



STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

Eastern Region Office

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August 25, 2026

Dr. Fred E. Kirschner
Senior Scientist
Spokane Tribe Natural Resources
P.O. Box 100
Wellpinit, WA, 99040

Re: Response to Comments on the 2024 Draft Final Periodic Review Report:

- **Site Name:** L-Bar Site
- **Site Address:** Hwy 395 Chewelah, WA 99109
- **Cleanup Site ID:** 88
- **Facility/Site ID:** 762

Dear Dr. Kirschner:

The Department of Ecology (Ecology) has received the Spokane Tribe Natural Resources' letter dated September 7, 2025, with comments on Ecology's draft final 2024 periodic review (PR) report for the L-Bar Site (Site). The PR report is the third PR report for this site since the Site cleanup action was completed in 2004.

General Comment No. 1:

"The Tribe was told that the entire remedial action focused only on Flux Bar Residues (FBR) which are the newer generation of processed materials. In essence WADOE has segregated the site into at least two Operable Units (OUs). One being FBR and the other being the older magnesium containing ores. The FBR containing OU was addressed via removal and relocation to a disposal facility³. The Old Ore OU allows uncover, uncapped ore processing wastes to remain onsite, relying on "natural attenuation" and perpetual institutional controls as the 'cleanup mechanism'."

Ecology Response:

Two separate industrial processes were active at the Site in the past and totally independent of each other in time. The first process was the manufacturing of magnesite bricks for lining steel smelting furnaces using local magnesite ores and the second process was the processing of flux bar (FB containing magnesium metal) and flux bar residue (FBR free from magnesium metal) from magnesium smelting and refining to be used as a fertilizer additive. The first process took place from the time of WWI until 1967. The second process, the flux bar residue operation, took place from the mid-1970s until 1991. These two processes were conducted by two completely separate companies independent of each other. The company that manufactured the magnesite bricks is now defunct and there are no legal entities left that can be named Potentially Liable Persons (PLPs) under the Model Toxics Control Act (MTCA). Northwest Alloys, a subsidiary of Alcoa, performed the FB and FBR processing, including turning FB into FBR by removing residual magnesium metal. Northwest Alloys brought in FB and FBR from Alcoa's magnesium smelter in Addy north of the Site for processing. Consequently, Alcoa was named a PLP for a cleanup action of the contamination left behind from only the flux bar and flux bar residue processing under Northwest Alloy's control.

General Comment No. 2:

"The Tribe also notes that site-specific metallurgical flow-sheets and reagent lists have alluded the RPM. The Tribe pointed out that WADOE needed these to understand chemical process and determine what COCs may have been released."

Ecology Response:

The FB and FBR were produced from the refining of magnesium metal at Alcoa's magnesium smelter in Addy north of the Site. The magnesium was smelted using a ferro-silicon reductive method known as Magnetherm. A paper describing the Magnetherm operations at Addy is included as Attachment 1.

Raw materials used in the smelting process were dolomite (calcium-magnesium carbonate), bauxite (aluminum hydroxides), ferrosilicon, and magnesite (magnesium carbonate). From the smelting operation, impure magnesium metal and slag was produced. The molten impure magnesium metal were refined by adding alkaline and alkaline earth chlorides and fluorides as flux. Barium chloride was added to the flux so it would settle below the molten magnesium metal and instead the refined clean magnesium metal would float to the top of the crucible. The flux residue from the refining operation is known as flux bar (FB).

Flux bar residue (FBR) is created by removing residual free magnesium metal in the FB. The FB and FBR contain magnesium oxide; chlorides of sodium, potassium, magnesium, calcium, barium; and fluorides and in particular, calcium fluoride. Due to reaction with the nitrogen at the high smelting temperature, nitrides would also form in the FB and FBR. Later reaction with available water in the environment converts the nitride into ammonia.

Consequently, anticipated compounds of concern to be found in the FB and FBR would be chlorides, fluorides, ammonia, and barium. Due to the presence of ammonia, FB and FBR would have an elevated pH as well.

General Comment No. 3:

“The WADOE RPM admitted that heavy metals are still present. These likely include but are not limited to residuals from FBR, ore, fly ash, crushing, grinding, sieving, flotation, and smelting wastes. The RPM stated that ‘thallium and arsenic are major concerns’”.

Ecology Response:

The draft final PR report did not mention arsenic because arsenic is not a compound of concern or an indicator hazardous substance at this Site. Identified Site metal indicator hazardous substances (IHSs) in accordance with MTCA include three metals: barium, manganese, and thallium. These three IHS metals are discussed below in Ecology’s response to comment No. 4.

Of these three metals, only barium was used in the magnesium smelting process. Instead, manganese, selenium, and thallium are commonly found in coal ash. The magnesite contains coal ash from the burning of coal during the calcination process of the magnesite. Additionally, manganese is a minor element that is present in natural rock and soil. Extensive sampling of other substances that were used in the magnesium smelting process such as fluorides showed that these were not detected above calculated Site cleanup levels. The results from the remedial Site investigation are presented in the Site RI/FS report dated 1998.

General Comment No. 4:

“The Tribe pointed out that our main concern is the ground water to surface water pathway. WADOE explained that the remainder of the remedy (or remedy for OU2, wastes generated in the earlier processes) relies on natural attenuation and monitoring to protect surface water. The Tribe pointed out that the three-dimensional distribution of COCs as well as minerals relied upon to provide buffering of acid rock drainage (ARD) production must be well defined via characterization of the nature and extent of contamination, and that this high-level of characterization is required to estimate the decay of release. Judging from the time-period that

this was completed, and the PRPs involved, it is clear that this issue will need to be revisited, and re-evaluated once the document request has been filled. The RPM verbally explained that uncovered/uncapped/unlined wastes are located throughout the site, directly over the uppermost aquifer. The uppermost geologic unit is comprised of alluvial sands/gravels and is on the order of 10 feet thick. This unit rests on top of an aquitard--a 60 foot thick clay unit. A lower artesian aquifer is below the clay unit. As long as these conditions are maintained, the vertical component of the hydraulic gradient in this underlying artesian lower aquifer and clay units, does not enable contaminants to leach into the uppermost aquifer and travel deeper in the system. The Tribe pointed out that, in this situation, the topography of uppermost surface of the clay layer controls the direction of flow in the uppermost aquifer, and the presumed buffering is believed to control the rate of release of metals to the uppermost aquifer. Based on groundwater monitoring data obtained over the years from a handful of wells completed in the uppermost aquifer, the RPM believes WADOE COCs are fully immobilized due to high pH of waste material matrix.⁷ If the RPM is correct on total immobilization of all COCs, then metals are being precipitated deeper in the piles or in the aquifer. The Tribe pointed out that the buffering capacity is finite and is not being replenished. The buffering capacity also is not being monitored.

The threat of release is clear and present as soon as the buffering capacity decays. This is a major fallacy associated with all attempts to rely on natural attenuation that relies on non-natural sources of COCs providing buffering capacity. A peak release of COCs will appear as soon as buffering capacity is diminished. The direct connection with the Colville River and then the Columbia means these waterways will be affected by this release. This is clear rationale for immediate full removal and relocation on all remaining materials."

Ecology Response:

Acid mine drainage is not of a concern at this Site. Free sulfides that can create acid drainage are not found in the magnesite residue piles nor in FB and FBR. Instead, due to the presence of carbonates (magnesite, dolomite, and calcite) in the magnesite residue and ammonia in the FBR residue, the Site pH is generally alkaline and rarely below seven but can be over eight in some areas of the Site. Therefore, there are concerns that contamination at the Site is mobile in groundwater in neutral to alkaline conditions, not acidic conditions found where acid mine drainage occur.

All FB and FBR have been removed from the Site; therefore, what is left is dissolved contamination in the form of chlorides, ammonia, and barium in the upper aquifer. As mentioned above in response to Comment 2, manganese, selenium and thallium did not

originate from the FB and FBR, but instead from the magnesite waste piles. The magnesite residue consists primarily of carbonates (dolomite, magnesite, and calcite) which will buffer the groundwater pH at a neutral to slightly alkaline pH for the foreseeable future. Groundwater monitoring at the Site for the last 20 years shows that the only metals of concern are manganese, barium, selenium, and occasionally thallium. Of these four metals, only manganese may reach Colville River.

Manganese is found in several wells in the swampy north field and also in some wells within the magnesite pile. Manganese is a minor element that is commonly found in low concentrations in natural soil, particularly in the type of waterlogged soils found at the Site. The presence of dissolved manganese is commonly determined by the redox conditions in soil and groundwater; i.e. reducing conditions is the common cause for an increase in manganese solubility in groundwater in contact with organic material such as muck and peat.. Attachment 2, manganese Eh-pH (Pourbaix) diagram, shows that the manganese solubility in groundwater decreases with an increase in pH and at very high pH (>9) it becomes very insoluble.

Attachment 3, selenium Pourbaix diagram, shows that selenium solubility in water increases with a higher pH. Because of the elevated pH conditions at the Site, Ecology is following the distribution of this element closely.

The thallium is suspected to have always been present in groundwater before the FB and FBR operation. As shown in Attachment 4, thallium Pourbaix diagram, monovalent thallium is soluble in both acidic and basic environments except for very high pHs (>9) where thallium precipitate presents as trivalent thallium hydroxide.

General Comment No. 5:

“Alternatively, the RPM could be wrong regarding full immobilization of COCs and metals are currently being mobilized and transported to the creek, un-detected by the handful of monitoring wells. This situation has occurred at the Dawn Uranium Mill site in Ford, WA, where a previously unidentified alluvial material-filled channel is incised in the uppermost portion of the clay unit and transmits contaminated water to Chamokane Creek. The geologic units and hydrogeology are similar to those at Chewelah. This is the main reason the Tribe asked about topography of clay surface. The RPM did not have details, only stating that the surface ‘slopes towards creek’”.

Ecology Response:

The Site is located on a flat floodplain underlain by a thick sequence of fine-grained glacial and post glacial sediments. The presence of deeply incised alluvial channel with coarser sediments is unlikely in the Colville River floodplain with the glaciofluvial environment at Chamokane Creek being located in an environment with a steeper topography than the Colville River flood plain, where deeply incised river channels are likely to form. The absence of deeply incised river channels at the Site was proved in the electromagnetic geophysical survey performed at the Site as part of the remedial investigation. The survey showed that saline water is flowing from the Site toward Colville River in a uniform layer coinciding with the shallow aquifer. No distinct river channels were observed in the results from this geophysical survey.

Conclusion

Of the metals originally identified to be of concern at the Site and considered to be IHS substances at the Site, only manganese may reach Colville River. The presence of manganese in groundwater is likely due to natural causes as discussed above due to reducing redox conditions in the groundwater; however, at this time the PLP is not monitoring redox conditions in the Site groundwater. Therefore, Ecology has requested that the PLP monitor redox conditions in the groundwater to assess the effect redox conditions have on the solubility of manganese in the groundwater.

Additionally, Ecology has requested that the PLP continue the current surface water monitoring program and not implement the changes as originally proposed in the draft final PR report. Instead, Ecology will request that the PLP include manganese as part of the current surface water sampling program to assess the manganese concentrations in the Colville River. Finally, after a close review of the Pourbaix diagrams for the Site IHS metals, Ecology requested that the PLP also analyze filtered samples for metals. Currently, only unfiltered samples are analyzed, and therefore results may be biased to be too high due to the presence of metals as suspended solid particles in the water samples.

We appreciate your cooperation in this matter. If you have any questions or need additional information about this corrective action notice, please contact Christer Loftenius, site manager, at 509-385 8380 or christer.loftenius@ecy.wa.gov.

Dr. Fred E. Kirschner

August 25, 2026

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Sincerely,

A handwritten signature in blue ink, appearing to read "Christer Loftenius".

Christer Loftenius Site Manager

Toxics Cleanup Program

Attachments: Third Periodic Review

cc: Nicholas Acklam, Ecology
Kristin Gains, Alcoa
Charlie Kessler, Stevens County 
Craig Sauer, Great West Engineering
Ecology Site File



THIRD PERIODIC REVIEW

L-BAR SITE
Cleanup Site ID# 88
Facility Site ID# 762

Prepared by
Washington State Department of Ecology Eastern Regional Office
Toxics Cleanup Program Spokane, WA

August 2026

EXECUTIVE SUMMARY

This document is the third periodic review of compliance monitoring data gathered from 2018–2023 to evaluate the effectiveness of the remedial actions and institutional controls for the L-Bar Site located at Highway 395, Chewelah, Washington, 99109 in Stevens County (Site).

The purpose of periodic reviews is to determine the long-term effectiveness of the implemented cleanup actions at sites where residual contamination is still present above the Site cleanup levels (CULs). CULs were established for Site groundwater and surface water.

Remedial actions were implemented at the Site from 2001 to 2004. Earlier interim removal actions were also conducted from 1997 to 2000. The cleanup actions implemented at the Site included source material removal, natural attenuation, closure of one of the drainage ditches, and long-term monitoring. Previous source removal actions were effective at eliminating the primary contaminant release mechanisms that allowed source-related contaminants to move into soil, sediments, shallow groundwater, and surface water at the Site. Therefore, CULs have not been established for soil at this Site.

Site CULs established for surface- and groundwater have not been met, although some improvements to groundwater and surface water quality have been demonstrated since the last periodic review. Primary indicator hazardous substances (IHSs) in surface water and shallow groundwater are chloride, ammonia, pH, and total dissolved solids that are still elevated compared to their established CULs.

Concentrations of secondary IHSs (trace metals, nitrate, and nitrite) exceed groundwater CULs at some locations. Surface water IHS concentrations exceed the Site CULs in the West Ditch located within the Site. Site CULs are not exceeded in Colville River downstream from the Site.

Detections of ammonia in the Site water production well can be best explained by ammonia cross-contamination between samples either during sampling, transport, or analysis. Better sample handling and transport procedures are recommended to reduce the risk for ammonia cross-contamination of samples.

CULs are still being exceeded at the Site. However, as long as the existing Restrictive Covenants are active and remain effective in protecting human health and the environment from exposure to hazardous substances, no further action is required beyond compliance monitoring. Because of the no exceedances of surface water CULs in Colville River and the intermittent flow in the upper portion of the West Ditch, the current surface water sampling points in Colville River and the upper portion of the West Ditch can be eliminated. Instead, two surface water samples will still be collected, one in the West Ditch before discharging into Colville River and one sample from Colville River 30-90 ft downstream of the West Ditch outfall.

IHS concentrations in groundwater are expected to decline over time, due to natural attenuation.

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LIST OF ACRONYMS

Ammonia-N – Nitrogen as ammonium ions or free ammonia CAP – Cleanup Action Plan
CMP – Compliance Monitoring Plan
CSID No. – Dept. of Ecology Cleanup Site Identification Number CUL – Cleanup Level
DCAP – Draft Cleanup Action Plan FCAP – Final Cleanup Action Plan FB –Flux Bar
FBR –Flux Bar Residue
FSID No. – Dept. of Ecology Facility Site Identification Number FB/FBR – Flux bar/Flux bar residue
FSQV – Freshwater Sediment Quality Values FS – Feasibility Study
IHS – Indicator Hazardous Substances MTCA – Model Toxics Control Act
N – Nitrogen
NPDES – National Pollution Discharge Elimination System NWA- Northwest Alloys, Inc.
RI – Remedial Investigation
SCCD – Stevens County Conservation District SWBU – Shallow Water Bearing Unit
TDS – Total Dissolved Solids

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1 INTRODUCTION

The Washington State Department of Ecology (Ecology) completed this third periodic review of compliance monitoring data from 2018 – 2023 to evaluate the effectiveness of the remedial actions and institutional controls at the L-Bar Site (Site). Site periodic reviews are required for sites with institutional controls in accordance with Washington Administrative Code (WAC) 173-340-420(2)(a). Site remedial actions were completed from 1996 to 2004 under the Model Toxics Control (MTCA) Cleanup Regulation, Chapter 173-340 WAC.

Cleanup levels (CULs) for the Site are based on the following:

- Method B for groundwater
- Method C industrial for soils
- Method B for the surface water in the west ditch, which is discharging to the Colville River
- Method C for the surface water in the west ditch which currently does not discharge to the Colville River
- Method C industrial levels for soils and sediments that are protective of surface water in the west ditch and the Main Ditch

Past cleanup actions at this Site were carried out in accordance with the requirements of Agreed Order No. DE 00TCPER-984 dated June 12, 2000, entered into between Northwest Alloys, Inc. (NWA) and Ecology. NWA implemented the remedial actions from 2001 to 2004 in accordance with the L-Bar Material Removal and Compliance Monitoring Work Plan (CH2M, 2001a) and as required by the Ecology's June 2000 final Cleanup Action Plan (CAP) found in Ecology (2000). Earlier interim removal actions were also conducted from 1997 to 2000 under Agreed Order No. DE 94TC-E104. The cleanup actions implemented at the Site included source material removal, natural attenuation, closure of one of the drainage ditches (west ditch), and long-term monitoring.

1.1 PURPOSE OF THE FIVE-YEAR REVIEW

The purpose of periodic reviews is to determine the long-term effectiveness of the implemented cleanup actions at sites as promulgated in WAC 173-340-120(5)(b) and WAC 173-340-420, where residual contamination is still present above Site CULs.

This document includes the following information to support the evaluation of the long-term effectiveness of the cleanup actions implemented at the Site:

- A brief description of the site history, including property ownership, regulatory applicability, feasibility study, cleanup levels, remedial actions, and recent supplemental

activities/data collection.

- A brief description of the current status of the compliance monitoring program (CMP), groundwater, and surface water monitoring programs.
- A summary of current surface water and groundwater contaminant levels.
- A summary of apparent changes in surface water and groundwater contaminant levels since the previous (2019) periodic review was completed.
- An evaluation of areas where CULs have been attained in response to previous source removal actions and ongoing natural attenuation processes.
- A trend analysis that includes all the CMP groundwater wells and constituents to assess relative changes in groundwater concentration to document progress toward achieving CULs.
- An estimate of the remaining restoration period using calculated chloride groundwater flux and surface water discharge data.
- Recommendations (as needed) to (1) address potential data gaps, (2) further optimize remedial action performance, and (3) amend the existing CMP to improve the effectiveness and efficiency of existing monitoring and reporting requirements.

2 SUMMARY OF SITE CONDITIONS

2.1 SITE DESCRIPTION

The Site is located on the west side of Highway 395 two miles south of Chewelah in the Colville River Valley of Stevens County (Figure 1).

The Site occupies approximately 67 acres of industrial and agricultural land. The industrial area covers approximately 50 acres. An adjoining 17-acre agricultural field (the north field) lies between the industrial area and the Colville River.

The Site layout is described as follows (see Figure 2):

- The magnesite residue pile covers nearly 17 acres within the southwest quadrant of the Site. The magnesite residue materials represent mining/milling byproducts from an earlier era of Site industrial operations (Northwest Magnesite) and are not subject to cleanup due to L-Bar's past on-Site operations.
- The west ditch provides drainage for the western part of the Site and continues to discharge to the Colville River.
- The former west ditch provided drainage from the interior part of the Site and had previously discharged to the Colville River. In 1994, a dam was constructed to stop further the discharge to the river. In summer 2003, the ditch was covered and closed.
- Two high-density polyethylene-(HDPE) lined storage ponds, the evaporation pond and the holding pond, were part of the water management system during L-Bar's operating years. These ponds are still present on the Site; however, the evaporation pond is no longer in use and does not support current remedial actions at this site. The holding pond continues to be used for collection and storage of storm water that originates primarily as runoff from paved portions of the main plant area.
- Excess water from the holding pond discharges into the Colville River via a HDPE-lined drainage ditch that runs parallel to the former west ditch.
- Former flux bar (FB) and flux bar residue (FBR) that was on top of the southern portion of the Magnesite pile and removed during an interim cleanup action.
- A former covered FBR pile on the east side of the Site and outside the magnesite residue pile was removed as part of the cleanup actions.
- The former magnesite processing plant and later agricultural warehousing buildings located along the east side of the Site. Even though these buildings are located inside the Site, these buildings were not affected by the former FB operations and are not considered any further in this report. Some of the buildings are used for hay storage while

the remainder are abandoned and in a derelict state.

- A HDPE-lined Sanitary Lagoon formerly used for on-site sewage waste management that is currently inactive.

2.1.1 Current Site Ownership

The Site consists of six parcels: Stevens County Parcel Nos. 2600000, 2601080, 2600700, 2600800, 2600900, and 2600500. Figure 3 shows the parcel layout at the Site and surroundings.

Parcel 2600000 forms the northern portion of the Site and includes approximately 19.05 acres. The parcel is currently owned by Washington Valley Properties LLC. The parcel consists of grass meadows (the north field in Fig. 2.2) that are bounded by Colville River to the north and the railroad right-of-way/Highway 395 to the east. The north field commonly floods during the late winter/early spring season.

Parcel 2601080 is located within the eastern and north-central part of the Site and includes approximately 27.25 acres. Washington Valley Properties LLC currently owns the parcel. The former magnesite and FB processing buildings were located on this parcel, as well as the former covered FBR pile (Figure 2). The holding pond and the former evaporation pond are also located within this parcel. The lined ditch draining the holding pond runs along the boundary of this parcel and Parcel 2600000 toward the Colville River. A portion of Parcel 2601080, including much of the former covered FBR pile footprint, was used for an agricultural enterprise, but is currently deserted.

Parcel 2600700 encompasses the southern portion of the magnesite residue pile and includes approximately 10.70 acres. Several piles of FB used to be stored within the parcel. These FBR piles were removed as part of the interim Site cleanup action as described in subsection 2.5 of this document. The parcel is currently owned by Marsha Brauner.

Parcel 2600800 forms the very southeastern corner of the Site and includes approximately 0.42 acres. This parcel is occupied by three elevators and storage bunkers that were used to store processed magnesite product. The parcel is currently owned by Washington Valley Properties LLC.

Parcel 2600900 forms the northern portion of the magnesite residue pile and includes approximately 11.08 acres. The parcel is currently owned by Bruce Brauner.

Parcel 2600500 forms the western boundary of the Site, bordering the Magnesite Residue pile, and is approximately 80.00 acres. The parcel is currently agricultural land. Contaminated groundwater occurs under the northeastern corner of this parcel. The current owner of this parcel is Elite Equities LLC.

Until 2005, the Site (except for Parcel 2600500) was under the ownership and control of NWA. In late 2005, NWA sold the five parcels described above to the Ernie Smith Trust. As part of the

sales agreement, NWA (currently Alcoa) and its representatives retain access rights to the Site (and the five parcels) for CMP in support of MTCA cleanup activities. Alcoa has permission from the property owner to enter Parcel 2600500 and sample well P-25.

2.1.2 Site Surroundings

The Site is bounded to the north by the Colville River. The land beyond the river to the north is currently agricultural with a strip of wetland meadows along the river. The Site is bounded to the east by Highway 395 and the BNSF Railway right-of-way. Across the highway to the east, Stevens County owns the land, which includes agricultural fields and a road maintenance and vehicle equipment yard southeast of the Site. The City of Chewelah owns a cemetery northeast of the Site across Highway 395.

The Site is bounded to the south by an active industrial/commercial operation (White Stone Calcium Properties) that processes rock for decorative purposes. Large piles of aggregate material currently are stockpiled throughout the White Stone Calcium property. A landscaping supply store, Chelsey's Courtyard, is located to the west of the rock processing facility. The west side of the Site is bounded by agricultural fields irrigated with water from the Colville River.

2.2 SITE HISTORY

2.2.1 Former Operations and Cleanup Activities

The Site has been associated with magnesium processing since 1917 (Independent, 2017). Large quantities of magnesite ore for magnesium oxide production were processed and stockpiled at the Site until 1968 (Independent, 2017). In the mid-1970s, the facility was converted to recover magnesium from FB, a magnesium processing byproduct. NWA supplied FB primarily from their magnesium plant near Addy, Washington, and sold it to the facility owners. The magnesium recovery facility was owned and operated by Phoenix Resources Recovery, Inc. from 1977 to 1986. L-Bar Products, Inc. operated the facility from 1986 to 1991 when it closed down due to insolvency.

The magnesium recovery process involved crushing raw flux bar (FB) and screening the crushed materials to recover metallic magnesium granules. The remaining material was called flux bar residue (FBR). Magnesium, magnesium oxide, magnesium chloride, potassium chloride, calcium chloride, and lesser amounts of magnesium nitride and magnesium fluoride were the primary constituents of the FB and in the FBR piles. These materials were very reactive with water; the reactions were exothermic and had caused several fires at the Site during the plant's operating years. The reaction of magnesium nitride with water releases ammonia. The magnesium and potassium chloride salts were highly soluble in water and easily leached from these materials into groundwater. These materials also designated as "state-only dangerous waste" due to fish toxicity.

When the plant closed in December 1991, predominantly raw FB with some FBR was stored on top of the southern half of the Magnesite Residue pile in several separate uncovered piles (CES,

2001). The magnesite residue pile is not vegetated, is currently uncovered, and has steep side slopes.

Processed FBR was stockpiled in a large HDPE-covered pile to the north of the plant's main processing area at the east side of the Site.

Ecology issued several enforcement orders and penalties to L-Bar for violations of air quality, water quality, and dangerous waste regulations while the plant was in operation. Some emergency actions and plant rehabilitations were undertaken to address the orders. However, when the plant closed, an estimated more than 100,000 tons of FB and FBR materials (under the covered pile, on top of the magnesite pile, and in buildings) were left on Site. Past operating practices and inadequate storage of FB and FBR resulted in soluble components leaching from the materials into soil, groundwater, and surface water.

The formal MTCA cleanup process began in 1994. NWA entered into an agreed order with Ecology in 1995 that included provisions for conducting interim actions, a remedial investigation (RI), and a feasibility study (FS). The RI/FS included further site investigations and sampling and evaluating cleanup alternatives for the Site. CH2M completed the RI in 1998 and the FS in 1999. Interim actions under this agreed order performed from 1996 to 1999 included removing FB and FBR from the top of the Magnesite Residue pile and removing additional FB and FBR from the plant's main processing area (CH2M, 2001).

Ecology issued a draft CAP in April 2000; after public review and comment, the final CAP was issued in June 2000 as part of Agreed Order No. DE 00TCPER-984 (Ecology, 2000). Cleanup actions included removing the covered FBR pile north of the processing area and closing the main ditch, which took place from 2000 through 2004 (CH2M, 2001a and CH2M, 2012a). On-Site operations that occurred before L-Bar's ownership generated the magnesite pile, which was not subject to cleanup actions under the agreed order.

2.3 PHYSICAL SITE CHARACTERISTICS

2.3.1 Site Geology

The Site is located near the center of the Colville River Valley. The uppermost soils underlying the Site represent a mixture of naturally deposited sediments and artificially placed fill as identified in the RI (CH2M, 1998). These soil units can be grouped into four lithologically distinct deposits:

- Fill/magnesite residue
- Recent alluvium
- Volcanic ash
- Glacial silt and clay

Fill deposits, predominantly magnesite pile residue, are found in the southern portion of the Site, in the L-Bar plant area, in areas around the holding pond and evaporation pond, and along the eastern side of the former main ditch. The north field is underlain by recent alluvial sediments consisting of silty sand, silt, and intermittent organic-rich layers up to several feet. Volcanic ash was frequently encountered in the northern half of the Site at depths ranging from 3 to 6 feet below grade and typically lies atop a thick (>100 feet) sequence of silt and clay deposited in a glacial lake. A very stiff-to-hard clayey silt up to 10 feet thick underlies the L-Bar Site and represents the uppermost member of the glacial lake sediments.

2.3.2 Surface Water Hydrology

Primary surface water features associated with the L-Bar Site historically have included the following:

- Main Ditch
- West Ditch
- Colville River

The main ditch was a man-made drainage feature that extended diagonally across a large portion of the Site. The ditch ran from the southeast corner of the site to near the northwest corner (mouth) where it formerly discharged to the Colville River (Figure 2). The main ditch provided an important drainage function for the Site. This ditch captured both surface water runoff and shallow groundwater discharge and routed these waters to the river. The main ditch was filled with granular soil material in 2003 as part of the final Site cleanup actions.

The west ditch runs along the western Site margins. This man-made ditch collects surface water runoff from areas immediately south of the Site and from adjacent agricultural fields west of the Site. The west ditch also captures shallow groundwater from along the west side of the Magnesite Residue pile. Water in the west ditch (when present) discharges directly into the Colville River.

Discharge from the west ditch typically ranges from being dry, typically during the summer to early fall, and peaks during the spring seasonal with a maximum flow of 455 gallon per minute (gpm) (SCCD, 2024). Discharge in the west ditch is influenced by seasonal precipitation events and an influx from shallow groundwater along its length. During seasonal flooding of the Colville River, river flow can back-up into the lower reaches of the west ditch and interrupt typical drainage conditions.

The Colville River forms the northern Site boundary. The river's current course near the Site has been influenced to some degree by historical channelization and realignment. The Colville River serves as the primary hydrologic feature influencing surface water and shallow groundwater flow at the Site.

The discharge measured at the Colville River stations typically ranges from a seasonal (July-August) low of a minimum flow of 12 cubic feet per minute (cfm) and peaks in the range of 250 to 450 cubic feet per second (cfs) during spring snow melt seasonal highs (typically late March through early May) with a maximum recorded flow of 461 cfs. The Colville River discharge data was based on monthly readings from 2018 to spring of 2024 (SCCD, 2024). The average flow in Colville River passing the site is 86 cfs.

Further discussion of the latest surface water discharge data is in Section 5, Compliance Monitoring Results.

2.3.3 Groundwater Hydrology

Groundwater at the Site is present in three units:

- SWBU – a thin, unconfined water-bearing zone, generally 1 to 3 feet thick, that maintains a water table approximately 1 to 8 feet below ground surface (bgs) under normal seasonal conditions. However, during periods of intermittent drought, these shallow water-bearing zones may be discontinuous or locally absent. The average hydraulic conductivity, based on slug tests in select wells, is 4.6 feet per day (CH2M, 1998).
- Intermediate Aquifer – confined, locally developed water-bearing zone at a depth of approximately 70 to 80 feet bgs that averages about 50 feet of thickness. This zone is
- separated from the SWBU by a clay aquitard. A strong upward vertical gradient exists between this deeper confined aquifer unit and the SWBU. A site groundwater supply well (PW) have supplied water to past Site activities. This well is artesian with positive water pressure at the wellhead.
- Deep Aquifer – confined, regionally distributed sand and gravel aquifer encountered at a depth ranging from 190 to 360 feet bgs.

Groundwater levels typically fluctuate 2 to 4 feet seasonally. Seasonal highs typically occur in February, and seasonal lows typically occur in October. In the north field, shallow groundwater (1 to 8 feet bgs) locally occurs at or near the ground surface during the wet season. Seasonal flooding of the north field has occurred over the years.

Groundwater from either the intermediate or deep aquifer is the primary source of potable drinking water for rural residents and commercial operations near the Site. Former on-Site agricultural operations were supplied from a well (L-Bar in Fig 2.3 and 2.4) that is screened in the intermediate aquifer. No known water supply wells are within the SWBU in the immediate vicinity of the Site (CH2M, 1998).

Groundwater in the SWBU flows in a general northwesterly direction toward the Colville River under an average site-wide hydraulic gradient of 0.003 to 0.006. Shallow groundwater flow in the

north field is slow because of the low permeability of the alluvial sediments (consisting of silty sand, silt, and intermittent organic-rich layer) and volcanic ash in the area.

A more expanded discussion of current hydrologic conditions is presented in Section 6, Compliance Monitoring Results.

2.4 NATURE AND EXTENT OF CONTAMINATION

This section describes the nature and extent of contamination as presented in the CH2M 1998 RI Report.

2.4.1 Magnesite Residue Pile

During the RI, a distinct chloride and/or ammonia-leaching front was evident at approximately 7 to 15 feet below the interface between the magnesite residue and the raw FB and FBR material. The depths are based on field screening results for chloride and ammonia. Trace metal and metalloid concentrations in the FB materials below the leaching front were similar to those above the front demonstrating little potential leaching or mobilization of metals/metalloids.

2.4.2 Unsaturated Zone Soils

Several unsaturated zone soil samples collected from the north field and main plant areas contained elevated concentrations of chloride and nitrogen as ammonia. The elevated concentrations in the main plant area were found in areas where source material stockpiling occurred. In the north field, elevated levels of chloride and ammonia as nitrogen in the unsaturated soils likely resulted from seasonal saturation of the soils by high groundwater generated near the covered pile and/or surface water seeping from the main ditch into the SWBU.

2.4.3 Saturated Zone Soils

The RI investigation discovered that chloride and ammonia had penetrated into the clay beneath the SWBU at least 10 feet bgs. Chloride concentrations up to 4,650 milligrams per kilogram (mg/kg) and 216 mg/kg of ammonia were detected. Over 1,000 mg/kg of chloride was still detected at 10 feet bgs and approximately 4 feet into the clay beneath the SWBU.

2.4.4 Groundwater

Groundwater in the SWBU has been contaminated by chemicals that leached from FB and FBR. In contrast, the intermediate and deep aquifers do not show evidence of chemical impacts from FB or FBR.

Based on RI data, the following indicator hazardous substances (IHS) to establish cleanup requirements in the CAP (Ecology, 2000) within the SWBU:

- Chloride – This contaminant is found as an anion (negatively charged ion). Chloride in shallow groundwater is primarily sourced from the FB and FBR materials, which contain various metal salts. Chloride is a primary tracer that helps delineate areas of residual contamination caused by FB and FBR.
- Total Dissolved Solids (TDS) – TDS is a measure of the dissolved mineral content of water and commonly includes carbonates, chlorides, sulfates, nitrates, sodium, potassium, calcium, and magnesium.
- Ammonia-N (as nitrogen [N]) – The FB and FBR materials both contain ammonia that occurs as a byproduct of the magnesium smelting and refining process. Ammonia-N can be toxic to certain aquatic organisms.
- Nitrate-N (as N) – Nitrate is an anion that is often associated with biological activity, including waste byproducts. At the Site, the primary source of nitrate is from biological oxidation of ammonia into nitrite and then into nitrate (nitrification).
- Nitrite-N (as N) – Nitrite is an anion in groundwater. Nitrite typically forms as a short-lived, intermediate byproduct of ammonia nitrification.
- pH – The pH value of groundwater was influenced by various source materials and naturally occurring geochemical processes at the Site. The chemical composition of the L-Bar source materials and Magnesite Residue pile tended to create slightly to moderately basic (alkaline) groundwater conditions (pH values >7.0 but <10.5).
- Metals and Metalloids – The L-Bar source materials contained various metals and metalloids including barium and manganese. Other metals such as selenium and thallium also were detected at slightly elevated concentrations in shallow groundwater. Chemical changes in the magnesite pile caused by L-Bar source materials may have influenced selenium, thallium, and possibly other trace metals to become slightly enriched in shallow groundwater at the Site.

2.4.5 Surface Water

Some of the IHS were also found in surface water. Before the main ditch was closed and covered in 2003, elevated chloride, ammonia, and TDS concentrations were observed throughout the length of this man-made drainage feature.

- Elevated chloride and ammonia concentrations were observed throughout the west ditch, from the southwest corner of the Magnesite Residue pile to the mouth. Vegetation growth along the banks of the ditch may help selectively remove some source-related contamination, such as ammonia and/or nitrate during portions of the

year.

- A slight increase from upstream to downstream chloride and ammonia concentrations was observed routinely in the Colville River; however, none of the concentrations exceeded the surface water criteria.

2.5 INTERIM ACTIONS

Agreed Order No. 94TC-E104 provided for interim actions that would address water management and removal of on-site materials. An interim action involving the removal and off-site disposal of materials piled around and on top of the magnesite residue pile began in June 1997 and was completed in 1999. The interim action focused on characterizing and removing weathered FB and FBR materials.

These FB and FBR materials were characterized as “special wastes” or solid wastes under WAC 173-303, Dangerous Waste Regulations. The 68,000 tons of material on top of the magnesite residue pile were transported by railcars to an Ecology-approved solid waste disposal facility (Columbia Ridge Landfill, Arlington, Oregon) between May 1997 and December 1999. About 5,000 tons of prilled FBR material was removed from one of the process buildings and applied as a fertilizer product on fields in Eastern Washington and Oregon (CH2M, 2001b).

3 CLEANUP ACTION PLAN

Ecology issued the final CAP in June 2000 (Ecology, 2000) and entered into an agreed order with NWA to implement the identified cleanup actions.

3.1 REMEDIAL ACTION GOALS

The remedial action goals for the Site are to:

- Protect beneficial uses of the Colville River.
- Reduce concentrations of contaminants in soil, SWBU, and ditches to Site CULs (Table 1) at the designated points of compliance.
- Prevent or minimize leaching of contaminants from materials to the environment.

3.2 CLEANUP STANDARDS

The two primary components of cleanup standards are cleanup levels and points of compliance.

3.2.1 Cleanup Levels

CULs determine the concentration at which a particular hazardous substance does not threaten human health or the environment. Site CULs were developed as follows:

- Groundwater: Method B CULs were based on protection of drinking water, surface water, and irrigation water.
- Soils: Method C industrial CULs were used for direct contact. Soil CULs that are protective of groundwater were established at 100 times the groundwater cleanup. Since Method C CULs were used, a restrictive covenant was required.
- Surface Water:
 - West Ditch – Method B CULs protective of drinking water, surface water, and irrigation (since this ditch discharges to the Colville River) were used.
 - Main Ditch – The main ditch did not discharge to the River. Method C industrial CULs for groundwater were used. This ditch was covered and closed in 2003; therefore, cleanup levels for this ditch are no longer applicable.
- Sediments:
 - West Ditch – CULs were based on Method C industrial for soils, protection of ditch water, and the Freshwater Sediment Quality Values in Washington State (Ecology, 1997).

- Main Ditch – No CULs were set because this feature was covered and closed in 2003.

Table 1 lists applicable Site CULs. The CMP Workplan Addendum No. 1 (CH2M, 2012a) divided the IHS into primary and secondary categories. Primary IHS are sampled and analyzed twice per year, whereas secondary IHS are sampled and analyzed twice every other year.

3.2.2 Points of Compliance

For groundwater, the point of compliance is throughout the Site. Where the affected groundwater flows into the Colville River, a conditional point of compliance located within the surface water as close as technically possible to the point or points where groundwater flows into surface water may be approved under the requirements listed in WAC 173-340-720(6)(d).

For soil, the point of compliance is throughout the Site down to the groundwater table. The point of compliance for the west ditch is the point of discharge to the Colville River. For sediments in the west ditch, the point of compliance is everywhere in the ditch.

3.3 SITE CLEANUP ACTION

The Site's selected cleanup actions identified in the final CAP included the following:

- Removal and off-site disposal of FBR source materials in the covered pile.
- Monitoring groundwater to demonstrate compliance with CULs.
- Monitoring of surface water to demonstrate compliance with CULs.
- Institutional controls to set restrictions on the Site to maintain the integrity of cleanup actions undertaken.

4 CLEANUP ACTION AND FOLLOW-UP ACTIONS

4.1 MATERIALS REMOVAL AND OFF-SITE DISPOSAL

Full-scale source removal activities involving the covered pile and FB/FBR materials in plant buildings were conducted between 2000 and 2004. Over 133,000 tons of FB-related materials were excavated or removed and disposed of at an approved waste disposal facility. The amount of source material removed from the covered pile area was approximately 129,000 tons. Clean, granular fill material was placed into the footprint of the former covered pile area following excavation and removal of the source materials (CH2M, 2004).

4.2 ADDITIONAL ACTIONS

- During summer 2003, the main ditch was filled with clean, granular fill material and graded to match the existing grades along the perimeter of the ditch (CH2M, 2004).
- The west ditch continues to discharge to the Colville River. This discharge was required to meet all substantive requirements of a National Pollutant Discharge Elimination System (NPDES) permit until June 2006 when the NPDES permit requirements ended.
- In April 2006, Ecology approved terminating the NPDES Permit discharge-limit monitoring when the permit requirements ended.
- When cleanup construction was finished, NWA implemented a CMP to gauge the effectiveness of the cleanup action and to comply with the conditions set forth in the CAP (CH2M, 2001a).

4.3 CURRENT INSTITUTIONAL CONTROLS

The Restrictive Covenant for the L-Bar properties was recorded in 2001. This Restrictive Covenant limits certain activities and land uses until CULs at the Site have been met.

4.4 FIRST PERIODIC REVIEW IN 2012

Ecology conducted the first periodic review in 2012 (Ecology, 2012) to evaluate the effectiveness of the cleanup action based on information provided in CH2M (2011). The review had the following key conclusions:

- Site CULs had not been met, although some improvements to groundwater and surface water quality had been shown. Chloride, ammonia, and TDS concentrations were still elevated compared to their CULs.
- Concentrations of indicators in the north field area east of the former main ditch did not indicate a clear trend during this assessment period. Elevated concentrations or increases had been observed along with seasonal variations. These appeared to be the

delayed effects of excavation-related disturbances that occurred during removal of materials from the covered FBR pile. The observed concentration response was thought to be influenced by the characteristically fine-grained nature of the alluvial soils and the low groundwater flow rates in the SWBU.

- Shallow groundwater in the north field discharged to the Colville River. Although indicators in this groundwater exceeded CULs, continued monitoring of the Colville River upstream and downstream of the Site did show that impacts from this groundwater were negligible. Surface water standards had not been exceeded in the river.
- CULs were still being exceeded at the Site, although some improvements to groundwater and surface water quality had been shown. In a few wells, such as SA-10 (located on the magnesite residue pile), concentrations appeared to be increasing. However, the existing Restrictive Covenant was active and effective in protecting human health and the environment from exposure to hazardous substances and protecting the integrity of the cleanup actions.
- Residual FB residue could be present at the Site in the vicinity of well SA-10 based on the observed increase in contaminants in the well.
- A restoration time frame of 20 to 30 years was considered likely, in part because shallow groundwater flow was relatively slow within the fine-grained north field soils, thereby limiting the natural attenuation processes that help reduce residual contaminant concentrations over time.

Based on these conclusions, the first review recommended the following:

- Continue groundwater and surface water monitoring in accordance with the following frequencies: (1) Yearly semi-annual monitoring for field parameters (temperature, pH, conductivity) and indicators (chloride, ammonia-N, and TDS); and (2) semi-annual monitoring for indicators (nitrate-N, nitrite-N, barium, manganese, selenium, and thallium) with less elevated concentrations should be conducted two times per year, every other year.
- The method detection limit (MDL) for thallium analysis should not exceed two times the CUL. If this is not achievable, the next periodic review should take into consideration the current cleanup level in relation to its practical quantitation limit (PQL)/MDL.
- A supplemental site investigation in the area of well SA-10 should be carried out to determine if source materials are still present and to conduct additional materials removal, if necessary.

4.5 SUPPLEMENTAL SITE INVESTIGATION AT WELL SA-10

NWA and their consultants conducted a supplemental site investigation at the southern end of

the magnesite residue pile in response to Ecology's recommendation to assess Site conditions in the area around well SA-10. The supplemental site investigation work was performed in two successive phases from 2012 to 2013 and was conducted to determine if residual FB and/or FBR source material was present in areas where former source removal actions had been conducted.

The field activities, investigation methods, data summaries, and key findings from these supplemental investigations have been documented in two reports:

- *Data Summary Report for the Supplemental Geophysical Survey Work Conducted at the L-Bar Site near Chewelah, Washington* (CH2M, 2012b)
- *Focused Site Investigation Data Summary Report for the L-Bar Site near Chewelah, Washington* (CH2M, 2014)

The first report (CH2M, 2012b) summarizes on-Site geophysical work using electromagnetic equipment to map soil conductivity and the presence of buried metallic objects. The purpose of this geophysical study was to determine whether residual FB/FBR materials were remaining in the magnesite residue pile. The second report outlined the work and results addressing the recommendations set forth in the geophysical site investigation report.

From the first phase of the investigation mapping soil conductivity, areas were identified where residual FB/FBR could be present. The geophysics report recommended installing soil vapor probes in these areas to test for ammonia to confirm the presence of FB/FBR. The geophysics report also recommended testing shallow (< 6 inches) soil to the south and east of the magnesite residue pile for electric conductance to determine if residual FB material potentially was present.

The second phase of the investigation (CH2M, 2014) was carried out in accordance with the recommendations from the geophysics investigations; the soil vapor probes were installed and sampled, and shallow soils were tested for electric conductance. Several key findings and conclusions from this supplemental site investigation work are summarized below:

- Some areas of elevated soil conductivity were observed in the southeastern quadrant of the magnesite residue pile and likely correlate with former FB and FBR stockpile areas.
- Shallow soil samples (i.e., soil/water slurry) did not show elevated electrical conductivity values that would indicate the likely presence of residual FB or FBR. The investigators concluded that elevated levels of chloride, TDS, and ammonia in groundwater at well SA-10 are not likely caused by ongoing releases of residual contaminants from the upper few feet of the magnesite residue pile materials.
- No elevated ammonia vapors were detected in soil vapor probes installed 6 feet bgs within the southeastern quadrant of the magnesite residue pile. All reported ammonia concentrations were <5 parts per million by volume, indicating little residual ammonia in the upper 6 feet of the magnesite residue pile.

- Potentiometric information from two new piezometers installed near the southeast corner of the magnesite residue pile helped refine the understanding of seasonal groundwater flow conditions in the area between well SA-10 and the former main ditch.

4.6 MONTHLY GROUNDWATER MEASUREMENTS 2015–2016

Monthly groundwater level measurements were collected from January 2015 until December 2016 at all CMP wells. This information helped refine the understanding of seasonal changes in water level fluctuations and apparent groundwater flow direction throughout the site.

4.7 SECOND PERIODIC REVIEW IN 2019

Ecology conducted the second periodic review in 2019 (Ecology, 2019) based on information provided by Jacobs (2018) to evaluate the effectiveness of the cleanup action. The review had the following key conclusions:

- Previous source removal actions were effective at eliminating the primary contaminant release mechanisms that allowed source-related contaminants to migrate into soil, sediments, shallow groundwater, and surface water at the Site.
- The existing monitoring network for surface water and groundwater were adequate for evaluating changes (both temporal and spatial) in IHS concentrations.
- Site activities and operations had changed since the previous 2012 periodic review. However, the current Site activities and operations did not appear to have affected or adversely impacted ongoing cleanup.
- Site CULs had not been met, although some improvements to groundwater and surface water quality had been demonstrated since the last periodic review.
- The specific sources or mechanisms that have caused elevated manganese, barium, selenium, and thallium concentrations in shallow groundwater did not appear to be clearly tied to a single source or geochemical factor.
- Concentrations of chloride, ammonia, and TDS (primary IHS) were declining in many areas of the Site.
- Groundwater monitoring data analysis demonstrated declining concentration trends at several locations within the monitoring network. An increasing concentration trend was observed in one well located in the magnesite residue pile. At this location, residual contaminants from formerly stockpiled FB/FBR materials are still being flushed from this large pile of legacy wastes associated with a former magnesite processing facility.
- Surface water quality in the west ditch (station D2) showed progressive improvement since the previous 2012 periodic review.

- Continued monitoring of the Colville River upstream and downstream of the Site showed that impacts from this groundwater discharge are negligible. Surface water standards were not exceeded in the river.
- The existing Restrictive Covenant in 2018 contained omissions and inaccuracies that potentially could affect the long-term effectiveness of the remedy.
- Based on these conclusions, the 2019 review recommended the following:
- CULs were still being exceeded at the Site. However, as long as the existing Restrictive Covenant remains active and effective in protecting human health and the environment from exposure to hazardous substances, no further action was required beyond compliance monitoring and periodic review.
- A predictive trend analysis should be performed to determine if the current projected concentration trends remain similar, gradually flatten (approach asymptotic levels), or show a more rapid rate of concentration decline.
- Continue groundwater and surface water monitoring in accordance with the following frequencies:
 - Monitor for five field parameters (temperature, pH[primary IHS], oxidation-reduction potential, conductivity, and turbidity) and primary IHSs (chloride, ammonia-N, and TDS) semi- annually.
 - Monitor for nitrate-N, nitrite-N (ammonia transformation products), and barium semi- annually, every other year.
 - Monitor for remaining secondary IHSs (manganese, selenium, and thallium) semi- annually, every other year.
- Conduct two sampling events per year at the four surface water monitoring stations (CR1, CR3, D2 and D3). During these two sampling events collect water quality samples and conduct ditch discharge measurements at the two west ditch monitoring stations (D2 and D3).
- Collect annual discharge data from the Colville River at stations CR1 and CR3 to help assess ongoing contaminant flux to the river during late summer/fall flow conditions
- Perform the spring/early summer groundwater and surface water monitoring events during May or early June after the peak spring freshet. Delaying the monitoring to this later seasonal period should provide more accurate and reliable flow measurements in the west ditch – particularly in station D2.
- Perform the fall surface water and groundwater sampling events when a surface water

discharge of at least 10 gpm is present at west ditch station D2. The typical window for conducting the fall sampling event is early October to mid-November

- The reporting limits for the thallium analyses must not exceed the thallium CUL.
- Well P-09 should be retained in the current monitoring network during 2019–2023.
- Update the Restrictive Covenant for the Site to comply with the Uniform Environmental Covenants Act (Chapter 64.70 RCW) and file the Covenant with Stevens County and have it recorded by the County Auditor.

5 SITE COMPLIANCE MONITORING, NETWORK AND PROCEDURES

Beginning in November 2000, routine groundwater and surface water monitoring transitioned to compliance monitoring under the *L-Bar Material Removal and Compliance Monitoring Work Plan* (CH2M, 2001a).

Jacobs (2020) prepared an amended CMP Workplan implementing the recommendations from the second five-year review and replacing the earlier 2012 CMP workplan amendment (Jacobs, 2020). This CMP amendment was followed by a second CMP amendment in 2021, this time prepared by GreatWest Engineering (GreatWest, 2021). This section briefly describes the current 2020 and 2021 CMP amendments.

5.1 SURFACE WATER COMPLIANCE MONITORING

The primary objective of the surface-water monitoring program for the Site is to document surface water quality in the west ditch and the adjacent Colville River. On behalf of NWA, the Stevens County Conservation District (SCCD) administers and performs the routine compliance surface water monitoring as outlined in the CMP Addendum No. 1 (CH2M, 2012a, Jacobs, 2020, and GreatWest, 2021). Four surface-water monitoring stations are included as part of the current CMP surface-water monitoring program shown in Figure 4:

- Station D3 – upstream in the west ditch (upstream of station D2)
- Station D2 – mouth of the west ditch (direct discharge to Colville River)
- Station CR1 – Colville River at the Highway 395 Bridge (upstream of the Site and west ditch mouth)
- Station CR3 – Colville River (approximately 300 feet downstream from the west ditch mouth)

Routine field sampling methods, quality control, and data management for the compliance surface-water monitoring program are presented in the CMP Addendum No. 2 (Jacobs, 2020).

5.2 GROUNDWATER COMPLIANCE MONITORING

The CMP groundwater monitoring network consists of 13 sampling locations, including 12 shallow resource-protection groundwater monitoring wells and one deep production well in the intermediate aquifer (see Figure 4). Groundwater monitoring is conducted semi-annually (CH2M, 2001a; CH2M, 2012a; Jacobs 2020; and Great West 2021). The 12 wells monitor the SWBU and the intermediate, confined, alluvial water-bearing zone. Wells in the Site groundwater-monitoring network are grouped into the following categories:

- Site Background: Represented by well P-12 and until this periodic review, the production well (L-Bar) completed in the deeper intermediate and confined aquifer. The production

well will be transferred to the Site Interior group of wells in the next periodic review period after detections of ammonia exceeding the Site CUL as discussed below.

- Source Removal Areas: Represented by well P-13, located immediately south of the magnesite residue pile, and wells SA-10, SA-11, and SA-14 located atop the magnesite residue pile and in locations where former source removal actions have been completed.
- Site Interior: Represented by well P-09, located within the former operations area east of the magnesite residue pile and south of the covered FBR pile. The L-bar production well will be included in this group of wells during the next periodic review period as discussed above.
- North Field: Represented by wells P-05, P-06, P-19, P-20B, P-25, and P-27.

The groundwater monitoring analytical suite, test methods, and preliminary CULs are presented in Great West's compliance monitoring program (CMP) report (Great West, 2024). Jacobs (2020) and Great West (2021) provide additional details on groundwater sampling procedures, quality control, and data management. Primary indicator parameters (ammonia, chloride, pH, and TDS) are sampled twice per year, while the secondary parameters are sampled twice per year every other year (during even numbered years in). Hence, the secondary parameters were analyzed in 2018, 2020, and 2023. Thus, the most recent groundwater data evaluated in this report are the primary parameters collected in 2023, and the secondary parameters collected in 2022 (Great West, 2023) Note that pH is not included in the 2020 CMP workplan as an IHS.

5.2.1 Overview of 2023 CMP Groundwater Data Evaluation

Groundwater analytical data through 2023 were used to perform an expanded evaluation and analysis of existing groundwater quality conditions at the Site (Great West, 2024). The 2024 CMP report specifically included additional statistical analysis and data presentation approaches that support this Periodic Review and the overall assessment of cleanup progress at the Site. A brief summary of these supplemental statistical analyses included in the 202 CMP report is presented below.

5.3 DATA ANALYSIS

Evaluation of site monitoring data (Great West, 2024) includes (1) time series plots, (2) comparison to site cleanup levels, and (3) evaluation of statistically significant trends.

5.3.1 Time Series Plots

Time series plots between spring of 1996 and fall of 2023 are provided for all primary IHSs except pH, and between fall of 2000 and fall of 2023 for secondary IHSs in all thirteen monitoring wells in Great West's 2024 summary report. The purpose of these plots was to provide a general indication of whether groundwater conditions are showing progress toward

achievement of groundwater CULs within or by the anticipated restoration period of 20-30 years from the date of the completion of the cleanup action as stated in the 2000 CAP (Ecology, 2019). The previous periodic review report (Ecology, 2019) stated that the original projected cleanup target date was between 2024 and 2034 since the Site cleanup action was completed in 2004.

5.3.2 Comparison of Site Cleanup Levels

WAC 173-340-410 describes compliance monitoring requirements for cleanup sites. Performance monitoring [WAC 173-340-410(a)] is performed to confirm that the cleanup action has attained cleanup standards. For this current periodic review, groundwater quality data from 2018 to 2023 were compared to the Site CULs (Table 1) to assess the effectiveness of the implemented cleanup actions.

5.3.3 Trend Analysis

Trend analyses for the Site have been performed in prior annual CMP reports to assess relative changes (improvements) in groundwater quality following source removal actions and progress toward achieving CULs and to complement time series plots discussed above analysis. For the 2024 CMP annual report, trend analyses were performed using the Mann- Kendall method. Groundwater monitoring data from spring 2017 through fall 2023 were used to perform the analysis.

Backup data and output documentation generated in support of this trend analysis are presented in Appendix E of the CMP 2024 Monitoring report (Great West, 2024).

6 COMPLIANCE MONITORING RESULTS

6.1 HYDROLOGIC CONDITIONS 2018–2023

6.1.1 Surface Water Flow Data

Surface water flow in the Colville River typically ranged from 23–59 cfs from October to November and 31–215 cfs from May to June. Surface water flow measurements collected since 2012 show general similarity to the flow values prior to 2018 (SCCD, 2024).

Surface water discharge from the west ditch into Colville River ranged between 10 and 48 gpm October to November and between 7 to 29 gpm from May to June.

6.1.2 Groundwater Elevation and Flow

No long-term temporal trends in groundwater elevations are evident. A site hydrograph showing monthly measurements from February 2001 to November 2023 for all the CMP wells and the two piezometers (PZSP and PZEP) near the Magnesium Residue pile is presented in Figure 5.

Groundwater elevations during the 2018-2023 review period ranged from an approximate maximum of 1,645.5 feet above mean sea level (amsl) at upgradient of the site (well P-12 at the south end of site) to an approximate minimum of 1,633.5 feet amsl (well P-27 located closer to the Colville River). Groundwater from the SWBU generally flowed north- northwesterly beneath the site and discharged either into the west ditch or the Colville River. Some losses due to evapotranspiration are likely to occur in the north field as well.

Figure 6 presents May 2023 groundwater elevation contours (potentiometric surface map) and the inferred groundwater flow direction. Groundwater conditions depicted in Figure 6 represent seasonal high groundwater elevations, which coincided with spring flood conditions in the Colville River during 2023. Figure 7 presents November 2023 groundwater elevation contours and the inferred groundwater flow direction. Groundwater conditions depicted in Figure 7 represent dry season hydrologic conditions and coincide with seasonal low flow conditions in the Colville River.

An apparent radial flow pattern away from wells SA-10 and SA-11 occurs in groundwater beneath the magnesite residue pile during the dry season as shown in Figure 7; where groundwater flow is to the northwest, northeast, and southeast from wells SA-10 and SA-11. This partly reflects the water retention capacity of the fine-grained magnesite residue pile materials versus the more free-draining characteristics of the native SWBU soils. The general groundwater flow direction at the Site is to the north-northwest during both the wet (spring) and dry (fall) seasons.

6.2 WATER QUALITY CONDITIONS 2018–2023

6.2.1 Surface Water Quality Results

SCCD monitors surface water quality (SCCD, 2024) at the four locations described in Section 5.1. This includes two stations on the west ditch (D2 and D3) and two stations on the Colville River (CR1 and CR3). Surface water monitoring parameters include:

- pH
- Temperature
- Dissolved oxygen
- Specific conductance
- Chloride
- Ammonia
- TDS (Station D3 only)

Table 2 below summarizes the range of surface water quality conditions observed over this approximate 6-year period 2018-2023.

The data from Table 2 demonstrate that concentrations of chloride and ammonia, associated with the former FB and FBR source materials remain elevated in the west ditch surface water, as compared to concentrations measured in the Colville River. While the west ditch discharge (station D2) contains elevated concentrations of these constituents, the relatively small discharge from the west ditch into the Colville River results at most a small net increase in the concentration of these parameters between stations CR1 (upstream) and CR3 (downstream).

6.2.2 Surface Water Quality Trends 2018–2023

6.2.2.1 West Ditch

Surface water quality has shown some degree of measurable improvement as compared to the conditions documented by the previous periodic review for the surface water (2012–2016).

Table 3 summarizes the observed changes in chloride and ammonia concentrations and specific conductance at station D2 (mouth of west ditch). The values presented in the table represent the observed high and low measurements during these selected intervals. These data indicate that cleanup progress is attributable to the earlier source removal actions and ongoing natural attenuation processes are still ongoing.

Table 4 provides a more refined snapshot of water quality changes. Specifically, Table 4 presents a comparison of average chloride and ammonia concentrations and specific conductance field measurement of this current surface water periodic review cycle (May 2018–October 2023) and compared with parts of the previous periodic review cycle (April 2016–October 2017). The data indicate that water quality in the west ditch has shown measurable improvement. These decreases demonstrate positive progress toward achieving CULs.

6.2.2.2 Colville River

Water quality conditions for the analyzed IHSs within the Colville River during this periodic review period have not changed measurably since the previous 2012–2017 periodic review period (SCCD, 2024).

6.2.3 West Ditch Loading Rates 2018–2023

Chloride and ammonia loading rates at station D2 further demonstrate a progressive decline in contamination levels at the Site. Table 5 summarizes the estimated range of chloride and ammonia loading (pounds/day) that was discharged to the Colville River from the west ditch during the 2012–2017 and the 2018–2023 periods. Table 5 indicates an overall decline in the mass of chloride being discharged to the river from the ditch. The mass flux of ammonia also appears to be showing a measurable decline. Along with the apparent decreasing trends in contaminant concentrations), the loading data provide additional evidence indicating progress is being made toward achieving Site cleanup goals.

6.2.4 Groundwater Quality Conditions 2018–2023

Groundwater samples are collected from the 13 wells depicted in Figure 2. Groundwater analytical results between 2018 and 2023 are presented in Appendix A. The bold values in Appendix A indicate groundwater concentrations that exceed Site CULs. Table 6 presents the CUL factor of exceedance for each non-background well and each primary indicator parameter.

6.2.4.1 Site Background Wells

The concentrations of primary IHSs in upgradient well P-12 are below the established CULs for the Site, based on samples collected in 2018–2023. However, the ammonia concentration in the L-Bar production well exceeded the CUL at three monitoring events, the last and highest exceedance (0.712 mg/l ammonia) occurred at the last sampling event in the fall of 2023. The remaining primary IHSs in the production well were below the CULs. The secondary IHS parameter concentrations for these background wells were below the established CULs based on samples collected this periodic review report period. Note that the reporting limit for the thallium analyses for both the production well and well P-12 exceeded the thallium CUL five out of the six sampling events during the periodic review report period. The highest pH level in well P-12 was 8.4 recorded in the fall of 2021; and in the production well the highest pH recorded above the CUL was in 8.9 also in the fall of 2021 (Table 7).

The location of well P-12 and the groundwater quality data continue to justify the use of this well for general background comparison purposes. Compared to the previous periodic review period 2012-2017, the current periodic review period 2018-2023 showed increased ammonia concentrations in the L-bar production well and at times exceeding the Site CUL for ammonia. Consequently, the L-bar production well cannot be considered a suitable background well for future monitoring until the issue with the ammonia detections and high pH in this well has been resolved. Instead, the L-bar production well will be part of the group of Site interior wells.

6.2.4.2 Non-Background Wells

The 2023 concentrations of IHSs continues to exceed established CULs throughout the Site, including wells located in the vicinities of the magnesite residue pile, plant interior, north field, and west field (P-25). Table 7 shows recorded pH levels in the wells for this periodic review period and exceedances above the pH CUL are highlighted. For the secondary indicator parameters, cleanup levels for pH, manganese, barium, and selenium were exceeded in the following wells:

- Manganese is exceeded in eight wells (P-13, SA-10, P-09, P-06, P-19, P-20B, and P-25)
- Selenium is exceeded in three wells (SA-10, SA-11, and SA-14)
- Thallium is exceeded in three wells (SA- SA-10, SA-11, and SA-13)
- Barium is exceeded at one well (P-27)
- pH is exceeded in five wells (P-9, P-13, SA-10, SA-11, and SA-14)

6.2.5 Groundwater Quality Trends 2018-2023

Table 8 presents trend results from the Mann-Kendall method for primary IHSs that are analyzed annually and includes data from spring 2018 through fall 2023. Trends were identified as statistically significant at a 95 percent (or higher) confidence level. Of the total 39 possible well-constituent combinations tested (13 wells and 3 constituents), eight cases were found to be statistically significant; of these, a total of two were increasing trends, six were decreasing trends, and the remainder were not statistically significant (Great West, 2024).

Decreasing trends are expected in response to the previous remedial actions conducted at the site. Ongoing natural attenuation (dispersion for chloride and oxidation of ammonia) processes also are expected to produce a progressive reduction in the concentration of residual contaminants in Site soil and groundwater over time. Lack of a declining trend, or in some cases increasing trends, primarily indicate ongoing, transient conditions following the earlier stage of source removal. Residual contaminants are still being flushed and mobilized from former source areas, particularly in the area around well SA-11.

6.2.5.1 Site Background

At well P-12, a decreasing concentration trend was identified for chloride that contrast with the previous periodic review period 2012-2017 when increased trends were observed for chloride and total dissolved solids. Well P-12 is located next to Logan Road at the south end of the Site. Logan Road provides local access to commercial/light industrial operations located immediately south of the Site.

Increasing trends for background well P-12 may be caused by changes in local land use, agricultural practices, and/or expanded use of road salt during winter months. These apparent changes in background groundwater quality should be tracked and monitored carefully in future CMP monitoring evaluations. Long-term changes of groundwater quality in well P-12 Could indicate a shift in groundwater quality in the SWBU overall that could potentially affect monitoring wells within the Site proper. Note that the groundwater levels or water pressure in the production well have not been recorded during past groundwater monitoring events.

Existing concentrations of these indicator parameters are relatively low compared to the corresponding Site CULs in background well P-12

An increasing trend of ammonia was identified for the production well (L-Bar) that at times exceeded the Site CUL. However, because this well is artesian, it is unlikely that ammonia could have migrated downward and impacted the intermediate aquifer. Instead, the likely cause of the ammonia detections in the production well water is ammonia cross-contamination during sampling, transport, or analysis.

6.2.5.2 Magnesite Residue Pile Wells

Noteworthy concentration trends have been observed at the four magnesite residue monitoring wells (P-13, SA-10, SA-11, and SA-14), including:

- Chloride shows an increasing trend at SA-11 and a decreasing trend at P-13
- Ammonia shows a decreasing trend at P-13
- TDS shows a decreasing trend at SA-14

6.2.5.3 Site Interior Well P-09

Trend results for Site interior well P-09 and north field wells show no trends (chloride, ammonia, TDS).

6.2.5.4 North Field and West Field Wells

The Mann-Kendall test did detect two decreasing trends in the north field wells.

- Chloride shows a decreasing trend in well P-05
- Ammonia shows a decreasing trend in well P-20B

7 PERIODIC REVIEW

WAC 173-340-420(2) requires that:

“When evaluating whether human health and the environment are being protected during periodic review, the factors the department shall consider include:

- (a) The effectiveness of ongoing or completed cleanup actions;
- (b) New scientific information for individual hazardous substances or mixtures present at the site;
- (c) New applicable state and federal laws for hazardous substances or mixtures present at the site;
- (d) Current and projected site use;
- (e) Availability and practicability of higher preference technologies; and
- (f) The availability of improved analytical techniques to evaluate compliance with cleanup levels.

The department [Ecology] shall publish a notice of all periodic reviews in the site register and provide an opportunity for public comment.”

7.1 EFFECTIVENESS OF COMPLETED CLEANUP ACTIONS

7.1.1 Implemented Removal Action and Effect on Current IHS Trends

The completed cleanup actions primarily involved removing uncovered source materials (FB/FBR) from atop the magnesite pile, removal of FB/FBR materials stored within on-Site buildings and structures, and removal of FBR contained within the covered FBR pile. The main ditch was also eliminated as a primary site drainage feature. Vegetative uptake of selected IHS, in particular ammonia and nitrate, is an ongoing, cleanup process in portions of the Site, most notably the north field area. These past cleanup actions and ongoing contaminant reduction processes have resulted in the following:

- Cleanup of the main plant area, removal of materials from the buildings and magnesite residue pile and closing the main ditch have resulted in decreasing trends for chloride, ammonia-N, and TDS. However, IHS concentrations (in particular chloride) in shallow groundwater still exceed CULs; the rate of decline in IHS concentrations at plant interior monitoring well P-09 has been relatively slow to non-existent since the removal actions were completed as shown the concentration time series plots presented in Great West (2024) and the data presented in Appendix A.
- Monitoring wells located within the magnesite residue pile (SA-10, SA-11, and SA-14)

have shown different concentration trend patterns following removal of the FB/FBR source materials from this area. The trend analysis indicates increasing, decreasing, and non-evident concentration trends depending on the well and the monitoring parameter under consideration (Table 8). The persistent high chloride, total dissolved solids, and ammonia concentrations and the increase in chloride concentrations in well SA-11 strongly suggests that groundwater CULs for the primary IHSs will not be achieved in this portion of the Site by 2034.

- Some downward concentration trends for chloride, and ammonia (Table 8) are evident at two north field monitoring wells: P-05, P-20B. However, Ammonia-N concentrations remain highest at well P-20B, located closest to the former main ditch. Note that ammonia concentrations at the other north field wells are 10 to 100 times lower than the ammonia concentrations at P-20B. The CUL for barium is exceeded at well P-27, with no current indications of a statistically significant downward concentration trend. Similarly, the CUL for manganese is exceeded at wells SA-10, P-06, P-13, P-19, P-20B, and P-25 with no current indications of a statistically significant downward concentration trend. Residual IHS concentrations at several north field wells may not achieve CULs by 2034 based on existing flat trends and observed concentrations.
- Decreasing chloride and ammonia-N concentrations and mass loading has been observed at the lower west ditch station D2 since the last periodic review (Table 3). A similar concentration trend for chloride and ammonia also is evident at side-stream west ditch station D3 (SCCD, 2024). These declining trend observations (concentration and mass loading) are attributed largely to source material removal actions completed from 1997–2004.

The CAP anticipated a restoration time frame of 20 to 30 years (2024–2034) from the time of the completion of the CAP that occurred in 2004. This projected restoration time frame may not be achievable for all primary and secondary IHS, based on the current predictive trend analyses performed. However, by removing the source materials, maintaining existing (or similar) land use practices into the foreseeable future, and ensuring that the Restrictive Covenant provisions are followed, overall risk to human health and the environment will remain low.

7.1.2 Expected Origin and Fate of IHS Compounds

7.1.2.1 Primary IHS: chloride, ammonia, pH, and TDS

Elevated chloride, ammonia, pH, and TDS concentrations in site media (soil, shallow groundwater, surface water) and residual material processing byproducts (magnesite residue) are largely attributed to leaching from former FB and FBR stockpiles. Leaching of chloride and ammonia from FB likely began shortly after L-Bar Products began stockpiling FB (and some FBR) on top of the magnesite residue pile in 1988 (CH2M, 1998). Similarly, chloride and ammonia were being actively leached from the covered FBR stockpile throughout its lifetime by infiltrating precipitation and direct contact with shallow groundwater and surface water (west

ditch). The IHS that leached from these various source material stockpiles eventually impacted water quality in the underlying groundwater system (SWBU) and former west ditch.

FB/FBR and magnesite residue materials have a slightly elevated pH. Only one well at the site, SA-14 and occasionally P-13 well within the magnesite residue pile, has a pH value above the recommended upper limit of 8.5. Note that wells SA-10 and SA-11 also have elevated pH albeit below 8.5. Magnesite and magnesium carbonate found in the stockpile have a pH slightly above 10. The pH in groundwater will decline depending on the inflow of water that has been in contact and equilibrated with the matrix in the magnesite stockpiles. It is possible that the pH in some wells within the magnesite stockpile may not decrease depending on the influx of water infiltrating through the stockpiles. The pH is anticipated to decrease downgradient of the magnesite stockpiles where groundwater will be affected by more acidic natural geochemical conditions and also be affected by redox conditions created by vegetation in the downstream portion of the west ditch.

Plant growth (sedges and grasses) in the north field continues to assist with the seasonal removal of ammonia from soil and shallow groundwater. Similarly, periodic flooding of the Colville River, and the ongoing discharge of shallow groundwater and surface water (west ditch) to the Colville River, slowly and progressively flushes non-degradable inorganic constituents such as chloride from the northern portion of the site. Over time, these processes will continue to reduce the concentration of chloride, ammonia, and TDS. However, existing site hydraulics, fine-grained site soils, the dispersed nature of the former FB/FBR piles, and the chemical characteristics of the primary IHS likely will limit the rate at which these residual contaminants are flushed and removed from the Site.

7.1.2.2 Secondary IHSs: nitrate and nitrite

Nitrate and nitrite are derived, through natural chemical transformation processes, from ammonia that was present either in the original source materials transported to the Site or generated in place by weathering of the FB and FBR stockpiles. Nitrite has been detected occasionally during the sampling events during this review period. Nitrite levels did not exceed the Site CUL. Elevated nitrate has been observed in only a single north field well (P-20B) located close to the former west ditch. Levels of nitrate in well P-20B exceeded the Site CUL during the last four sampling events in 2020 and 2022. Like ammonia, nitrate can be used by plants growing in the north field. Plants growing within or along the west ditch are likely to seasonally extract and utilize nitrate that is conveyed to this drainage feature from shallow groundwater. Nitrate is expected to dissipate to background levels over time, as ammonia residuals in soil and shallow groundwater continue to dissipate and decline.

7.1.2.3 Secondary IHSs: barium, manganese, selenium, and thallium

A small suite of trace metals/metalloids (barium, manganese, selenium, and thallium) were identified as IHS in the CAP. The presence of these metals/metalloids indicate three potential or likely source origins and/or mobilization mechanisms:

- A known or suspected component within FB/FBR materials
- A possible component in the magnesite residue pile material that became mobilized/solubilized into groundwater through changes in geochemical conditions caused by FB/FBR-associated contamination
- A naturally occurring constituent within the local alluvial soils that became mobilized/solubilized into groundwater through changes in geochemical conditions caused by FB/FBR-associated contamination

The specific source or mechanism(s) that has caused elevated manganese concentrations in shallow groundwater is not readily apparent. No strong linkage to the FB materials has been documented. It is possible that geochemical changes in areas impacted by elevated chloride, ammonia, and other source-related constituents may have influenced the tendency for naturally occurring manganese in the native alluvial soils to dissolve and become enriched in shallow groundwater. Manganese concentrations are expected to decline over time as the residual FB/FBR contaminants are progressively flushed from soil and shallow groundwater. Manganese solubility is strongly dependent on the redox conditions of the surface and groundwater. Redox conditions have not been recorded consistently during the groundwater sampling. Selenium concentrations exceeding the Site CULs were observed in three of the magnesium pile monitoring wells SA-10, SA-11, and SA-14. Selenium concentrations exceeded Site CUL during one sampling event (5/28/2020) in north field well P-27. Thallium detection above the Site CULs were observed in three of the four magnesite wells SA-10, SA- 11, and SA-13.

The specific sources or mechanisms that have caused elevated barium, selenium, and thallium concentrations in shallow groundwater are not clearly tied to a single source or geochemical factor. The Phase I RI report (CH2M, 1998) mentions that magnesite residue contains various heavy metals and metalloids. The heavy metal content of the magnesite residue is attributed, in part, to the presence of coal ash that was mixed in with waste magnesite residuals disposed at the magnesite residue pile. Common contaminants in coal ash are barium, manganese, selenium, and thallium. Local wind-blown dispersion of fine-grained magnesite “dust” into the local soils may have contributed to localized enrichment of these metals in shallow groundwater.

Concentrations of these trace metals are expected to decline over time, due to ongoing natural attenuation processes, and/or as the residual FB/FBR contaminants are progressively flushed from soil and shallow groundwater.

Elevated concentrations of barium are limited to a single north field area well (P-27), located within the footprint of the groundwater plume that largely emanated from the covered FBR pile. Barium is known to be present in the magnesite residue materials and was also commonly used as a fluxing agent in the particular magnesium metal refining process used by NWA. However, it is also a fairly common trace metal in northeast Washington alluvial soils containing volcanic ash such as those found in the north field. Water with high chloride concentration found

at well P-27 can mobilize barium. Either mechanism might explain the localized barium enrichment observed at P-27. The barium concentration is expected to decline over time as residual FB/FBR contaminants are progressively flushed from soil and shallow groundwater.

7.2 NEW SCIENTIFIC INFORMATION FOR IHS OR MIXTURES PRESENT AT THE SITE

There is no new pertinent scientific information for the contaminants related to the Site.

7.3 NEW APPLICABLE STATE AND FEDERAL LAWS FOR HAZARDOUS SUBSTANCES PRESENT AT THE SITE

MTCA cleanup levels for the indicators have not changed since remedial actions were completed at the Site in 2004.

7.4 CURRENT AND PROJECTED SITE USE

Current operations adjacent to the Site include commercial and light industrial activities. A portion of Parcel No. 2601080 was previously used for agricultural purposes that are now inactive. All plants used in the agricultural operation have been removed from the Site. There is no expected or anticipated change in the future use of the Site. If a change in site use does occur, the limitations in the Restrictive Covenants will prevent activities or disturbances that may increase the likelihood for exposure by humans or ecological receptors to hazardous substances remaining at the Site.

Review of the existing 2001 Restrictive Covenant for the L-Bar Site identified inaccuracies and omissions that require correction to ensure ongoing protectiveness of the existing remedy.

Updated Restrictive Environmental Covenants have been prepared that are in conformance with the Uniform Environmental Covenants Act (Chapter 64.70 RCW) and been mailed to the affected Site property owners for ratification.

The existing monitoring network (wells and surface water sampling stations) is expected to remain intact until the next periodic review. Ecology believes the current monitoring well network, and associated network of surface water monitoring stations, provides reasonable spatial distribution and positioning to track the ongoing cleanup action progress throughout the Site.

7.5 AVAILABILITY AND PRACTICABILITY OF HIGHER PREFERENCE TECHNOLOGIES

The implemented remedy was considered practicable and preferred from a cost-benefit standpoint, which considered the contaminants involved and the projected future uses of the property. This determination has not changed.

7.6 AVAILABILITY OF IMPROVED ANALYTICAL TECHNIQUES TO EVALUATE COMPLIANCE WITH CLEANUP LEVELS

The analytical techniques used to quantify IHS concentrations are considered adequate for determining compliance with the established CULs for this Site. During certain monitoring events in 2016, the reporting limits for thallium exceeded the established CUL for thallium. Ecology communicated these concerns with the potentially liable persons (PLPs) at the time of the completion of 2018 periodic review report. Unfortunately, the problem with thallium reporting limits higher than the thallium CUL still persist throughout the 2018-2023 review period.

8 CONCLUSIONS

Based on the findings presented in Chapter 6 and 7 in this report, Ecology has drawn the following conclusions:

- Previous source removal actions were effective at eliminating the primary contaminant release mechanisms that allowed source-related contaminants to migrate into soil, sediments, shallow groundwater, and surface water at the Site.
- The existing monitoring network for surface water and groundwater is adequate for evaluating changes (both temporal and spatial) in IHS concentrations.
- Site activities and operations have changed since the 2013-2017 review period. The agricultural on-Site operation observed during the 2013-2017 review period has been discontinued, and all live plants have been removed.
- The 2020 CMP update does not include pH as a Site primary IHS.
- Site CULs have not been met, although some improvements to groundwater and surface water quality have been demonstrated since the last periodic review. Concentrations of primary IHS (chloride, ammonia, and TDS) in surface water and shallow groundwater are still elevated compared to their established CULs. Concentrations of secondary IHS (trace metals, nitrate, nitrite, and pH) exceed CULs at some locations.
- Concentrations of chloride, ammonia, and TDS (primary IHS) are declining progressively in many areas of the Site.
- The primary environmental fate of chloride is mobilization and transport from solid phase media (soil and magnesite residue) to shallow groundwater and surface water, with eventual discharge to the Colville River.
- The primary environmental fate of nitrogenous compounds such as ammonia and nitrate is influenced in part by plant uptake that is occurring primarily within the north field (agricultural field), and likely to some degree by vegetation growing along or within the west ditch. Some ammonia and possibly nitrate currently discharge to the Colville River via surface water (West Ditch) and shallow groundwater.
- Surface water quality in the West Ditch sampling point near the outfall into Colville River(station D2) is showing progressive improvement since the previous 2018 periodic review was conducted. More specifically, the concentration and loading of IHSs declined measurably between the first periodic review interval (2005-2011), the second periodic review interval (2012-2017), and now the third periodic review interval (2018-2023).
- Groundwater monitoring data analysis demonstrates declining concentration trends at several locations within the monitoring network. An increasing concentration trend is

observed in one well (SA-11) located in the magnesite residue pile. This increasing trend may be caused by a migrating “slug” of impacted groundwater migrating from the southwest where past FB/FBR used to be stored before the Site removal action (CH2M, 2014). However, it is possible that contaminants may still being flushed from residual FB/FBR components left behind within this large pile of legacy wastes associated with the former magnesite processing facility.

- Shallow groundwater in the north field discharges to the Colville River. Although primary IHS in north field groundwater and the west ditch outfall exceed CULs, continued monitoring of the Colville River upstream and downstream of the Site has shown that impacts from this groundwater discharge are negligible. Surface water standards have not been exceeded in the river.
- The specific sources or mechanisms that have caused elevated manganese, barium, selenium, and thallium concentrations in shallow groundwater do not appear to be clearly tied to a single source or geochemical factor.
- Trace metal concentrations in groundwater are expected to decline over time due to ongoing natural attenuation processes. The environmental fate of trace metals likely will include sorption to soil under favorable geochemical conditions, or gradual flushing, dispersion, and discharge to the Colville River via shallow groundwater.
- Groundwater levels or water pressure in the production well have not been measured and recorded during past groundwater monitoring events.
- Groundwater in the artesian L-bar production well may show an impact of Site contaminants with ammonia and pH sometimes exceeding Site CULs. The ammonia and pH impacts in the production well water may be caused by other factors such as ammonia cross-contaminated between samples during the sampling event or analysis.
- Reporting limits for thallium exceed the thallium Site CUL in most samples collected during the 2018-2023 review period.
- The original 2001 environmental restrictive covenants that did not cover some parcels have been augmented with new restrictive covenants that conform with the Uniform Covenants Act. Hence, activities within all Site parcels are now controlled by an environmental restrictive covenant.

9 RECOMMENDATIONS

Based on the conclusions presented above, Ecology makes the following recommendations:

- CULs are still being exceeded at the Site. However, as long as the existing Restrictive Covenant is active and remains effective in protecting human health and the environment from exposure to hazardous substances, no further action is required beyond compliance monitoring and periodic review.
- Continue performing the spring/early summer groundwater and surface water monitoring events during May or early June after the peak spring flood.
- Continue performing the fall surface water and groundwater sampling events when a surface water discharge of at least 10 gpm is present at west ditch station D2. The typical window for conducting the fall sampling event is early October to mid-November.
- Amend the 2020 and 2021 Compliance Monitoring updates to include documentation of procedures and routines to measure pH (a Site primary IHS).
- Continue surface water monitoring in accordance with the Compliance Monitoring Program Sampling and Analysis Work Plan, 2020 Revision.
- Continue groundwater water monitoring in accordance with the following frequencies and procedures set in accordance with the Compliance Monitoring Program Sampling and Analysis Work Plan, 2020 and 2021 Revisions.
- Measure the groundwater levels or record the water pressure in the production well during future groundwater sampling events.
- The L-bar production well shows increasing trends of IHS compounds, ammonia and pH have exceeded the Site CUL during some of the sampling events during this review period. Determine the cause for the detections of ammonia and potentially resulting in elevated pH in the production well water and take appropriate corrective action.
- Well P-09 should be retained in the current monitoring network until further notice. While contaminant concentrations at P-09 have declined, this well provides important tracking of groundwater conditions within the main plant area. Demolition of existing buildings (some in deteriorated condition) near P-09 also may occur in the future, and any disturbances or impacts to shallow groundwater caused by these actions will need to be monitored.
- As noted in the previous 2018 Periodic Review report, the reporting limits for the thallium analyses must not exceed the thallium CUL. If this is not achievable, the next periodic review should take into consideration the current cleanup level in relation to its

PQL/MDL. The PLPs will need to identify analytical laboratories that can achieve these analytical concentration goals for thallium and are properly accredited. Ecology must approve any changes in writing regarding thallium sampling preparation and/or analytical methods before sampling.

- Specific attention should be placed on wells SA-10 and SA-11 during the next five years to follow any trends of primary IHSs and increasing trends in particular. The purpose of this attention is to determine whether there may be residual FB/FBR in the area of wells SA-10 and SA-11 or whether the cause for increase of chloride in well SA-11 is caused by a northeast migrating “slug” of contaminated groundwater.
- Statistical analysis and graphic review of available groundwater monitoring data indicate that groundwater CULs will be achieved at some but not all locations by 2034 (30-year cleanup time frame from the implemented cleanup action in 2004). Continuing progress toward achieving cleanup levels throughout the site should be evaluated closely during the next periodic review (2028). A predictive trend analysis should be performed at this time to determine whether the current projected concentration trends are gradually leveling out (approaching asymptotic levels) or show a more rapid rate of concentration decline.

10 REFERENCES

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11 TABLES

Table 1 Site Cleanup Levels (CULs), Analytical Methods, and Sampling Frequency (from GreatWest, 2024)

Groundwater Analytical Suite, Test Methods, and Preliminary Cleanup Levels
2023 L-Bar Site Five Year Review Report

Wells ^(a)	Analytical Parameter	Method	MRL ^(b)	Cleanup Level ^(c)	Sampling Frequency ^(d)
All Wells: P-05, P06, P-09, P-12, P-13, P-20B, P-25, P-27, SA-10, SA-11, SA-14, and PW (Refer to Fig. 1)	Primary Indicator Parameters:				
	Ammonia (NH ₄ as N)	EPA 350.1	0.05 mg/L	0.13 mg/L	Semi-Annual (2x/year)
	Chloride (Cl)	EPA 300.0	0.2 mg/L	230 mg/L	Semi-Annual (2x/year)
	Total Dissolved Solids (TDS)	SM 2540C	5 mg/L	1092 mg/L	Semi-Annual (2x/year)
	Secondary Parameters:				
	Nitrate (as N)	EPA 353.2	0.05 mg/L	10 mg/L	Every other year (2x/year)
	Nitrite (as N)	SM 4500B	0.05 mg/L	1 mg/L	Every other year (2x/year)
	Barium (total)	EPA 200.7	0.02 mg/L	1 mg/L	Every other year (2x/year)
	Manganese (total)	EPA 200.7	0.0006 mg/L	0.44 mg/L	Every other year (2x/year)
	Selenium (total)	EPA 200.8	0.001 mg/L	0.0082 mg/L	Every other year (2x/year)
	Thallium (total)	EPA 200.8	0.0002 mg/L	0.00112 mg/L	Every other year (2x/year)

Notes:

- (a) Well network shown in Figure 1.
- (b) MRL = method reporting limit.
- (c) Cleanup Levels from Table 4-14 of *L-Bar Cleanup Levels Development and Feasibility Report* (CH2M HILL 1999).
- (d) Primary indicator parameters are sampled consistently twice per year (semi-annually); secondary parameters are sampled twice per year every other year. Secondary parameters typically sampled during even years, for example, 2012, 2014, 2016, etc.

Table 2, Summary of Surface Water Quality Monitoring Results (2018–2023)

Parameter	West Ditch Mouth (D2)	Upper West Ditch (D3)	Colville River Upstream (CR1)	Colville River Downstream (CR3)
pH	7.16 – 8.00	7.45 – 8.35	7.55 – 8.59	7.24 – 8.11
Temperature (degrees F)	1.1 – 19.6	1.5 – 18.7	2.4 – 17.1	3.4 – 16.5
Specific Conductance (µS/cm)	1,500 – 3,003	1,093 – 8,080	242 – 411	278 – 415
Dissolved Oxygen (mg/l)	1.3 – 5.3	NM	8.2 – 14.7	7.6 – 13.9
Chloride (mg/l)	184 – 610	62.2 – 139	2.15 – 6.72	2.81 – 6.-01
Ammonia as NH3-N (mg/l)	< 0.02 – 5.97	< 0.02 – 1.46	<0.02 – 0.07	<0.02 – 0.12
Total Dissolved Solids (mg/L)	NM	535 – 3,350	NM	NM

NM – not measured

Table 3, Comparison of Water Quality Conditions at West Ditch outlet into Colville River (Station D2): 2012–2017 (Second Periodic Review) vs. 2018–2023 (Third Periodic Review)

Parameter	Observed Range (2012–2017)	Observed Range (2018-2023)
Specific Conductance ($\mu\text{S}/\text{cm}$)¹	2,040 – 7,090	1,500 – 3,003
Chloride (mg/l)¹	490 – 1,750	184 – 610
Ammonia (mg/l)	3.8 – 62.4	< 0.02 – 5.97

Notes: $\mu\text{S}/\text{cm}$ – micro-Siemens per centimeter, mg/l – milligrams per liter

¹ Excludes measurements during seasonal flooding of Colville River.

Table 4, Comparison of Water Quality Conditions at West Ditch Station D2: 2016–2017 vs. 2018–2023

Parameter	Average Concentration (April 2016–October 2017) ¹	Average Concentration (May 2018–October 2023) ²
Specific Conductance (µS/cm)	3,300	2,338
Chloride (mg/l)	600	405
Ammonia (mg/l)	6.0	1.77

Notes: µS/cm – micro-Siemens per centimeter, mg/l – milligrams per liter

¹ From monitoring data presented in Ecology (2019).

² From monitoring data provided in SCCD (2024)

Table 5 Comparison of Contaminant Loading Rates at West Ditch Station D2: 2012–2017 vs. 2018– 2023

Parameter	Calculated Range (2012–2017)	Calculated Range (2018–2023)
Chloride Load (pounds/day)	¹ 70 – 640	27.9-156.8
Ammonia Load (pounds/day)	0.8 – 6.7	0 ² -2.11

¹ Flow measurements were not obtained in 2012 or early 2013.

² Zero value reflects an absence of flow (dry) in the West Ditch during late summer conditions.

**Table 6, Cleanup Level Factor of Exceedance Values for Groundwater Monitoring Wells
Primary Indicator Parameters from GreatWest (2023).**

TABLE 6.
Groundwater Quality Data - Cleanup Level Ratios For 2023
2023 L-Bar Site Five-Year Review Report

Analyte *	Cleanup Level *	Units	Cleanup Level Ratios ^c												
			Site Background		Former Source Area / Magnesite Residue Pile				Site Interior	North Field					
			P-12	PROD. WELL	P-13	SA-10	SA-11	SA-14	P-09	P-05	P-06	P-19	P-20B	P-25	P-27
Ammonia-N*	0.13	mg/L	0.37	2.8	168	3,615	1,049	150	48.3	3.0	2.8	1.4	85	5.9	0.6
Chloride*	230	mg/L	0.02	0.0047	3.1	36	42	5.1	3.7	6	0.36	29	6.0	3.3	29
TDS*	1,092.4	mg/L	0.64	0.27	3.2	13	15	2.7	1.6	2.6	0.51	8.5	3.0	1.9	4

Notes:

*Primary indicator parameters indicated with "**".

^b Cleanup Levels as listed in the *L-Bar Cleanup Levels Development and Feasibility Report* (CH2M HILL 1999).

^c Cleanup Level Ratio = (mean 2023 concentration)/(cleanup level)

BOLD font are cleanup level ratios > 1

TDS = Total Dissolved Solids

Non-detect results replaced with the quantitation limit - for ammonia the quantitation limit was 0.02 mg/L

L-Bar Site

August 2026

Table 7. Field pH Values 2020-2023*L-Bar Site - Supplemental Data for Ecology**Periodic Review*

Date	P-12	P-13	SA-10	SA-11	SA-14	P-9	P-5	P-6	P-27	P-19	P-20B	P-25	PW
5/28/2020	7.7	7.3	7.9	8.6	10.2	7.6	7.3	7.3	7.2	6.8	7.2	7.0	7.9
11/5/2020	7.9	7.4	8.0	8.4	10.5	8.9	7.8	7.6	7.3	7.0	7.3	7.2	8.1
5/20/2021	7.9	8.9	8.5	8.7	10.8	8.9	7.7	7.8	7.7	7.2	7.8	7.3	8.6
11/11/2021	8.4	8.0	8.5	9.2	11.1	8.9	8.0	8.3	7.7	7.6	7.8	7.9	8.9
5/12/2022	7.8	8.8	7.9	8.6	10.5	7.8	7.5	7.5	7.3	6.8	7.6	7.0	8.3
10/27/2022	7.9	7.9	8.4	8.6	10.9	8.6	7.6	7.7	7.2	7.0	7.5	7.2	8.2
5/11/2023	7.6	9.1	7.8	8.1	10.2	7.3	7.6	7.3	7.3	6.6	7.6	6.8	7.7
11/9/2023	7.9	8.4	7.7	8.4	10.6	8.0	7.7	8.2	7.2	7.0	7.6	7.5	8.3

Table 8, Mann-Kendall Method Trend Analysis Results From Great West (2024)

Area	Well	Constituent Name	No of Datapoints	% Non-detects	Slope	Trend Direction	Confidence
Background	P-12 (bg)	Chloride (mg/L)	12	0	-0.6912	Decreasing	95%
Background/deeper unit	PW (bg)	Total Dissolved Solids (mg/L)	12	8.333	20.17	Increasing	95%
Upgradient/Former Source Area	P-13 (bg)	Ammonia-N (mg/L)	12	0	-3.635	Decreasing	95%
Upgradient/Former Source Area	P-13 (bg)	Chloride (mg/L)	12	0	-49.67	Decreasing	95%
Former Source Area/MRP	SA-11 (bg)	Chloride (mg/L)	12	0	715.3	Increasing	95%
Former Source Area/MRP	SA-14 (bg)	Total Dissolved Solids (mg/L)	12	0	-138.4	Decreasing	95%
North Field	P-05 (bg)	Chloride (mg/L)	12	0	-86.26	Decreasing	95%
North Field	P-20B (bg)	Ammonia-N (mg/L)	12	0	-2.767	Decreasing	95%

Note:

Trend results tested on primary suite from data over 2018 to 2023 (past 6 years).

Refer to Appendix C for time-series and Appendix D for full output of Mann-Kendall trend testing showing all cases tested.

12 FIGURES

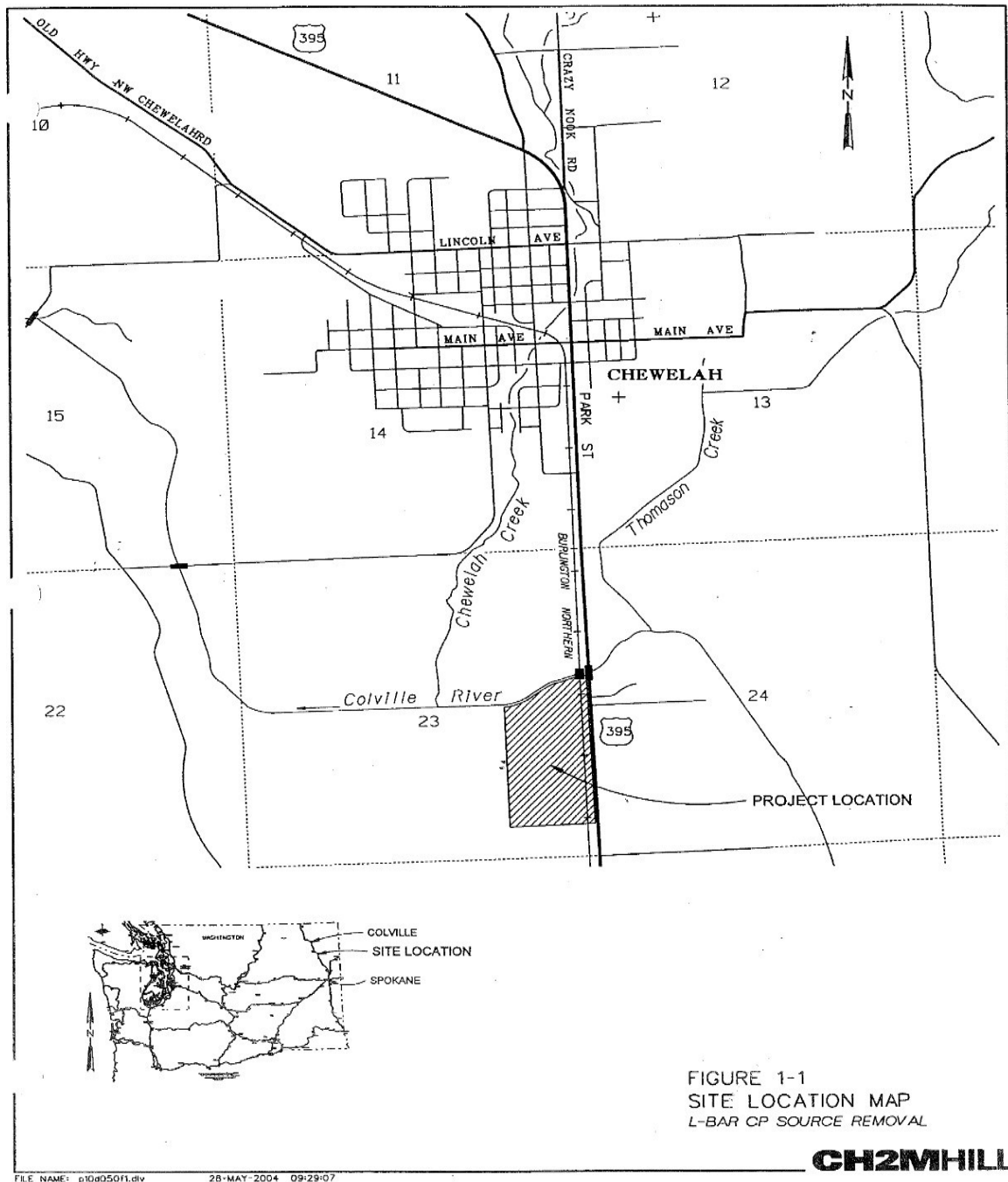


Figure 1 Site Location Map (from CH2M, 2017)

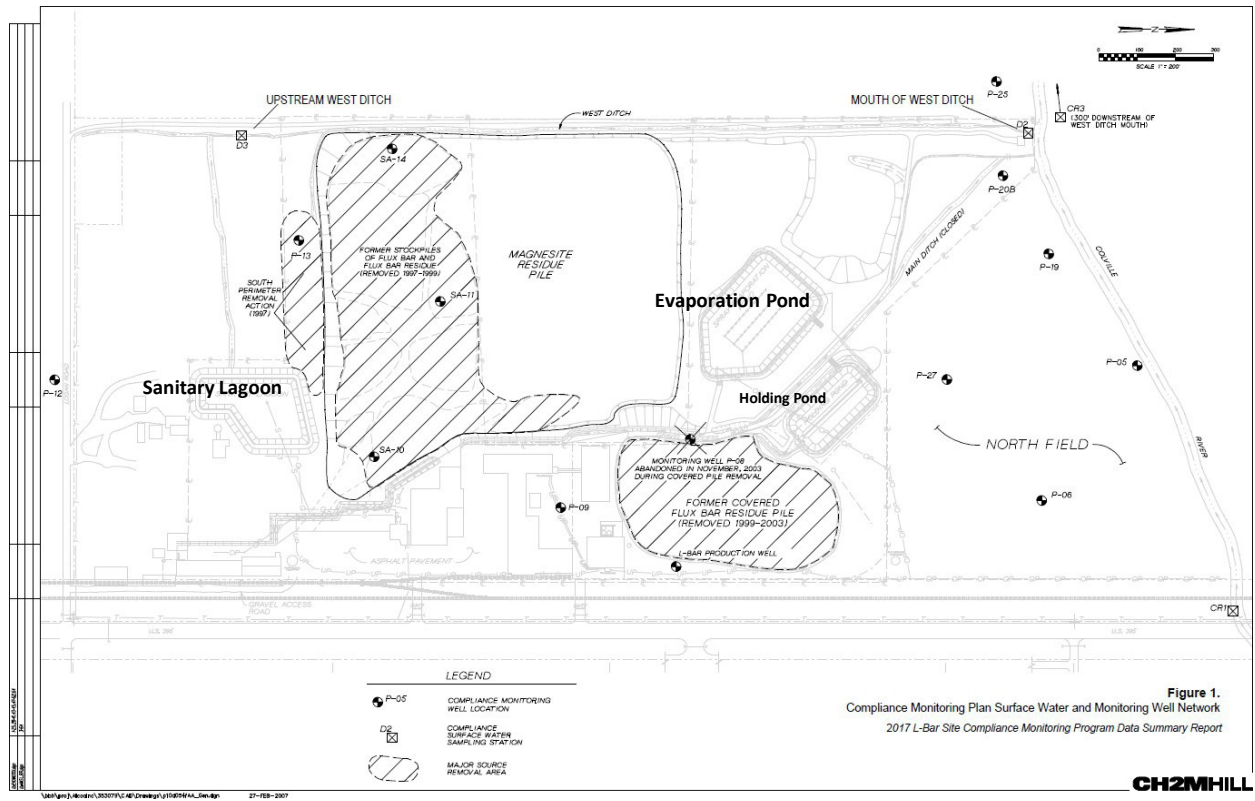
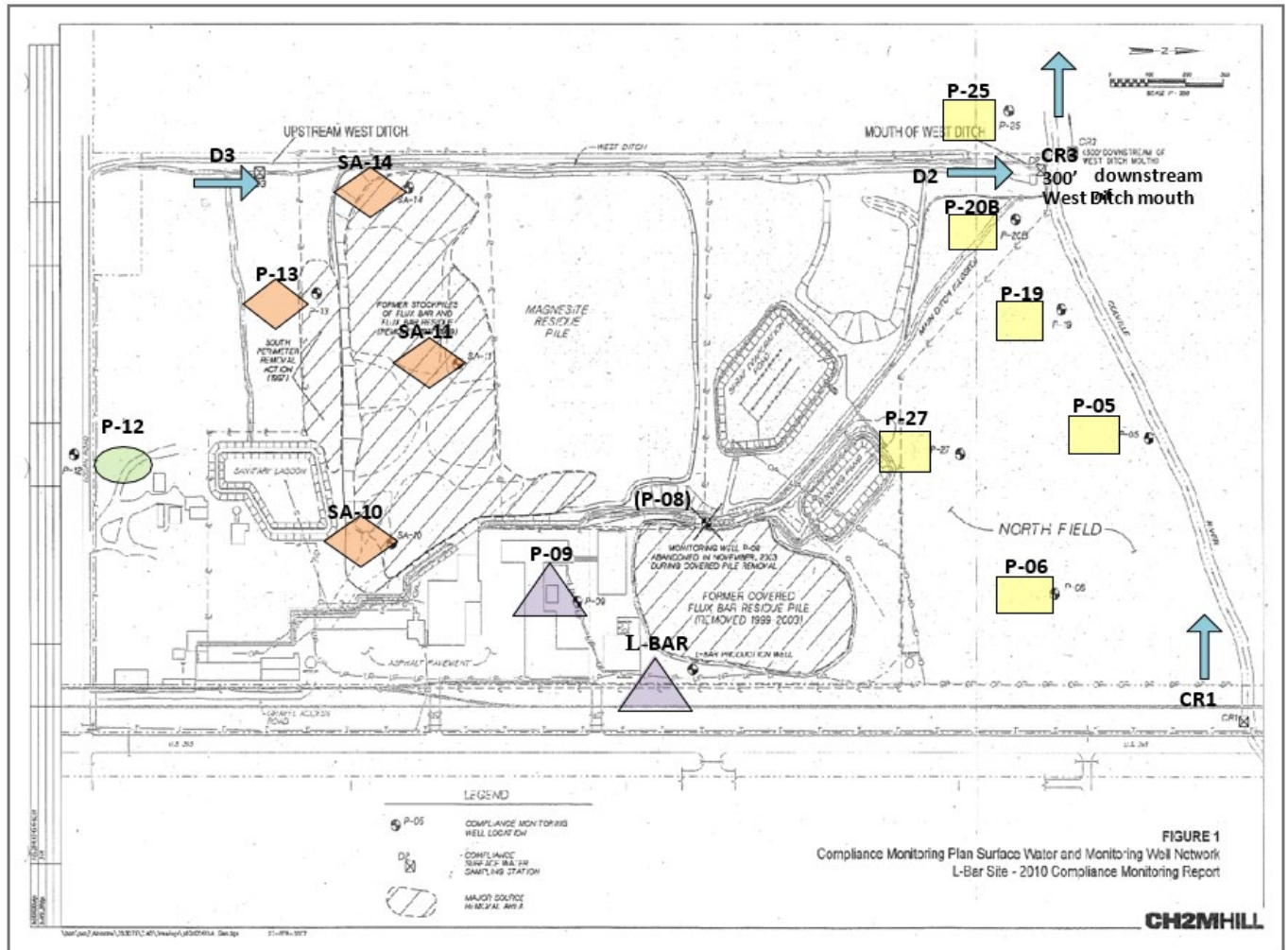


Figure 2, Site Map (CH2M 2017)



Figure 3, Site and Vicinity Parcel Map (from Stevens Co. Assessor's Office)

Figure 4, Compliance Monitoring Well and Surface Water Network



- North Field Wells
- Magnesite Residue Pile Wells
- Plant Interior Wells
- Background Well (P-12) and Production Well (L-Bar)
- Surface Water Sampling Location

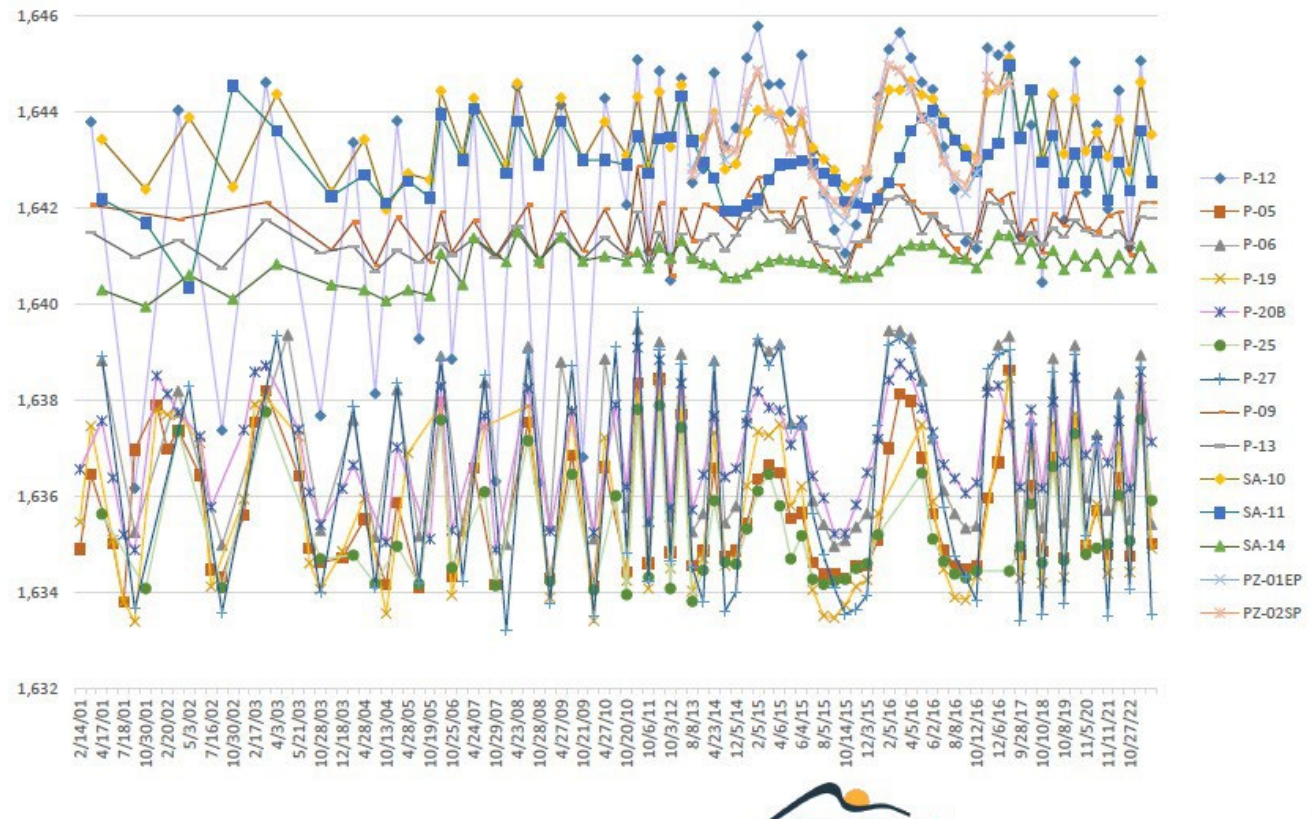
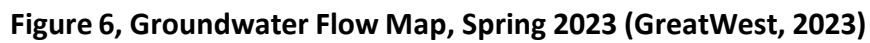


Figure 5, Semi-annual Groundwater Elevation Hydrograph (from GreatWest, 2023)



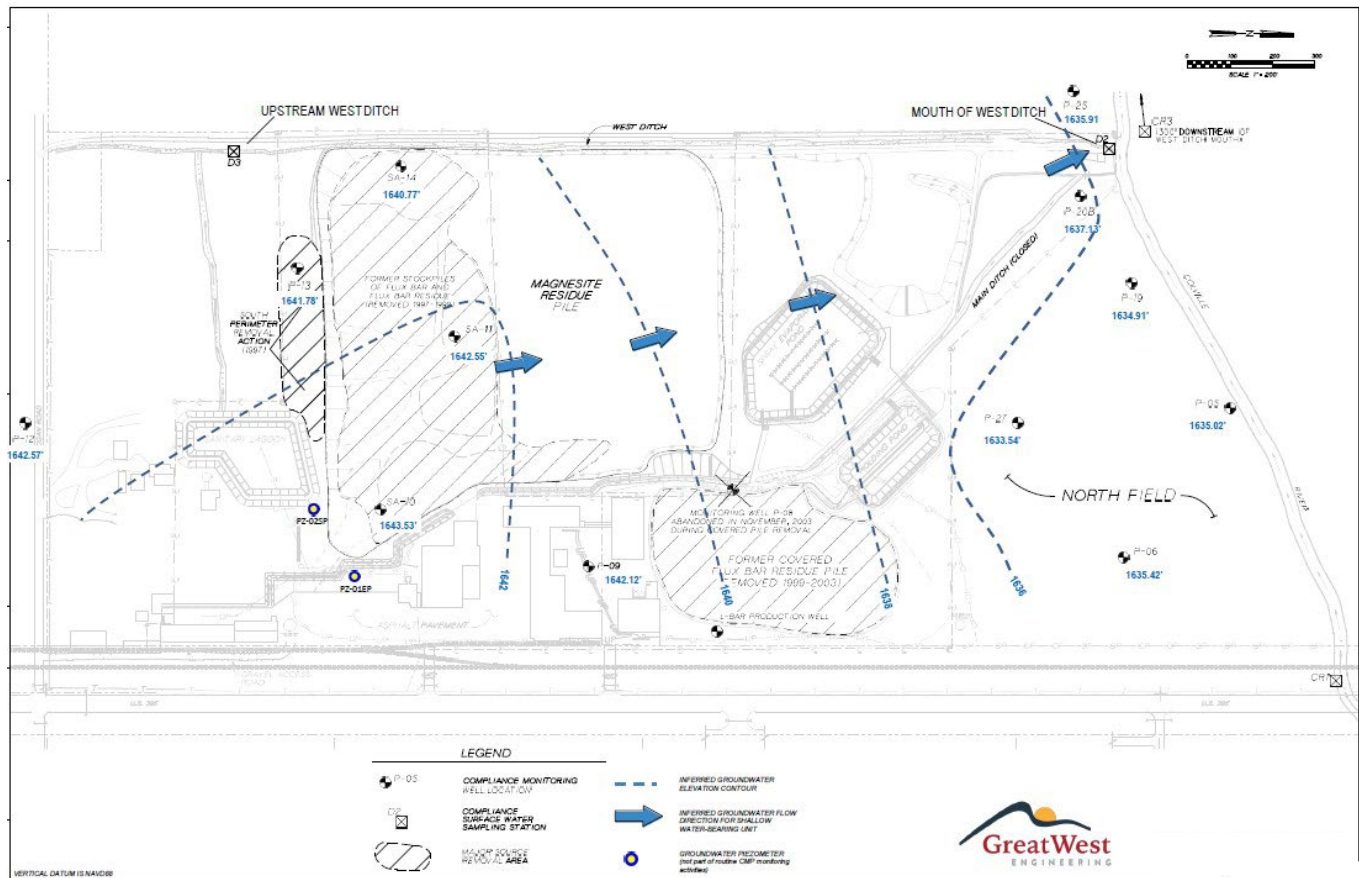


Figure 7, Groundwater Flow Map, Fall 2023 (From GreatWest, 2023)

13 APPENDICES

APPENDIX A

Appendix A. Summary of Groundwater Quality Data and Comparison to Cleanup Levels
(2018-2023) Addendum to L-Bar Site 2023 Periodic Review Report, Revision 1, February 2025

Well	Date	Constituents Units Cleanup Levels	Ammonia-N (mg/L)	Chloride (mg/L)	TDS (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	Barium (mg/L)	Manganese (mg/L)	Selenium (mg/L)	Thallium (mg/L)
			0.13	230	1,092	10	1	1	0.44	0.0082	0.0002
P-12											
Background Well	6/6/2018		< 0.0200 (U)	9.73	782	1.65	< 0.100 (U)	0.0359	0.00224	< 0.00100 (U)	< 0.00100 (U)*
	10/10/2018		< 0.0200 (U)	8.64	669	1.43	< 0.100 (U)	0.0357	0.0154	< 0.00100 (U)	< 0.00100 (U)*
	4/30/2019		< 0.0200 (U)	8.26	764	n/a	n/a	n/a	n/a	n/a	n/a
	10/8/2019		0.0414	7.19	724	n/a	n/a	n/a	n/a	n/a	n/a
	5/28/2020		< 0.0200 (U)	8.11	648	1.08	< 0.100 (U)	0.0298	< 0.00100 (U)	< 0.00100 (U)	< 0.00100 (U)
	11/5/2020		< 0.0200 (U)	7.11	562	1.24	< 0.100 (U)	0.0336	< 0.00100 (U)	< 0.00100 (U)*	< 0.00100 (U)*
	5/20/2021		< 0.0200 (U)	7.05	679	n/a	n/a	n/a	n/a	n/a	n/a
	11/11/2021		< 0.0200 (U)	6.49	681	n/a	n/a	n/a	n/a	n/a	n/a
	5/12/2022		< 0.0200 (U)	6.54	601	1.33	< 0.100 (U)	0.0424	0.0299	< 0.00100 (U)	0.0029
	10/27/2022		< 0.0200 (U)	5.55	718	1.44	< 0.100 (U)	0.0272	0.00234	0.00105	< 0.00100 (U)*
	5/11/2023		< 0.0200 (U)	5.76	690	n/a	n/a	n/a	n/a	n/a	n/a
	11/9/2023		0.0477	5.45	719	n/a	n/a	n/a	n/a	n/a	n/a
P-13			0.13	230	1,092	10	1	1	0.44	0.0082	0.0002
Magnesium Residue Pile Well	6/6/2018		38	1,200	4,896	0.425	< 0.100 (U)	0.0506	4.46	0.00365	< 0.00100 (U)*
	10/10/2018		40.5	1,150	4,570	2.7	< 0.100 (U)	0.0505	4.55	< 0.00100 (U)	< 0.00100 (U)*
	4/30/2019		36.7	1,150	5,150	n/a	n/a	n/a	n/a	n/a	n/a
	10/8/2019		43.3	1,170	5,370	n/a	n/a	n/a	n/a	n/a	n/a
	5/28/2020		39.9	1,200	4,470	0.155	0.31	0.0437	4.62	0.00299	< 0.00100 (U)
	11/5/2020		38.4	1,190	4,110	3.67	< 0.100 (U)	0.0521	4.55	< 0.00100 (U)*	< 0.00100 (U)*
	5/20/2021		31.2	1,050	4,970	n/a	n/a	n/a	n/a	n/a	n/a
	11/11/2021		32.5	1,100	6,070	n/a	n/a	n/a	n/a	n/a	n/a
	5/12/2022		24.6	1,140	4,240	2.38	< 0.100 (U)	0.0841	1.54	< 0.00100 (U)	0.005
	10/27/2022		27.4	996	5,010	6.21	< 0.100 (U)	0.0662	2.65	0.00223	< 0.00100 (U)*
	5/11/2023		16.7	611	2,500	n/a	n/a	n/a	n/a	n/a	n/a
	11/9/2023		27.1	810	4,520	n/a	n/a	n/a	n/a	n/a	n/a
P-05			0.13	230	1,092	10	1	1	0.44	0.0082	0.0002
North Field Well	6/6/2018		< 0.0200 (U)	2,190	3,625	< 0.100 (U)	< 0.100 (U)	0.465	0.00662	0.0031	< 0.00100 (U)*
	10/10/2018		< 0.0200 (U)	1,980	3,780	< 0.100 (U)	< 0.100 (U)	0.545	0.647	< 0.00100 (U)	< 0.00100 (U)*
	4/30/2019		< 0.0200 (U)	1,890	3,340	n/a	n/a	n/a	n/a	n/a	n/a
	10/8/2019		0.0273	2,100	3,460	n/a	n/a	n/a	n/a	n/a	n/a
	5/28/2020		< 0.0200 (U)	2,080	3,260	< 0.100 (U)	< 0.100 (U)	0.401	0.0862	0.00223	< 0.00100 (U)
	11/5/2020		< 0.0200 (U)	2,460	2,860	< 0.100 (U)	< 0.100 (U)	0.742	0.511	< 0.00100 (U)*	< 0.00100 (U)*
	5/20/2021		< 0.0200 (U)	2,040	5,340	n/a	n/a	n/a	n/a	n/a	n/a
	11/11/2021		< 0.0200 (U)	1,980	3,720	n/a	n/a	n/a	n/a	n/a	n/a
	5/12/2022		< 0.0200 (U)	901	3,340	0.19	0.979	0.0823	0.221	0.00453	< 0.00100 (U)*
	10/27/2022		< 0.0200 (U)	1,890	3,190	< 0.100 (U)	< 0.100 (U)	0.597	0.216	0.00116	< 0.00100 (U)*
	5/11/2023		0.567	1,220	2,270	n/a	n/a	n/a	n/a	n/a	n/a
	11/9/2023		0.202	1,580	3,330	n/a	n/a	n/a	n/a	n/a	n/a
P-06			0.13	230	1,092	10	1	1	0.44	0.0082	0.0002
North Field Well	6/6/2018		0.511	703	456	< 0.100 (U)	< 0.100 (U)	0.185	1.83	< 0.00100 (U)	< 0.00100 (U)*
	10/10/2018		0.508	37.1	390	< 0.100 (U)	< 0.100 (U)	0.177	1.25	< 0.00100 (U)	< 0.00100 (U)*
	4/30/2019		0.63	100	450	n/a	n/a	n/a	n/a	n/a	n/a
	10/8/2019		0.147	35.5	526	n/a	n/a	n/a	n/a	n/a	n/a
	5/28/2020		0.654	136	636	< 0.100 (U)	< 0.100 (U)	0.229	1.91	< 0.00100 (U)	< 0.00100 (U)
	11/5/2020		0.484	73.8	840	0.149	< 0.100 (U)	0.361	1.74	< 0.00100 (U)*	< 0.00100 (U)*
	5/20/2021		0.493	94.9	745	n/a	n/a	n/a	n/a	n/a	n/a
	11/11/2021		0.0958	177	457	n/a	n/a	n/a	n/a	n/a	n/a
	5/12/2022		0.462	70.2	494	0.251	< 0.100 (U)	0.185	1.15	< 0.00100 (U)	< 0.00100 (U)*
	10/27/2022		0.29	48.2	475	< 0.100 (U)	< 0.100 (U)	0.154	1.12	< 0.00100 (U)	< 0.00100 (U)*
	5/11/2023		0.684	86	591	n/a	n/a	n/a	n/a	n/a	n/a
	11/9/2023		0.0448	81.1	514	n/a	n/a	n/a	n/a	n/a	n/a
P-09			0.13	230	1,092	10	1	1	0.44	0.0082	0.0002
Interior Well	6/6/2018		1.31	522	1,419	< 0.100 (U)	< 0.100 (U)	0.162	0.585	0.00121	< 0.00100 (U)*
	10/10/2018		0.678	523	1,190	< 0.100 (U)	< 0.100 (U)	0.122	0.148	< 0.00100 (U)	< 0.00100 (U)*
	4/30/2019		1.6	588	1,440	n/a	n/a	n/a	n/a	n/a	n/a
	10/8/2019		0.387	494	1,070	n/a	n/a	n/a	n/a	n/a	n/a
	5/28/2020		2.68	850	1,800	< 0.100 (U)	< 0.100 (U)	0.293	1.51	< 0.00100 (U)	< 0.00100 (U)
	11/5/2020		0.365	514	1,210	< 0.100 (U)	< 0.100 (U)	0.0831	0.0934	< 0.00100 (U)*	< 0.00100 (U)*
	5/20/2021		0.153	595	2,260	n/a	n/a	n/a	n/a	n/a	n/a
	11/11/2021		1.12	421	1,640	n/a	n/a	n/a	n/a	n/a	n/a
	5/12/2022		1.94	1,030	1,790	0.38	< 0.100 (U)	0.296	0.153	< 0.00100 (U)	< 0.00100 (U)*
	10/27/2022		0.35	495	1,120	0.148	< 0.100 (U)	0.135	0.121	< 0.00100 (U)	< 0.00100 (U)*
	5/11/2023		11.1	809	1,640	n/a	n/a	n/a	n/a	n/a	n/a
	11/9/2023		1.47	907	1,910	n/a	n/a	n/a	n/a	n/a	n/a
P-19			0.13	230	1,092	10	1	1	0.44	0.0082	0.0002
North Field Well	6/6/2018		0.654	5,550	9,590	0.477	< 0.100 (U)	0.182	1.95	0.00543	< 0.00100 (U)*
	10/10/2018		0.425	3,190	6,830	< 0.100 (U)	< 0.100 (U)	0.0923	1.96	0.00165	< 0.00100 (U)*
	4/30/2019		0.792	6,200	10,400	n/a	n/a	n/a	n/a	n/a	n/a

Constituents		Ammonia-N	Chloride	TDS	Nitrate-N	Nitrite-N	Barium	Manganese	Selenium	Thallium
Units		(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Cleanup Levels		0.13	230	1,092	10	1	1	0.44	0.0082	0.0002
P-19 North Field Well	10/8/2019	0.193	3,340	7,070	n/a	n/a	n/a	n/a	n/a	n/a
	5/28/2020	0.87	6,210	9,040	< 0.100 (U)	< 0.100 (U)	0.165	2.18	0.00598	< 0.00100 (U)
	11/5/2020	0.722	4,810	7,320	< 0.100 (U)	< 0.100 (U)	0.0935	2.38	< 0.00100 (U)*	< 0.00100 (U)*
	5/20/2021	0.0512	5,680	14,000	n/a	n/a	n/a	n/a	n/a	n/a
	11/11/2021	< 0.0200 (U)	5,320	6,230	n/a	n/a	n/a	n/a	n/a	n/a
	5/12/2022	0.846	6,060	1,320	0.253	< 0.100 (U)	0.164	1.89	< 0.00100 (U)	< 0.00100 (U)*
	10/27/2022	0.357	3,450	6,780	< 0.100 (U)	< 0.100 (U)	0.058	1.6	0.00211	< 0.00100 (U)*
	5/11/2023	0.202	9,840	11,100	n/a	n/a	n/a	n/a	n/a	n/a
	11/9/2023	0.156	3,270	7,520	n/a	n/a	n/a	n/a	n/a	n/a
P-20B North Field Well	6/6/2018	0.13	230	1,092	10	1	1	0.44	0.0082	0.0002
	10/10/2018	20.5	1,530	4,343	2.18	< 0.100 (U)	0.126	2.12	0.00262	< 0.00100 (U)*
	4/30/2019	37	1,980	4,370	7.44	< 0.100 (U)	0.148	2.45	< 0.00100 (U)	< 0.00100 (U)*
	10/8/2019	16.6	1,670	4,450	n/a	n/a	n/a	n/a	n/a	n/a
	5/28/2020	29.3	2,000	4,320	n/a	n/a	n/a	n/a	n/a	n/a
	11/5/2020	17	1,590	3,550	12	< 0.100 (U)	0.0482	0.366	0.00398	< 0.00100 (U)*
	5/20/2021	21.2	1,610	3,160	18.1	< 0.100 (U)	0.0828	0.635	< 0.00100 (U)*	< 0.00100 (U)*
	11/11/2021	12.7	1,400	4,630	n/a	n/a	n/a	n/a	n/a	n/a
	5/12/2022	19.2	2,100	4,600	n/a	n/a	n/a	n/a	n/a	n/a
	10/27/2022	11.6	15.8	4,040	12.7	0.821	0.0506	0.496	< 0.00100 (U)	< 0.00100 (U)*
	5/11/2023	10.3	1,370	3,640	12.8	< 0.100 (U)	0.0638	0.832	0.00288	< 0.00100 (U)*
	11/9/2023	8.69	1,130	2,550	n/a	n/a	n/a	n/a	n/a	n/a
		13.4	1,620	4,080	n/a	n/a	n/a	n/a	n/a	n/a
P-25 North Field Well	6/6/2018	0.13	230	1,092	10	1	1	0.44	0.0082	0.0002
	10/10/2018	0.504	520	1,694	< 0.100 (U)	< 0.100 (U)	0.0476	10.7	0.00102	< 0.00100 (U)*
	4/30/2019	0.687	900	2,892	< 0.100 (U)	< 0.100 (U)	0.168	10	< 0.00100 (U)	< 0.00100 (U)*
	10/8/2019	0.703	645	2,190	n/a	n/a	n/a	n/a	n/a	n/a
	5/28/2020	0.687	837	1,580	n/a	n/a	n/a	n/a	n/a	n/a
	11/5/2020	0.559	720	2,110	< 0.100 (U)	< 0.100 (U)	0.0449	11.5	< 0.00100 (U)	< 0.00100 (U)
	5/20/2021	0.924	340	1,890	< 0.100 (U)	< 0.100 (U)	0.0651	10.7	< 0.00100 (U)*	< 0.00100 (U)*
	11/11/2021	0.566	748	3,180	n/a	n/a	n/a	n/a	n/a	n/a
	5/12/2022	0.184	820	1,640	n/a	n/a	n/a	n/a	n/a	n/a
	10/27/2022	0.477	849	1,820	0.108	< 0.100 (U)	0.0391	7.68	< 0.00100 (U)	< 0.00100 (U)*
	5/11/2023	0.525	849	2,220	< 0.100 (U)	< 0.100 (U)	0.0604	8.02	< 0.00100 (U)	< 0.00100 (U)*
	11/9/2023	0.798	726	1,900	n/a	n/a	n/a	n/a	n/a	n/a
		0.728	774	2,360	n/a	n/a	n/a	n/a	n/a	n/a
P-27 North Field Well	6/6/2018	0.13	230	1,092	10	1	1	0.44	0.0082	0.0002
	10/10/2018	0.0459	5,900	8,467	< 0.1 (U)	< 0.1 (U)	1.81	0.00217	0.00791	< 0.00100 (U)*
	4/30/2019	< 0.0200 (U)	6,670	10,700	< 0.100 (U)	< 0.100 (U)	2.17	0.333	0.00101	< 0.00100 (U)*
	10/8/2019	0.218	6,920	11,800	n/a	n/a	n/a	n/a	n/a	n/a
	5/28/2020	0.0266	6,850	10,600	n/a	n/a	n/a	n/a	n/a	n/a
	11/5/2020	< 0.0200 (U)	7,600	10,900	< 0.100 (U)	< 0.100 (U)	2.14	0.00451	0.0103	< 0.00100 (U)
	5/20/2021	0.0281	7,200	8,650	< 0.100 (U)	< 0.100 (U)	1.87	< 0.00100 (U)	< 0.00100 (U)*	< 0.00100 (U)*
	11/11/2021	0.0897	5,390	11,400	n/a	n/a	n/a	n/a	n/a	n/a
	5/12/2022	< 0.0200 (U)	6,250	10,900	n/a	n/a	n/a	n/a	n/a	n/a
	10/27/2022	< 0.0200 (U)	5,840	8,940	0.796	0.958	1.99	0.115	< 0.00100 (U)	< 0.00100 (U)*
	5/11/2023	< 0.0200 (U)	6,380	9,040	< 0.100 (U)	< 0.100 (U)	1.45	0.112	0.00268	< 0.00100 (U)*
	11/9/2023	< 0.0200 (U)	8,680	1,010	n/a	n/a	n/a	n/a	n/a	n/a
		0.148	4,790	8,460	n/a	n/a	n/a	n/a	n/a	n/a
SA-10 Magnesite Pile Well	6/6/2018	0.13	230	1,092	10	1	1	0.44	0.0082	0.0002
	10/10/2018	551	6,770	17,323	< 1 (U)	< 1 (U)*	0.0564	4.51	0.00321	< 0.00100 (U)*
	4/30/2019	587	5,360	19,700	1.6	< 0.100 (U)	0.0471	3.42	0.00222	< 0.00100 (U)*
	10/8/2019	110	6,440	17,500	n/a	n/a	n/a	n/a	n/a	n/a
	5/28/2020	514	5,660	17,500	n/a	n/a	n/a	n/a	n/a	n/a
	11/5/2020	662	8,240	20,700	< 0.100 (U)	< 0.100 (U)	0.055	4.95	0.01	< 0.00100 (U)
	5/20/2021	676	7,590	16,400	0.401	< 0.100 (U)	0.0513	2.63	< 0.00100 (U)*	< 0.00100 (U)*
	11/11/2021	721	12,200	27,500	n/a	n/a	n/a	n/a	n/a	n/a
	5/12/2022	704	16,600	14,300	n/a	n/a	n/a	n/a	n/a	n/a
	10/27/2022	539	7,440	19,700	1.27	< 0.100 (U)	0.0472	2.81	< 0.00100 (U)	0.004
	5/11/2023	626	9,110	21,600	0.96	< 0.100 (U)	0.0402	1.78	0.00301	< 0.00100 (U)*
	11/9/2023	505	12,200	14,200	n/a	n/a	n/a	n/a	n/a	n/a
		435	4,310	14,300	n/a	n/a	n/a	n/a	n/a	n/a
SA-11 Magnesite Pile Well	6/6/2018	0.13	230	1,092	10	1	1	0.44	0.0082	0.0002
	10/10/2018	63.4	4,420	12,828	< 1 (U)	< 1 (U)*	0.0397	0.318	0.00564	< 0.00100 (U)*
	4/30/2019	57.4	4,760	11,800	< 0.100 (U)	< 0.100 (U)	0.0308	0.201	0.0128	< 0.00100 (U)*
	10/8/2019	47	6,120	15,400	n/a	n/a	n/a	n/a	n/a	n/a
	5/28/2020	105	5,150	12,500	n/a	n/a	n/a	n/a	n/a	n/a
	11/5/2020	77	6,220	14,100	< 0.100 (U)	< 0.100 (U)	0.0363	0.312	0.0157	< 0.00100 (U)
	5/20/2021	97.4	8,340	14,300	0.627	< 0.100 (U)	0.062	0.56	< 0.00100 (U)*	< 0.00100 (U)*
	11/11/2021	71.5	7,590	21,100	n/a	n/a	n/a	n/a	n/a	n/a
	5/12/2022	53.9	5,370	10,900	n/a	n/a	n/a	n/a	n/a	n/a
	10/27/2022	78.6	7,330	15,800	0.24	< 0.100 (U)	0.0508	0.474	< 0.00100 (U)	0.005
	5/11/2023	79.6	7,620	15,000	0.784	< 0.100 (U)	0.0425	0.418	0.00589	< 0.00100 (U)*
	11/9/2023	92.8	11,200	15,700	n/a	n/a	n/a	n/a	n/a	n/a
		180	8,010	16,700	n/a	n/a	n/a	n/a	n/a	n/a
		0.13	230	1,092	10	1	1	0.44	0.0082	0.0002

Constituents		Ammonia-N	Chloride	TDS	Nitrate-N	Nitrite-N	Barium	Manganese	Selenium	Thallium
Units		(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Cleanup Levels		0.13	230	1,092	10	1	1	0.44	0.0082	0.0002
SA-14		0.13	230	1,092	10	1	1	0.44	0.0082	0.0002
Maonesite Pile Well	6/6/2018	19	1,130	3,735	< 0.100 (U)	< 0.100 (U)	0.0162	0.00563	0.0262	< 0.00100 (U)*
	10/10/2018	19.9	1,010	3,590	< 1 (U)	< 1 (U) *	0.0145	0.0051	0.0207	< 0.00100 (U)*
	4/30/2019	18.2	952	3,550	n/a	n/a	n/a	n/a	n/a	n/a
	10/8/2019	19.2	868	3,370	n/a	n/a	n/a	n/a	n/a	n/a
	5/28/2020	9.9	1,070	3,760	< 0.100 (U)	< 0.100 (U)	0.0157	0.0046	0.0188	< 0.00100 (U)*
	11/5/2020	19.1	1,000	2,940	< 0.100 (U)	< 0.100 (U)	0.0168	0.0104	< 0.00100 (U)*	< 0.00100 (U)*
	5/20/2021	16.4	921	4,200	n/a	n/a	n/a	n/a	n/a	n/a
	11/11/2021	16.6	960	3,170	n/a	n/a	n/a	n/a	n/a	n/a
	5/12/2022	14.5	425	3,150	< 0.100 (U)	< 0.100 (U)	0.0197	0.00246	< 0.001	< 0.00100 (U)*
	10/27/2022	13	584	2,940	0.132	< 0.100 (U)	0.0124	0.00463	0.00962	< 0.00100 (U)*
	5/11/2023	18.8	765	3,000	n/a	n/a	n/a	n/a	n/a	n/a
	11/9/2023	20.1	1,590	2,940	n/a	n/a	n/a	n/a	n/a	n/a
PW		0.13	230	1,092	10	1	1	0.44	0.0082	0.0002
Intermediate Confined Aquifer	6/6/2018	< 0.0200 (U)	0.924	n/a	< 0.100 (U)	< 0.100 (U)	0.0772	0.00208	< 0.00100 (U)	< 0.00100 (U)*
	10/10/2018	< 0.0200 (U)	0.966	196	< 0.100 (U)	< 0.100 (U)	0.0684	0.00128	< 0.00100 (U)	< 0.00100 (U)*
	4/30/2019	0.166	0.794	205	n/a	n/a	n/a	n/a	n/a	n/a
	10/8/2019	< 0.0200 (U)	1.16	241	n/a	n/a	n/a	n/a	n/a	n/a
	5/28/2020	0.287	1.15	236	< 0.100 (U)	< 0.100 (U)	0.0746	0.00113	< 0.00100 (U)	< 0.00100 (U)
	11/5/2020	< 0.0200 (U)	1.02	286	< 0.100 (U)	< 0.100 (U)	0.0775	< 0.00100 (U)	< 0.00100 (U)*	< 0.00100 (U)
	5/20/2021	< 0.0200 (U)	0.942	275	n/a	n/a	n/a	n/a	n/a	n/a
	11/11/2021	< 0.0200 (U)	2.56	254	n/a	n/a	n/a	n/a	n/a	n/a
	5/12/2022	< 0.0200 (U)	1.1	253	< 0.100 (U)	< 0.100 (U)	0.00823	0.00274	< 0.00100 (U)	< 0.00100 (U)
	10/27/2022	< 0.0200 (U)	0.799	231	< 0.100 (U)	< 0.100 (U)	0.0692	0.0033	< 0.00100 (U)	< 0.00100 (U)
	5/11/2023	< 0.0200 (U)	0.895	265	n/a	n/a	n/a	n/a	n/a	n/a
	11/9/2023	0.712	1.27	331	n/a	n/a	n/a	n/a	n/a	n/a

Notes:

Cleanup levels (CULs) developed in the L-Bar Cleanup Levels Development and Feasibility Study Report (CH2M, 1999).

Site-specific cleanup levels shown in boxed headers via bold-black font; the bold-italic colored font exceed the respective cleanup levels.

Non-detects shown as 'less-than' followed by (U); the value in these instances is the method Reporting Limit (RL) or Practical Quantitation Limit (PQL).

Primary parameters (ammonia, chloride, TDS) sampled consistently semi-annually; secondary parameters (Nitrate, nitrite, Ba, Mn, Se, Th) sampled every-other year.

* Indicates where result was non-detect but laboratory RL was higher than the respective CUL.