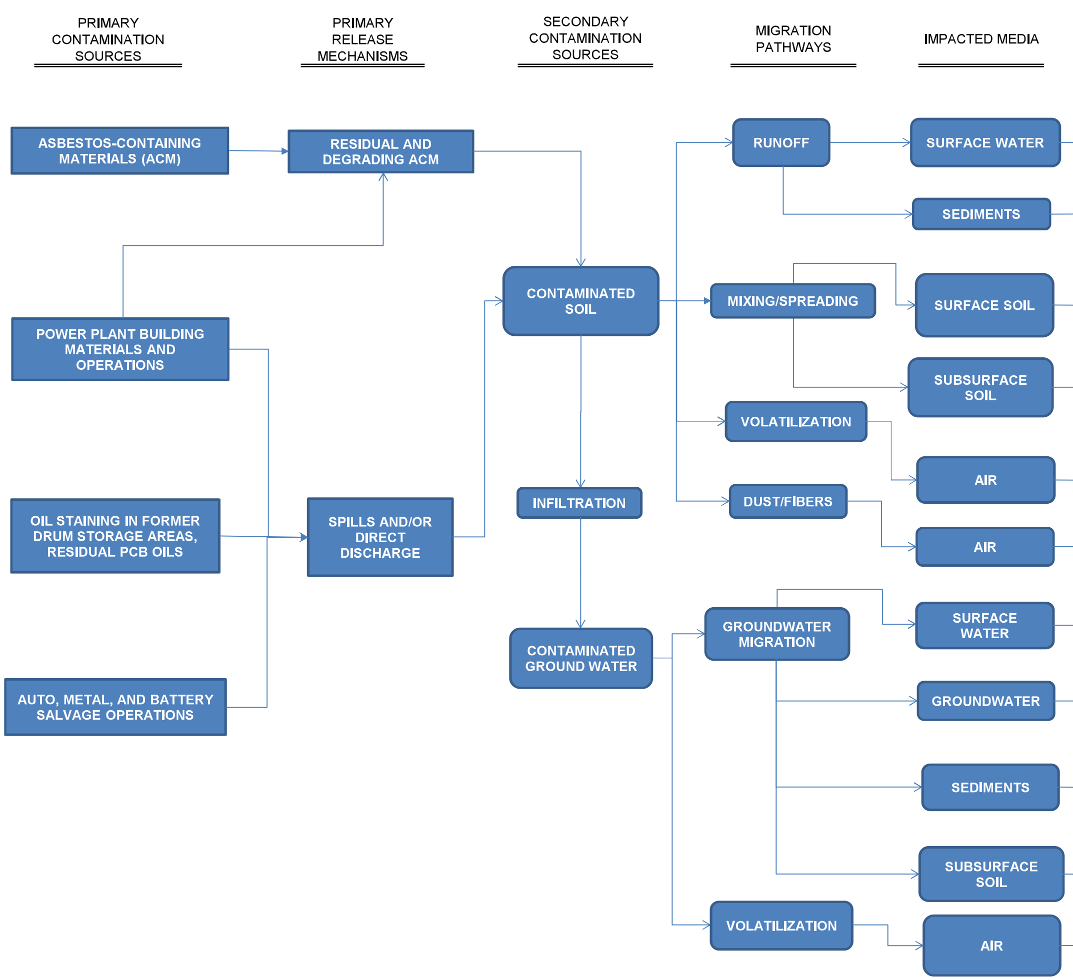
3.0 SITE CONCEPTUAL MODEL

Based on the results of the Phase I and Phase II ESAs (Weston 2017a, 2017b, and 2017c), interviews, observations during Site Stabilization (WWC 2019a), and the results of the Site Assessment, a site conceptual model (SCM) has been developed for the Site. The SCM is a description of the surface, subsurface, and environmental setting of the Site. The SCM includes known contamination sources, release mechanisms, impacted media, migration pathways, potential human receptors, potential ecological receptors, and exposure pathways. A preliminary SCM was developed prior to Site Assessment to determine data gaps to focus the Site Assessment (WWC 2019b). The SCM has been updated following the results of the Site Assessment to aid remediation planning and risk assessment. Figure 14 is a visual representation of the SCM.

3.1 Contamination Sources

Primary contamination sources at the Site include components of the facilities and power plant operations, which included combustion of coal for power generation, oils and greases using PCBs, insulation utilizing asbestos, and cleaning chemicals or solvents used to clean equipment. An onsite railroad spur was used to deliver coal to the Plant; therefore, emissions from engine combustion and creosote-preserved railroad ties were onsite. Activities at the Site following power plant operations included metal salvage, transformer recycling, battery recycling, and auto salvage.

SITE CONCEPTUAL MODEL
FORMER ACME POWER PLANT



EXPOSURE PATHWAY	POTENTIAL RECEPTORS					
	HUMAN			ECOLOGICAL		
	VISITORS	COMMERCIAL/ INDUSTRIAL WORKERS	TRESPASSERS	TERRESTRIAL (INCLUDING AVIAN)	AQUATIC	BENTHIC
CONTACT	•	•	•	•	•	•
INGESTION		•		•	•	•
CONTACT	•	•	•	•	•	•
INGESTION	•	•	•	•	•	•
CONTACT	•	•	•	•		
INGESTION	•	•	•	•		
CONTACT		•		•		
INGESTION		•		•		
INHALATION	•	•	•	•		
INHALATION	•	•	•	•		
CONTACT	•	•	•	•	•	•
INGESTION		•		•	•	•
CONTACT		•				
INGESTION		•				
CONTACT	•	•	•	•	•	•
INGESTION		•		•	•	•
CONTACT		•		•		
INGESTION		•		•		
INHALATION	•	•	•	•		

FIGURE 14. SITE CONCEPTUAL MODEL FOR THE FORMER ACME POWER PLANT

Other activities onsite, or neighboring agricultural activities, may have included weed or pest control using herbicides or pesticides.

For the purposes of the Site Assessment under the PS #0807 SOW, the Study Area is the property within the fenced boundary on the south side of the Tongue River. Although a portion of the Owner's property is north of the Tongue River, that property is excluded from this study. The Study Area is shown on Figure 2.

Primary sources of contamination in the Study Area from power plant activities include coal ash, degraded and friable ACM, and residual PCB oils or greases on equipment. Primary sources of contamination in the Study Area from battery recycling and metal recycling include fragments of batteries and remnants of scrap metal. Primary sources of contamination from auto salvage included drums and 5-gallon buckets filled with used motor oil, which were disposed of offsite during Site Stabilization. Secondary sources of contamination at the Site (i.e., areas of high concentration that present continued sources of contamination) include contaminated soil (surface and subsurface), groundwater, and sediments. The focus of this SCM is surface and subsurface soil contamination, groundwater contamination, surface water contamination, and sediment contamination.

Historical sampling and analysis within the Study Area, which included surface and subsurface soils, groundwater, river sediments, coal ash, building sediments, drums, and other containers, building materials, and equipment surfaces, indicate that there are elevated levels of DRO, ORO, PCBs, metals, PAHs, VOCs, SVOCs, and an herbicide (PCP). COCs identified during the Phase II ESA as exceeding WDEQ/VRP CULs or screening levels are shown in Table 24. Table 24 compares the COCs identified during the Phase II ESA with those identified during Site Assessment and shows the media impacted by each COC. As shown by the table, while there is some overlap in COCs between the Phase II ESA and Site Assessment, Site Assessment tended to eliminate COCs through more extensive sampling and analysis. This was accomplished through calculating the 95% UCL of the arithmetic mean for each constituent in each sample medium. Table 25 summarizes the detected COCs above WDEQ/VRP CULs following the conclusion of Site Assessment, as well as the respective media in which the COCs were detected.

No LNAPL or DNAPL were observed during the Phase II ESA investigation. However, monitor wells were of temporary construction and not specifically designed to detect LNAPL or DNAPL. The presence of LNAPL and DNAPL were investigated during Site Assessment through the construction of monitor wells to allow LNAPL and DNAPL into the wells for sampling. Specifically, wells were constructed to allow for the observation of contaminants such as petroleum hydrocarbons (specific gravity less than 1.0) or contaminants such as PCE or hexachlorobenzene with specific gravities greater

Table 24. Summary of COCs Based on Phase II ESA Compared to Site Assessment

COC[1]	**Analyte Type**	**Impacted Media**					
		Surface Soil	Subsurface Soil	Groundwater	Surface Water	Cooling Tunnel	Sediment
DRO	Hydrocarbons	O					XO
ORO	Hydrocarbons	X*O	X*	X*	X*	X*	X*O
GRO	Hydrocarbons						O
PCB-1260 (Aroclor 1260)	PCB	XO					X
PCB, Total	PCB	X					
Aluminum	Metal			O			
Antimony	Metal	O					
Arsenic	Metal	XO	X	O			XO
Cobalt	Metal			O			
Copper	Metal	O					O
Iron	Metal	O	O	O			X
Lead	Metal	XO	X	O			XO
Manganese	Metal	O		O			
Mercury	Metal						O
Nickel	Metal						O
Benzo(a)anthracene	PAH	O					X
Benzo(a)pyrene	PAH	O	O				X
Benzo(b)fluoranthene	PAH	O	O				X
Bis(2-ethylhexyl)phthalate	PAH	O					
Dibenzo(a,h)anthracene	PAH	O					X
Indeno(1,2,3-cd)pyrene	PAH	O					
Benzene	VOC	O	O				
Tetrachloroethene (PCE)	VOC	O	O	XO		X~	
Trichloroethene (TCE)	VOC					X	
Pentachlorophenol (PCP)	Herbicide	O					
Hexachlorobenzene	SVOC			O			
Phenanthrene	SVOC	X	X	X	X	X	
Asbestos[2]	Mineral	XO					

NOTES: X = COC determined from Site Assessment, O = COC from Phase II ESA, X* = Potential COC from Site Assessment which may not fully correlate to ORO, X~ = COC in cooling tunnel

[1] Final COC list is limited to detected constituents only (non-detected constituents are not listed per the detection frequency evaluation).

[2] Asbestos in surface soils was determined to be a COC through ABS described in Appendix A.

Source of Phase II ESA results: Weston 2017b

Table 25. Summary of COCs Based on Results of the Site Assessment

COC[1]	**Analyte Type**	**Impacted Media**					
		Surface Soil	Subsurface Soil	Groundwater	Surface Water	Cooling Tunnel	Sediment
DRO	Hydrocarbons	O					XO
ORO	Hydrocarbons	X*O	X*	X*	X*	X*	X*O
PCB-1260 (Aroclor 1260)	PCB	XO					X
PCB, Total	PCB	X					
Arsenic	Metal	XO	X	O			XO
Iron	Metal	O	O	O			X
Lead	Metal	XO	X	O			XO
Benzo(a)anthracene	PAH	O					X
Benzo(a)pyrene	PAH	O	O				X
Benzo(b)fluoranthene	PAH	O	O				X
Dibenzo(a,h)anthracene	PAH	O					X
Tetrachloroethene (PCE)	VOC	O	O	XO		X~	
Trichloroethene (TCE)	VOC					X	
Phenanthrene	SVOC	X	X	X	X	X	
Asbestos[2]	Mineral	XO					

NOTES: X = COC determined from Site Assessment, O = COC from Phase II ESA, X* = Potential COC from Site Assessment which may not fully correlate to ORO, X~ = COC in cooling tunnel

[1] Final COC list is limited to detected constituents only (non-detected constituents are not listed per the detection frequency evaluation).

[2] Asbestos in surface soils was determined to be a COC through ABS described in Appendix A.

Source of Phase II ESA results: Weston 2017b than water (1.62 and 2.04, respectively) (CDC 2010). As discussed in Section 2.2, LNAPL and DNAPL were not observed during Site Assessment. Moreover, the concentrations of contaminants detected in groundwater are not indicative of LNAPL or DNAPL.

3.2 Release Mechanisms

Initial release mechanisms for contamination at the Site are believed to have included spills or poor housekeeping during operations. The release mechanisms for ACM included component dismantling and tracking outside, poor housekeeping, and degrading and friable ACM components inside the Plant that have been subsequently transported outside the Plant by wind, wildlife, or trespassers.

Secondary release mechanisms include leaching of contaminants from soil and transport of contaminants through groundwater; surface water runoff transporting contaminants as sediment; surface water transporting contaminants due to contact with groundwater or sediments; and airborne transport of contaminants (e.g., asbestos fibers or contaminated dust) via wind.

3.3 Impacted Media

Impacted media at the Site include soil (surface and subsurface), groundwater (due to localized PCE hotspots, although the COC screening analysis eliminated all analytes detected above MDLs as sitewide COCs), the water in the cooling tunnel (likely influenced by groundwater and is not representative of Tongue River water), river sediments, and air through disturbance of asbestos fibers or release of asbestos fibers to the environment from the Plant. Tables 24 and 25 identify the media in which COCs were detected.

3.4 Migration Pathways

The primary migration pathways of site contaminants have included intentional transport of materials from the interior of the building, likely spills, poor housekeeping, and possible direct and intentional discharge of contaminants.

Secondary migration pathways of Site contaminants from contaminated soils could be a result of runoff, mixing/spreading of soil, volatilization of contaminants, and spreading of dust and fibers. Secondary migration pathways of contamination from groundwater could be a function of the groundwater potentiometric surface or possible volatilization of contaminants from groundwater; however, the measured concentrations of volatiles in groundwater indicate that volatilization is likely minimal. Examples of migration pathways include leaching into groundwater, potential mixing between alluvial groundwater and surface water (i.e., the Tongue River), groundwater transport, surface water transport, surface water runoff, airborne particulate transport, transport from the Plant through the cooling tunnel to the Tongue River (refer to Section 1.5.2 and Section 12.0), transport from the Plant and other buildings through open windows or doorways, transport by trespassers, and uptake by aquatic and terrestrial life.

Based on the potentiometric contours presented in Figures 8 through 11, the groundwater gradient trends to the northeast or east-northeast, indicating groundwater migrates toward the Tongue River. The bedrock contours shown in Figure 7 indicate that a higher elevation of bedrock near ACME-MW-07 may cause possible DNAPL migration (if present) toward the south or southeast in a localized area. Figures in Appendix K depict groundwater “hotspots” of PCE around the Plant. However, the detected concentrations of PCE are not indicative of DNAPL.

The Tongue River may function as a surface water migration pathway and environment for uptake by aquatic life. Measured concentrations of contaminants in ACME-SW-01 and ACME-SW-03 did not indicate significant contributions of contamination from the Study Area. Measured concentrations of contaminants at ACME-SW-02 were orders of magnitude above WDEQ/VRP CULs in some cases. As discussed in the surface water and groundwater interaction study provided in Appendix AA, the water in the cooling tunnel is likely influenced by groundwater; however, the cooling tunnel provides a pathway for contamination to reach the Tongue River during high river stage events.

Airborne contaminant migration of either volatilized VOCs or asbestos fibers may result in receptor inhalation. Based on the detected concentrations of contaminants in soils, volatilization of VOCs or petroleum hydrocarbons are unlikely to pose significant risks. As discussed in the ABS report in Appendix A, the measured concentrations of asbestos and the corresponding risk calculations indicate that asbestos fibers in the soil can pose an unacceptable inhalation risk should fibers become airborne.

3.5 Potential Human Receptors

As the Site is vacant, fenced, and demarcated with hazard signs, the only potential human receptors within the Site boundary at this time are workers for assessment or cleanup activities and trespassers. Evidence of trespassing has been observed by the Owner and WWC during Site Stabilization and Site Assessment; therefore, it is likely that trespassers are human receptors. The future use of the Site is currently unknown, but the Owner’s vision includes ensuring public access and use following cleanup and remediation. Conservatively, the COC analyses considered unrestricted Site use when completing the screening analysis using WDEQ/VRP CULs in Fact Sheet #12D (WDEQ/VRP 2018c).

3.6 Potential Ecological Receptors

Since soil, surface water, and river sediments are impacted media, the corresponding ecological receptors include terrestrial, aquatic, benthic, and avian life. Potential ecological receptors of soil contamination include terrestrial plants, invertebrates, birds, reptiles, and mammals. Potential ecological receptors of surface water and river sediments contamination include birds, mammals, reptiles, plants, fish, and benthic invertebrates.

A component of the PS #0807 SOW was an ecological risk assessment. An ecological risk assessment is a four-step process following WDEQ/VRP Fact Sheets #14 and #19. Step 1 of the assessment is the Ecological Exclusion Assessment. A simple form is provided in Fact Sheet #14 to complete the Ecological Exclusion Assessment (WDEQ/VRP 2016b). This form has been completed for the Site and is included in Appendix F of the QAPP (WWC 2019b). The Ecological Exclusion Assessment concluded that the process must proceed to Step 2 – the Ecological Scoping Assessment. The Ecological Scoping Assessment was completed by WWC and reviewed by TRC (a qualified environmental professional experienced with the ecological risk processes). The Ecological Scoping Assessment is provided in Appendix Z. It concluded that the assessment must proceed to Step 3. TRC completed Step 3 using the guidance of Fact Sheet #19 (WDEQ/VRP 2016c). Step 3 of the Ecological Screening Assessment is discussed in Section 11.0 and provided in Appendix Z.

3.7 Exposure Pathways

Exposure pathways for human receptors from contaminated material include dermal contact, inhalation, skin/eye contact, and/or ingestion. Although it is unlikely that contaminated material would be ingested directly, food contacting contaminated skin and subsequently being eaten or inadvertently ingested by workers or trespassers is possible. Fugitive soil also may be captured in a person's mouth who is working around the soil. If contamination were to migrate to groundwater or surface water used as a human water source, contaminants may also be introduced to human receptors through the ingestion exposure pathway.

Exposure pathways for ecological receptors (i.e., terrestrial, aquatic, benthic, and avian life) are like those of human receptors, although ecological receptors are more likely to be exposed through ingestion and bioaccumulation.

4.0 TIER II DATA VALIDATION

A quality assurance and quality control (QA/QC) program was conducted as specified by the QAPP (WWC 2019b). Specific QA/QC samples collected for each medium are discussed in the respective subsections of Section 2.0. All quality control data, including chain-of-custody forms, are provided with the respective analytical results. Pace Analytical Services, LLC (Pace) of Billings, Montana, Minneapolis, Minnesota, and Indianapolis, Indiana provided laboratory services for the Site Assessment. Pace provided a QC report with all laboratory analyses in the respective appendices. Pace is accredited with American Association for Laboratory Accreditation (A2LA) and the National Environmental Laboratory Accreditation Program (NELAP) as may be found on its corporate website.

4.1 Field QA/QC Samples

As discussed in the subsections of Section 2.0, field QA/QC samples were collected, including trip blanks, rinsate blanks, and duplicates. The field QA/QC samples are summarized in Tables 5, 10, 16, and 21 for soils, groundwater, surface water, and river sediments, respectively. The following subsections discuss the results of QA/QC samples and the impact to data quality.

4.1.1 Trip Blanks

As shown in Table 5 for soils, there were either no detections in trip blanks or there were low-level detections of methylene chloride above the MDL but below the reporting limit (RL) (J flags). Methylene chloride is not a COC for soils. Methylene chloride was also detected in trip blanks during the Phase II ESA (Weston 2017b). The detections did not impact Site Assessment results or conclusions.

Table 10 provides the trip blank results for groundwater. There were two detections of toluene in trip blanks from the December 2019 sampling event below the RL (J flags). Since, toluene is not a COC in groundwater, the detections are not considered significant. One trip blank from the March 2020 sampling event had a detection of PCE above the RL and a detection of TCE below the RL (J flag). This may indicate that off-gassing from samples contaminated the trip blank or contamination of the trip blank occurred in the laboratory. Groundwater analyses for PCE or TCE during the third quarter (March 2020) could be biased low.

Table 16 provides the trip blank results for surface water. There were no detections in trip blanks.

One trip blank for river sediment sampling is summarized in Table 21. There was a low-level detection of methylene chloride below the RL (J flag). Methylene chloride is not a COC in river sediments. Additionally, detections of methylene chloride below the RL occurred in other trip blanks from Pace. The detection is not considered significant.

4.1.2 Rinsate Blanks

Rinsate blanks for soil are summarized in Table 5. Soils were mostly sampled with disposable sampling equipment. Rinsate blanks primarily accounted for use of the drilling shoe and stainless-steel bowls for soil homogenization. As shown by Table 5, only iron, manganese, and methylene chloride were detected in the rinsate blanks at low concentrations. None of the analytes are COCs. Iron and manganese may be naturally occurring in the Study Area. The detections in the soil rinsate blanks are not considered significant.

As shown in Table 10, low-level detections occurred in groundwater rinsate blank samples. No COCs were detected in the rinsate blanks. The only equipment reused during groundwater sampling was a tubing weight used between wells. However, enough tubing weights were on hand that weights were typically used once per day. All other sampling equipment was disposable and used only for one well. Field measurement devices did not contact the groundwater that was pumped directly into sample containers. The low-level detections in the rinsate samples are not considered significant.

Table 16 provides the rinsate samples for surface water sampling. Like groundwater, only a tubing weight was used between sampling locations. Enough tubing weights were available that a weight did not have to be reused during a sampling event. Surface water was pumped directly into sample containers. Field measurement sampling devices did not contact the surface water that was sampled. Field measurements were collected in a separate, disposable container. None of the analytes detected in the rinsate samples are COCs. The detections are not considered significant.

Sampling of river sediment samples utilized disposable equipment only. No rinsate samples were required or collected for river sediments.

4.1.3 Duplicates

Based on guidance from the WDEQ/VRP QAPP (WDEQ/VRP 2018b), WWC only collected duplicates of groundwater samples. Soils and sediments are subject to natural variations in composition and texture. It is typically not possible to isolate the effects of sampling technique and laboratory procedures from natural soil heterogeneity. Therefore, field duplicates were not collected for soil/solid evaluations (WDEQ/VRP 2018b). Additionally, duplicates were not collected during surface water sampling due to the natural variability of a flowing stream.

Groundwater duplicates were collected to calculate the precision of groundwater sampling. Precision is a measure of agreement among repeated measurements of the same characteristic or parameter, usually under identical or substantially similar conditions. Precision provides information about the consistency of sampling methods. Precision has been assessed quantitatively with duplicate samples that contain concentrations of target analytes above the detection limits, and expressed as relative percent difference (RPD) by the following equation:

$$\text{RPD}\ (\%) = \frac{|\text{X1} - \text{X2}|}{(\text{X1} + \text{X2})/2} * \ 100$$

Where:

RPD (%) = Relative percent difference

X1 = Original sample concentration

X2 = Duplicate sample concentration

|X1 - X2| = Absolute value of X1 - X2

Field duplicate samples were obtained, preserved, transported, and analyzed in the same manner as environmental samples. Field duplicates were collected at a frequency of 5 percent (1 duplicate per 20 field samples collected) for each analytical parameter, or a minimum of one per sampling event. For Site Assessment, one duplicate was collected per sampling event. Precision for groundwater should meet ±30%. Table 10 lists the groundwater duplicate samples and the corresponding groundwater environmental sample. The precision calculations (RPD) are provided in Appendix U. One table in Appendix U shows the detections and calculations for all analytes; the second table shows the RPD calculations for detected analytes only. If an analyte was detected in one sample but not in the other, the non-detected concentration was set at the MDL for calculation of the RPD.

Most analytes were within the specified 30% RPD for groundwater. Five analytes had a calculated RPD greater than 30%, with a total of seven occurrences of an RPD greater than 30%. The analytes and number of occurrences with RPD greater than 30% are:

- Aluminum (2 occurrences)
- Bis(2-Ethylhexyl)phthalate (1 occurrence)
- Copper (1 occurrence)
- Lead (2 occurrences)
- Phenanthrene (1 occurrence)

Of these five analytes, only phenanthrene is a potential COC in groundwater. The RPD of phenanthrene in one occurrence from ACME-MW-05 is 32.5%, which is very close to the specified precision for groundwater sampling. Additionally, both detections are “J flags,” which means the detected concentrations are between the MDL and RL and the concentration is estimated. Both are low-level concentrations. Since phenanthrene is a potential COC without a comparable RSL, the RPD is close to 30%, and the detected concentrations are low-level estimates between the MDL and the RL, the precision of groundwater sampling is deemed acceptable.

4.2 Laboratory QA/QC Samples (Accuracy/Bias Using % Recovery)

Bias is a systematic or persistent distortion of a measurement process that causes error in one direction. A bias data quality indicator is a quantitative indicator of the magnitude of systematic error resulting from biased sampling design, calibration errors, response factor shifts, unaccounted-for interferences, and chronic laboratory contamination (WDEQ/SHWD 2007).

Accuracy is the closeness of agreement between an observed value and an accepted reference value. When applied to a set of observed values, accuracy is a combination of random error (precision) and of a common systematic error (or bias) component. Accuracy, as expressed in percent bias, indicates the systematic error in an analytical method. Negative values indicate underestimation while positive values indicate overestimation. As bias approaches zero, accuracy increases (WDEQ/SHWD 2007).

Accuracy/bias is a measure of confidence that describes how close a measurement is to its "true" value. Accuracy/bias was assessed as related to recovery, as well as regarding potential contamination sources. Both terms were evaluated quantitatively. Accuracy/bias related to recovery is an assessment of laboratory analytical methods alone. For laboratory control samples (LCS), it was expressed as % Recovery by the following equation:

$$\%\ \text{Recovery} = \frac{\text{X}}{\text{T}} * 100$$

Where:

X = Measured concentration

T = True spiked concentration

For matrix spike (MS) samples, it was expressed by the following equation:

$$\%\ \text{Recovery} = \frac{(\text{B} - \text{A})}{\text{T}} * 100$$

Where:

B = Measured concentration of spiked sample

A = Measured concentration of unspiked sample

T = True spiked concentration

The frequency of LCS and/or MS samples associated with the analytical parameters was completed at a rate of one for every 20 samples (5 percent), or a minimum of one per sampling event. No LCS or MS samples were analyzed as field measurements.

Pace provides QC reports with each analytical report. These are provided in Appendix C for surface and subsurface soils, Appendix I for groundwater, Appendix P for surface water, and Appendix S for river sediments. Nearly all analytical reports contain data qualifiers.

4.3 Representativeness

Representativeness indicates whether the samples that are being collected accurately represent the environment from which they were collected. Representativeness is primarily a qualitative parameter, which is dependent upon the proper design of the sampling program and proper laboratory protocol. It was the goal of this sampling program to obtain representative samples during each sampling procedure. This goal was accomplished through following acceptable sampling procedures and state-of-the-art sampling methodology (WDEQ/SHWD 2007). Evaluations using the accuracy and precision measures have been used to determine whether the samples are representative.

As discussed in Section 4.1.3, the RPD calculations for groundwater samples indicate that the precision of groundwater sampling was adequate for Site Assessment. This indicates that groundwater samples were representative of groundwater on the Site. Additionally, the similar results and constituents detected during Site Assessment versus the Phase II ESA (Weston 2017b) are also indicative that the samples collected during Site Assessment are representative of the Study Area. Tables 24 and 25 compare the COCs of the Phase II ESA and Site Assessment.

Measures utilized to ensure representativeness included collecting samples and placing them directly into clean, unused sample containers from the analytical laboratory. Field parameters, when appropriate, were collected to ensure that conditions were stable and consistent with previous sampling events. Review of quarterly groundwater and surface water sampling results indicates that water samples were similar at each sampling location from quarter to quarter. Biased sampling targeted areas indicative of contamination, and detected contaminants were expected. These sampling measures and examples suggest that samples collected during Site Assessment are representative of the Study Area.

4.4 Comparability

Comparability is a qualitative measure performed to ensure that the samples being collected can be compared to one another. Comparability has been evaluated by comparing sample collection and handling methods, sample preparation and analytical procedures, holding times, stability issues, and quality assurance protocols (EPA 2002).

The data collected were maintained in standard units for easier and uniform comparison to state, federal, and commercial analysis reports. The procedures identified and presented in the QAPP were followed to ensure that samples could be compared to one another and used to make conclusions and decisions where appropriate. The analytical laboratory utilized standard EPA test methods and complied with criteria established in the laboratory certification process.

A few lines of evidence demonstrate that comparability was achieved during Site Assessment. First, as discussed in Section 4.1.3, the RPD calculated for groundwater demonstrated that groundwater samples were collected using procedures that provided repeatable and precise samples. During the review of COCs determined during Site Assessment versus COCs determined during the Phase II ESA (Weston 2017b), the results mostly aligned with each other. As shown by Table 24 and Table 25, Site Assessment generally provided evidence that supported the findings of the Phase II ESA. Some COCs were eliminated due to site-wide assessment and a greater number of samples reducing the EPC for the entire Study Area.

4.5 Confidence Limit

The confidence limit (CL), or 95% UCL, of the true sample mean was calculated using statistical methods appropriate for the data distribution. If it was determined that a constituent followed an approximately normal distribution, the 95% UCL was calculated using the following formula, or by using EPA ProUCL software:

$$95\% \, UCL = x \pm 1.965S$$

Where:

x = Sample mean

S = Standard deviation

When it was determined that the constituents did not follow a normal distribution, then the 95% UCL was calculated using ProUCL software with appropriate statistical methods consistent with EPA guidance (EPA 2002).

The CL was calculated to determine the EPC for each constituent during the COC analyses. In particular, the CL was used to determine the EPC for surface and subsurface soils, groundwater, and surface water samples. The maximum detected concentration was utilized during the river sediment COC screening analysis. The COC screening process is described for each medium in Appendices D, J, Q, and T.

4.6 Completeness

Completeness is the amount of valid data obtained compared to the planned amount and may be assessed quantitatively and/or qualitatively. To assess the term quantitatively, % Completeness will be expressed by the following equation:

$$\%\ \text{Completeness} = \frac{\text{N}}{\text{T}} * 100$$

Where:

N = Number of usable results

T = Total targeted number of samples planned to be collected

Where relevant, data collected were used to characterize various media quality within the Site. Due to a variety of circumstances, samples scheduled to be collected cannot be collected (e.g., weather conditions, etc.) or the data from the samples cannot be used (e.g., samples bottles are broken in transit, sample holding times are grossly exceeded, cassettes are overloaded with particulates or fibers, etc.). The completeness goal was set at 90 percent. If the completeness goal is not met, re-sampling and/or re-analysis may be required. As shown by the following calculations, the % Completeness goal was met for Site Assessment.

Surface and Subsurface Soil

N = 80 usable samples

T = 80 targeted samples

$$\%\ \text{Completeness (Soil)} = \frac{80}{80} * 100 = 100\%$$

Groundwater

N = 40 usable samples

T = 40 targeted samples

$$\%\ \text{Completeness (Groundwater)} = \frac{40}{40} * 100 = 100\%$$

Surface Water

N = 11 usable samples

T = 12 targeted samples

$$\%\ \text{Completeness} (Surface\ Water) = \frac{11}{12} * 100 = 91.7\%$$

River Sediments

N = 8 usable samples

T = 8 targeted samples

$$\%\ \text{Completeness (River Sediments)} = \frac{8}{8} * 100 = 100\%$$

4.7 Summary and Conclusions

Based upon the results of this Tier II data validation, samples during Site Assessment met the QA/QC requirements of the QAPP.

5.0 DECONTAMINATION

Decontamination of equipment used during Site Assessment was conducted according to the decontamination SOP in Appendix E of the QAPP (WWC 2019b). Decontamination typically consisted of scrubbing surfaces of equipment that came in contact with samples or hazardous wastes. Decontamination typically included using inert brushes with Alconox® solution, rinsing the equipment with clean tap water, and final rinsing with deionized water. Decontamination occurred on reusable sampling equipment between collection of each sample. Free-product or a sheen were not encountered during Site Assessment, and an appropriate solvent was not required to clean equipment. For large equipment (e.g., the drill rig), decontamination typically consisted of a hot water, high-pressure wash between each boring per WDEQ/VRP guidance (WDEQ/VRP 2018a). Decontamination wastes were containerized in 55-gallon drums for offsite disposal.

Disposable wipes were used as much as possible for decontamination of skin and small equipment such as cameras and writing utensils to minimize generation of decontamination water and wastes. Disposable personal protective equipment (PPE) and disposable sampling equipment (such as scoops) not requiring decontamination were used to minimize generation of decontamination water. All solid wastes such as PPE and disposable wipes generated during Site Assessment were bagged. PPE used outside buildings with minimal contamination or exposure to friable ACM were disposed of at the nearest solid waste landfill (City of Sheridan Landfill). Decontamination water and wastes generated were containerized and stored onsite for disposal with drums of monitor well purge water by Beartooth.

6.0 INVESTIGATION-DERIVED WASTE DISPOSAL

IDW for Site Assessment included residual drill cuttings (soils), groundwater from purging and sampling, contaminated disposable PPE, decontamination materials, and disposable sampling equipment (disposable sampling scoops and pump tubing). Disposable PPE and sampling equipment were not contaminated to an extent that required special disposal and were bagged for disposal at the City of Sheridan Landfill. Soil cuttings were containerized in drums specific to drill locations. The analytical results for those drill locations were used to develop the waste profile. Groundwater was containerized in well-specific drums. The results from groundwater analyses were used to characterize the groundwater waste. A summary of the drums used to containerize IDW is provided in Appendix V. Also provided in Appendix V are the waste profiles for the contents of the drums.

As shown in Appendix V, nine of the thirteen soil drums were classified as hazardous waste. Since soils were classified as hazardous waste, the decontamination waste automatically classified as hazardous waste since it resulted primarily due to cleaning drill rigs. Comparing the results of groundwater to hazardous concentration standards, no groundwater results exceeded hazardous concentrations; however, local water treatment plants in Sheridan and Ranchester, Wyoming would not accept the groundwater for treatment. Therefore, the water was classified as hazardous and was disposed offsite. The waste profiles for soil and groundwater are provided in Appendix V.

Beartooth disposed of drill cuttings and purge water as IDW on September 28, 2020, for hazardous soils, purge water, and decontamination wastes. This IDW was disposed offsite at the Clean Harbors Environmental Services, Inc. (Clean Harbors) disposal facility in Kimball, Nebraska. The waste disposal manifests for hazardous wastes are provided in Appendix W. Nonhazardous soils were disposed at the City of Sheridan Landfill by WWC on September 30, 2020. The disposal ticket for nonhazardous soils is provided in Appendix W. The following summarizes the IDW disposal.

- Soils
    - Stored in 55-gallon drums onsite and labeled appropriately.
        - Hazardous soils were disposed at the Clean Harbors disposal facility. Nonhazardous soils were disposed at the City of Sheridan Landfill.
- Groundwater
    - Stored in 55-gallon drums onsite and labeled appropriately.
        - Disposed at the Clean Harbors disposal facility.
- Decontamination fluids
    - Stored in 55-gallon drums onsite and labeled appropriately.
        - Disposed at the Clean Harbors disposal facility.
- PPE
    - PPE used outside buildings with minimal contamination or exposure to friable ACM was disposed of at the nearest solid waste landfill (City of Sheridan Landfill). All disposable PPE was bagged prior to disposal.

- Disposable sampling equipment
    - Disposable sampling equipment was not contaminated to a degree requiring special disposal. It was disposed of at the nearest solid waste landfill (City of Sheridan Landfill).

7.0 FIELD DOCUMENTATION

Field observations were recorded on the appropriate sampling field forms for all sampling events. Field forms for ABS are provided in Appendix A. Field forms for soil drilling and sampling are provided in Appendix B. Calibration forms are provided in Appendix G. Groundwater sampling forms are provided in Appendix H. Slug test field forms are provided in Appendix M. Surface water sampling forms are provided in Appendix O. River sediment sampling forms are provided in Appendix R. Photographs collected during Site Assessment are provided in Appendix X. Additional documentation was maintained, which included sample container labels and chain-of-custody forms. Field samples were collected in clean, unused plastic and/or glass containers provided by the contract laboratory. A chain-of-custody for each field sample was maintained from collection through laboratory analysis. The chain-of-custody forms are provided in Appendices A, C, I, P, and S for ABS, soils, groundwater, surface water, and river sediment samples, respectively.

8.0 HEALTH AND SAFETY PLAN

A health and safety plan (HASP) was developed by ES Consulting, reviewed and approved by a certified industrial hygienist, and provided in Appendix J of the QAPP (WWC 2019b). The HASP was reviewed by WWC, subcontractors, and other onsite personnel prior to commencement of work. The HASP outlined the Site hazards, safety responsibilities, PPE requirements, monitoring requirements, Site control, emergency response plan, confined space entry, and spill containment.

9.0 GREEN AND SUSTAINABLE REMEDIATION BEST MANAGEMENT PRACTICES

Best efforts were put forth to reduce the quantity of energy and non-renewable resources required, consistent with the green and sustainable remediation (GSR) best management practices (BMPs) in Fact Sheet #21 (WDEQ/VRP 2016d).

- Vehicle traffic and idling were minimized as practicable;
- Trips to the Site were minimized by using trips to accomplish multiple tasks;
- Local contractors, such as samplers, drillers and laboratory services, were used to the extent practicable to reduce travel;
- Vegetation disturbance was minimized;

- When appropriate and effective, non-phosphate detergent, or other appropriate non-toxic substances, were used to decontaminate field equipment;
- Disposal facilities were chosen based on proximity, if possible;
- Wastes generated by Site work were minimized as reasonably possible;
- Like wastes were combined into as few containers as possible; and
- Health and safety risks were minimized.

10.0 DISADVANTAGED BUSINESS ENTERPRISE (DBE) SEARCH AND SOLICITATION

In compliance with the requirements of EPA Site Assessment Grant BF96845801, WWC searched for businesses that fell under the DBE category as woman-owned or minority-owned businesses (WBEs and MBEs, respectively). WWC used the EPA Office of Small Business Programs (OSBP) registry to search for small, disadvantaged businesses to provide applicable services for Site Assessment (EPA 2019). WWC also used local networking and communication to contact WBEs. WWC communicated with the following companies regarding services for Site Assessment:

- Wyoming Analytical Laboratories (Laramie, Wyoming): analytical services
- MC2 Engineering and Construction (Sheridan, Wyoming): field sampling
- Alpine Remediation (Golden, Colorado): drilling

Upon receiving rates and MDLs from Wyoming Analytical Laboratories, it was determined that neither the cost constraints nor the MDLs were satisfactory for Site Assessment. Additionally, although Wyoming Analytical Laboratories is owned by a woman, the laboratory had not registered as a WBE with EPA as of the 2019 search.

WWC determined that the owner of MC2 Engineering and Construction was experienced in site assessment and maintained the necessary safety training to work onsite. WWC corresponded with the owner of the WBE, but rates and a cost proposal for onsite sampling were not received. No further correspondence with the WBE occurred.

WWC corresponded with Alpine Remediation regarding drilling services. In 2019, Alpine Remediation was a registered WBE. Alpine Remediation could offer direct-push drilling services for environmental drilling. WWC requested drilling bids from Alpine Remediation, AET, and Y Environmental. Of the three, AET was the most competitive bid. After consulting the WDEQ/VRP project manager, both WDEQ/VRP and EPA suggested using the most competitive bid from AET. AET was subsequently selected to drill.

11.0 ECOLOGICAL RISK ASSESSMENT

Since soil, surface water, and river sediments are impacted media, there could be ecological receptors to Site contaminants. The potential terrestrial ecological receptors include terrestrial plants, soil invertebrates, avian and mammal herbivores, avian and mammal invertivores, and avian and mammal carnivores/omnivores. Potential aquatic receptors include aquatic plant community, fish/aquatic invertebrates, potentially aquatic amphibians/reptiles, aquatic avian and mammal herbivores, aquatic avian and mammal invertivores, and aquatic avian and mammal carnivores.

A component of the PS #0807 SOW was an ecological risk assessment. An ecological risk assessment is a four-step process following WDEQ/VRP Fact Sheets #14 and #19. Step 1 of the assessment is the Ecological Exclusion Assessment. A simple form is provided in Fact Sheet #14 to complete the Ecological Exclusion Assessment (WDEQ/VRP 2016b). This form has been completed for the Site and is included in Appendix F of the QAPP (WWC 2019b). The Ecological Exclusion Assessment concluded that the process must proceed to Step 2 – the Ecological Scoping Assessment. The Ecological Scoping Assessment was completed by WWC and reviewed by TRC (a qualified environmental professional experienced with the ecological risk processes). The Ecological Scoping Assessment is provided in Appendix Y. It concluded that the assessment must proceed to Step 3. TRC completed Step 3 using the guidance of Fact Sheet #19 (WDEQ/VRP 2016c). Step 3 of the Ecological Screening Assessment is provided in Appendix Z along with the conceptual ecological exposure model.

The conclusion of Step 3 was there may be a potential for adverse effects to ecological receptors. The greatest risk to ecological receptors may be those chemicals detected above receptor-specific screening levels. Since risk to ecological receptors within the Study Area cannot be eliminated, a Step 4 baseline ecological risk assessment could be completed to more fully evaluate site-specific conditions and potential ecological risk for the Site.

12.0 SURFACE WATER AND GROUNDWATER INTERACTION STUDY

WWC evaluated the surface water and groundwater interaction between December 2020 and June 2021 under the Site Stabilization (PS #0793) contract with WDEQ/VRP. In particular, the study focused on the relationship between the Tongue River, groundwater, the cooling tunnel, and the sheet pile weir constructed adjacent to the Plant in the Tongue River. Using water level elevations and potentiometric surfaces, WWC determined that the water in the cooling tunnel is likely in communication and influenced by groundwater rather than surface water. WWC also determined the approximate water surface elevations required for the Tongue River to be in communication with the cooling tunnel. Due to the contamination detected in the cooling tunnel, it provides a pathway for contamination to reach the Tongue River during high river stages. Low-level detections of PCE were found in the river sediments adjacent to the weir. This indicates that contamination may have transported from the tunnel during a high river stage event. The full report is provided in Appendix AA.

13.0 PRELIMINARY REMEDIAL ALTERNATIVES EVALUATION

Preliminary remedial alternatives were evaluated by Ayres Associates (Ayres) of Madison, Wisconsin. The preliminary remedial alternatives were based on the resulting COCs of Site Assessment. The preliminary remedial alternatives included in the evaluation for soils were an engineered cap, solidification and stabilization, and excavation with off-site disposal. Alternatives included for groundwater were in-situ oxidation or reductive dichlorination, phytoremediation, and monitored natural attenuation. River protection and sediment remediation alternatives included conventional capping, amended capping, monitored natural recovery, and excavation or dredging for offsite disposal. As the remedial alternatives evaluations were preliminary, the evaluations have not been included in this report.

14.0 REFERENCES

Bouwer, H. and R.C. Rice, 1976, A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resources Research, v. 12, p. 423-428.

Center for Disease Control and Prevention (CDC), 2010, NIOSH Pocket Guide to Chemical Hazards, September 2010.

Driscoll, Fletcher G., 1986, *Groundwater and Wells* (Second Edition): A comprehensive study of groundwater and the technologies used to locate, extract, treat, and protect this resource.

Environmental Protection Agency (EPA), 2019, Search the OSBP Registry, August 2019, https://cfpub.epa.gov/sbvps/index.cfm?fuseaction=app.search.

_____, 2002, Guidance for Quality Assurance Project Plans, EPA QA/G-5, December 2002. Retrieved February 2016 from https://www.epa.gov/quality/guidance-quality-assurance-project-plans-epa-qag-5.

_____, 1994, Evaluating and Identifying Contaminants of Concern for Human Health, Region 8 Superfund Technical Guidance, September 1994. Retrieved July 2020 from: https://www.epa.gov/sites/production/files/documents/r8_ra03-cocs.pdf.

GEI Consultants, Inc. (GEI), 2000, Vintage Power Plants: Environmental Characterization, Decontamination, & Demolition.

Weston Solutions, Inc. (Weston), 2017a, Phase I Environmental Site Assessment for Acme Power Plant, 165 Acme Road, Sheridan, Sheridan County, Wyoming, Prepared for the U.S. Environmental Protection Agency, Denver, January 2017.

_____, 2017b, Phase II Environmental Site Assessment for Acme Power Plant, 165 Acme Road, Sheridan, Sheridan County, Wyoming, October 2017.

_____, 2017c, Phase II Environmental Site Assessment for Acme Power Plant Hazardous Building Materials, 165 Acme Road, Sheridan, Sheridan County, Wyoming, October 2017.

WWC Engineering (WWC), 2019a, Site Stabilization Final Report: Former Acme Power Plant VRP #58.220 (PS #0793) Site Stabilization, March 2019.

_____, 2019b, Quality Assurance Project Plan: Former Acme Power Plant VRP #58.220 (PS #0807) EPA Site Assessment Grant BF96845801, August 2019.

Wyoming Department of Environmental Quality/Solid and Hazardous Waste Division (WDEQ/SHWD), 2007, Quality Assurance Project Plan for Hazardous Waste

Sampling. Sent via email from Cindi Martinez, Natural Resources Program Principal (WDEQ/VRP), to Greg Reid (WWC Engineering), December 10, 2015.

Wyoming Department of Environmental Quality, Voluntary Remediation Program (WDEQ/VRP), 2007, Fact Sheet 28, Data Quality Objectives, April 2007.

_____, 2015, Fact Sheet 12B, Statewide Background Values for Select Metals Final Tech Memo #2 12 29 2015, December 2015.

_____, 2016a, Fact Sheet 9, Grid Soil Sampling Outside of Source Areas, May 2016.

_____, 2016b, Fact Sheet 14, Ecological Risk Assessment – Steps 1 and 2 Ecological Exclusion and Scoping Assessments, May 2016.

_____, 2016c, Fact Sheet 19, Ecological Risk Assessment – Steps 3 and 4 Screening and Baseline Ecological Risk Assessment, May 2016.

_____, 2016d, Fact Sheet 21 Attachment, VRP Green and Sustainable Remediation Best Management Practices, June 2016.

_____, 2018a, Fact Sheet 29, Sampling and Analysis Plan, July 2018.

_____, 2018b, Quality Assurance Project Plan (QAPP). Sent via email from Jaymee Binion, Hazardous Waste and Voluntary Remediation Programs Project Manager, to Loren Ruttinger (WWC Engineering), September 10, 2018.

_____, 2018c, Fact Sheet 12D, Soil and Groundwater Cleanup Level Tables, October 2018.

_____, 2019, Fact Sheet 20, Human Health Risk Assessment, October 2019.