FINAL REPORT

Post-Closure Groundwater Monitoring Second Report, Year 2020

Prepared for

Alcoa Intalco Works
Ferndale, Washington

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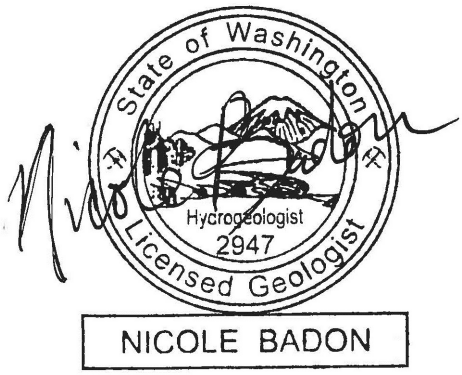

Executive Summary

This report presents and evaluates groundwater monitoring data collected from the uppermost aquifer located near the former landfill area at the Alcoa Intalco Works (Intalco) facility in Ferndale, Washington. The groundwater monitoring data were collected in accordance with the post-closure monitoring plan approved by the Washington State Department of Ecology. During the post-closure monitoring period, which began in 2012 after closure of the Triple-lined Landfill, Intalco will collect and analyze four quarters of groundwater monitoring data from the installed groundwater monitoring system once every 5 years, beginning in 2015, over the 30-year post-closure period. The groundwater monitoring system encompasses the area of the three closed landfills - the unlined landfill, Double-lined Landfill, and Triple-lined Landfill. Eleven existing wells are included in the post-closure groundwater monitoring program. This report includes data collected during the landfill operational period from 1988 through 2011 and post-closure monitoring data collected during the calendar years 2015 and 2020.

Groundwater Quality Data and Maximum Contaminant Level Exceedances

The groundwater quality data for the calendar year 2020 are generally consistent with data collected during the operational period groundwater monitoring program from 1988 through 2011 and the first post-closure monitoring year in 2015, based on visual analysis of long-term time-series plots, including several primary or secondary maximum contaminant level (MCL) exceedances. There are, however, several MCL exceedances recorded in 2020 that were not recorded in the previous sampling quarters in 2015 and are further described, in Section 3.3. Eleven wells were sampled: six point of compliance wells, 4 additional monitoring locations, and one background location. All point of compliance wells met the primary MCLs. For the point of compliance wells, the following parameters exceeded a secondary MCL for one or more quarterly monitoring events in 2020:

- Chloride (secondary MCL) in well SMW-03.
- The pH levels (secondary groundwater quality standard; below the lower limit of 6.5) in well SMW-08.
- Specific conductance (secondary MCL) in wells SMW-03 and SMW-12,

In addition to the exceedances listed above, aluminum concentrations showed substantial increases from previous monitoring data at SMW-2, SMW-03, SMW-06, SMW-08, SMW-12, SMW-14, and SMW-15. The reason for the increase was because the samples had not been filtered as they had been in previous years. The facility has updated their procedures to prevent future reoccurrence.

Groundwater Elevation and Flow Data

The groundwater flow paths and flow velocities generated for the four quarters of 2020 are very similar to the ones produced over the previous 12 years of landfill operational period groundwater monitoring and the 2015 post-closure monitoring (CH2M HILL, 2000, 2001, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012; CH2M, 2016; MFG, 2002, 2003, 2004). This indicates there is no significant change in either groundwater flow direction or flow velocities and that the monitoring well network is appropriately positioned to detect releases from the closed landfills into the uppermost aquifer at the site.

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Acronyms and Abbreviations

µmhos/cm	micromhos per centimeter
cm/sec	centimeter per second
COC	constituent of concern
Ecology	Washington State Department of Ecology
GWQS	groundwater quality standard
Intalco	Alcoa Intalco Works
MCL	maximum contaminant level
mg/L	milligram per liter
RCRA	Resource Conservation and Recovery Act
SMW	shallow monitoring well
WAC	Washington Administrative Code

SECTION 1

Introduction

This report presents and evaluates groundwater monitoring data collected from the uppermost aquifer located near the three closed solid waste landfills at the Alcoa Intalco Works (Intalco) facility at 4050 Mountain View Road, Ferndale, Washington 98248. Per the Washington State Department of Ecology (Ecology)-approved post-closure plan for the former Triple-lined landfill (Anchor, 2011), and in accordance with the Washington Administrative Code (WAC) Chapter 173-303-610, Intalco is required to monitor the groundwater quality and report the groundwater flow rate and direction on a quarterly basis once every 5 years during the 30-year post-closure period, which began in 2012. Post-closure monitoring is conducted during the year prior to the 5, 10, 15, 20, 25, and 30 monitoring years. This report includes data collected during the landfill operational period from 1988 through 2011 along with post-closure monitoring data collected during the calendar years 2015 and 2020, and is the second post-closure groundwater monitoring report.

Similar to the 23 years of monitoring conducted during the operational period groundwater monitoring program, Intalco will conduct the post-closure groundwater monitoring program approved by Ecology for the Landfill Area encompassing the closed unlined landfill, the closed Double-lined Landfill, and the closed Triple-lined Landfill. Intalco collects and analyzes samples from the installed groundwater monitoring system on a quarterly basis every fifth year per the Ecology-approved program. The groundwater monitoring program focuses on the landfilled wastes associated with the aluminum smelter, which have been the only site operations since it was constructed in 1969. Wastes landfilled at the site and the associated constituents of concern (COCs) have been consistent over the life of the landfills. The current approved groundwater monitoring program monitors for COCs for wastes placed in the landfill area, which includes spent potliner.

SECTION 2

Background

This section presents a summary of the operational period and post-closure period groundwater monitoring programs at the landfill area at the Intalco facility from 1986 through the present.

During 1986 and early 1987, Intalco closed an existing solid waste disposal facility and opened a new facility consisting of two cells known as the double-lined and triple-lined cells located north of the main plant (Figure 1). The double- and triple-lined cells were constructed using best available design, material, and construction methods coupled with the implementation of a groundwater monitoring program to monitor for release from any of the three landfills in the landfill area to the site upper most aquifer. In 2007, Intalco completed closure of the double-lined landfill. And, in November 2011, after reaching capacity in June 2011, Intalco completed closure of the triple-lined landfill. Intalco has worked with Ecology and the Whatcom County Health Department consistently over the life of the landfills to design and install a groundwater monitoring network acceptable to Ecology. The current 15 well monitoring network encompasses the closed unlined landfill, the closed Double-lined Landfill, and the closed Triple-lined Landfill and effectively monitors the upper aquifer of the landfill area (refer to Ecology letter of March 5, 2002). Following is a description of the evolution of the program:

The proposed groundwater monitoring plan for the landfill area, including the new double-lined and triple-lined cells, was submitted with the solid waste permit application in April 1986 and included the use of existing monitoring wells and five new wells. In July 1987, a monitoring plan was approved by Ecology's Industrial Waste Section. This monitoring system consisted of the following shallow monitoring wells (SMW): SMW-02, SMW-03, SMW-06, SMW-08, SMW-09, SMW-10, SMW-11, SMW-12, and SMW-13 (Figure 1). Wells SMW-11 and SMW-13 were considered the upgradient or background wells. A revised groundwater monitoring system was approved by Ecology in 1989. This system included the addition of wells SMW-14, SMW-15, SMW-16, and SMW-17.

In October 1999, Intalco representatives met with Ecology representatives to discuss Intalco's request for a waiver to the groundwater monitoring requirements contained in the Resource Conservation and Recovery Act (RCRA) Interim Status Regulations (Title 40 of the Code of Federal Regulations Part 265). These regulations apply to the groundwater monitoring network associated with the triple-lined landfill and its lateral extension. In February 2000, Ecology issued a letter requiring Intalco to install one additional groundwater monitoring well at a location approved by Ecology. Intalco was required to monitor the new well for 1 year. If the new well was continuously dry for 1 year, Ecology would grant the waiver. If the well was not continuously dry for 1 year, it would be integrated into the existing monitoring well network for all onsite landfills.

In August 2000, Intalco installed two additional groundwater monitoring wells at locations approved by Ecology (SMW-18 and SMW-19). SMW-18 has been continuously dry since it was installed. SMW-19 has produced groundwater monitoring data, and is included in the monitoring network.

In 2011, Ecology approved the Triple-lined Landfill post-closure plan which covers groundwater monitoring and landfill cover maintenance requirements for the 30-year post-closure period, in accordance with WAC 173-303-610. Based on analysis of time series data from 22 years of operational period groundwater monitoring at the landfill area, closure monitoring was reduced from quarterly monitoring on an annual basis to quarterly monitoring once every 5 years over the 30-year post-closure period. The number of monitoring wells included in the post-closure monitoring program was also reduced from 15 existing wells to 11 existing wells, to exclude wells that were consistently dry during

operational period monitoring (SMW-11, SMW-16, SMW-17, and SMW-18) or were not installed in the uppermost aquifer (SMW-4). The post-closure monitoring period began in 2012, after Ecology's approval of the Triple-lined Landfill closure report.

In 2015, the first round of post-closure 5-year quarterly monitoring events was conducted. Based on the monitoring results from these events, no changes were recommended to the Ecology-approved post-closure groundwater monitoring program (CH2M, 2016).

Table 1 presents a listing of wells currently used to comply with the requirements of WAC 173-303-610 and the post-closure monitoring plan. Figure 1 shows the location of each well. Well SMW-13 is the background well. All other wells are considered downgradient wells to well SMW-13.

Table 1 Intalco Groundwater Monitoring System

Well	Required Sampling Frequency	Well Designation	Data Included In this Report?
SMW-02	Quarterly in 2015 2020 2025 2030 2035 2040	Point of Compliance Well	Yes
SMW-03		Point of Compliance Well	Yes
SMW-06		Additional monitoring location	Yes
SMW-08		Point of Compliance Well	Yes
SMW-09		Additional monitoring location	Yes
SMW-10		Additional monitoring location	Yes
SMW-12		Point of Compliance Well	Yes
SMW-13		Background monitoring well	Yes
SMW-14		Point of Compliance Well	Yes
SMW-15		Additional monitoring location	Yes
SMW-19		Point of Compliance Well	Yes

Note: Appendix A presents a listing of documents prepared for the site well installations, characterization, and monitoring programs.

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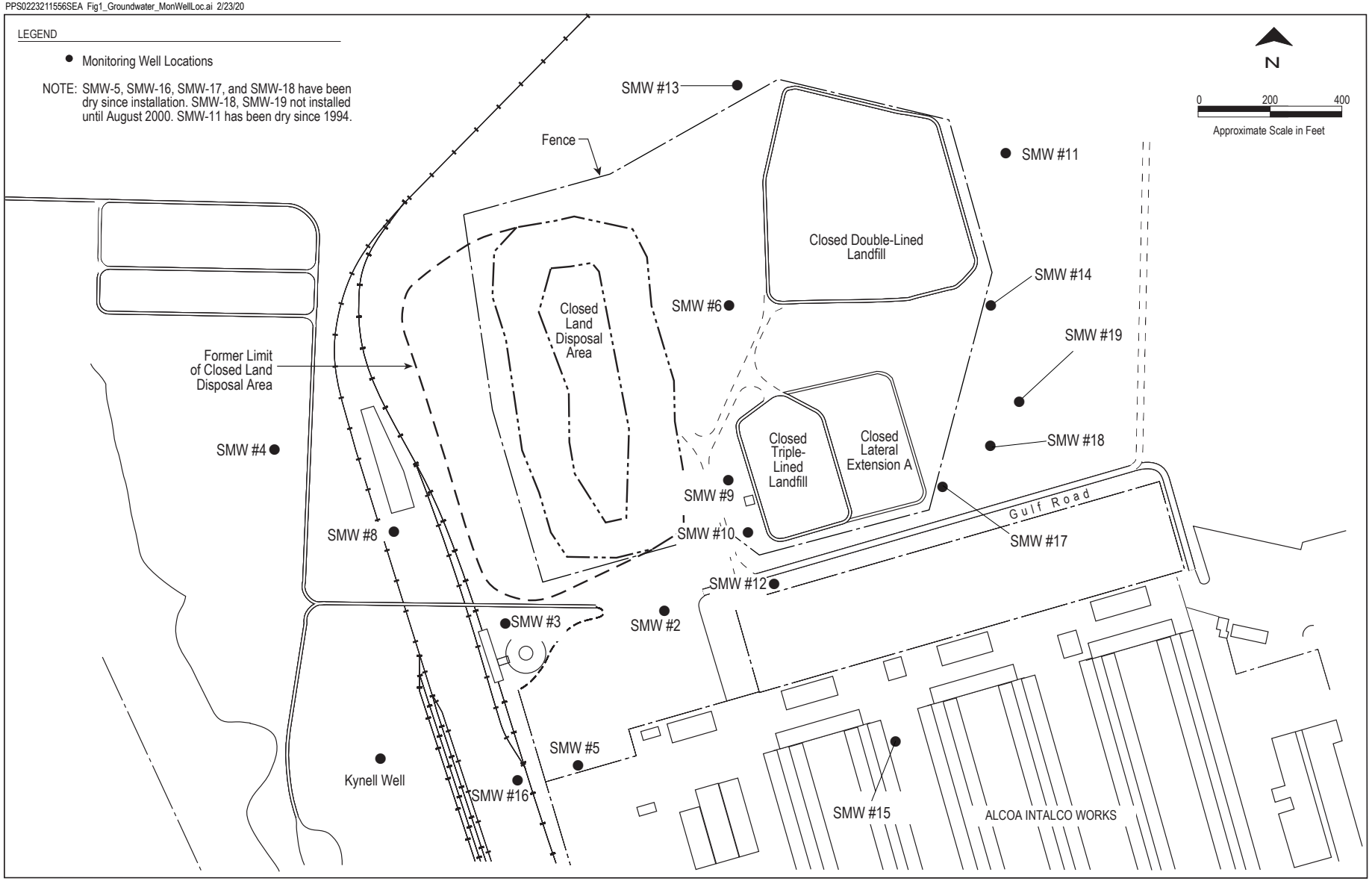

Figure 1
Monitoring Well Locations
ALCOA Intalco Works, Ferndale, WA

SECTION 3

Groundwater Quality Data Analysis

3.1 Groundwater Quality Data - 2020

The Ecology-approved monitoring plan stipulated that Intalco test for the following groundwater quality parameters:

- Temperature
- pH
- Specific conductance
- Total aluminum
- Total calcium
- Chloride
- Total cyanide
- Total fluoride
- Total potassium
- Total sodium
- Sulfate

Appendix B presents a tabulation of the data collected from the first quarter of 2020 through the last quarter of 2020 for wells SMW-02, SMW-03, SMW-06, SMW-08, SMW-09, SMW-10, SMW-12, SMW-13 (designated as USMW013 in Appendix B), SMW-14, SMW-15, and SMW-19.

3.2 Analytical Methods

Time-series plots (including a comparison to applicable primary and secondary maximum contaminant levels [MCLs]) are used to evaluate the groundwater monitoring data. A visual examination of concentrations over time was conducted to identify any substantive changes or possible trends in the data.

3.2.1 Time-Series Plots

Time-series plots are useful for detecting trends in monitoring data over time. The inclusion of the primary and secondary MCLs, if applicable, provides a context for the data. Time-series plots for the required parameters (except temperature) from the earliest monitoring date through the last quarter of 2020 are presented in Appendix C.

Each parameter is graphed separately and within each parameter graph, the background well (SMW-13) is graphed separate from the rest. Results for the downgradient wells are presented in two separate plots for clarity. The drinking water standards per WAC 246-290-310 and groundwater quality standards (GWQS) per WAC 173-200 are included in the plots, where applicable. The required parameters that have associated MCLs are:

- Chloride — 250 milligrams per liter (mg/L) (Secondary MCL)
- Cyanide (as HCN) — 0.2 mg/L (Primary MCL)
- Fluoride — 4.0 mg/L (Primary MCL), 2.0 mg/L (Secondary MCL)
- pH — 6.5 to 8.5 (Secondary GWQS)

- Specific Conductance 700 micromhos per centimeter (µmhos/cm) (Secondary MCL)
- Sulfate 250 mg/L (Secondary MCL)

Primary standards are for the protection of human health. Secondary standards are based on aesthetics such as taste, odor, and possible staining of tooth enamel (fluoride).

3.3 Results of Time-Series Analysis

The time-series plots are presented in Appendix C and are discussed below. The parameters that have been detected in the groundwater monitoring network for the entire landfill area and discussed in this section have been consistent over time and included in each annual report since the monitoring program began after construction of the two new landfills and closure of the former unlined landfill. Ecology has attributed the identified parameter detections in the groundwater monitoring network to releases from the closed unlined spent potliner landfill which was closed and capped in 1986. There are no documented releases from the double-lined and triple-lined landfills constructed in 1986, which are now closed.

The following parameters exceeded the MCLs or GWQS in the indicated downgradient wells for one or more quarterly monitoring events in 2020:

- Chloride (secondary MCL) in well SMW-03
- Fluoride (primary MCL) in well SMW-15
- The pH levels (secondary GWQS; below the lower limit of 6.5) in wells SMW-08
- Specific conductance (secondary MCL) in wells SMW-03, SMW-12, and SMW-13 (background well)

The time-series plots are generally consistent over time regarding MCL or GWQS exceedances and observance of apparent trends, based on visual examination. Out of all parameters, only aluminum concentrations show a substantive departure from previously observed levels, as shown in Appendix C. For 2020, the following changes in parameter concentration over time were observed in the time series plots:

- Aluminum concentrations showed notable increases compared to the historical and the 2015 data in wells SMW-2, SMW-03, SMW-06, SMW-08, SMW-12, SMW-14, and SMW-15. A substantial increase in concentration occurred in SMW-12 during the fourth quarter 2020, where the aluminum concentration was reported at 196 mg/L compared to a range of 0.01 mg/L to 0.11 mg/L in 2015 and the first, second, and third quarters of 2020. A substantial increase in concentration also occurred in SMW-15 where 2020 concentrations ranged from 7.38 mg/L (fourth quarter) to 80.1 mg/L (first quarter) compared to the 2015 range of 0.016 m/L to 0.02 mg/L. No primary or secondary GWQSs are established for aluminum.
- Calcium concentrations are fairly consistent over time, based on visual examination of the time series, for most wells, with two exceptions: SMW-03 and SMW-12. Concentrations at SMW-03, which had previously decreased in 2015, increased to be within the range of pre-2015 observations. Concentrations in SMW-12 remained similar to 2015 concentrations for the first quarter of 2020 (96 mg/L in the fourth quarter of 2015 and 92.6 mg/L in the first quarter of 2020), but then decreased to 58.1 mg/L in the second quarter of 2020 and then to 55.8 mg/L in the fourth quarter of 2020. No primary or secondary GWQSs are available for comparison.
- Chloride concentrations over time are consistently detected below the secondary MCL of 250 mg/L, with the exception of SMW-03 and SMW-12. Compared to chloride concentrations detected below the MCL in 2015, chloride concentrations in SMW-03 increased to levels above the secondary MCL during all four monitoring quarters of 2020 (maximum concentration of 420 mg/L in the fourth

quarter), as was frequently observed in pre-2015 data. In SMW-12, concentrations show a continuation of the decreasing trend observed in the 2015 data with all quarterly results showing concentrations below the secondary MCL. Visual examination of chloride concentrations in SMW-10 continue to show an apparent decreasing trend, and concentrations in SMW-02 show an apparent increasing trend over time.

- Cyanide concentrations are consistently detected below the primary MCL of 0.2 mg/L; none of the 2020 detected concentrations exceeded the primary MCL. Cyanide concentrations were reported as non-detect (below the laboratory detection limit/threshold of 0.0039 mg/L [historically 0.005 mg/L]) in 7 of the 11 wells (SMW-02, SMW-06, SMW-08, SMW-14, SMW-15, SMW-19, and background well SMW-13) for one or more quarters of 2020 and have historically been reported as non-detect in most wells.
- The primary MCL for fluoride is 4.0 mg/L and the secondary MCL is 2.0 mg/L. Fluoride concentrations were above the MCLs in SMW-15 for all four 2020 monitoring quarters, which represents a substantial increase in concentration for SMW-15 from previous monitoring events and the first time that concentrations at this well have exceeded MCLs. Fluoride concentrations for all other wells were below the MCLs for all 2020 monitoring quarters. A third quarter spike in fluoride concentrations was observed in all wells except for SMW-15. Five wells (SMW-09, SMW-12, SMW-14, SMW-19, and background well SMW-13) had non-detect concentrations for one or more of the four quarters in 2015.
- pH was within the secondary GWQS range of 6.5 to 8.5 for all four 2020 monitoring quarters except for SMW-08, for which the first quarter sample fell below the lower limit of 6.5. A visual examination of the pH levels over time show that levels fluctuate, with occasional exceedances outside of the secondary GWQS range.
- Potassium concentrations are fairly consistent over time, based on visual examination, for most wells. Potassium concentrations in SMW-15 had a high of 4.74 mg/L in the first quarter of 2020, which is greater than the typical range of <4 mg/L for that well. No primary or secondary GWQSs are available for comparison.
- Sodium concentrations were relatively stable in all wells over the four quarters of 2020 with a few exceptions. Concentrations in SMW-10 fluctuated throughout the year with a high concentration of 31.1 mg/L in the third quarter and a low concentration of 20.4 mg/L in the fourth quarter. Concentrations in SMW-12 decreased throughout the year from a high of 46.3 mg/L in the first quarter to a low of 35.6 mg/L. In addition, concentrations in SMW-03 have increased from 2015 minimum values of 26.4 mg/L to 2020 maximum values of 85.4 mg/L, which are comparable to pre-2015 concentrations. No primary or secondary GWQSs are available for comparison.
- Specific conductance levels in the background well SMW-13 exceeded the secondary MCL of 700 µmhos/cm during the first quarter of 2020, similar to previous exceedances over time. Specific conductance levels in downgradient wells SMW-03 and SMW-12 fluctuated and consistently exceeded the secondary MCL, consistent with results dating back to the initial start date of groundwater monitoring. The specific conductance levels measured in SMW-03 during 2020 were higher than recent results from 2015 and are similar to pre-2015 concentrations. Modest and steady increases are observed in a number of downgradient wells over the period of record.
- Sulfate concentrations are consistently detected below the secondary MCL of 250 mg/L; none of the 2020 detected concentrations exceeded the secondary MCL. Concentrations from 2020 exhibited more fluctuation than was observed in the 2015 data. Based on visual examination of the sulfate levels over time, an apparent increasing trend is observed in several downgradient wells.

SECTION 4

Groundwater Elevations and Flow

Per the Ecology-approved post-closure plan, and in accordance with WAC 173-303-610, Intalco evaluates and reports groundwater direction and flow rate in the uppermost aquifer from quarterly data collected every 5 years. This section discusses the methods used to fulfill this requirement and presents the results of the evaluation for the 2020 quarterly monitoring data.

4.1 Methods

Groundwater-level measurements were collected from each well as part of the quarterly sampling protocol. The data are summarized in Table 2. These data were used to construct the groundwater elevation contour maps (potentiometric maps) of the uppermost aquifer for each quarter (Figures 2 through 5). The direction of groundwater flow can be estimated from the potentiometric maps by drawing flow-lines perpendicular to the groundwater elevation contours from highest to lowest elevation. Minor deviations from perpendicular are sometimes required to smooth the flow lines. These have no significant effect on the calculated gradients.

Groundwater flow rates (velocities) were calculated based on the hydraulic gradients measured from the potentiometric maps and estimated aquifer coefficients. The flow velocity is estimated based on a modified form of Darcy's Law:

$$V = Ki / n$$

Where:

V = Average linear groundwater flow velocity (length/time)
K = Average hydraulic conductivity (length/time)
i = Hydraulic gradient along flow line (length/length)
n = Estimated effective porosity (dimensionless)

Input parameters for this equation were as follows:

K – During the well installation program in 1987, a relatively undisturbed soil sample of shallow aquifer material (Esperance sand) was obtained from the 57- to 58-foot depth interval in the boring that is now SMW-13. The triaxial cell permeability test of this sample yielded a hydraulic conductivity of 1.4×10^{-4} centimeters per second (cm/sec) (CH2M HILL, 2000).

i – The hydraulic gradient was calculated based on the potentiometric maps (Figures 2 through 5). Three flow lines were chosen for each quarterly map to account for the variability in the groundwater gradient within the site.

n – The estimated effective porosity of silty sand and sandy silt in the uppermost aquifer is 0.20 (EPA, 1989).

Table 2 2020 Quarterly Groundwater Level Data

Well Number	2020 Measuring Date	Measuring Point Elevation (feet AMSL[1])	Depth to Water (inches)	Depth to Water (feet)	Water Level Elevation (feet AMSL[1])
SMW-2	29-Mar	199	768	64	135.4
	28-Jun		760	63.3	136.1
	28-Sep		764.4	63.7	135.7
	6-Nov		763.2	63.6	135.8
SMW-3	30-Mar	199	618	51.5	147.4
	16-Jun		619	51.6	147.3
	22-Sep		615.6	51.3	147.6
	5-Nov		618.0	51.5	147.4
SMW-6	27-Feb	214	731	60.9	153.0
	25-Jun		832	69.3	144.6
	15-Sep		730.8	60.9	153.0
	23-Oct		732	61.0	152.9
SMW-8	24-Mar	196	641	53.4	142.4
	15-Jun		640	53.3	142.5
	22-Sep		640	53.3	142.5
	27-Oct		641	53.4	142.4
SMW-9	29-Mar	212	823	68.6	143.8
	18-Jun		816	68.0	144.4
	25-Sep		812.4	67.7	144.7
	28-Oct		828.0	69.0	143.4
SMW-10	24-Mar	210	835	69.6	140.8
	17-Jun		847	70.6	139.8
	24-Sep		848.4	70.7	139.7
	29-Oct		848.4	70.7	139.7
SMW-12	28-Feb	204	833	69.4	134.6
	24-Jun		824	68.7	135.3
	21-Sep		824.4	68.7	135.3
	26-Oct		828.0	69.0	135.0
SMW-13[2]	23-Mar	216	728	60.7	155.1
	18-Jun		724	60.3	155.5

Table 2 2020 Quarterly Groundwater Level Data

Well Number	2020 Measuring Date	Measuring Point Elevation (feet AMSL[1])	Depth to Water (inches)	Depth to Water (feet)	Water Level Elevation (feet AMSL[1])
	17-Sep		722.4	60.2	155.6
	22-Oct		726.0	60.5	155.3
SMW-14	26-Feb	221	1,993	166.1	54.9
	23-Jun		1,996	166.3	54.7
	17-Sep		1994.4	166.2	54.8
	21-Oct		1995.6	166.3	54.7
SMW-15	29-Mar	198	1,471	122.6	75.5
	29-Jun		1,460	121.7	76.4
	28-Sep		1449.6	120.8	77.3
	2-Nov		1,452	121.0	77.1
SMW-19	11-Mar	218	2,027	168.9	48.6
	30-Jun		2,052	171.0	46.5
	29-Sep		2070.0	172.5	45.0
	30-Oct		2064.0	172.0	45.5

[1] Feet above mean sea level according to National Geodetic Vertical Datum (NGVD)

[2] Monitoring well SMW-13 is the background well for the Intalco facility.

4.2 Results

Figures 2 through 5 present the groundwater elevation contours and inferred groundwater flow directions at the site. Table 3 presents the results of the groundwater flow velocity calculations for each flow-line identified in the groundwater elevation contour maps.

The three groundwater flow paths and flow velocities generated for the four quarters of 2020 are similar to the ones produced for previous monitoring years including 2015 (CH2M HILL, 2000, 2001, 2005, 2006, 2007, 2008, 2009, 2010, 2011; CH2M, 2016; MFG, 2002, 2003, 2004). This indicates there is no significant change in either groundwater flow direction or flow velocities and that the monitoring network is appropriately positioned downgradient to detect a release from the closed landfill area to the uppermost aquifer at the site.

Table 3 2020 Groundwater Flow Velocity

2020 Quarterly Event	Estimated Groundwater Flow Velocity (feet per day)		
	Flow Line #1	Flow Line #2	Flow Line #3
First Quarter	0.26	0.22	0.20
Second Quarter	0.22	0.26	0.22
Third Quarter	0.24	0.26	0.20
Fourth Quarter	0.26	0.26	0.20

V = average linear groundwater flow velocity (ft/day) = (K*i)/n

K = average hydraulic conductivity = 0.00014 cm/sec = 0.397 ft/day

i = average hydraulic gradient along flow line (ft/ft)

n = estimated effective porosity = 0.20

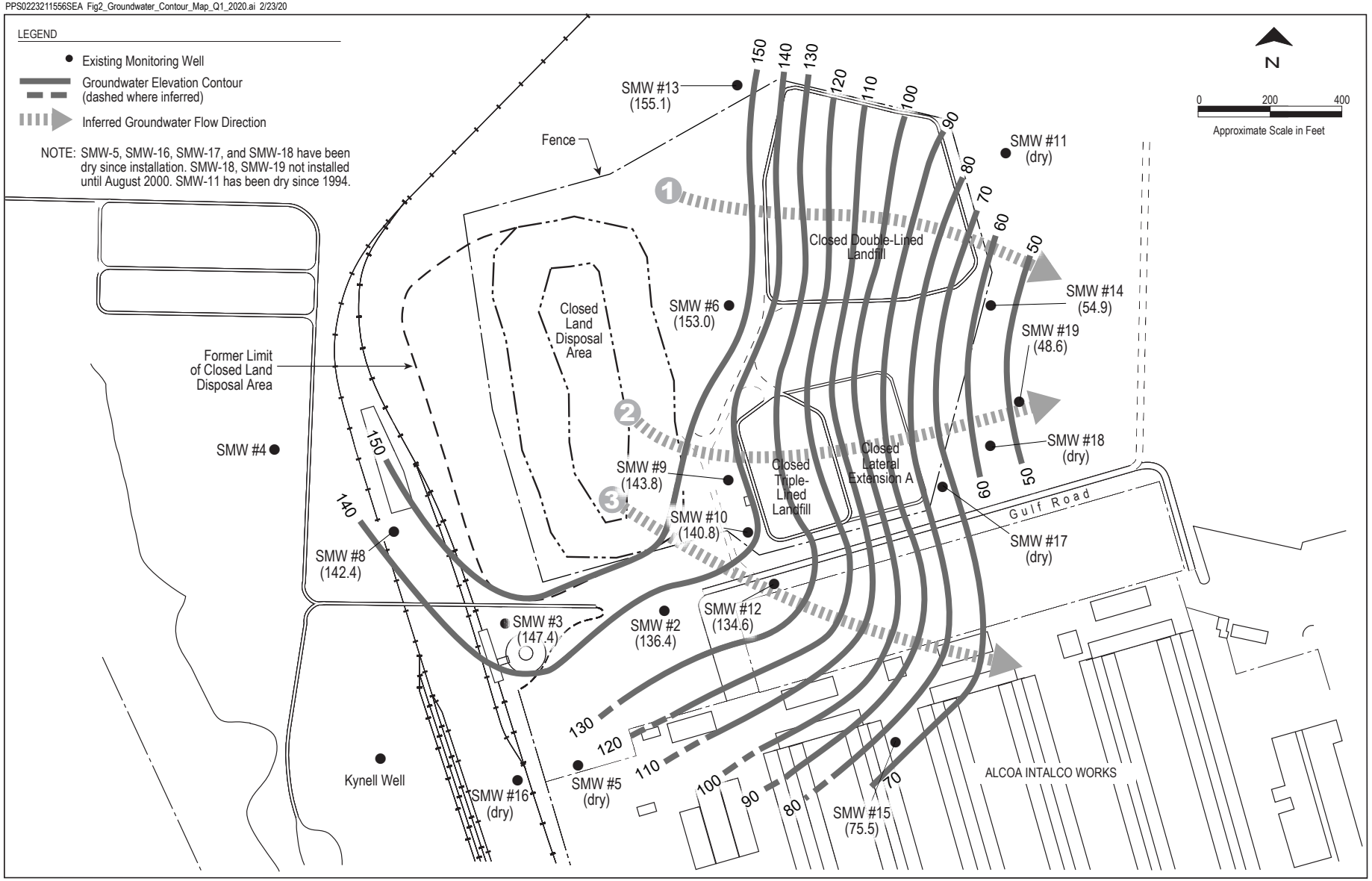

Figure 2
Groundwater Elevation Contour Map
First Quarter 2020
ALCOA Intalco Works, Ferndale, WA

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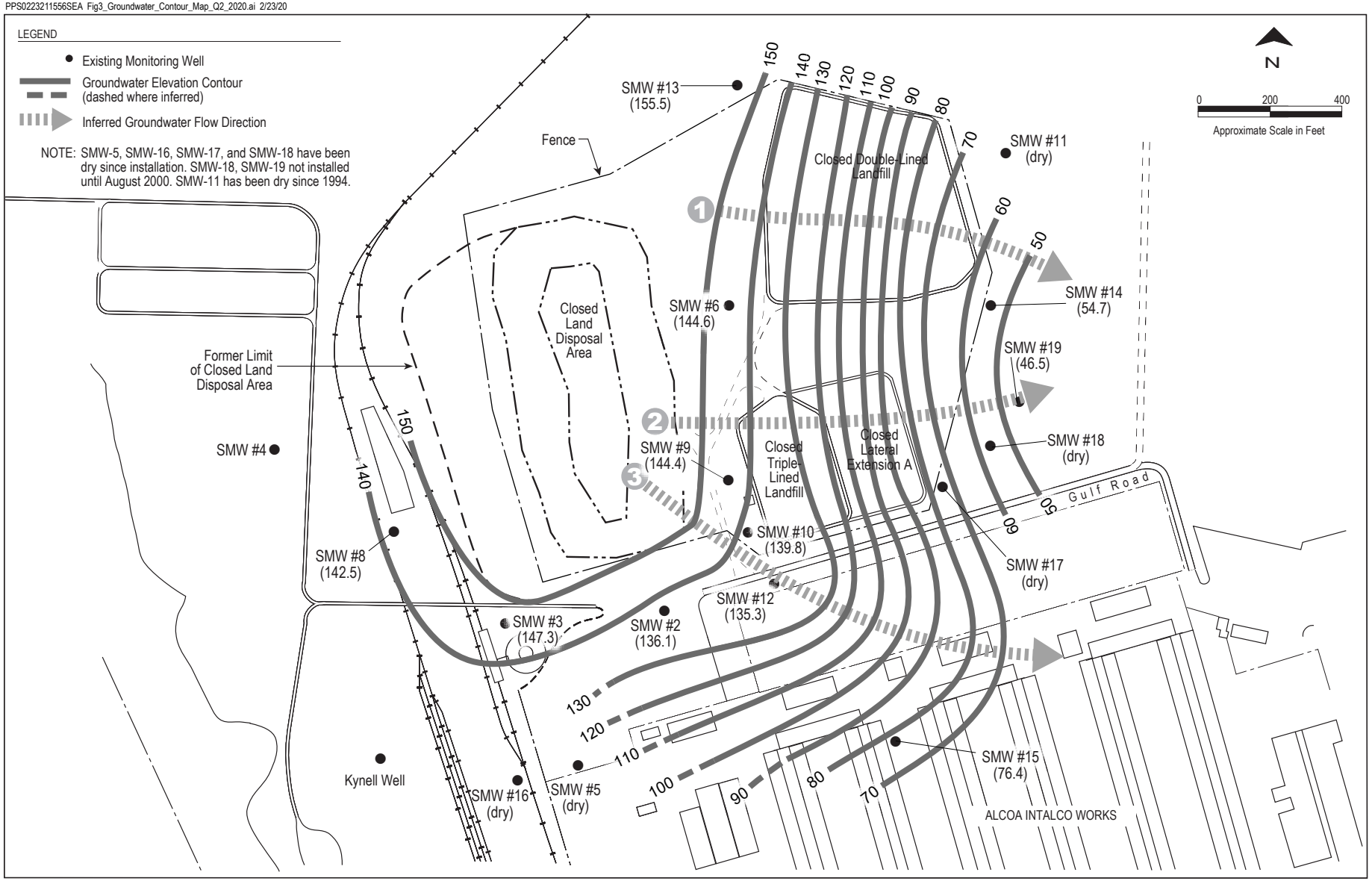

Figure 3
Groundwater Elevation Contour Map
Second Quarter 2020
ALCOA Intalco Works, Ferndale, WA

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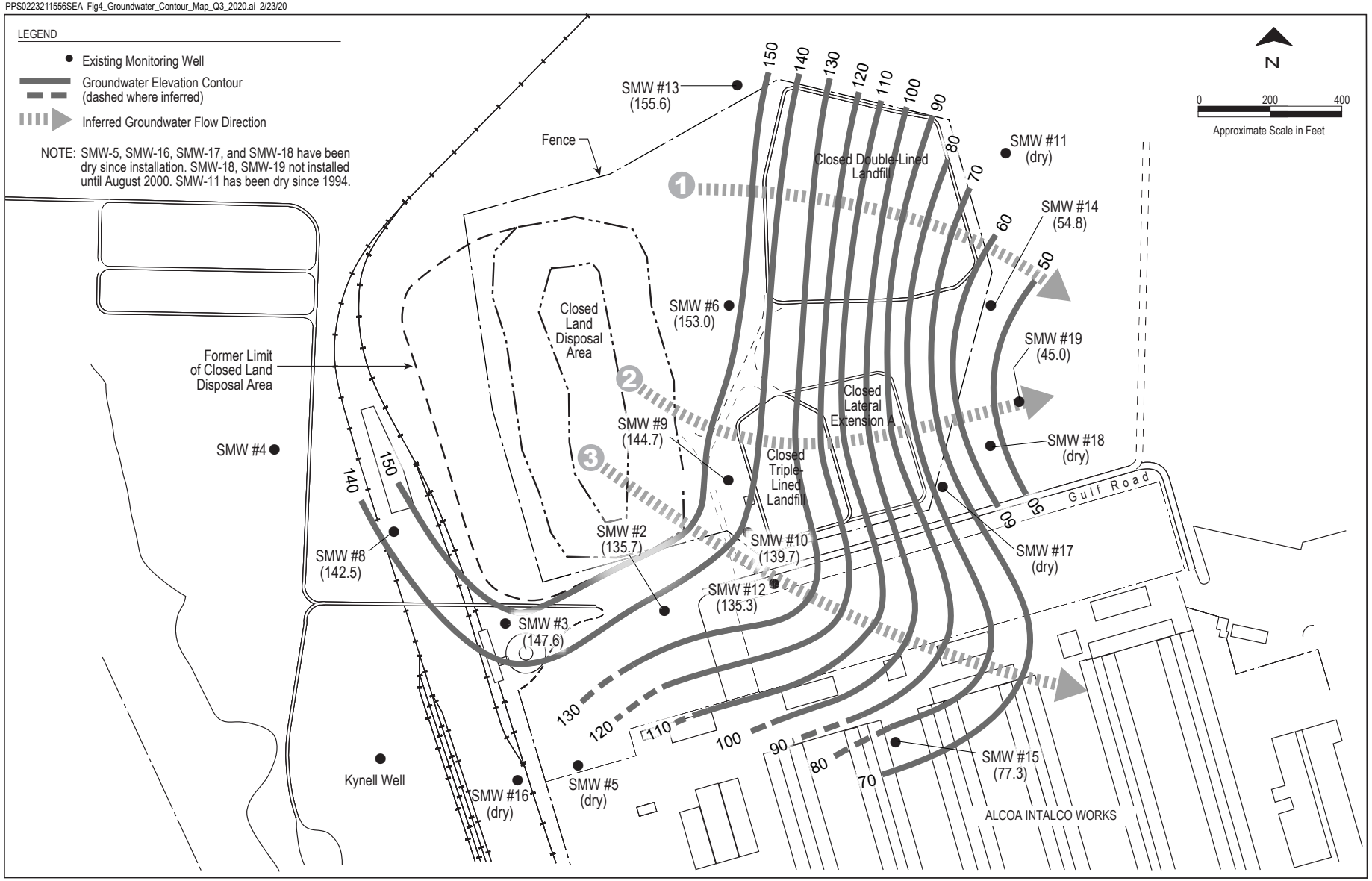

Figure 4
Groundwater Elevation Contour Map
Third Quarter 2020
ALCOA Intalco Works, Ferndale, WA

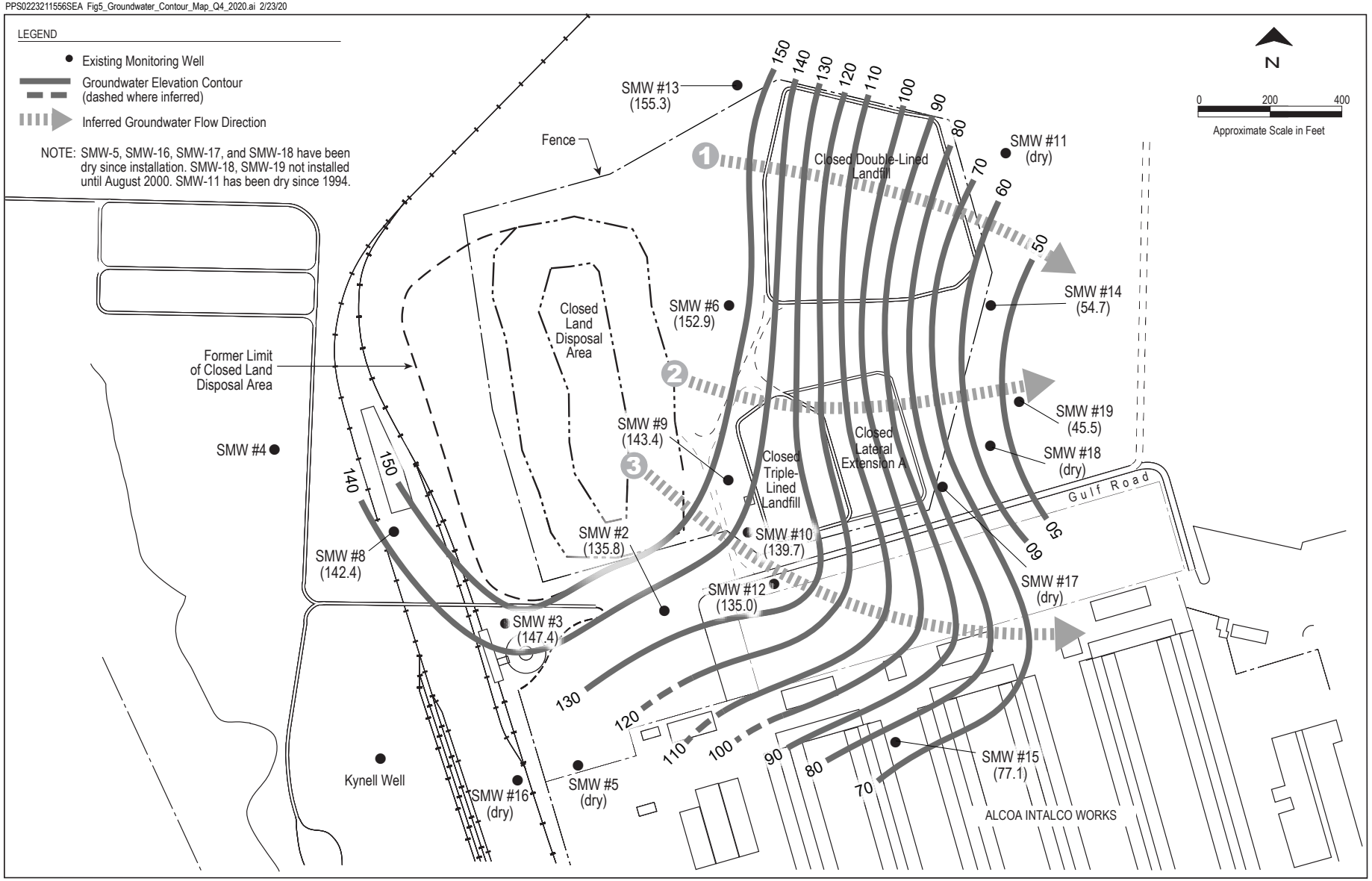

Figure 5
Groundwater Elevation Contour Map
Fourth Quarter 2020
ALCOA Intalco Works, Ferndale, WA

SECTION 5

Summary and Recommendations

Intalco completed the closure of the double-lined landfill in 2007 per the July 2006 Ecology Cleanup Action Plan. The triple-lined landfill was in operation through approximately July 2011 when closure construction activities began. Closure of the triple-lined landfill was completed in November 2011, and the 30- year post-closure period began in 2012. The first round of post-closure groundwater monitoring events was completed in 2015. This 2020 annual report is the second post-closure groundwater monitoring report. The data from the 2020 monitoring year are mostly consistent with previous years regarding the MCL or GWQS exceedances reported for the groundwater samples collected from the 11 monitoring wells; however, one well, SMW-15, exhibited an exceedance of the fluoride MCLs for each of the four quarterly events in 2020. These are the first exceedances of the fluoride MCLs at SMW-15 since monitoring began at the site. The reason for the increase was because the samples had not been filtered as they had been in previous years. No other constituents exceeded the MCLs for 2020, which had not exhibited historical exceedances. However, concentrations of aluminum at several wells (SMW-2, SMW-03, SMW-06, SMW-08, SMW-12, SMW-14, and SMW-15) were several orders of magnitude higher than had been previously detected since monitoring began at the site.

Eleven monitoring wells are monitored as part of the Intalco post-closure groundwater monitoring program. Of these 11 wells, 6 had concentrations below the secondary MCLs for all constituents. For the remaining 5 wells, the following parameters exceeded the secondary MCLs for one or more quarterly monitoring events in 2020:

- Chloride (secondary MCL) in well SMW-03.
- Fluoride (primary MCL) in well SMW-15
- The pH levels (secondary GWQS; below the lower limit of 6.5) in wells SMW-08
- Specific conductance (secondary MCL) in wells SMW-03, SMW-12, and SMW-13 (background well)

There are no changes recommended at this time to the Ecology-approved post-closure groundwater monitoring program. There have been no significant changes in either groundwater flow direction or flow velocities during 2020 and the monitoring network is appropriately positioned downgradient to detect a release from the landfill area to the uppermost aquifer at the site. It is recommended that the field sampling procedures and prior field documentation be reviewed in preparation for the next field event, and that samples are field filtered and collected consistent with all previous events, to maintain low turbidity within the samples.

SECTION 6

References

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Appendix A
Groundwater Monitoring Network Documentation

One groundwater monitoring network encompasses the area covering the closed Double-lined Landfill and closed Triple-lined Landfill, as well as the closed unlined spent potliner landfill that was closed and capped in 1986. The network was designed, installed, and operated per the solid waste permit and regulations since 1988. Site characterization data and site groundwater monitoring system design data for the Intalco facility landfill area are presented in the following documents that have been prepared over time:

Site Characterization Data

- Solid Waste Operating Permit Application (1986)
- RCRA Part B Permit Application (1992)
- Subpart F Waiver Application (1999)
- Monitoring Wells SMW-18 and SMW-19 Installation Report (2000)
- Annual Groundwater Monitoring Reports 1999 to date

Site Groundwater Monitoring System Design Data

- Solid Waste Operating Permit Application (1986)
- RCRA Part B Permit Application (1992)
- Subpart F Waiver Application (1999)
- Monitoring Wells SMW-18 and SMW-19 Installation Report (2000)
- Ecology letter of March 5, 2002
- Annual Groundwater Monitoring Reports 1999 to 2011

Site Groundwater Monitoring Data and Analysis

- Annual reports from 1989 to 2011
- Post-closure Groundwater Monitoring Reports 2016 to date

Appendix B
Tabulated Analytical Results
Quarterly Groundwater Sampling
March 2020 through December 2020

Appendix B
INTALCO QUARTERLY GROUNDWATER MONITORING RESULTS
1st Through 4th Quarter 2020

Monitoring Well	Date Sampled	Temperature (C)	Total Aluminum (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Total Cyanide (mg/L)	Total Fluoride (mg/L)	pH (Std. Units)	Potassium (mg/L)	Sodium (mg/L)	Specific Conductance (µmhos/cm)	Sulfate (mg/L)
Screening Levels		*--*	*--*	*--*	***250*** [2]	***0.2*** [1]	***4*** [1]	***6.5 - 8.5*** [2]	*--*	*--*	***700*** [2]	***250*** [2]
SMW002	3/29/2020	9.2	3.55	49.8	60.6	0.00235 J	0.2375	7.67	3.28	14.1	430	4.58
SMW002	6/28/2020	11.6	2.27	47.4	55.2	0.00583 J	0.2125	7.77	3.08	15.7	382	11
SMW002	9/28/2020	11.3	1.19	48.2	54.4	0.0039 U	0.3375	7.72	2.96	14.3	392	9.69
SMW002	11/6/2020	8.7	0.859	42.8	53	0.00545 J	0.2	8.03	2.54	14.3	398	10
SMW003	3/30/2020	8	5.41	156	**345**	0.0105	0.15	7.24	5.44	81.3	**1,494**	6.63
SMW003	6/16/2020	10.4	2.73	147	**394**	0.012	0.1375	7.36	4.31	85.4	**1,554**	4.35
SMW003	9/22/2020	9.4	0.769	145	**322**	0.0118	0.325	7.43	4.36	84.1	**1,454**	17.3
SMW003	11/5/2020	8.5	0.244	135	**420**	0.013	0.1125	7.51	3.9	83.6	**1,409**	14.6
SMW006	2/27/2020	10.3	0.379	77.7	23.3	0.00253 J	0.625	7.31	1.96	17.2	535	17.9
SMW006	6/25/2020	16.8	0.234	76.5	23.2	0.00905 J	0.7875	7.26	1.89	19	572	19.8
SMW006	9/15/2020	11.5	0.288	67.7	24.4	0.0039 U	1.0375	6.75	2.14	17.1	501	20.2
SMW006	10/23/2020	9.7	64.2	66.2	22.8	0.0055	0.7125	7.03	1.7	16.1	585	20.6
SMW008	3/24/2020	9.3	0.225	34.6	37.8	0.002 U	0.1	**6.42**	1.92	14.4	372	36.5
SMW008	6/15/2020	9.5	0.155	35.6	25.8	0.0039 U	0.1125	7.46	1.8	15.1	357	9.39
SMW008	9/22/2020	11	0.129	31.8	28.5	0.0039 U	0.275	7.17	1.73	14.6	328	29.3
SMW008	10/27/2020	8.5	0.013	30.3	26.5	0.00514 J	0.1375	7.66	1.65	12.9	316	28.9
SMW009	3/29/2020	8.9	0.0557	61.8	19.6	0.0369	0.1	6.95	1.95	17.4	521	45.2
SMW009	6/18/2020	10.6	0.0821	51.9	15.7	0.0419	0.06 U	7.06	1.67	16.9	516	91.8
SMW009	9/25/2020	9.4	0.322	54.4	14.6	0.0341	0.3	7.19	1.74	15.8	445	86
SMW009	10/28/2020	8.5	0.0071	47.2	15.6	0.0447	0.125	7.78	1.53	14.4	444	85.7
SMW010	3/24/2020	7.7	2.19	50.1	25.4	0.0506	0.1125	6.74	1.53	22.8	460	127
SMW010	6/17/2020	10.4	0.211	36.4	14.5	0.0342	0.0875	7.07	1.35	31.1	399	78
SMW010	9/24/2020	9	0.105	47.8	18.1	0.019	0.2625	6.94	1.37	23.1	411	80.9
SMW010	10/29/2020	8.9	0.103	41.5	19.1	0.0232	0.1	6.99	1.23	20.4	409	84.3
SMW012	2/28/2020	10.7	0.0686	92.6	215	0.17	0.06 U	6.68	1.92	46.3	**923**	56
SMW012	6/24/2020	16.7	0.114	58.1	139	0.0888	0.06 U	6.81	1.54	39.8	682	47.6
SMW012	9/21/2020	15.5	0.0986	58.1	124	0.0641	0.1875	6.84	1.49	37.4	**722**	51.5
SMW012	10/26/2020	11.1	196	55.8	153	0.0604	0.125	6.95	1.45	35.6	**785**	52.9
SMW014	2/26/2020	7	0.429	30.8	7.23	0.00202 J	0.06 U	7.14	2.85	10.3	231	31
SMW014	6/23/2020	13.9	0.343	33.1	7.91	0.00587 J	0.06 U	7.39	2.96	11.6	294	34.6
SMW014	9/17/2020	10.6	0.149	28.7	7.29	0.0039 U	0.2375	7.52	2.65	8.77	268	32.7

Appendix B
INTALCO QUARTERLY GROUNDWATER MONITORING RESULTS
1st Through 4th Quarter 2020

Monitoring Well	Date Sampled	Temperature (C)	Total Aluminum (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Total Cyanide (mg/L)	Total Fluoride (mg/L)	pH (Std. Units)	Potassium (mg/L)	Sodium (mg/L)	Specific Conductance (µmhos/cm)	Sulfate (mg/L)
Screening Levels		*--*	*--*	*--*	***250*** [2]	***0.2*** [1]	***4*** [1]	***6.5 - 8.5*** [2]	*--*	*--*	***700*** [2]	***250*** [2]
SMW014	10/21/2020	8.6	0.149	28.1	7.37	0.005	0.1375	7.38	2.57	8.6	270	32.9
SMW015	3/29/2020	15.4	80.1	39.7	12.4	0.002 U	**16.5**	6.64	4.74	15.8	256	27.2
SMW015	6/29/2020	19.3	13.1	24.4	10.4	0.00591 J	**4.5**	6.72	2.03	15.2	263	66.9
SMW015	9/28/2020	17.6	45.5	29.5	11.8	0.00432 J	**12.5**	6.64	3.32	15.7	261	76.6
SMW015	11/2/2020	16.9	7.38	23	11.2	0.00437 J	**8**	7.28	1.72	14.2	273	73.3
SMW019	3/11/2020	9.7	0.0057 J	34.1	10.2	0.00251 J	0.06 U	8.24	4.45	12.5	268	70.6
SMW019	6/30/2020	8.23	0.425	29.4	8.35	0.0039 U	0.2125	8.46	5.07	14.19	250	53.7
SMW019	9/29/2020	8.2	0.447	30.9	8.2	0.00426 J	0.4	8.29	4.53	11.8	277	47.6
SMW019	10/30/2020	7.3	0.0159	26.9	7.88	0.00422 J	0.1	8.14	4.64	9.34	278	44.5
USMW013	3/23/2020	10.5	0.02 U	86.6	11.6	0.002 U	0.06 U	6.8	2.96	19.2	**809**	26.1
USMW013	6/18/2020	11.3	0.005 U	80	8.84	0.00654 J	0.075	6.81	3.36	19.3	678	20.8
USMW013	9/17/2020	12.8	0.005 U	78.6	9.28	0.0039 U	0.325	6.74	3.35	18.2	635	19.4
USMW013	10/22/2020	8.4	0.02 U	75.8	8.61	0.0546	0.1	6.93	2.71	18.2	631	19

Notes:

[1] Primary MCL

[2] Secondary MCL

The drinking water standards per WAC 246-290-310 and groundwater quality standards per WAC 173-200.

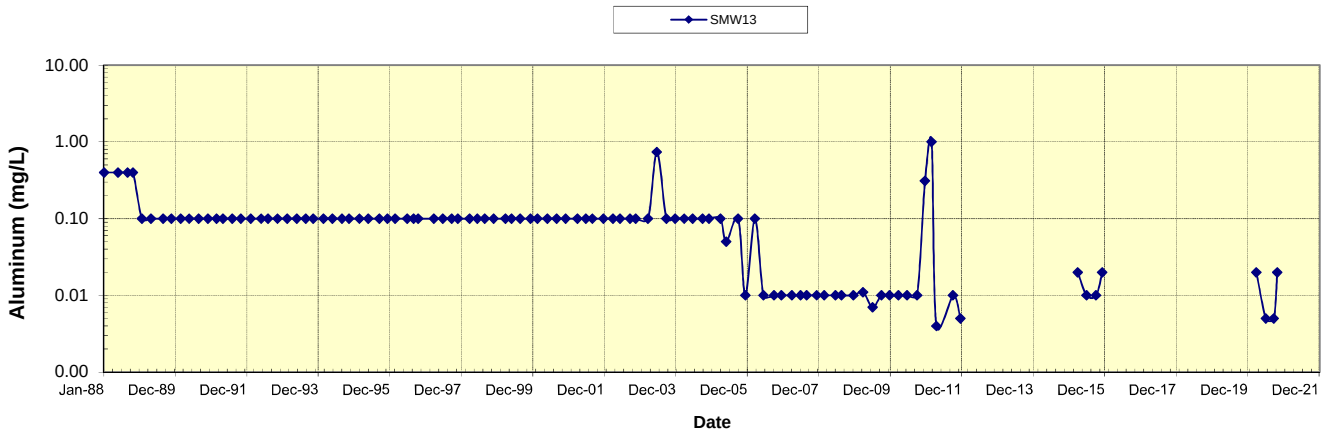
U - Analyte was not detected above the laboratory practical quantitation limit (PQL) or not above the Method Detection Limit (MDL).
The result is the method detection or other reporting limit

Shade/Bold = detected result exceeds MCL. For pH, detected results is outside of the secondary MCL limits between 6.5 to 8.5

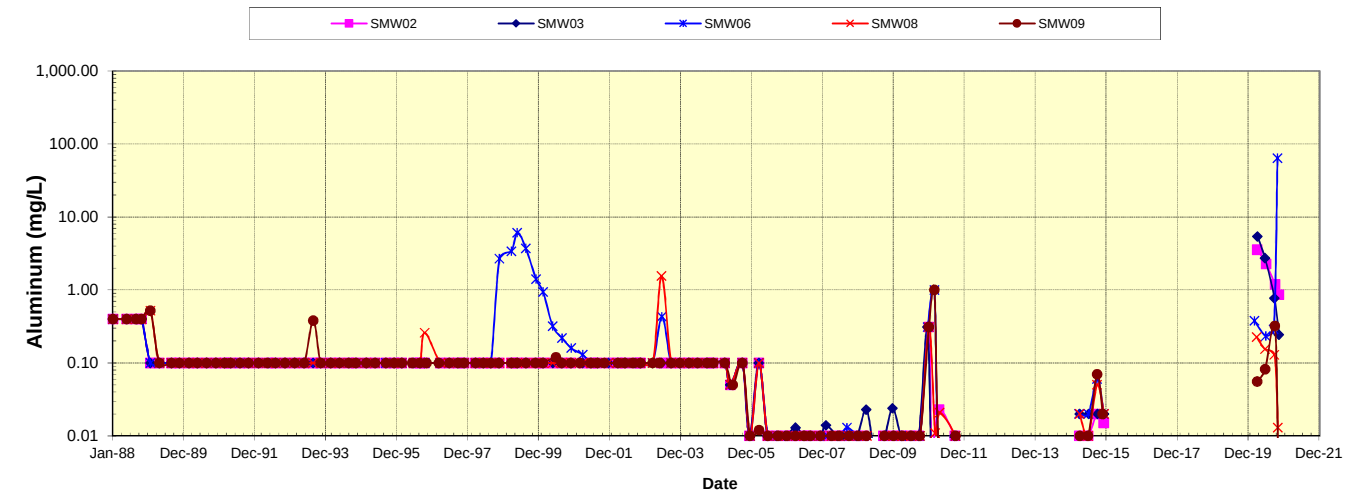
J - Indicates an estimated concentration. This occurs when an analyte concentration is below the calibration curve but is above the method detection limit.

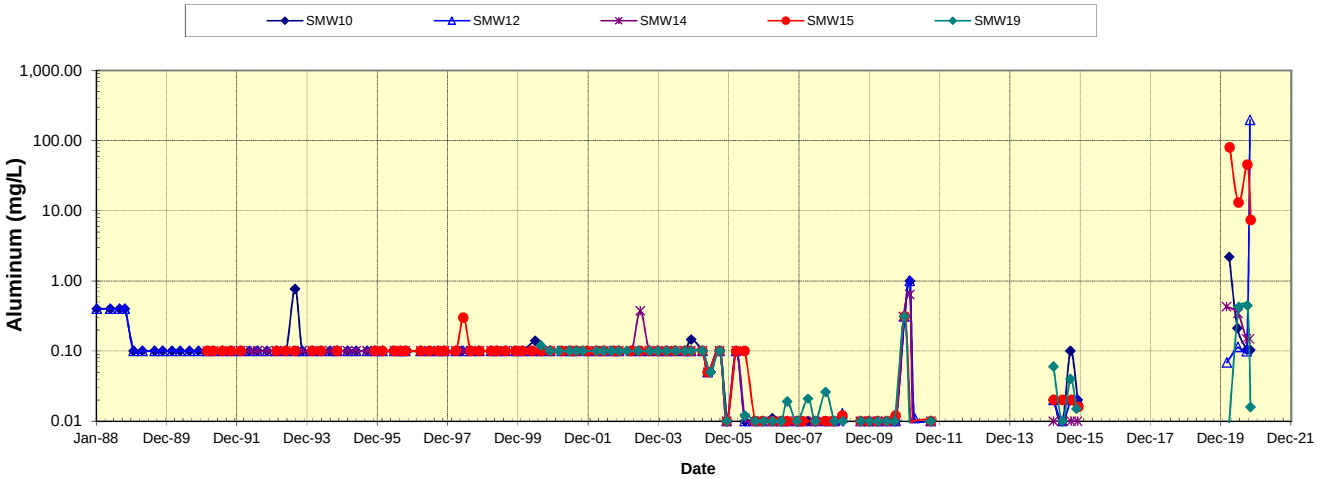
Appendix C
Time Series Plots
Quarterly Groundwater Sampling Results From Earliest Sampling Date through December 2020

UPGRADIENT WELL:



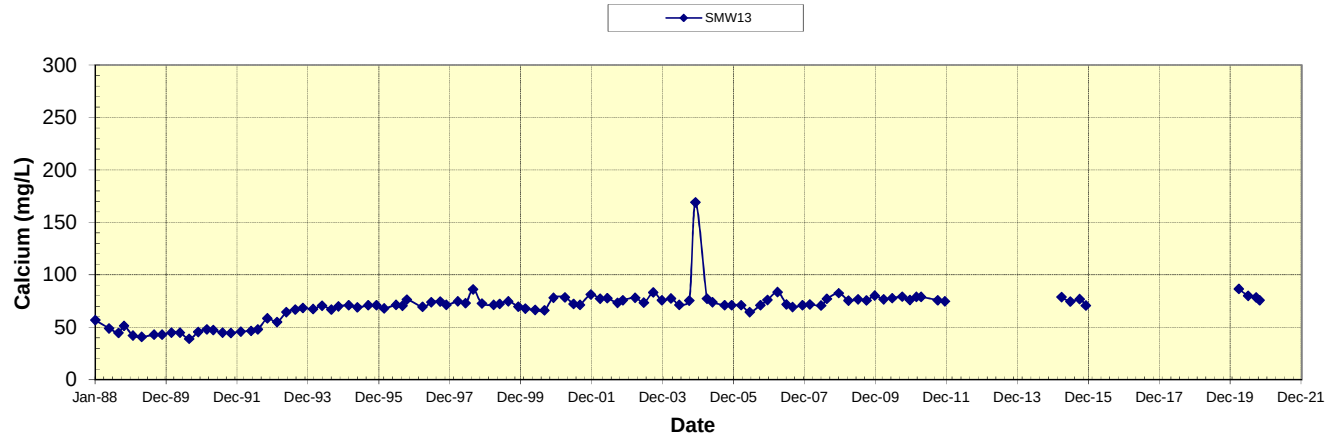
DOWNGRADIENT WELLS:



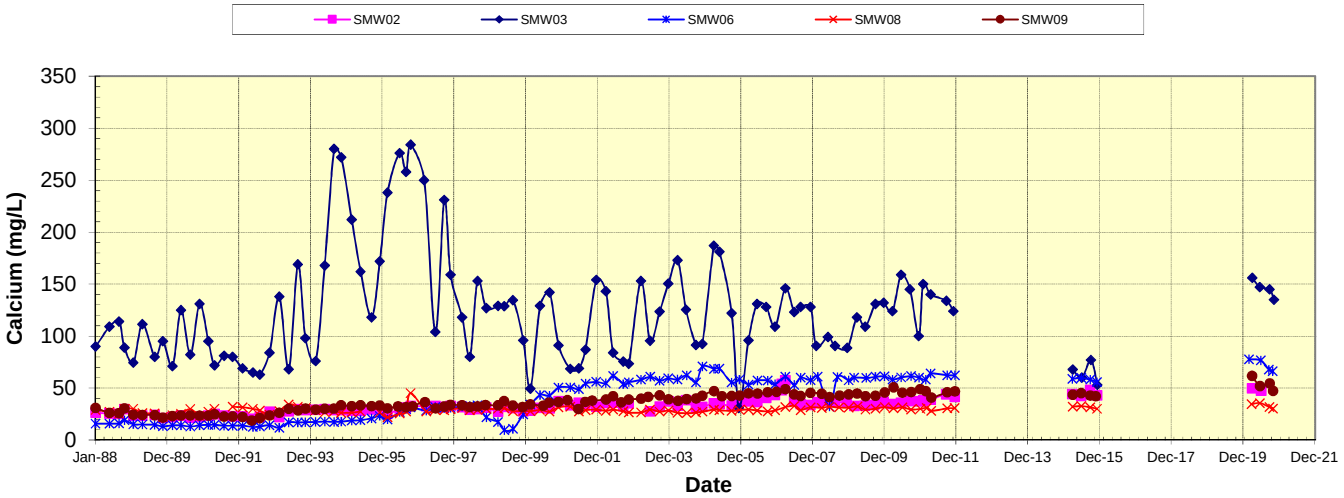


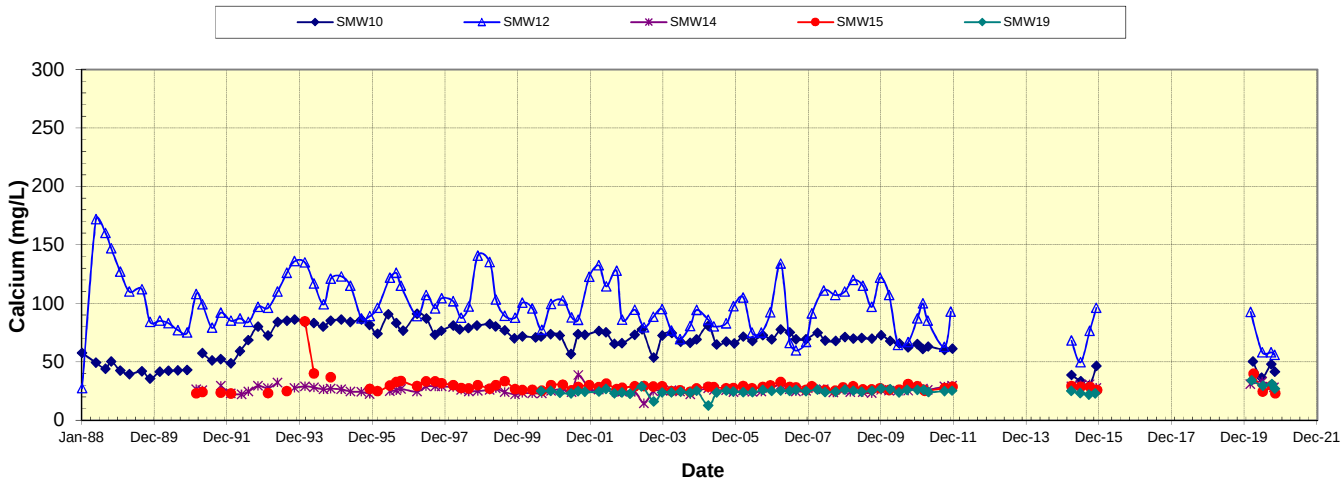
Time Series Plots
Aluminum (mg/L)

UPGRADIENT WELL:



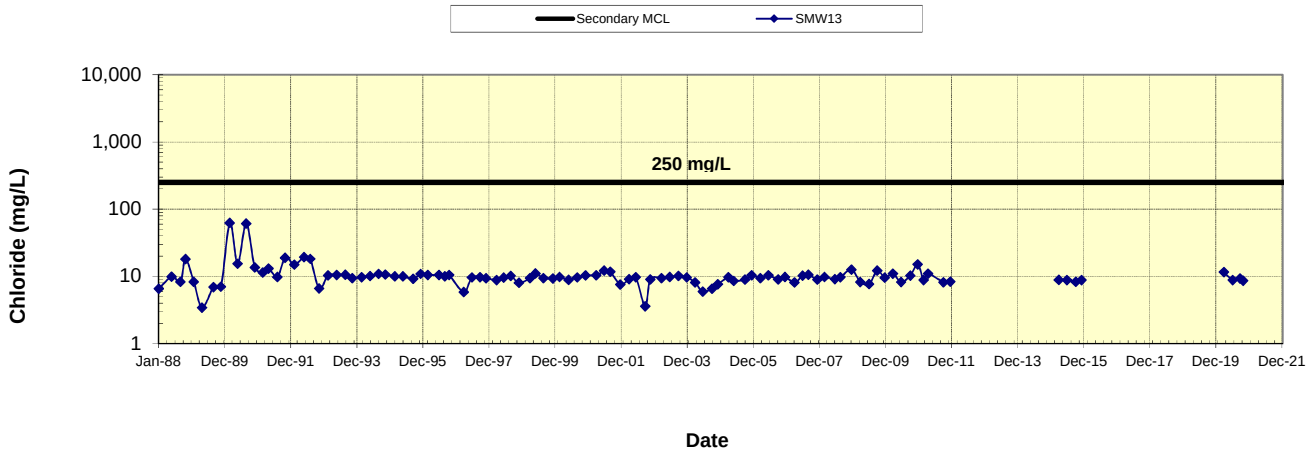
DOWNGRADIENT WELLS:



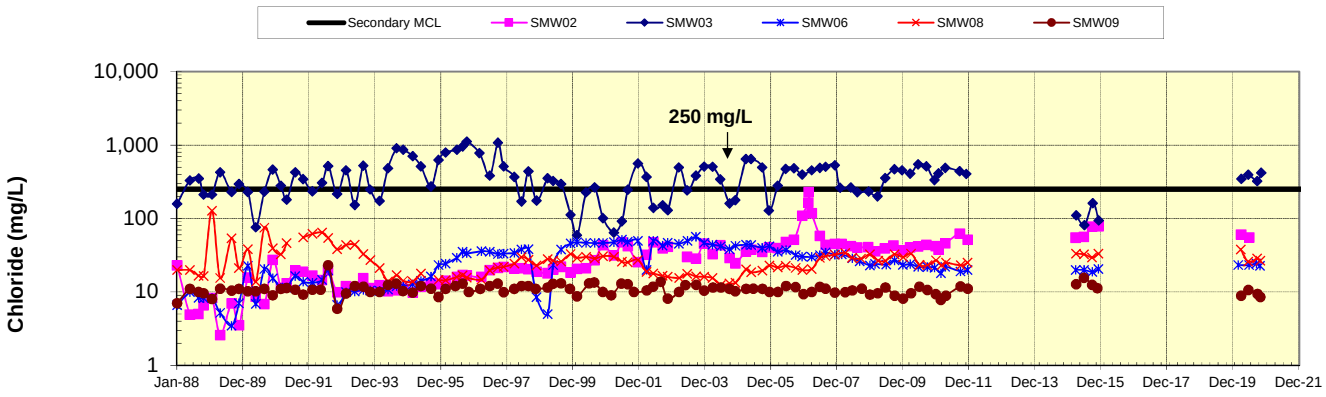


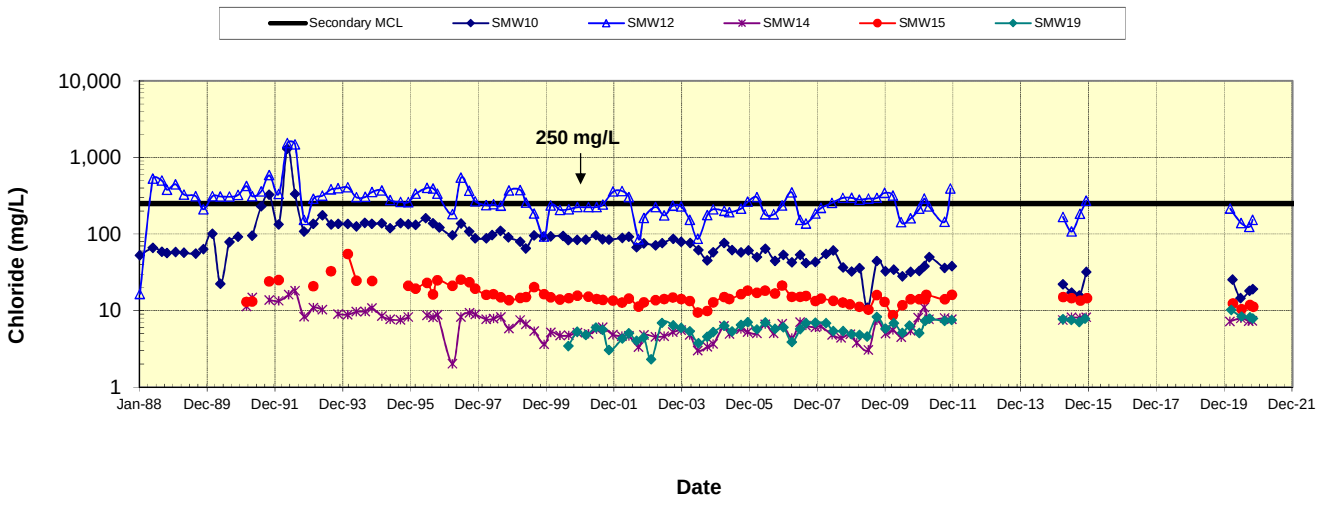
Time Series Plots
Calcium (mg/L)

UPGRADIENT WELL:



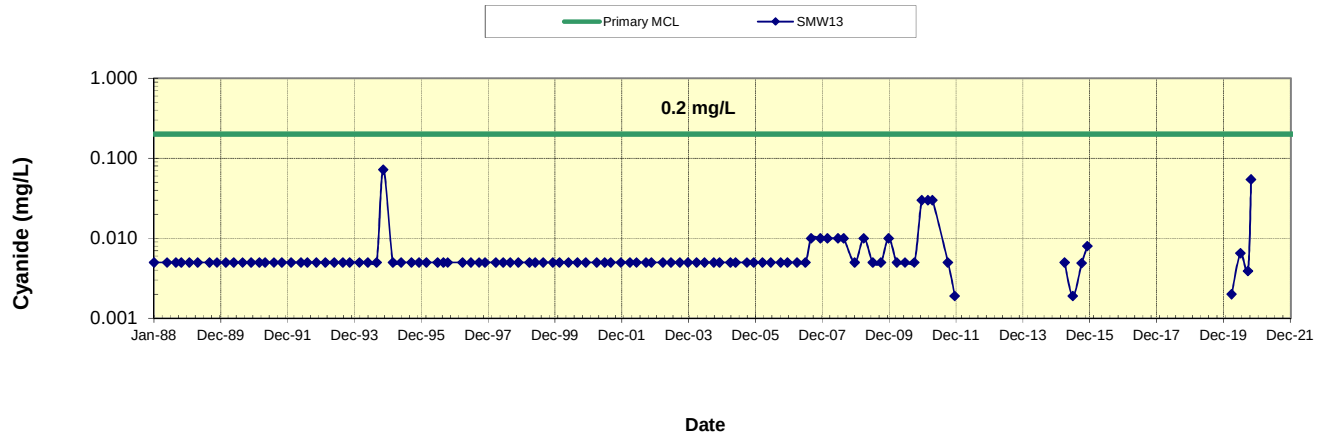
DOWNGRADIENT WELLS:



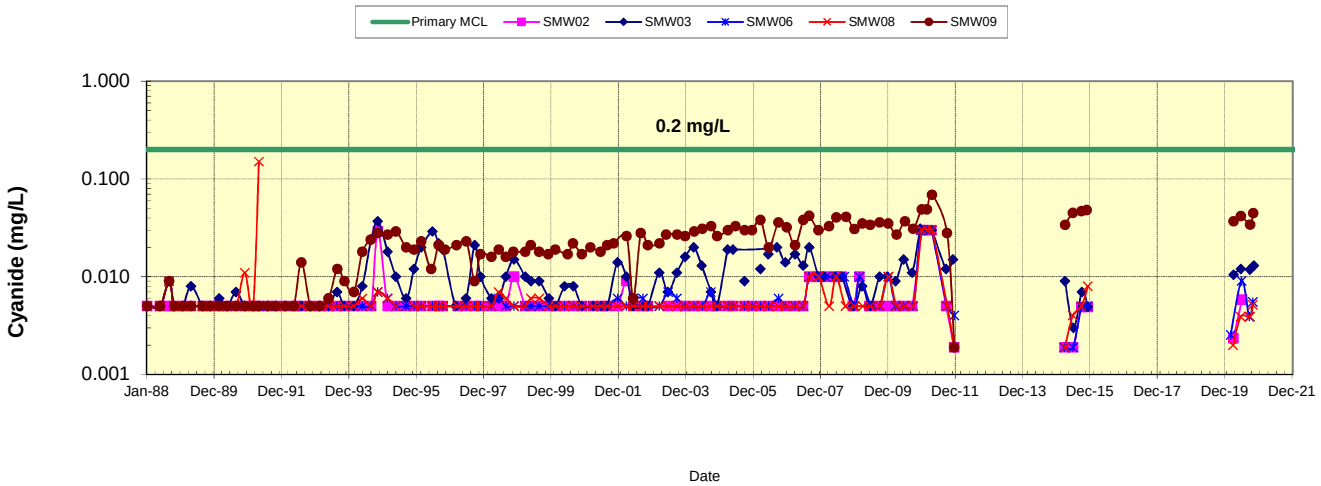


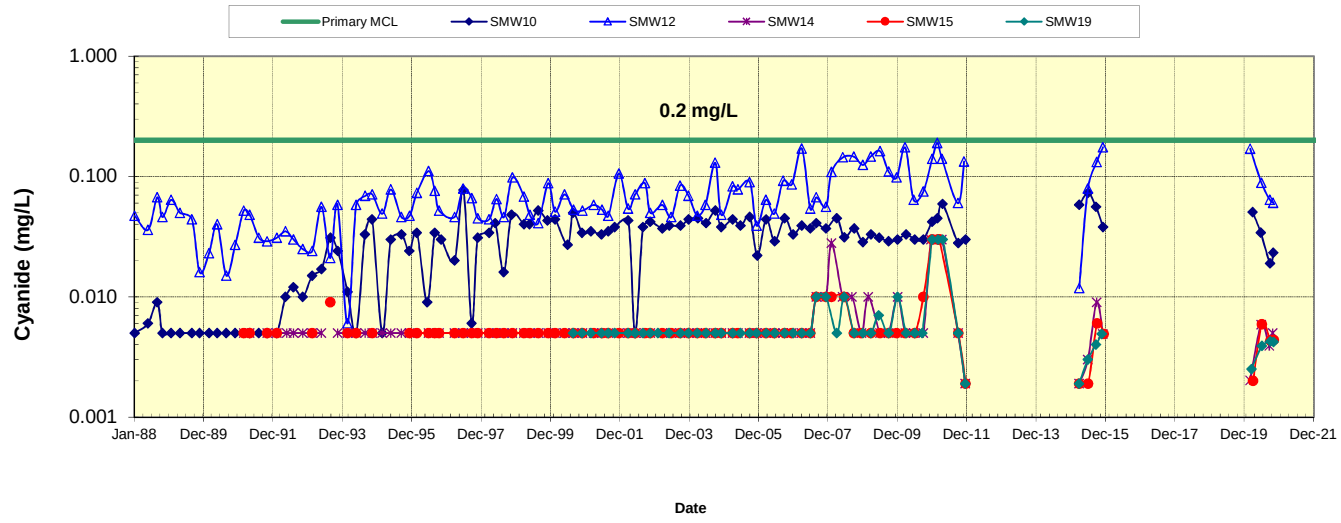
Time Series Plots
Chloride (mg/L)

UPGRADIENT WELL:



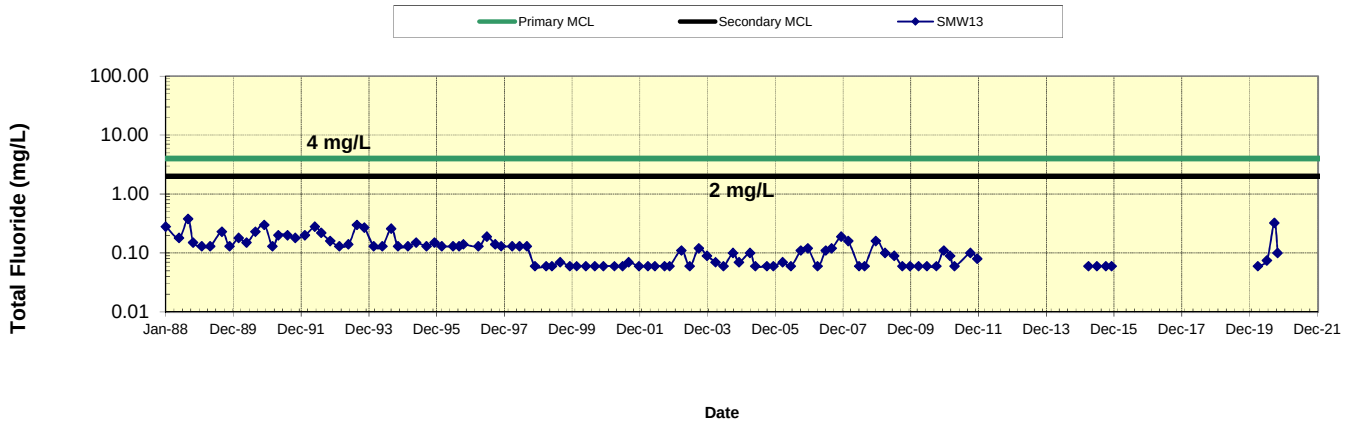
DOWNGRADIENT WELLS:



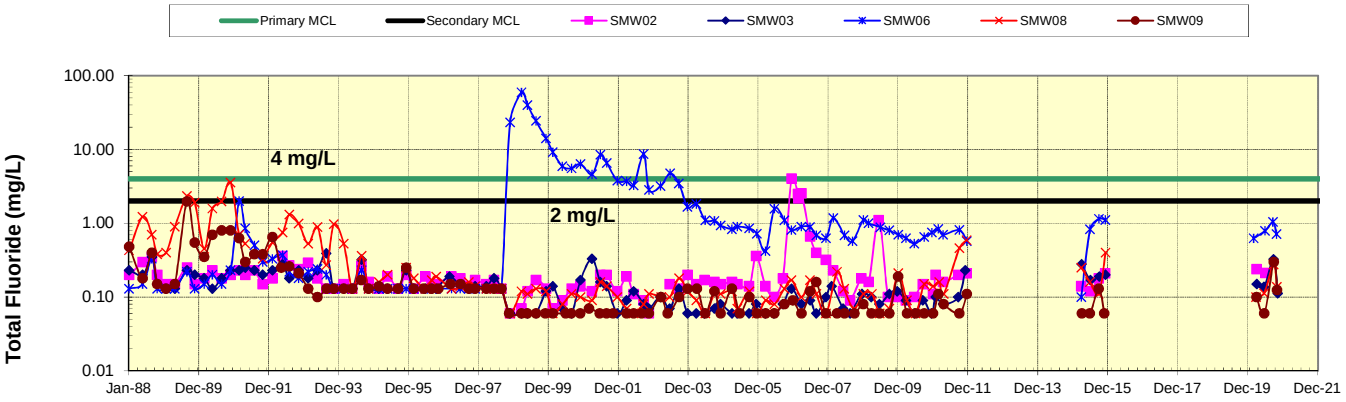


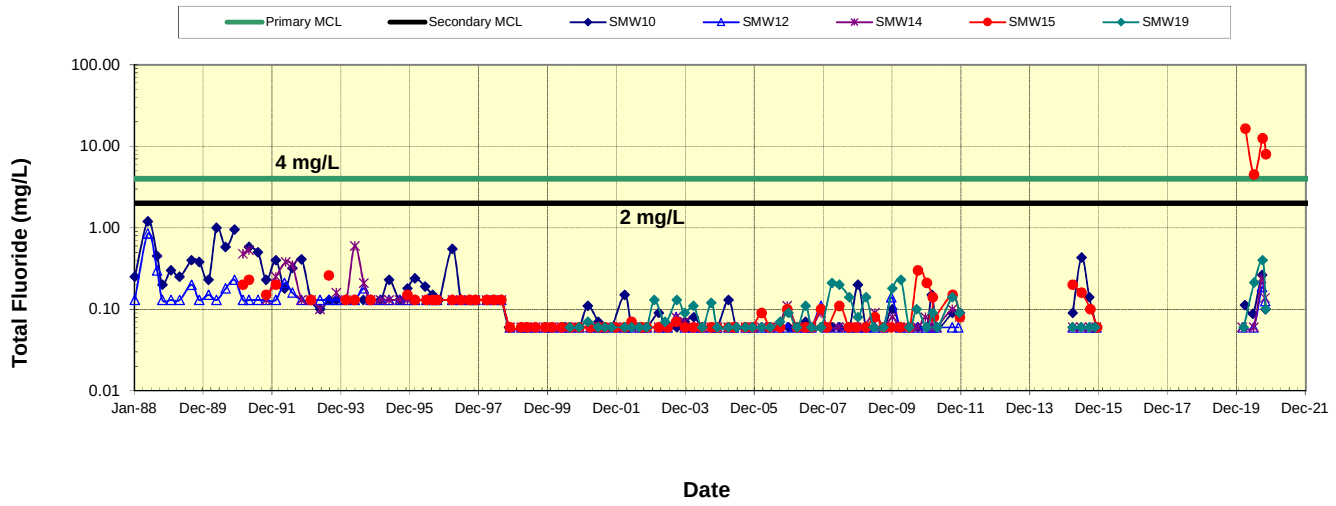
Time Series Plots
Cyanide (mg/L)

UPGRADIENT WELL:



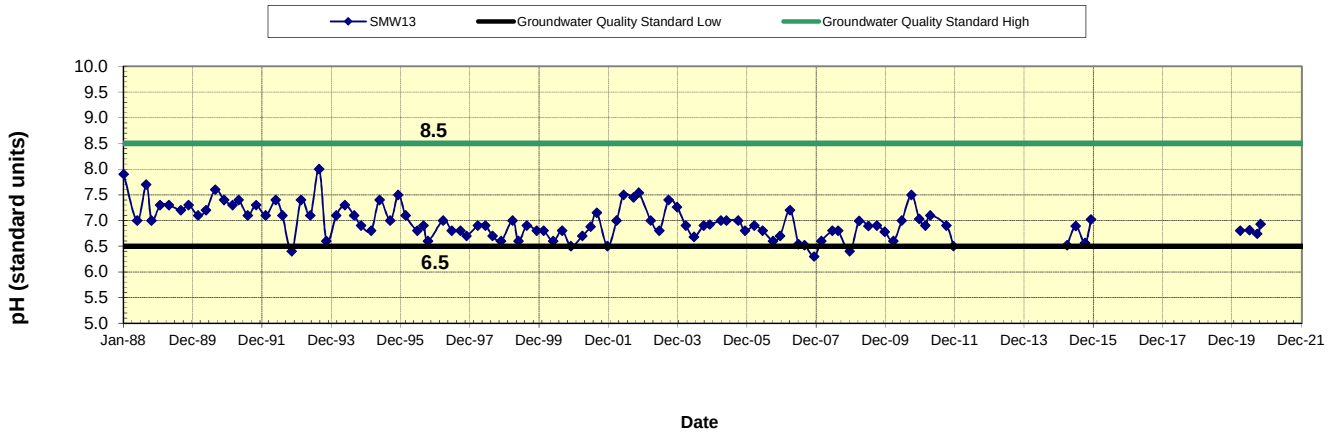
DOWNGRADIENT WELLS:



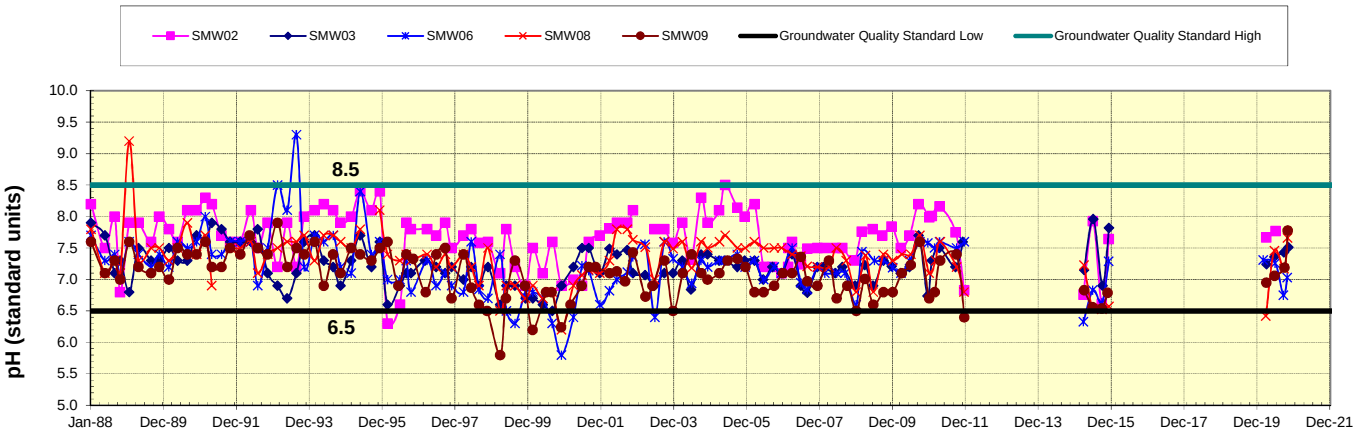


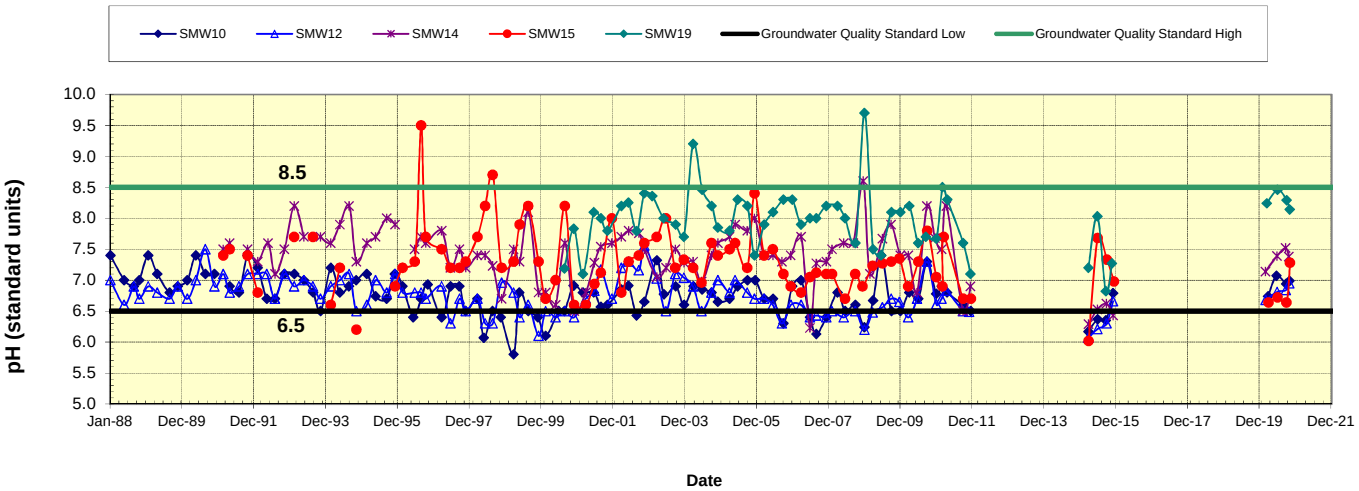
Time Series Plots
Fluoride (mg/L)

UPGRADIENT WELL:



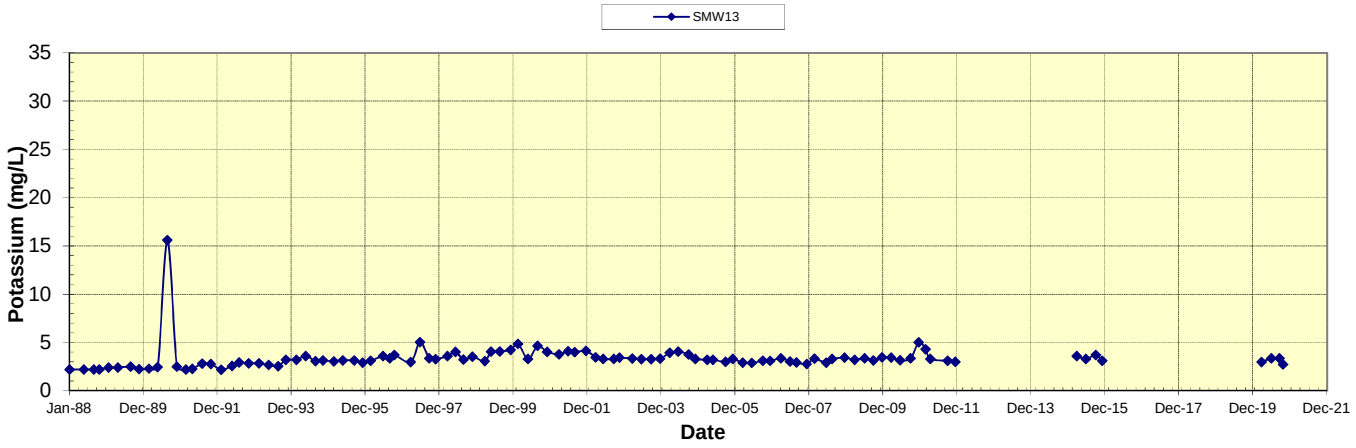
DOWNGRADIENT WELLS:



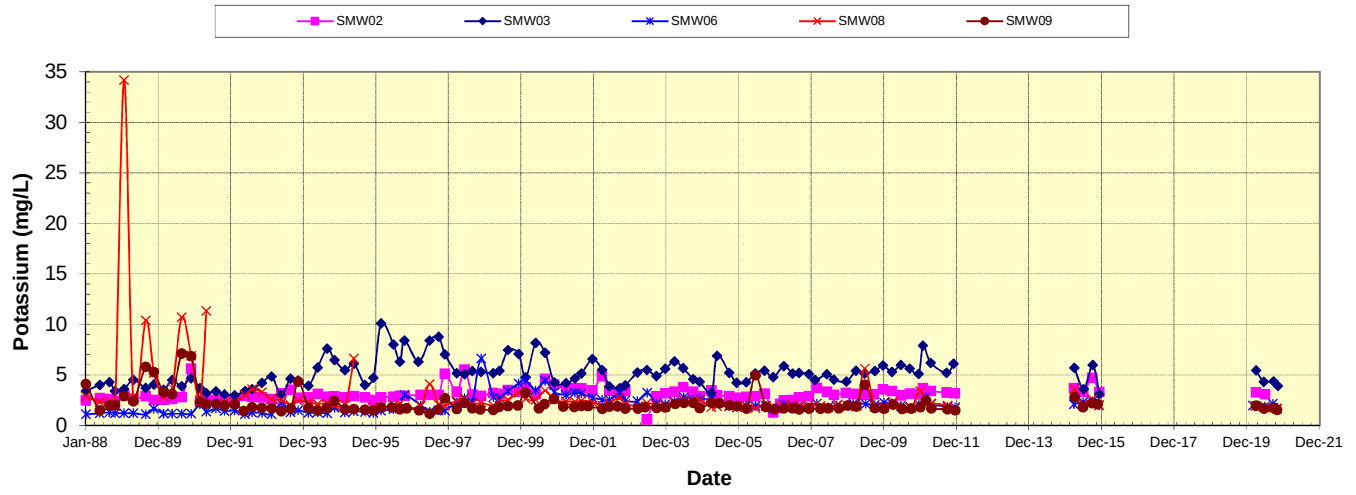


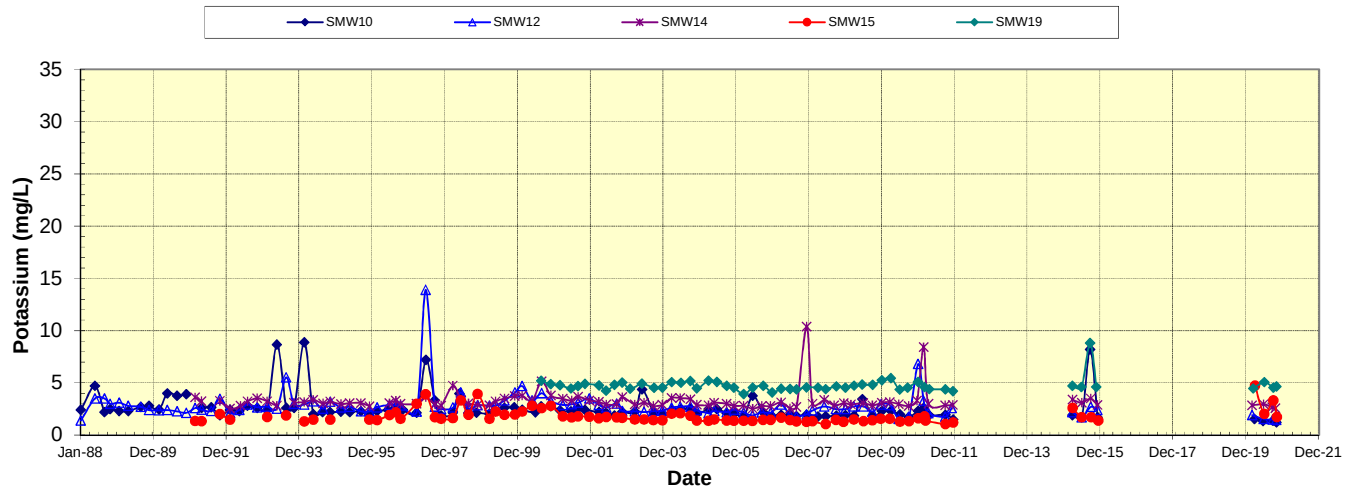
Time Series Plots
pH (Standard Units)

UPGRADIENT WELL:



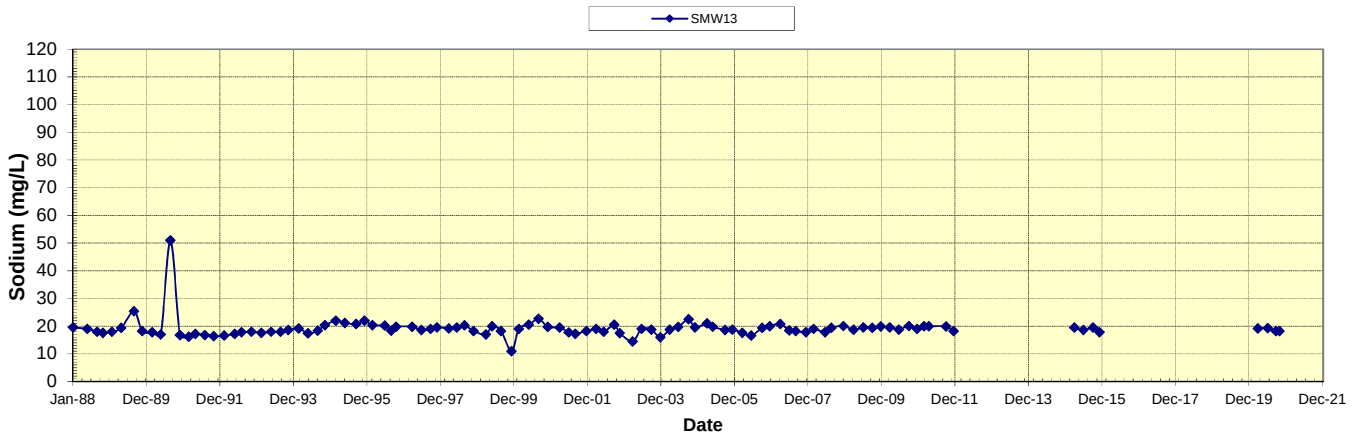
DOWNGRADIENT WELLS:



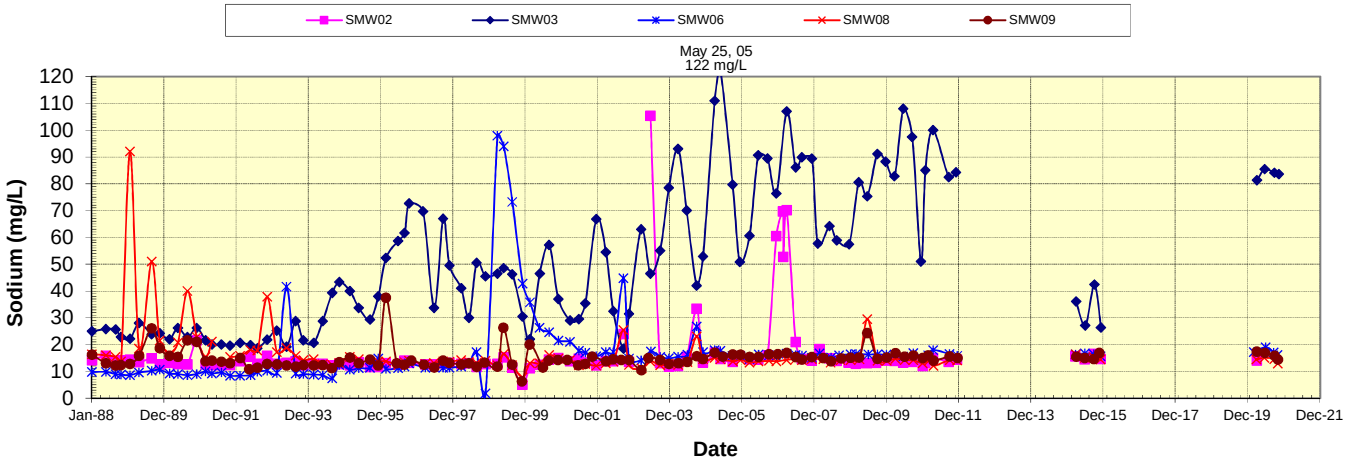


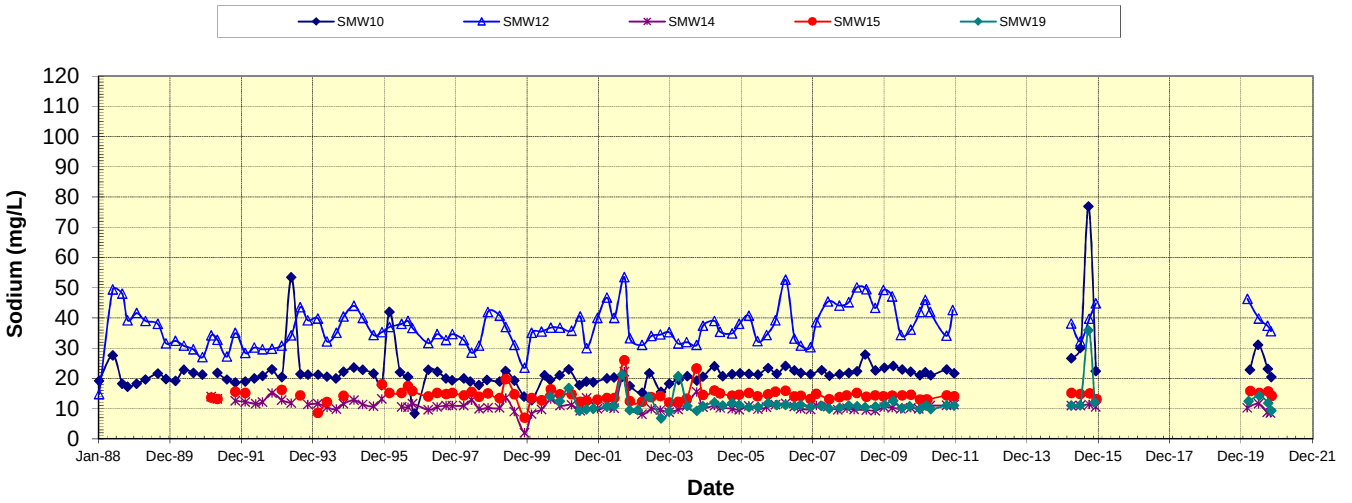
Time Series Plots
Potassium (mg/L)

UPGRADIENT WELL:



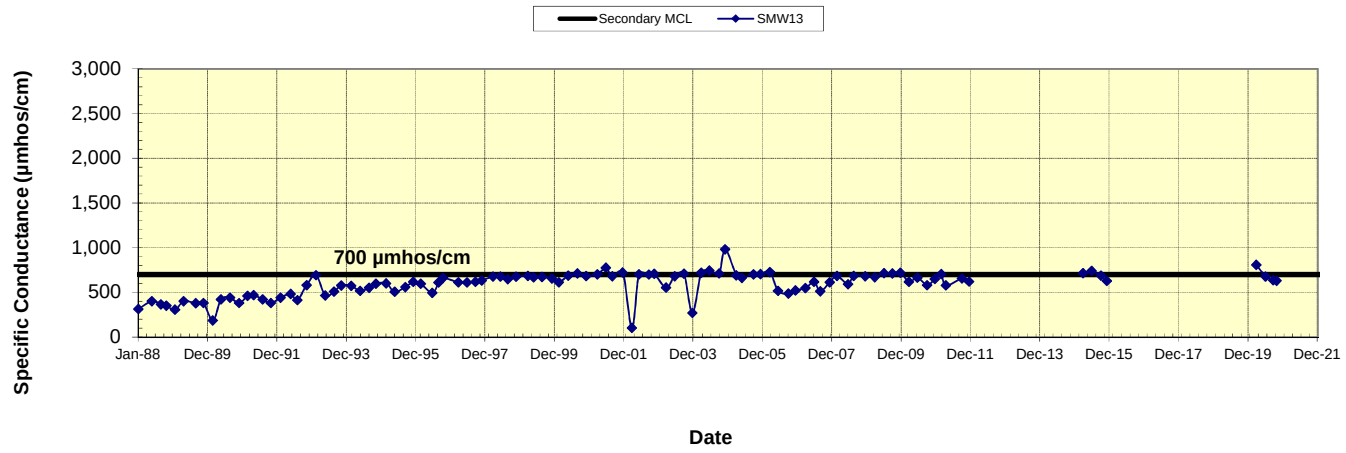
DOWNGRADIENT WELLS:



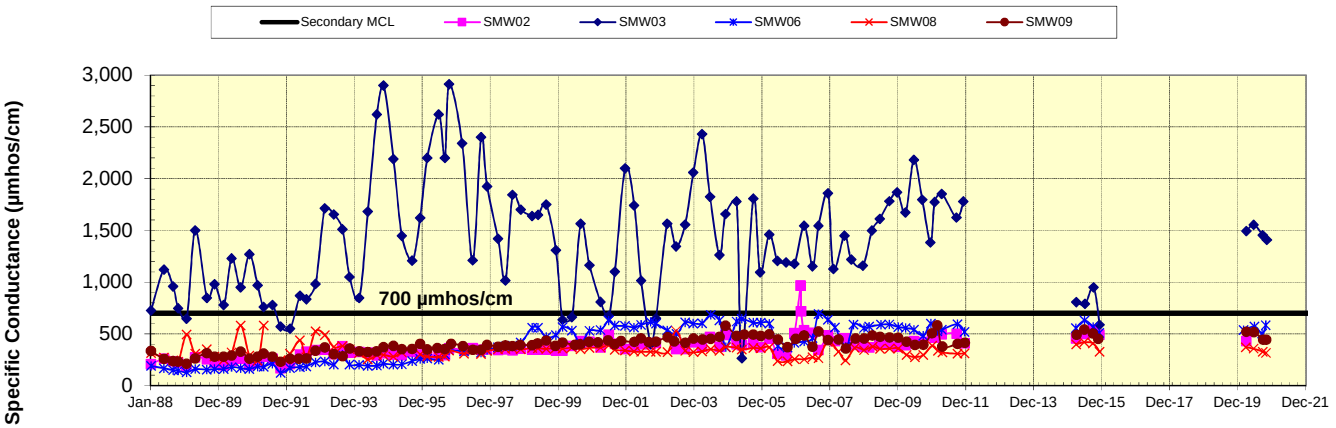


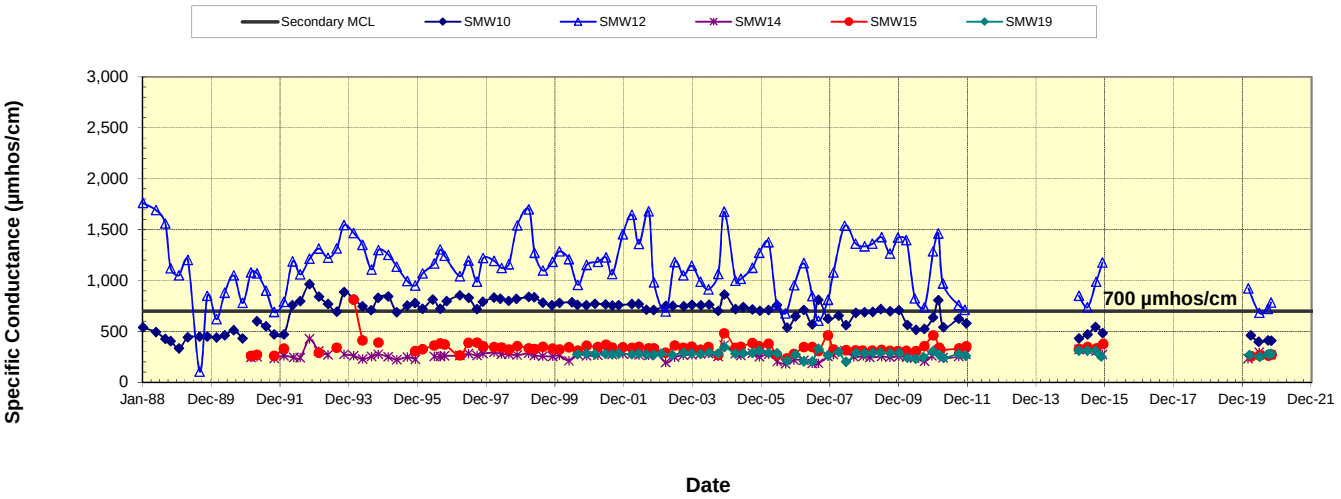
Time Series Plots
Sodium (mg/L)

UPGRADIENT WELL:



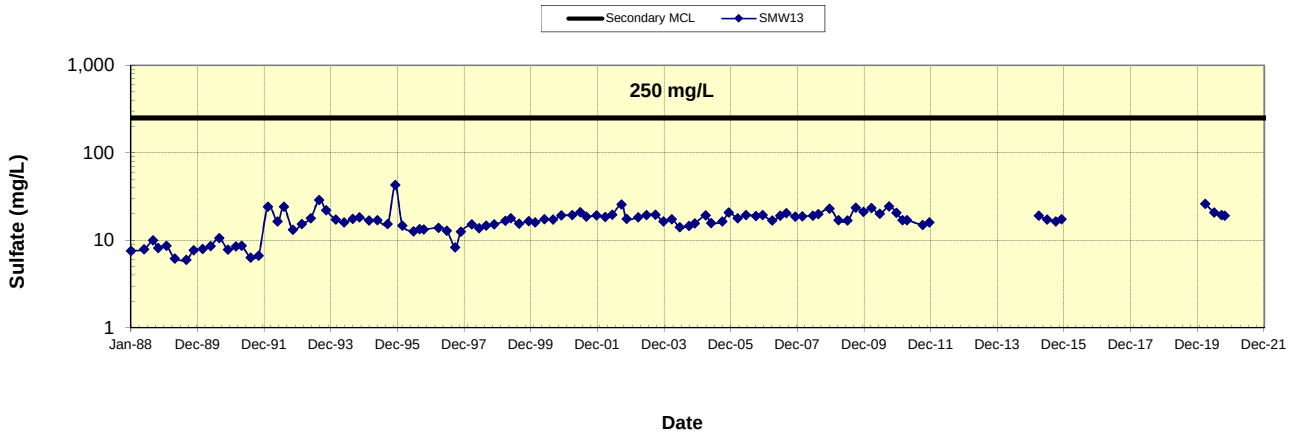
DOWNGRADIENT WELLS:



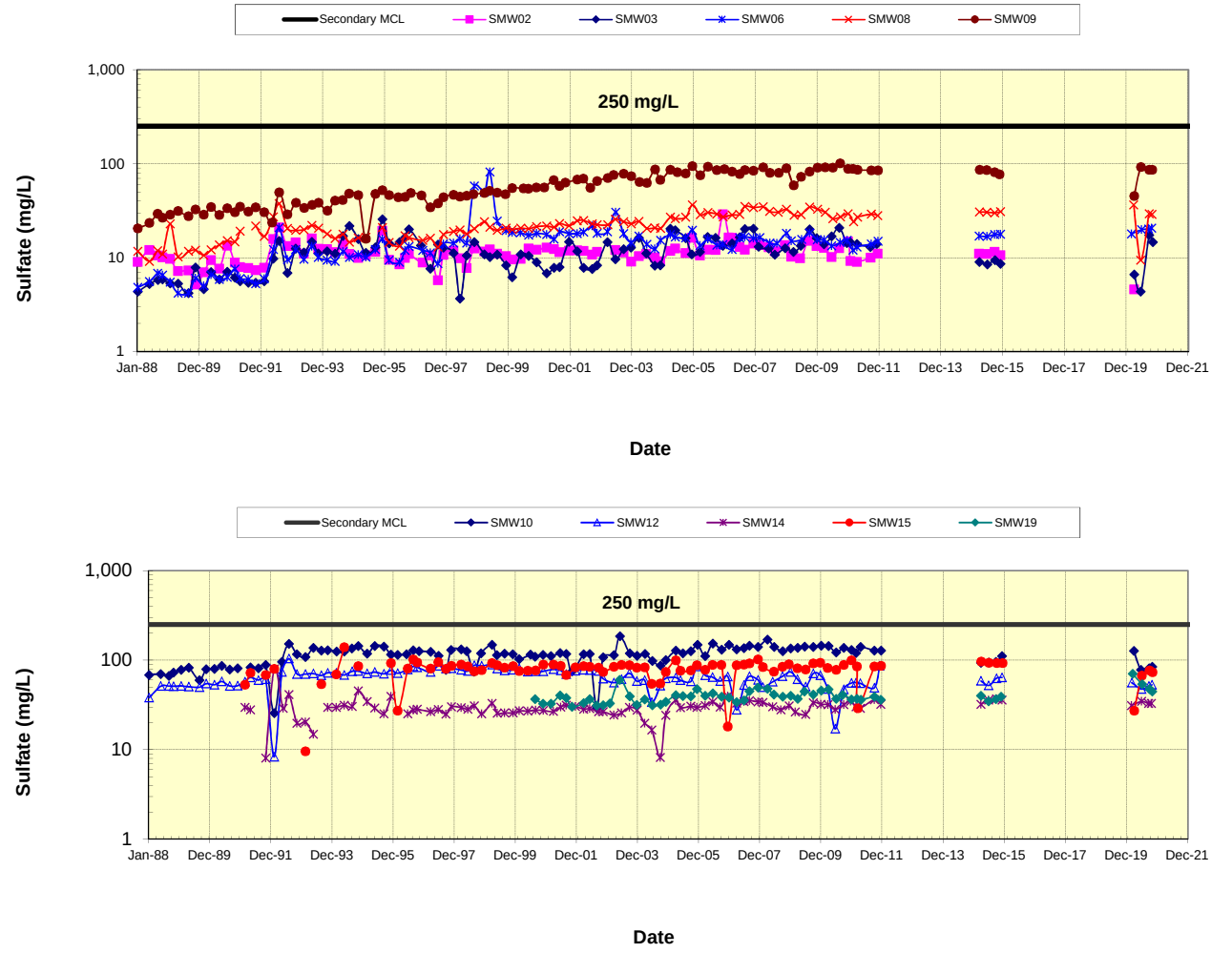


Time Series Plots
Specific Conductance (µmhos/cm)

UPGRADIENT WELL:



DOWNGRADIENT WELLS:



Time Series Plots
Sulfate (mg/L)