Aladdin Plating Site Groundwater Monitoring Results, 2022-2023: Data Summary Report

Environmental Assessment Program

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Publication 24-03-027

December 2024

Abstract

The Aladdin Plating site (the site), located in Tacoma, Washington, operated historically as a commercial electroplating facility between 1958 and 1994. In 2005, chromium (trivalent and hexavalent), lead, and nickel contamination were discovered in site soils and groundwater following an investigation conducted by the Washington State Department of Ecology (Ecology). The source of the contamination originates from historical electroplating activities at the site which impacted site soils and, subsequently, site groundwater.

Following building demolition and site investigation activities in summer of 2005, Ecology oversaw soil and concrete excavation to remove contaminant sources. Initial groundwater monitoring activities were conducted by Landau Associates between November 2005 and May 2007. Results from this initial monitoring period reported concentrations of total chromium and nickel near the source area as high as 920 µg/L and 42,400 µg/L, respectively. GeoEngineers completed a Remedial Investigation (RI) in 2014 to address data gaps and an Ecology contractor removed additional contaminated soil in 2018. GeoEngineers completed a post-excavation groundwater sampling event in 2019. Ongoing groundwater monitoring activities have been conducted by Ecology since 2022.

This report describes the water quality results for groundwater samples collected from four monitoring wells during semiannual monitoring events conducted between Fall 2022 and Fall 2023. The samples were analyzed for total and dissolved chromium and nickel.

Analytical results from groundwater samples between 2022 and 2023 indicate continued nickel impact on the near-surface aquifer at the former Aladdin Plating site. While nickel concentrations have decreased since initial site activities began in 2005, groundwater samples from the site continue to exceed (not meet) cleanup levels for nickel as established by the Cleanup Action Plan submitted by GeoEngineers in 2014, ranging as high as 10,800 µg/L for total nickel at MW-8s in April 2023.

Publication Information

This report is available on the Department of Ecology's website at:
https://apps.ecology.wa.gov/publications/SummaryPages/2403027.html.

Data for this project are available in Ecology's EIM Database. Study ID: FS1277-PerfMonGw

The Activity Tracker Code for this study is: 23-015

Suggested Citation:
Mohr, M., 2024. Aladdin Plating Site Groundwater Monitoring Results, 2022-2023: Data Summary Report. Publication 24-03-027. Washington State Department of Ecology, Olympia. https://apps.ecology.wa.gov/publications/SummaryPages/2403027.html.

Water Resource Inventory Area (WRIA) and 8-digit Hydrologic Unit Code (HUC) numbers for the study area:

- WRIA: 10 (Puyallup – White)
- HUC number: 12-171100

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Background

The Aladdin Plating site (the site) located at 1657 Center St., Tacoma, WA, operated as a commercial electroplating facility between 1958 and 1994 (Figure 1). Property ownership was assumed through foreclosure by Pierce County in the early 2000's. Soon after the Washington State Department of Ecology's (Ecology's) Toxic Cleanup Program (TCP) began management of the site's cleanup activities through designation as an orphan site. A private party purchased the site from Pierce County in 2021 and maintains the site as vacant property (Carnes 2022).

In 2005, Ecology oversaw demolition of site buildings and conducted a subsurface investigation, which identified site soils and groundwater as having been contaminated by historic electroplating operations. Contaminants consisted of chromium, lead, and nickel in site soils, and chromium and nickel in the shallow groundwater. This investigation consisted of the advancement of six direct-push probes completed to depths of approximately 38 to 40 feet (ft) below ground surface (bgs). Soil samples and grab groundwater samples were collected from these six locations. Laboratory analytical results indicated concentrations of total nickel as high as 12,000 mg/kg and total chromium concentrations up to 3,290 mg/kg, much greater than their respective Model Toxics Control Act (MTCA) Method A or Method B cleanup levels at five of the six direct-push probe locations (GeoEngineers 2014a). Grab groundwater samples collected in the direct push borings reported total chromium concentrations as high as 7,250 µg/L and a total nickel concentration of 918 µg/L, far exceeding the respective cleanup levels for each contaminant.

In July 2005, further site characterization activities included the digging of nine test pits to depths between 15 ft bgs and 17 ft bgs. Soil samples obtained from these test pits indicated concentrations of cadmium, total chromium, copper, lead, and nickel in excess of their respective MTCA cleanup levels. Initial remedial activities at the site took place in July 2005 under Ecology oversight and consisted of excavating approximately 40 tons of contaminated soil, and 47 tons of contaminated concrete for off-site disposal. Post-excavation confirmation soil samples were collected at depths ranging from 2 ft bgs to 2.5 ft bgs (GeoEngineers 2014a).

Between November 2005 and May 2007, Landau Associates (Landau) conducted further site investigations and routine monitoring. These investigations included a Phase I Environmental Site Assessment in November 2005, in which five groundwater monitoring wells were installed onsite (MW-1s, MW-2s, MW-3s, MW-4s, and MW-4d). Analytical results from soil samples collected during this Phase I investigation indicated that soil contamination primarily occurred on the west-central and east-northeast extent of the site. Analytical results from groundwater samples indicated an exceedance of MTCA cleanup levels for nickel (320 micrograms per liter [µg/L]) (GeoEngineers 2014a). Due to the closeness of the groundwater monitoring wells, groundwater flow direction could not be assessed as the measured groundwater gradient was essentially flat (Landau 2005).

Three additional groundwater monitoring wells (MW-5s, MW-6s, and MW-7s) were installed off-property in the City of Tacoma road right-of-way by Landau in June 2006 as part of a Phase II Environmental Site Assessment. Landau conducted a groundwater sampling event at the eight site monitoring wells in July 2006. Analytical results from this event indicated concentrations of nickel in MW-3s, and chromium, hexavalent chromium, and nickel in MW-4s were above their respective MTCA cleanup levels. Contaminant concentrations in excess of

MTCA cleanup levels at MW-6 were attributed to elevated turbidity during sampling procedures.

Landau continued groundwater monitoring activities, collecting groundwater samples in October 2006 and March 2007, and monthly measurement of groundwater levels between September 2006 and May 2007. Monthly groundwater levels indicated an east-southeast groundwater flow direction, and analytical results from the groundwater sampling events indicated continued exceedances of MTCA cleanup levels for total chromium, hexavalent chromium, and nickel in site groundwater (GeoEngineers 2014a).

As the previous investigations had not fully delineated the extent of site contamination, GeoEngineers performed remedial investigation activities on behalf of Ecology in 2014 as part of a Remedial Investigation and Feasibility Study (RI/FS). The remedial investigation activities consisted of 14 soil borings on-property, collection of groundwater levels and samples from the eight existing monitoring wells, and collection of grab-groundwater samples from 10 off-property direct-push borings completed downgradient from the site (GeoEngineers 2014a).

Analytical results from soil samples collected during this investigation indicated total chromium, total lead, and total nickel concentrations in excess of MTCA Method A and/or Method B cleanup levels in numerous shallow soil samples, and limited exceedance of cleanup levels in deeper soil samples. Analytical results from groundwater samples reported concentrations of total chromium, hexavalent chromium, and total nickel in excess of MTCA Method A and/or Method B cleanup levels in multiple onsite wells (Appendix A). The results of this investigation indicated that the extent of the contamination of both site soils and shallow groundwater primarily occurred in the inferred source area of MW-4s, and its proximal downgradient area (GeoEngineers 2014a). However, GeoEngineers concluded that the extent of downgradient nickel in groundwater had not been fully delineated by this investigation.

In 2014, GeoEngineers submitted a Cleanup Action Plan (CAP) following the RI/FS, which identified excavation and disposal of site soils that exceed cleanup levels as a potential remedial strategy (GeoEngineers 2014b). GeoEngineers anticipated that the removal of contaminated soils would result in a gradual decrease in the metal concentrations impacting groundwater, and act as an alternative to active groundwater remediation measures.

Additional cleanup activities began in 2018 and consisted of decommissioning the five original onsite monitoring wells, and the excavation of contaminated soils. Following these actions, two monitoring wells were installed by GeoEngineers. Well MW-4sR replaced the decommissioned well MW-4s, and well MW-8s was installed to capture groundwater downgradient of the former facility (GeoEngineers 2019). Post-excavation confirmation soil sampling indicated continued exceedance of nickel in the soil between 4 ft bgs to 8 ft bgs, which may act as a source of nickel contamination in the groundwater at the site (Ecology 2020b).

GeoEngineers continued groundwater monitoring activities in February 2019. Analytical results from this sampling event confirmed that nickel concentrations continued to exceed established cleanup levels in two monitoring wells, MW-4sR and MW-8s. Concentrations of chromium and nickel at well MW-4sR were nearly three times lower in samples collected during February 2019 than concentrations in MW-4s in March 2014, suggesting that the second soil excavation successfully reduced contaminant concentrations in the groundwater of the site (GeoEngineers 2019).

In 2022, Ecology published the Quality Assurance Project Plan (QAPP) detailing the semi-annual groundwater monitoring activities at four monitoring wells (MW-4sR, MW-6s, MW-7s, MW-8s) that Ecology will conduct. The fifth existing monitoring well associated with the site (MW-5s) is difficult to reliably access due to traffic and parked vehicles; as such, it is not included in the monitoring plan. This sampling program intends to collect representative groundwater monitoring data for total and dissolved nickel and chromium analysis. This data report summarizes the groundwater results monitoring events conducted between 2022 and 2023 (Carnes 2022). The data and associated monitoring reports for this project are available at Ecology's Environmental Information Management (EIM) website www.ecy.wa.gov/eim/index.htm. Search Study ID, FS-1277-PerfMonGW.

Physical Setting

The Aladdin Plating site occupies an approximately 100 ft by 30 ft parcel located approximately 240 ft above mean sea level (msl) in Tacoma, Washington. The site is in an industrial and commercial area of Tacoma and lies south of an approximately 80 ft tall bluff. The surroundings to the west, east, and south is relatively flat. The site is within the Puyallup-White Watershed (WRIA 10), which receives average annual precipitation ranging from 30 to 40 inches per year, falling mostly in the winter months (Ecology 2020).

Site geology consists of deposits from the Vashon Stade of the Fraser Glaciation and include the Steilacoom Gravels, the Colvos Sand, and the Vashon Till (Schuster et al. 2015). The topographically low portion of the site is underlain by the Steilacoom Gravels, a coarse unit consisting mainly of pebbles and boulders. The slope to the north of the site consists of the Colvos Sand, a glacial advance deposit consisting of sand with lenses of silt or gravel; and is capped by the Vashon Till, a highly compact mixture of clay, silt, sand, and gravel (Schuster et al. 2015). Well logs from the site describe primarily sand with gravel and minor silt (GeoEngineers 2014a). The direction of groundwater flow in the site vicinity was determined to be towards the east-southeast during the RI/FS (GeoEngineers 2014a).

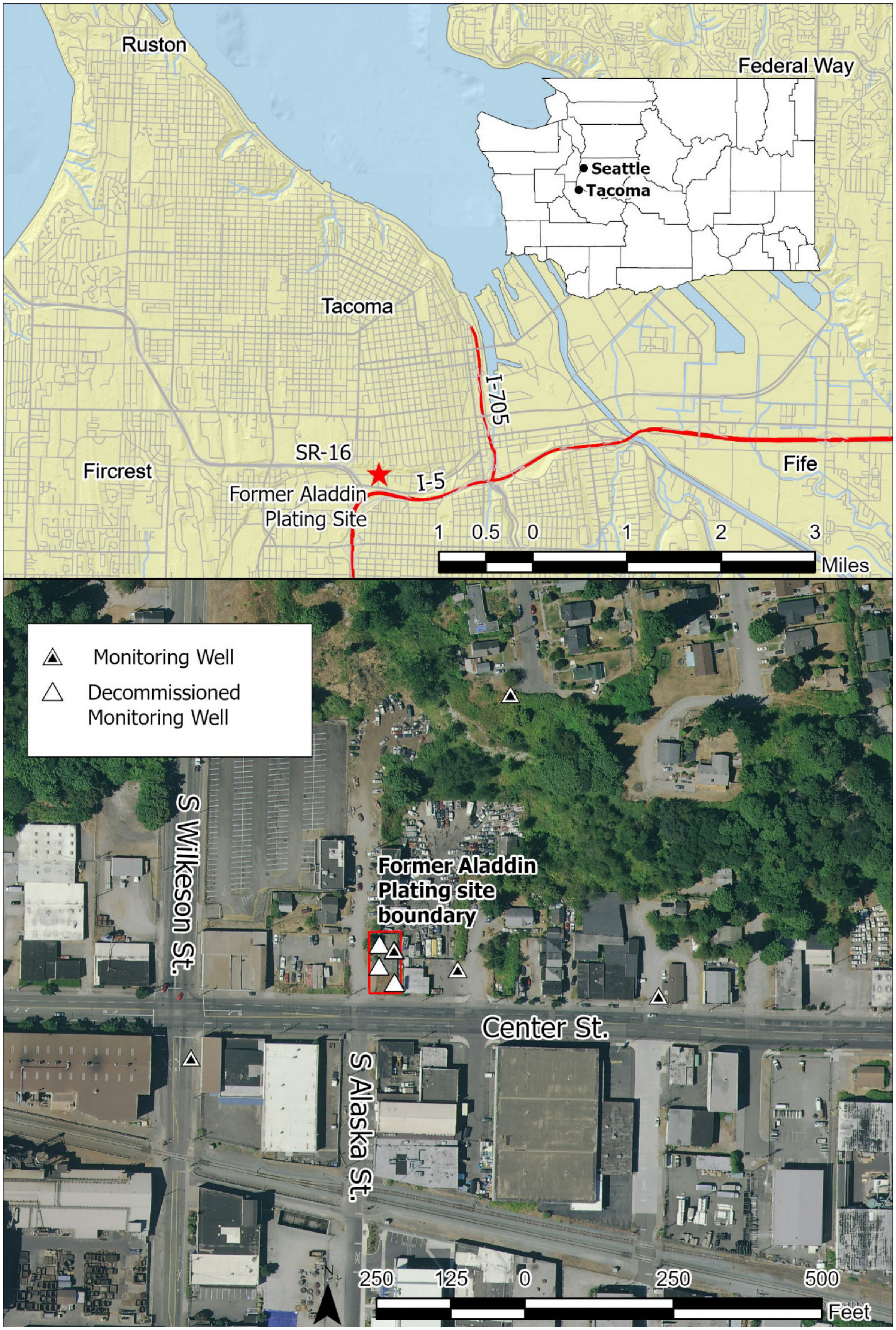


Figure 1. Aladdin Plating Site Location and Site Details

Methods and Results

In October 2022, April 2023, and October 2023, Ecology collected groundwater samples from four monitoring wells (MW-4sR, MW-6s, MW-7s, and MW-8s) at the former Aladdin Plating site (Figure 1). These wells constitute four out of the five remaining monitoring wells associated with the site. Historically, monitoring wells MW-4sR and MW-8s have had the highest concentrations of total and dissolved nickel. These two wells are located near and directly downgradient from the former electroplating facility, respectively (Figure 2).

Ecology sampled these wells using industry-standard low-flow sampling techniques. Due to depth to water exceeding maximum capabilities for a peristaltic pump at MW-6s, the wells were sampled with a stainless-steel bladder pump, using single-use polyethylene bladders and dedicated Teflon-lined polyethylene tubing at each well. The pump intake was placed midway into the screened interval at all wells but MW-6, which was pumped near the top of the screened interval.

Prior to and during purging, groundwater levels were measured to establish the static water level and assess possible drawdown as specified in standard operating procedure EAP052 (Marti 2023). Static water levels are provided in Table 1. When accessible, water levels were measured in well MW-5s.

Prior to sample collection, the wells were continuously purged through a flow-through cell at a rate of 0.3-liters/minute or less. The wells were purged until stabilization of field parameters (pH, temperature, specific conductance, dissolved oxygen, oxidation-reduction potential, and turbidity) as specified in standard operating procedure EAP100 (Pitz 2019). Stabilized field parameters from the October 2022, April 2023, and October 2023 sampling events are provided in Tables 2, 3, and 4, respectively.

Samples were collected directly from the discharge tubing into laboratory-supplied containers. Dissolved metal samples were field-filtered using standard in-line 0.45-micron membrane filters. Samples were stored on ice and transported using standard chain-of-custody protocol and delivered to the Manchester Environmental Laboratory (MEL) in Port Orchard, Washington. Samples were analyzed by MEL for total and dissolved chromium and nickel using EPA Method 200.8.

After the October 2022 sampling, Ecology re-developed monitoring wells MW-7s and MW-8s using a submersible pump to address high turbidity. Turbidity values in MW-7s and MW-8s were lower in both the April and October 2023 sample events (Tables 2, 3, and 4). High turbidity may result in elevated metals concentrations in samples collected in these wells that are not fully representative of site groundwater geochemistry.

Well purge water was collected and stored on site in a 55-gallon drums. Purge water transport and disposal procedures followed Washington State regulations (WAC 173-303-400).

Figure 2. Site Layout

Table 1. Well construction details and water levels from October 2022, April 2023, and October 2023.

Well ID	Top of Casing Elevation [a] (feet)	Well Depth (feet bgs)	Screen Interval (feet bgs)	October 2022 Groundwater Elevation [a] (feet)	April 2023 Groundwater Elevation [a] (feet)	October 2023 Groundwater Elevation [a] (feet)
MW-4sR	245.13	40	24-39	219.48	219.61	218.15
MW-5s	248.01	45	35-45	220.83	—	—
MW-6s	358.19	153.5	143-153	220.05	220.09	218.98
MW-7s	242.57	42	32-42	218.41	218.51	217.23
MW-8s	242.96	42.5	24-39	219.21	219.34	217.94

bgs: Below ground surface.

[a] Vertical datum for elevation data is NAVD88.

—: Water level not measured during this sampling event.

Table 2. Field measurements from the October 2022 sampling.

Well ID	pH (SU)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Oxidation-Reduction Potential (mV)	Temperature (°C)	Turbidity (NTUs)
MW-4sR	5.3	261	8.5	132	13.2	9.3
MW-6s	6.1	346	5.3	87	12.2	1.0
MW-7s	6.4	298	7.0	93	13.9 EST	9.3
MW-8s	5.5	128	9.0	158	13.7 EST	30

EST – Reading collected outside of acceptance criteria and is an estimate.

Table 3. Field measurements from the April 2023 sampling.

Well ID	pH (SU)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Oxidation-Reduction Potential (mV)	Temperature (°C)	Turbidity (NTUs)
MW-4sR	5.8	116	8.6	235	12.4	7.0
MW-6s	6.4	350	6.1	190	11.5	1.3
MW-7s	6.6	256	8.0	185	12.2	0.9
MW-8s	5.7	203	8.5	262	12.5	6.6

Table 4. Field measurements from the October 2023 sampling.

Well ID	pH (SU)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Oxidation-Reduction Potential (mV)	Temperature (°C)	Turbidity (NTUs)
MW-4sR	5.6	291	7.7	171	13.1	9.3
MW-6s	6.4	359	5.7	119	12.4	1.4
MW-7s	6.5	321	6.5	128	13.4	2.4
MW-8s	5.7	130	8.7	182	13.9	8.5

In April and October 2023, a water level could not be measured from MW-5s due to the well's proximity to parked cars and active traffic on the roadway near the well.

Groundwater samples collected during the October 2022, April 2023, and October 2023 sampling events were submitted for total and dissolved chromium and nickel analysis to assess the contamination of groundwater near and downgradient from the electroplating facility. Analytical results for the three sample events are presented in Tables 5, 6, and 7, respectively. MTCA Method A and Method B groundwater cleanup levels are provided for comparison to sample analytical results (WAC 173-340-720).

Blind field duplicate samples were collected for quality control from wells MW-8s in October 2022, MW-4sR in April 2023, and MW-8s in October 2023. Relative percent differences (RPDs) were calculated from these parent and duplicate samples. RPD values ranged from 0.00% to 5.04%, with the exception of the April 2023 total nickel results that had an RPD of 83.4%. For these samples the parent and duplicate results are reported as estimated values because the RPD exceeded the data quality objective of 20% as specified in the Quality Assurance Project Plan (Carnes 2022). On Figure 3 and Figure 4, the results are reported as the highest concentration between parent and duplicate sample result. RPDs of all duplicate samples are presented in Table 8. Overall, the laboratory data quality control and quality assurance results indicate that the analytical performance was good. All results are usable as reported.

Table 5. Analytical results from the October 2022 sampling and associated cleanup limits. All concentrations are in µg/L.

Well	Total Chromium	Dissolved Chromium	Total Nickel	Dissolved Nickel
MW-4sR	**3.45**	**2.89**	**<u>696</u>**	**<u>712</u>**
MW-6s	**0.56**	**0.46**	**5.16**	**5.03**
MW-7s	**1.49**	**0.5**	**3.41**	**2.23**
MW-8s	**29**	**25.7**	**<u>5860</u>**	**<u>5800</u>**
MW-8s (duplicate)	**30.5**	**25.5**	**<u>5820</u>**	**<u>5990</u>**
MTCA cleanup levels	*50*	*50*	*320*[a]	*320*[a]

Bold: Analyte was detected.
<u>Underline</u>: Values are greater than the MTCA Method A and/or Method B cleanup levels.
MTCA: MTCA Method A Groundwater Cleanup Level (WAC 173-340-720).
[a] No Method A Value exists for this metal, MTCA Method B Value was used in its place.

Table 6. Analytical results from the April 2023 sampling and associated cleanup limits. All concentrations are in µg/L.

Well	Total Chromium	Dissolved Chromium	Total Nickel	Dissolved Nickel
MW-4sR	**5.57**	**4.67**	**<u>432 J</u>**	**<u>406</u>**
MW-6s	**0.6**	**0.44**	**5.49**	**5.19**
MW-7s	**0.57**	**0.47**	**2.08**	**2.01**
MW-8s	**25.6**	**24.5**	**<u>10,800</u>**	**<u>9,870</u>**
MW-4sR (duplicate)	**5.74**	**4.68**	**<u>1,050 J</u>**	**<u>406</u>**
MTCA cleanup levels	*50*	*50*	*320[a]*	*320[a]*

Bold: Analyte was detected.
<u>Underline</u>: Values are greater than the MTCA Method A and/or Method B cleanup levels.
J: Sample value reported as an estimate due to RPD value exceeding DQOs of 20%.
MTCA: MTCA Method A Groundwater Cleanup Level (WAC 173-340-720).
[a] No Method A Value exists for this metal, MTCA Method B Value was used in its place.

Table 7. Analytical results from the October 2023 sampling and associated cleanup limits. All concentrations are in µg/L.

Well	Total Chromium	Dissolved Chromium	Total Nickel	Dissolved Nickel
MW-4sR	**2.4**	**1.65**	**<u>547</u>**	**<u>504</u>**
MW-6s	**0.62**	**0.49**	**5.47**	**5.3**
MW-7s	**0.6**	**0.47**	**2.42**	**2.33**
MW-8s	**25.4**	**23.8**	**<u>6,110</u>**	**<u>5,840</u>**
MW-8s (duplicate)	**24.6**	**23.5**	**<u>5,970</u>**	**<u>5,920</u>**
MTCA cleanup levels	*50*	*50*	*320[a]*	*320[a]*

Bold: Analyte was detected.
<u>Underline</u>: Values are greater than the MTCA Method A and/or Method B cleanup levels.
MTCA: MTCA Method A Groundwater Cleanup Level (WAC 173-340-720).
[a] No Method A Value exists for this metal, MTCA Method B Value was used in its place.

Table 8. Relative percent differences of duplicate sample results

Well	Sampling date	Total Chromium	Dissolved Chromium	Total Nickel	Dissolved Nickel
MW-8s	October 2022	5.04%	0.78%	0.68%	3.22%
MW-4sR	April 2023	3.01%	0.21%	83.4%	0.00%
MW-8s	October 2023	3.20%	1.27%	2.32%	1.36%

Analytical results for these sampling events are shown in Figures 3 and 4.
Historical analytical data from site activities occurring between June 2005 and February 2019 are included in Appendix A.

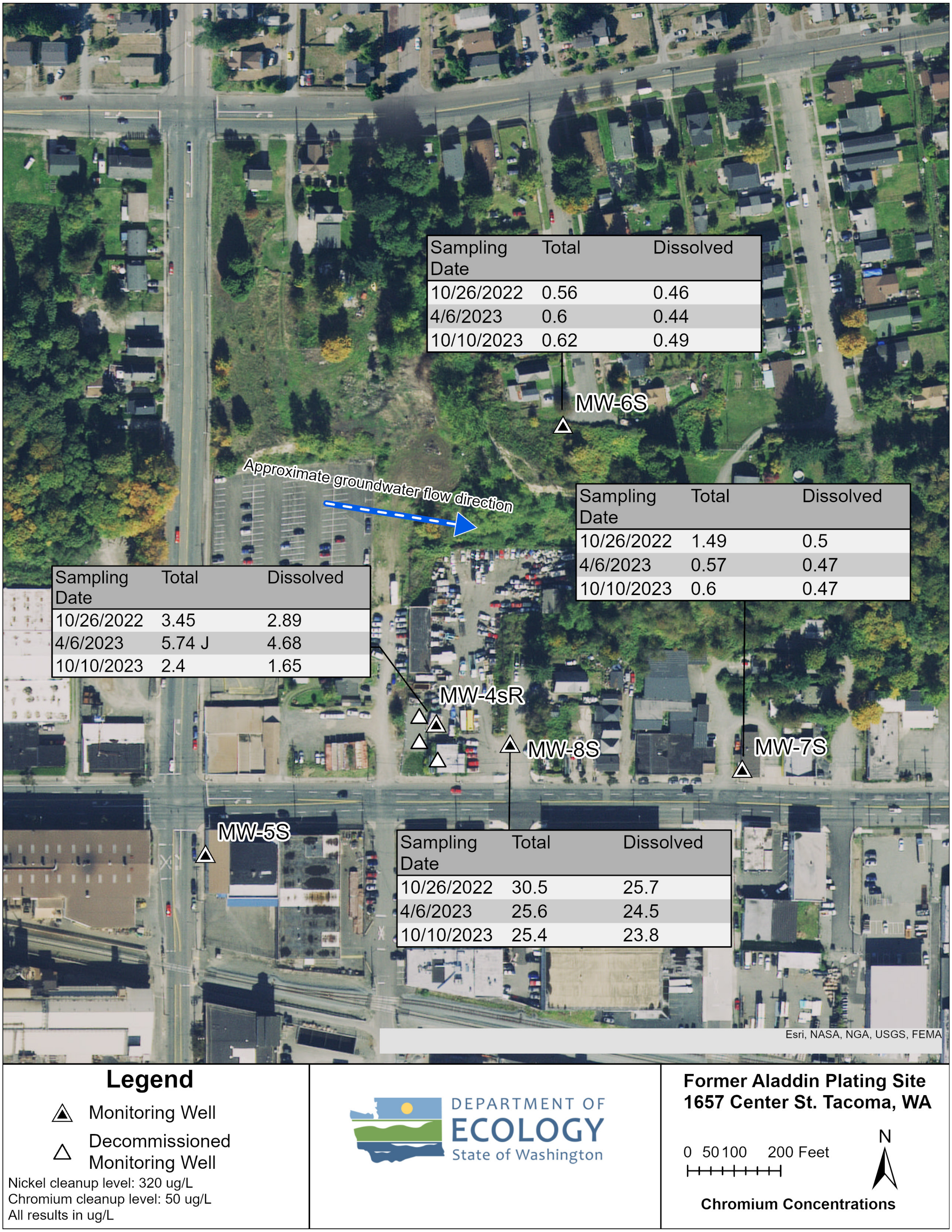
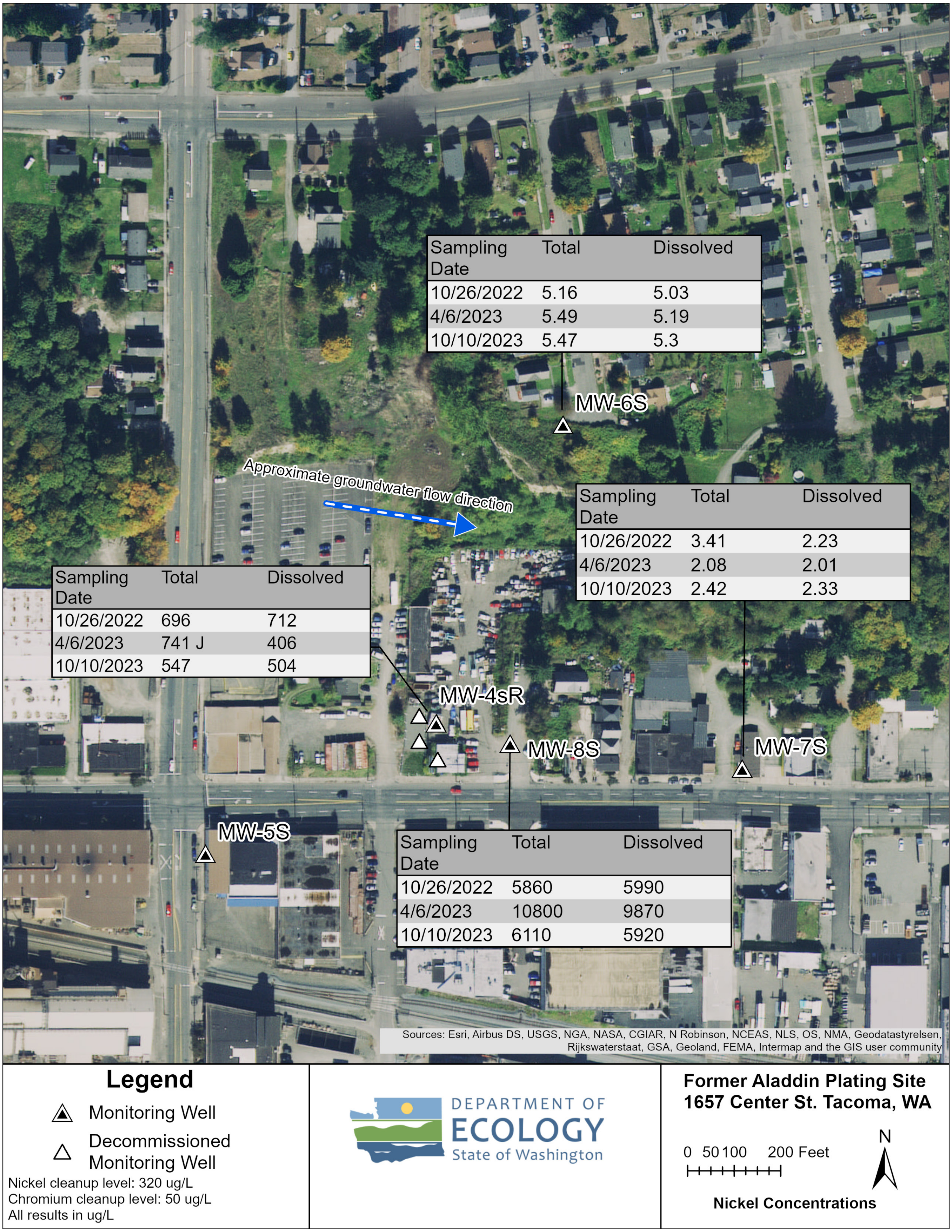


Figure 3. Total and Dissolved Chromium Concentrations (µg/L) in 2022 and 2023



Sampling Date	Total	Dissolved
10/26/2022	5.16	5.03
4/6/2023	5.49	5.19
10/10/2023	5.47	5.3

Sampling Date	Total	Dissolved
10/26/2022	3.41	2.23
4/6/2023	2.08	2.01
10/10/2023	2.42	2.33

Sampling Date	Total	Dissolved
10/26/2022	696	712
4/6/2023	741 J	406
10/10/2023	547	504

Sampling Date	Total	Dissolved
10/26/2022	5860	5990
4/6/2023	10800	9870
10/10/2023	6110	5920

Figure 4. Total and Dissolved Nickel Concentrations (µg/L) in 2022 and 2023

Historical Operations Area and Crossgradient Well — Wells MW-4sR, MW-6s

Well MW-4sR is in the footprint of the 2018 excavation performed by GeoEngineers and placed near the former location of wells MW-4s and MW-4d. Concentrations of total and dissolved nickel in this well continue to exceed (not meet) the applicable cleanup levels as specified in the Cleanup Action Plan (GeoEngineers 2014b, WAC 173-340-740). Nickel results in MW-4sR indicate a decrease in concentrations following the 2018 soil excavation (Appendix A). Chromium concentrations in well MW-4sR were below the cleanup levels during all sampling events.

Well MW-6s is located atop a bluff approximately 470 feet from and crossgradient to well MW-4sR. Chromium and nickel concentrations in well MW-6s were far below their respective cleanup levels during all sampling events.

Groundwater Downgradient from Site — Wells MW-7s and MW-8s

Well MW-8s is located approximately 110 feet downgradient of well MW-4sR. Both wells share similar construction depths and screened intervals (Table 1). Concentrations of total and dissolved nickel in well MW-8s continue to far exceed (not meet) the applicable cleanup levels. Well MW-8s had the highest nickel concentrations of all wells sampled in 2022 and 2023, with total nickel ranging from 5,860 µg/L to 10,800 µg/L and dissolved nickel ranging from 5,920 µg/L to 9,870 µg/L (Figure 4). Nickel concentrations in MW-8s were the highest in the April 2023 sampling event, however, these results indicate decreasing concentrations from historical concentrations (Appendix A). Chromium concentrations in MW-8s were below the cleanup levels during all sampling events.

Well MW-7s is located approximately 450 feet downgradient of well MW-4sR. Well construction details are similar to MW-4sR and MW-8s, however, MW-7s is screened three feet deeper (Table 1). Chromium and nickel concentrations in samples collected from well MW-7s during all sampling events were considerably below their respective cleanup levels.

Conclusions

Analytical data from samples collected during the October 2022, April 2023, and October 2023 sampling events indicate that the near-surface aquifer at the former Aladdin Plating site continues to be impacted by nickel contamination. Total and dissolved nickel concentrations in wells MW-4sR and MW-8s are higher than (not meeting) applicable cleanup levels, representing near-source and downgradient contamination, respectively.

Historical results indicate an initial decrease in nickel and chromium concentrations following excavation activities in 2005, with further decreases in concentrations in near-source and downgradient wells following the 2018 excavation (Tables 5, 6 and 7, Appendix A, Figures 3 and 4).

Comparisons of data from samples collected at well MW-4sR during the October 2022, April 2023, and October 2023 events indicate a gradual decrease in chromium and nickel at this location following the second site soil excavation in 2018 (Tables 5, 6 and 7, Figures 3 and 4, Appendix A). While contaminant concentrations at MW-8s continue to far exceed (not meet) cleanup levels, these concentrations also reflect a decrease following the 2018 soil excavation, indicating that the source removal is effectively reducing concentrations of chromium and nickel in the near-surface aquifer.

Recommendations

Based on analytical results from the October 2022, April 2023, and October 2023 monitoring events, the following is recommended:

- Semi-annual groundwater monitoring events should continue as scheduled due to nickel concentrations which continue to exceed (not meet) established cleanup levels. Analytical results from these sampling events indicate that source removal of impacted soil onsite has reduced concentrations of chromium and nickel in the near-surface aquifer, however, further semi-annual monitoring is necessary to confirm that these concentrations continue to naturally attenuate towards cleanup goals.

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Appendix A. Historical Data

Table A1. Analytical data (µg/L) from prior sampling of Aladdin Plating monitoring wells

Well	Analyte	CUL	June 2005[1]	Nov. 2005[1]	July 2006[1]	Oct. 2006[1]	Mar. 2007[1]	Mar. 2014[2]	Feb. 2019[3]
MW-1s[4]	Chromium (Total)	50	--	--	**5.61**	**4.8**	**3.3**	<5	--
	Nickel (Total)	320	--	--	**6.59**	**6.34**	**3.91**	<0.01	--
	Hexavalent Chromium (Total)	48	**2,580**	--	<11	<11	<11	<10	--
	Chromium (Dissolved)	50	--	--	--	**4.87**	**2.1**	--	--
	Nickel (Dissolved)	320	--	--	--	**3.69**	**2.41**	<10	--
	Hexavalent Chromium (Dissolved)	48	--	--	--	<11	<11	--	--
MW-2s[4]	Chromium (Total)	50	--	**29.3**	**25.4**	**9.8**	**62.8**	<5	--
	Nickel (Total)	320	--	**5.74**	**11.1**	**9.43**	**12.3**	<0.01	--
	Hexavalent Chromium (Total)	48	--	**28**	**12**	**26**	**13**	<10	--
	Chromium (Dissolved)	50	--	--	--	**4.95**	**44.2**	--	--
	Nickel (Dissolved)	320	--	--	--	**3.07**	**4.15**	<10	--
	Hexavalent Chromium (Dissolved)	48	--	--	--	<11	**58**	--	--
MW-3s[4]	Chromium (Total)	50	--	**13.6**	**49.6**	**27.1**	**100**	<5	--
	Nickel (Total)	320	--	**348**	**1,710**	**343**	**2,270**	**270**	--
	Hexavalent Chromium (Total)	48	--	<11	**15**	**20**	**85**	<10	--
	Chromium (Dissolved)	50	--	--	--	**22.9**	**78**	--	--
	Nickel (Dissolved)	320	--	--	--	**314**	**2100**	**250**	--
	Hexavalent Chromium (Dissolved)	48	--	--	--	**26**	**106**	--	--
MW-4s[4]	Chromium (Total)	50	--	**4.5**	**286**	**174**	**920**	**98**	--
	Nickel (Total)	320	--	**11**	**17,200**	**17,300**	**42,400**	**7,770**	--
	Hexavalent Chromium (Total)	48	--	<11	**361**	**199**	**933**	**44**	--
	Chromium (Dissolved)	50	--	--	--	**194**	**817**	--	--
	Nickel (Dissolved)	320	--	--	--	**16,300**	**41,900**	**7960**	--
	Hexavalent Chromium (Dissolved)	48	--	--	--	**193**	**951**	--	--
MW-4sR	Chromium (Total)	50	--	--	--	--	--	--	--
	Nickel (Total)	320	--	--	--	--	--	--	**2,600**
	Hexavalent Chromium (Total)	48	--	--	--	--	--	--	**12**
	Chromium (Dissolved)	50	--	--	--	--	--	--	**11**
	Nickel (Dissolved)	320	--	--	--	--	--	--	**2,700**
	Hexavalent Chromium (Dissolved)	48	--	--	--	--	--	--	--

Well	Analyte	CUL	June 2005[1]	Nov. 2005[1]	July 2006[1]	Oct. 2006[1]	Mar. 2007[1]	Mar. 2014[2]	Feb. 2019[3]
MW-4d[4]	Chromium (Total)	50	--	<0.50	**49.1**	**18.4**	**4.9**	<5	--
	Nickel (Total)	320	--	**1.86**	**36.6**	**14.6**	**8.58**	**10**	--
	Hexavalent Chromium (Total)	48	--	<11	**15**	<11	<11	<10	--
	Chromium (Dissolved)	50	--	--	--	**3.21**	**1.9**	--	--
	Nickel (Dissolved)	320	--	--	--	**3.5**	**6.67**	**260**	--
	Hexavalent Chromium (Dissolved)	48	--	--	--	<11	<11	--	--
MW-5s	Chromium (Total)	50	--	--	**9.27**	**11.4**	**6.27**	<5	--
	Nickel (Total)	320	--	--	**14.3**	**18.7**	**8.96**	<10	--
	Hexavalent Chromium (Total)	48	--	--	**12**	<11	<11	<10	--
	Chromium (Dissolved)	50	--	--	--	**2.1**	**2.3**	--	--
	Nickel (Dissolved)	320	--	--	--	**7.02**	**5.45**	<10	--
	Hexavalent Chromium (Dissolved)	48	--	--	--	<11	<11	--	--
MW-6s	Chromium (Total)	50	--	--	**135**	**1,630**	**36**	**10**	**8.1**
	Nickel (Total)	320	--	--	**118**	**1,780**	**45.3**	**10**	**12**
	Hexavalent Chromium (Total)	48	--	--	**19**	**47**	<11	<10	10 U
	Chromium (Dissolved)	50	--	--	--	**2.1**	**1.2**	--	1.0 U
	Nickel (Dissolved)	320	--	--	--	**19.2**	**11**	<10	8.0 U
	Hexavalent Chromium (Dissolved)	48	--	--	--	<11	<11	--	--
MW-7s	Chromium (Total)	50	--	--	**18.4**	**2.5**	**3.4**	<5	**2.1**
	Nickel (Total)	320	--	--	**18.2**	**4.86**	**4.76**	<10	8.0 U
	Hexavalent Chromium (Total)	48	--	--	**25**	<11	<11	<10	10 U
	Chromium (Dissolved)	50	--	--	--	**1.1**	**1.4**	--	1.0 U
	Nickel (Dissolved)	320	--	--	--	**1.93**	**3.08**	--	8.0 U
	Hexavalent Chromium (Dissolved)	48	--	--	--	<11	**11**	--	--
MW-8s	Chromium (Total)	50	--	--	--	--	--	--	**32**
	Nickel (Total)	320	--	--	--	--	--	--	**13,000**
	Hexavalent Chromium (Total)	48	--	--	--	--	--	--	**31**
	Chromium (Dissolved)	50	--	--	--	--	--	--	**28**
	Nickel (Dissolved)	320	--	--	--	--	--	--	**13,000**
	Hexavalent Chromium (Dissolved)	48	--	--	--	--	--	--	--

[1] Landau Associates, 2007
[2] GeoEngineers, 2014a
[3] GeoEngineers, 2019
[4] Monitoring well decommissioned in 2018
U: Analyte not detected at or above the reported value
--: Not analyzed for
Highlighted cells indicate exceedance of cleanup level
Bold text indicates analyte was detected above the laboratory reporting limit

Table A2. Analytical data (µg/L) from direct push boring grab water samples at Aladdin Plating site

Well	Analyte	CUL	June 2005[1]
ALDW1[1]	Chromium (Total)	50	**3,480**
	Nickel (Total)	320	--
	Hexavalent Chromium (Total)	48	**470**
ALDW2[1]	Chromium (Total)	50	**--**
	Nickel (Total)	320	**918**
	Hexavalent Chromium (Total)	48	**843**
ALDW3[1]	Chromium (Total)	50	**7,250**
	Nickel (Total)	320	**--**
	Hexavalent Chromium (Total)	48	**1,280**
ALDW4[1]	Chromium (Total)	50	**--**
	Nickel (Total)	320	**--**
	Hexavalent Chromium (Total)	48	**1,280**
ALDW5[2]	Chromium (Total)	50	--
	Nickel (Total)	320	--
	Hexavalent Chromium (Total)	48	**632**

[1] Landau Associates collected sample
[2] GeoEngineers collected sample
--: Not analyzed for

Appendix A References

GeoEngineers, Inc. 2014. Report of Findings — Soil Explorations and Groundwater Monitoring, Aladdin Plating Site, 1657 Center Street, Tacoma, Washington. June 16, 2014.

GeoEngineers, 2019. Aladdin Plating Groundwater Monitoring Event — February 2019. Former Aladdin Plating site, 1657 Center St. Tacoma Washington. https://apps.ecology.wa.gov/gsp/DocViewer.ashx?did=82251

Landau Associates, 2007. Groundwater Monitoring Report, Fall 2006 through Spring 2007, Former Aladdin Plating Facility, Tacoma, Washington. July 31, 2007.