FINAL
SRI PHASE 5 GROUNDWATER ELEVATION STUDY SUMMARY REPORT
CHELAN CHEVRON SITE
CLEANUP SITE ID: 6660
Chelan, Washington

May 26, 2023

Prepared for:
Washington State Department of Ecology – Central Region Office
1250 West Alder Street
Union Gap, Washington 98903

Prepared by:
Leidos, Inc.
11824 North Creek Parkway N, Suite 101
Bothell, Washington 98011

On Behalf of:
Resource Environmental, LLC
925 Salida Del Sol Drive
Paso Robles, California 93446

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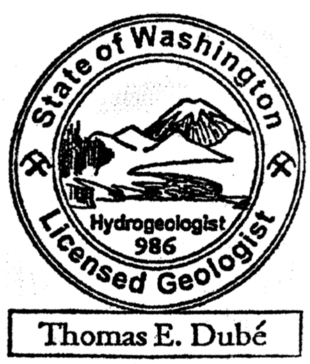

Thomas Dubé
5-26-2023

Thomas E. Dubé, LG/LHg

Russell S. Shropshire, PE

leidos

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SRI PHASE 5 GROUNDWATER ELEVATION STUDY SUMMARY REPORT
CHELAN CHEVRON SITE

1 INTRODUCTION

Leidos, Inc. (Leidos), on behalf of Resource Environmental, LLC (RELLC), an environmental service provider to Chevron Environmental Management and Real Estate Company (Chevron), has prepared this report to present the results of an approximately 15-month groundwater elevation study performed as part of the Supplemental Remedial Investigation Phase 5 (SRI-5) activities for the Chelan Chevron Site (the Site).

2 BACKGROUND

In June 2020, Arcadis prepared a work plan for SRI-5 field activities (SRI-5 Work Plan) that included installation of pressure transducers in four existing monitoring wells (MW-21, MW-27, MW-38, and MW-40). The objective of this study was to collect a higher-resolution data set more conducive to evaluating hydraulic connectivity, and to allow better insight into the ways precipitation, lake level fluctuations, and other regional phenomena affect potentiometric surfaces in the water-bearing zones present at the Site (Arcadis, 2020).

In September 2020, Leidos submitted an addendum to the SRI-5 Work Plan that expanded upon Arcadis' proposed scope for the study by proposing groundwater level data collection at eight monitoring well locations using pressure transducers (Leidos, 2020). The expanded scope was intended to assess groundwater elevation changes in four potentially distinct hydrogeologic zones that had previously been identified at the Site:

1. The eastern portion of the shallow perched water-bearing zone, which is represented by monitoring wells such as MW-5, MW-6, MW-8, MW-9, MW-15, MW-16, MW-17, and MW-18. Historical groundwater gauging results for these monitoring wells had suggested that the potentiometric surface of the shallow perched water-bearing zone in this area of the Site is not affected by changes in the surface level elevation of Lake Chelan.
2. The western portion of the shallow perched water-bearing zone, which is represented by monitoring wells such as MW-19 and MW-23. Historical groundwater gauging results for these monitoring wells indicated that the potentiometric surface of the shallow perched water-bearing zone in this area of the Site appears to be affected by changes in the surface level elevation of Lake Chelan.
3. The southern portion of the Site, which is represented by monitoring wells MW-11D, MW-13, MW-32, MW-33, MW-34, MW-35, MW-38, MW-39, and MW-40. Historical groundwater gauging results for these monitoring wells suggested that the shallow perched water-bearing zone is generally not present in this portion of the Site.
4. The deeper water-table aquifer, which is represented by monitoring wells MW-30, MW-31, and MW-37. Historical groundwater gauging results for these monitoring wells indicated that the potentiometric surface in the deeper water-table aquifer is affected by changes in the surface level elevation of Lake Chelan.

A Site map showing the location of all existing and previous monitoring wells is included as Figure 1.

Sections 2.1 and 2.2 below provide brief overviews of local geologic and hydrogeologic conditions at the Site, which are based on the results of the environmental investigations conducted to date. More detailed discussions of both local and regional geologic and hydrogeologic conditions can be found in Section 3 of the 2006 Remedial Investigation/ Feasibility Study (RI/FS) Report (SAIC, 2006). Section 2.3 below provides additional details regarding management of annual surface-level elevation changes for Lake Chelan.

2.1 GEOLOGY

Within the depth limits that have been investigated for the Site, three major distinct lithologic units have been identified, which are referred to in the 2006 RI/FS Report, from top to bottom, as unit A, unit B, and unit C.

2.1.1 Lithologic Unit A

Lithologic unit A consists of probable alluvial deposits and fill material. It is laterally and vertically varied, but generally consists of silt and sand. Below depths of approximately 4 to 5 feet below ground surface (bgs), coarser materials consisting of sand with varying degrees of gravel and cobbles are often encountered, which is difficult to drill through and may cause refusal for some drilling and sampling methods. The contact between units A and B has been encountered across the Site at depths ranging from approximately 8 to 20 feet bgs.

2.1.2 Lithologic Unit B

Lithologic unit B underlies unit A and consists of finer grained lacustrine deposits, including laminated silt with varying amounts of clay and clay-rich material. Thin layers of very fine sands are rarely present in this unit. In the northern portion of the Site, this silt and clay lithology is present at thicknesses of more than 60 feet. This lithology thins southward and is present at thicknesses averaging 25 feet (minimum 11 feet) in borings advanced along the southern portion of the Site, near Wapato Avenue. The contact between units B and C has been encountered across the Site at depths ranging from approximately 20 to 75 feet bgs, increasing to the north and northeast.

2.1.3 Lithologic Unit C

Lithologic unit C consists of glacially deposited material, including till and outwash. In the 2006 RI/FS Report (SAIC, 2006), four glacial layers (subunits) were recognized within unit C. More recent drilling/sampling and compilation of data have resulted in recognition of five glacial layers within the depth of drilling in unit C. These include alternating layers of till-like material with a fine-grained matrix, and coarser-grained outwash-like material. These five subunits from top to bottom include:

- C1: Silty sand and silt with gravel (till)
- C2: Very fine to coarse sand with gravel (outwash)
- C3: Silty sand and silt with gravel (till)
- C4: Very fine to medium sand with gravel (outwash)
- C5: Silty sand with gravel (till)

2.2 HYDROGEOLOGY

Groundwater occurs primarily in two water-bearing zones at the Site: a shallow perched water-bearing zone (referred to as a shallow perched aquifer in the 2006 RI/FS Report), and a deeper water-table aquifer. Most wells at the Site are screened within or above the shallow perched water-bearing zone. Only three monitoring wells (MW-30, MW-31, and MW-37) are screened in the deeper water-table aquifer.

2.2.1 Shallow Perched Water-Bearing Zone

The shallow perched water-bearing zone is present largely within lithologic unit B, the silt and clay unit. During very wet years, the perched water-bearing zone may extend locally up into unit A. The lower part of this saturated zone may extend a short distance into the upper portion of unit C, but the top of the dense till generally forms the base of this water-bearing zone, acting as a confining and perching layer.

Groundwater in the shallow perched water-bearing zone is typically encountered at depths of approximately 20 to 30 feet bgs, except for in monitoring wells located along and near Emerson Street (MW-16, MW-25, and MW-36), and in monitoring wells located in the Wells Fargo Bank parking lot (MW-9 and RW-2), where groundwater is more typically encountered at depths of approximately 40 feet bgs (Leidos, 2023).

The horizontal component of groundwater flow in the shallow perched water-bearing zone is generally toward the south. However, localized southwesterly and southeasterly gradients are present, which suggest that flow is generally converging toward the central portion of the Site (along Emerson Street). In the shallow perched water-bearing zone, groundwater elevation is consistently lowest at monitoring wells MW-16 and RW-2. Historically, monitoring wells located south of the alley between E. Woodin and E. Wapato avenues were found to be consistently dry, except for monitoring wells MW-9 and RW-2. The area south of the perched water-bearing zone, extending to the lakeshore, appears to be unsaturated above the deep water-table aquifer.

Groundwater horizontal flow rates in the perched zone are very low, calculated to be less than 10 centimeters per year (SAIC, 2006).

2.2.2 Deep Water-Table Aquifer

The deep water-table aquifer is situated entirely within lithologic unit C, the glacial drift unit. This aquifer occurs both within the sandy outwash and silty till layers, although the base of the aquifer is poorly defined. The deep aquifer appears to be unconfined (in areas with deep borings) based on the presence of dry soils above the water table in Unit C, and because water levels in the deep wells did not soon rise beyond where first encountered during drilling (SAIC, 2006).

Currently three monitoring wells at the Site (MW-30, MW-31, and MW-37) are screened in the deep water-table aquifer. Long-term groundwater monitoring results for these wells indicate that the water table has typically been encountered at depths of approximately 65 to 90 feet bgs. Within this aquifer, the horizontal component of groundwater flow is generally to the southeast, toward the Chelan River. The annual seasonal groundwater elevation change in these monitoring wells is typically on the order of 10 feet, and long-term elevation trends indicate that these changes generally track consistently with surface elevation changes for Lake Chelan (Leidos, 2023).

2.3 LAKE CHELAN SURFACE ELEVATION MANAGEMENT

Lake Chelan is the reservoir for the Lake Chelan Hydro Project, which is managed by the Chelan County Public Utility District (PUD). The lake level is managed on an annual cycle to generate hydroelectric power, provide recreation, protect fish, reduce erosion, and restore year-round flows to the Chelan River.

The Chelan County PUD expects to maintain the lake level within a range of 1,084 to 1,100 feet above sea level (approximately 1,086 to 1,102 feet relative to the North American Vertical Datum of 1988 [NAVD88]) during most years. In extremely wet years, the lake level could be lowered to 1,083 feet above sea level, or lower (the license minimum is 1,079 feet above sea level) as more capacity is needed to capture increased runoff. The annual high surface elevation for the lake typically occurs around late June/early July and extends through the summer to accommodate the peak tourist season. The lake level is allowed to drop through the autumn, winter, and early spring seasons, generally reaching its annual low surface elevation around late March/early April of each year (chelanpud.org/parks-and-recreation/lake-chelan-levels). Lake Chelan surface elevation data for the period of the groundwater elevation study are presented in Figures 2 and 3.[1]

3 INVESTIGATION METHODS

3.1 MONITORING LOCATIONS

The following locations were used for the study:

- Monitoring wells MW-15 and MW-17 were used to represent the portion of the shallow perched water-bearing zone, east of Emerson Street, that was not expected to be affected by surface level elevation changes in Lake Chelan.
- Monitoring wells MW-19 and MW-23 were used to represent the portion of the shallow perched water-bearing zone, west of Emerson Street, that was expected to be affected by surface level elevation changes in Lake Chelan.
- Monitoring wells MW-39 and MW-40 were used to represent the southern portion of the Site where the shallow perched water-bearing zone does not appear to exist and monitoring wells have historically been dry.
- Monitoring wells MW-30 and MW-37 were used to represent the deeper water-table aquifer.
- Barometric pressure for the study was monitored by equipment placed in a former remediation system equipment compound located behind the Chevron service station. This equipment was placed in a shaded area to minimize the potential for rapid temperature changes due to direct solar radiation.

The locations of monitoring wells used for the study are highlighted on Figure 1.

[1] Lake Chelan surface elevation data are provided by Chelan County PUD, through requests for public records.

3.2 EQUIPMENT

Equipment used for the study consisted of the following items:

- Eight In-Situ brand Rugged TROLL 200 data loggers for recording absolute pressure and temperature measurements at each of monitoring well location. Each data logger was equipped with a direct-read cable.
- One In-Situ brand Rugged Baro TROLL data logger for recording barometric pressure and temperature measurements in the vicinity of the study area.
- One wireless Rugged Troll communication device (Troll com device) to allow data logger setup and download of data using a smartphone application.

3.3 EQUIPMENT SETUP AND INSTALLATION

Prior to installation of the data loggers, the bottom depth of each monitoring well was gauged to check for accumulated fines or other obstructions within their screened intervals. On November 6, 2020, Leidos redeveloped monitoring wells MW-15, MW-17, and MW-23 by surging and bailing with a weighted bailer to remove accumulated sediment. Installation of the data loggers was completed in conjunction with other SRI-5 field activities over the course of several days between November 6 and November 13, 2020.

Data loggers were placed so they rested at the bottom of each monitoring well using direct-read cables that allowed connection of the data loggers to the Troll com device at the ground surface. Each unit was set up to record absolute pressure in units of pounds per square inch (psi) and temperature in degree Fahrenheit (°F), with one reading collected every hour.

During deployment of the data loggers, manual water level readings were collected using an electronic water-level meter or oil-water interface probe (for monitoring well MW-19, which contained light non-aqueous phase liquid [LNAPL] at thicknesses of approximately 1.5 to 2 feet during the study period) to check each data logger's pressure readings. Information including each data logger's serial number, date/time settings, and available battery and memory levels was also recorded.

3.4 DATA LOGGER CHECKS AND DATA RETRIEVAL

During the study, data logger checks and retrieval of recorded data were performed on the following dates:

- December 6, 2020 – conducted in association with groundwater sampling being performed by Gettler-Ryan that required temporary removal of the data loggers;
- April 15-16, 2021 – conducted in association with a groundwater and LNAPL gauging field event performed by Leidos;
- October 15, 2021 – conducted in association with a groundwater and LNAPL gauging field event performed by Leidos; and
- March 9-10, 2022 – final download and removal of data loggers.

During each data logger check, manual water level readings were collected using an electronic water-level meter or oil-water interface probe (monitoring well MW-19), and date/time settings, and battery/memory levels was also checked for each data logger.

4 RESULTS

Results of the groundwater elevation study are presented in Figures 2 and 3[2].

4.1 LAKE CHELAN SURFACE ELEVATION AND TRANSDUCER ABSOLUTE PRESSURE DATA

In Figure 2, data from the each of the eight monitoring well locations and barometric pressure are plotted versus time on the secondary (right) Y-axis of the graph, which represents absolute pressure readings that have been converted from pressure units of psi to feet of water. Data plotted at the top of the graph (light blue) represent the surface level elevation of Lake Chelan, measured in feet relative to NAVD 88, which are plotted versus time on the primary (left) Y-axis of the graph.

The data presented in this graph indicate the following:

- At the bottom of the graph, barometric pressure is represented by the set of brown-colored data points. As expected, these data indicate that barometric pressure through the study period remained at approximately 33 feet of water. Standard atmospheric pressure at sea level is approximately 34 feet of water, and at an elevation of 1,000 feet is approximately 33 feet of water (Chelan is at an elevation of approximately 1,100 feet above sea level). Also as expected, the barometric pressure data set shows greater variability in barometric pressure during the winter, spring, and autumn timeframes, and less variability during the summer season when weather patterns are more consistent in the Chelan area.
- The data set for monitoring well MW-40 (light gray) plots nearly identically to the barometric pressure data set. This indicates that MW-40 did not contain measurable water during the study period. This is consistent with observations made during manual depth-to-water measurements during the study period.
- The data set for monitoring well MW-39 (dark gray) generally tracks with the barometric pressure data set, but at a pressure level approximately 3 feet of water greater than barometric pressure. This indicates that monitoring well MW-39 contained approximately 3 feet of water in the well casing sump and that the water level in this well did not experience any significant elevation change during the study. This observation is consistent with observations from previous water level gauging at this monitoring well, which indicates that a generally static volume of approximately 3 feet of water is present in a blank section of well casing below the screened interval.
- The data sets for monitoring wells MW-30 (blue) and MW-37 (red), which are both screened in the deeper water-table aquifer, appear to almost mirror the data trend for the Lake Chelan surface elevation data; however, they show a time lag and an amplitude of change that is slightly muted:

[2] Transducer data sets presented in Figures 2 and 3 have been modified to remove nonrepresentative measurements collected on December 6, 2020, when the transducers were removed from monitoring wells to allow groundwater monitoring by Gettler-Ryan.

- The 2021 annual low-water surface elevation for Lake Chelan occurred on March 31 (1,087.78 above NAVD88) while the minimum absolute pressure measurements in monitoring wells MW-30 (50.85 feet of water) and MW-37 (47.89 feet of water) occurred on April 18 and April 25, respectively. This indicates a time lag of approximately 3 weeks in the deep water-table aquifer following low water in the lake.
- The 2021 annual high-water surface elevation for Lake Chelan occurred on July 1 (1,102.02 above NAVD88) while the maximum absolute pressure measurements in monitoring wells MW-30 (61.73 feet of water) and MW-37 (59.18 feet of water) both occurred on September 21. This indicates a time lag of approximately 12 weeks in the deep water-table aquifer following high water in the lake.
- The amplitude of change between the annual low-water and annual high-water surface elevations for Lake Chelan was 14.24 feet. The amplitude of change between the minimum and maximum absolute pressure measurements for monitoring wells MW-30 and MW-37 were 10.88 feet and 11.29 feet, respectively. This indicates an amplitude ratio averaging approximately 78 percent for the deep water-table aquifer.

These trends in the deep aquifer are consistent with long-term groundwater elevation monitoring data that have been collected for the Site (Leidos, 2023). The position of these curves, which vacillate between absolute pressure readings of approximately 48 to 62 feet of water, indicate that these two wells contained the greatest water column thickness of the monitoring wells included in the study.

- As seen in Figure 2, between plots for the bottom-most data sets (barometric pressure, MW-39, and MW-40) and the deeper water-table aquifer data sets (MW-30 and MW-37) are the data sets for the four study wells located in the shallow perched water-bearing zone (MW-15, MW-17, MW-19, and MW-23). The position of these data sets on the graph is due to the relatively shallow depth of these wells, which results in in-well water column thicknesses of approximately 8 to 15 feet of water.
  - The data set for monitoring well MW-23 (yellow) appears to follow a pattern similar to the data sets for Lake Chelan surface elevation and monitoring wells MW-30 and MW-37, although with a smaller amplitude of change between the low- and high-pressure readings. Again, this trend is consistent with previous observations based on long-term groundwater monitoring results (Leidos, 2023).
  - Although less clear, a similar pattern may also exist in the data sets for monitoring wells MW-15 (black), MW-17 (orange), and MW-19 (green). When comparing the data sets from the four shallow perched water-bearing zones, it appears that the amplitude of change between the low and high points of each data set decreases in a west to east direction along Woodin Avenue. The greatest amplitude of change is observed at monitoring well MW-23, which is the western-most shallow well in the study, and the least amplitude of change is observed at monitoring well MW-17, which is the eastern-most shallow well in the study.

4.2 WATER SURFACE ELEVATION AND MONTHLY PRECIPITATION DATA

Figure 3 presents similar data sets to those presented in Figure 2; however, for this figure the monitoring well pressure measurements have been converted to approximate groundwater potentiometric surface elevations that are plotted versus time on the primary (left) Y-axis of the graph, along with the surface level elevation of Lake Chelan. The secondary (right) Y-axis of this graph presents monthly average and actual precipitation data.[3]

The data presented in this graph indicate the following:

- Near the bottom of the graph, data sets for monitoring wells MW-30 and MW-37, which are screened in the deeper water-table aquifer, indicate groundwater elevation levels that vary from approximately 1,048 to 1,058 feet above NAVD 88. As this figure shows, the water level surface elevation differences between Lake Chelan and the deeper water-table aquifer indicate a strong downward vertical gradient from the lake toward the aquifer throughout the lake's annual water management cycle. In this data set, the lake's level is always at least 30 feet higher than the groundwater elevation in the deeper water-table aquifer. Therefore, if the lake and the deeper water-table aquifer were hydraulically connected, water movement between these units would always be from the lake down to the aquifer.
- In the central portion of the graph, the data sets for monitoring wells MW-39 and MW-40 are plotted. Because no change in water levels was observed at these locations during the study, these data are representative of the bottom of screen elevation for each of these wells (approximately 1,077 feet above NAVD 88). When compared to the Lake Chelan surface elevation data set, it becomes clear that the surface level of the lake is always maintained at an elevation that is at least 10 feet higher than the bottom of screen elevation for these monitoring wells. The data for these two monitoring wells, which are located closest to the lake, provide additional evidence that a hydraulic connection does not exist between the shallow perched water-bearing zone and Lake Chelan in the southern portion of the Site. If such a connection did exist, we would expect to see groundwater flow to these wells from the lake.
- In the upper portion of the graph, data sets for monitoring wells MW-15, MW-17, MW-19, and MW-23 are plotted, showing potentiometric surface variations between approximately 1,089 and 1,099 feet above NAVD88. The position of these data sets relative to one another, and relative to the Lake Chelan surface elevation data set, demonstrate the following patterns regarding groundwater flow in the shallow perched water-bearing zone, and its relationship with surface level elevation changes for Lake Chelan:
  - The position of the MW-17 data set, consistently above the data set for MW-15, indicates that the groundwater gradient includes a component of westerly flow in this eastern portion of the shallow perched water-bearing zone. Note that long-

[3] Precipitation data for the Chelan region are obtained from the website for the Western Regional Climate Center (wrcc.dri.edu) for Station No. 451350.

term monitoring results indicate groundwater flow in this area is generally toward the southwest (Leidos, 2023).

- The relative positions of the MW-19 and MW-23 data sets indicate that the groundwater gradient in the western portion of the shallow perched water-bearing zone during most of the study period (mid-June to February) includes a component of easterly flow (from MW-23 toward MW-19). During the period from approximately March to June 2021, the elevation of groundwater is higher in MW-19 than in MW-23. Note that long-term monitoring results for this portion of the Site indicate groundwater flow generally toward the southeast or south (Leidos, 2023).
- Some rise in groundwater elevation was observed in all four of these monitoring wells beginning around May/June 2021 that appears to be associated with increases in the surface elevation for Lake Chelan, with a time lag. This trend is most evident in the MW-23 data set, and the amplitude appears to decrease in the other wells relative to their distance to the east along Woodin Avenue, while the time lag increases to the east. The earlier "bump" in groundwater elevations observed in these wells during the period from approximately January to April 2021 appears to be associated with above-average precipitation that occurred in January 2021.
- Throughout much of the study period, the surface elevation of Lake Chelan was higher than groundwater levels in these monitoring wells along Woodin Avenue. The elevation of groundwater in the westernmost monitoring well, MW-23, was higher than the lake surface elevation only for a period of approximately three months between late January and late April 2021. These data indicate that groundwater flow throughout most of the year would be from the lake toward the shallow perched water-bearing zone near MW-23.
- Water levels in the four studied monitoring wells along Woodin Avenue exhibit a response to lake levels, with a decreased effect in the eastward direction. However, these wells are separated from the lake by a zone of unsaturated soils to the south and southwest, as discussed above for wells MW-39 and MW-40; this zone of dry wells extends eastward to MW-13 (Figure 1). Based on this configuration and the results from this study for all six monitoring wells in the shallow perched water-bearing zone, the effect from the lake on the perched groundwater along Woodin Avenue must originate from the general direction of west of MW-23.

5 SUMMARY AND CONCLUSIONS

Data logging pressure transducers were installed in eight monitoring wells and one barometric pressure monitoring location at the Site to generate a high-resolution data set of groundwater elevation changes during an approximate 15-month study period. These data were evaluated in combination with Lake Chelan surface elevation data obtained from the Chelan County PUD and average/actual monthly precipitation data for the Chelan area.

The results of the study are consistent with long-term groundwater elevation gauging data for the Site which have demonstrated:

- A direct relationship between Lake Chelan surface elevation changes and groundwater elevation changes in monitoring wells screened in the deeper water-table aquifer;
- A direct relationship between Lake Chelan surface elevation changes and groundwater elevation changes in monitoring wells screened in the shallow perched water-bearing zone in the western portion of the Site (in the vicinity of monitoring wells MW-19 and especially MW-23); and
- The shallow perched water-bearing zone is not present in the downgradient direction in the southern and southwestern portions of the Site, in the vicinity of Wapato Avenue and Chelan Riverwalk Park.

Results of the study also suggest that surface elevation changes in Lake Chelan are affecting groundwater elevations in the shallow perched water-bearing zone within monitoring wells located further east than was previously believed, in fact as far as MW-17.

As discussed in Section 4.2, with the direct relationship between Lake Chelan surface elevation changes and groundwater elevation changes in the deeper water-table aquifer, any hydraulic connection between these two units would result in continuous movement of water from the lake downward to the deeper aquifer. Consequently, it is assumed that the lake is one source of recharge to this deeper aquifer.

In the shallow perched water-bearing zone, groundwater levels affected by the lake surface elevation changes are most significant at MW-23 and decrease eastward. For most of the study period (approximately late April to late January), the lake level is higher in elevation than groundwater levels in MW-23. This would suggest that lake water is intruding into the nearshore shallow perched water-bearing zone to the west, and then producing groundwater mounding and a hydraulic wave that reaches MW-23 and continues moving eastward. The time lag is months-long as this wave slowly migrates eastward along the Woodin Avenue corridor. During the months when the lake level is below groundwater levels in MW-23 (late January to late April), the reverse condition would occur and the wave would subside, while the nearshore aquifer would discharge to the lake.

Similar to a tidally influenced shoreline (with a shorter time lag), most of the groundwater elevation change throughout the affected aquifer would not be due to physical transport of surface water a distance into the aquifer, but rather the passage of a hydraulic pressure wave due to nearshore mounding of groundwater at the point of surface water intrusion. This model is believed to account for the conditions seen at the Chelan Site.

Using the transducer study results in combination with long-term gauging results for the Site (Leidos, 2023), it appears that the groundwater elevation variations due to changing lake levels have a secondary effect on the overall groundwater gradient. The primary gradient in the shallow perched water-bearing zone is always approximately to the south, toward the unsaturated zone; and the hydraulic wave effects due to variations in the lake surface elevation is a secondary east-west effect. Because the petroleum hydrocarbons found in this perched zone are located farther east (MW-19 and eastward), this contamination does not appear to be significantly affected by the east-west hydraulic wave induced in the perched zone by the changing lake levels.

During the study period, comparison of water elevation data for the lake surface and in monitoring wells along Woodin Avenue suggest that any connection between surface water and groundwater would result in a net movement of water from the lake and cause intrusion into the perched zone. Thus, this mechanism would help prevent contaminant migration from the shallow perched water-bearing zone toward the lake. Within the perched zone, MW-23 is closest to the lake and has the most significant impact from the changes in lake elevations, but this location is also free of petroleum hydrocarbons. This information is based on groundwater sampling results for monitoring well MW-23, which indicate a consistent nearly 20-year trend of compliance with cleanup levels for petroleum-range hydrocarbons, despite its proximity to monitoring well MW-19, which has a similarly consistent trend of non-compliance, including the presence of LNAPL.

Results of the study are consistent with, and provide additional support for, previous hydrogeologic assessments for the Site, which have concluded that the lake maintains an elevation throughout the year that is higher than the deeper water-table aquifer, and also higher than the perched water-bearing zone along its downgradient southern edge. For most of the annual cycle, the lake elevation is also higher than perched groundwater at monitoring well MW-23 on the western edge of the Site. Consequently, although the lake appears to be affecting the water levels in these two water-bearing zones, the Site groundwater in these zones do not affect or reach the lake water. Similarly, the petroleum contamination within the shallow perched water-bearing zone does not reach the lake.

6 REFERENCES

Arcadis (2020). "Supplemental Remedial Investigation Work Plan – Phase 5, Chevron Service Station No. 9-6590." June 16.

Leidos (2020). "Final-Supplemental Remedial Investigation Work Plan – Phase 5, Addendum 1, Chelan Chevron – Cleanup Site ID 6660." September 24.

Leidos (2023). "202Re2 Annual Groundwater Monitoring Summary Report, Chelan Chevron Site." April 11.

SAIC (2006). "Final Remedial Investigation/Feasibility Study Report, Chevron Service Station No. 9-6590." December.

LIMITATIONS

This technical document was prepared on behalf of RELLC and is intended for their sole use and for use by the local, state, or federal regulatory agency that the technical document was sent to by Leidos. Any other person or entity obtaining, using, or relying on this technical document hereby acknowledges that they do so at their own risk, and Leidos shall have no responsibility or liability for the consequences thereof.

Site history and background information provided in this technical document are based on sources that may include interviews with environmental regulatory agencies and property management personnel and a review of acquired environmental regulatory agency documents and property information obtained from RELLC and others. Leidos has not made, nor has it been asked to make, any independent investigation concerning the accuracy, reliability, or completeness of such information beyond that described in this technical document.

Recognizing reasonable limits of time and cost, this technical document cannot wholly eliminate uncertainty regarding the vertical and lateral extent of impacted environmental media.

Opinions and recommendations presented in this technical document apply only to site conditions and features as they existed at the time of Leidos site visits or site work and cannot be applied to conditions and features of which Leidos is unaware and has not had the opportunity to evaluate.

All sources of information on which Leidos has relied in making its conclusions (including direct field observations) are identified by reference in this technical document or in appendices attached to this technical document. Any information not listed by reference or in appendices has not been evaluated or relied on by Leidos in the context of this technical document. The conclusions, therefore, represent our professional opinion based on the identified sources of information.

Figures

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Chelan Chevron Site
232 East Woodin Avenue
Chelan, Washington

FIGURE 1
Site Map

FILE NAME: Chelan_Site Map_2021.dwg
DATE: 04/25/2023

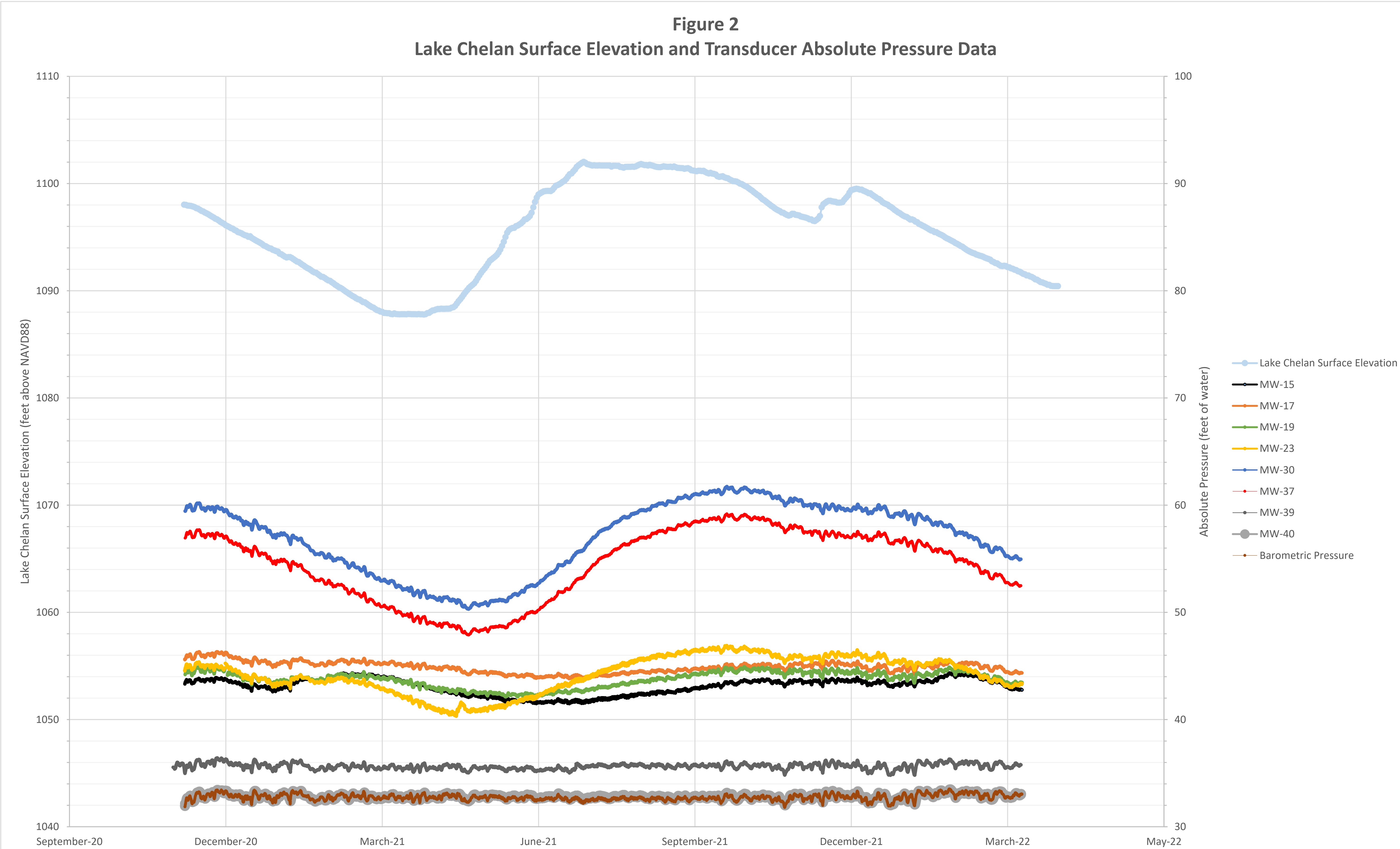
Figure 2
Lake Chelan Surface Elevation and Transducer Absolute Pressure Data
Lake Chelan Surface Elevation (feet above NAVD88)
Absolute Pressure (feet of water)
1110
1100
1090
1080
1070
1060
1050
1040
100
90
80
70
60
50
40
30
September-20
December-20
March-21
June-21
September-21
December-21
March-22
May-22
Lake Chelan Surface Elevation
MW-15
MW-17
MW-19
MW-23
MW-30
MW-37
MW-39
MW-40
Barometric Pressure

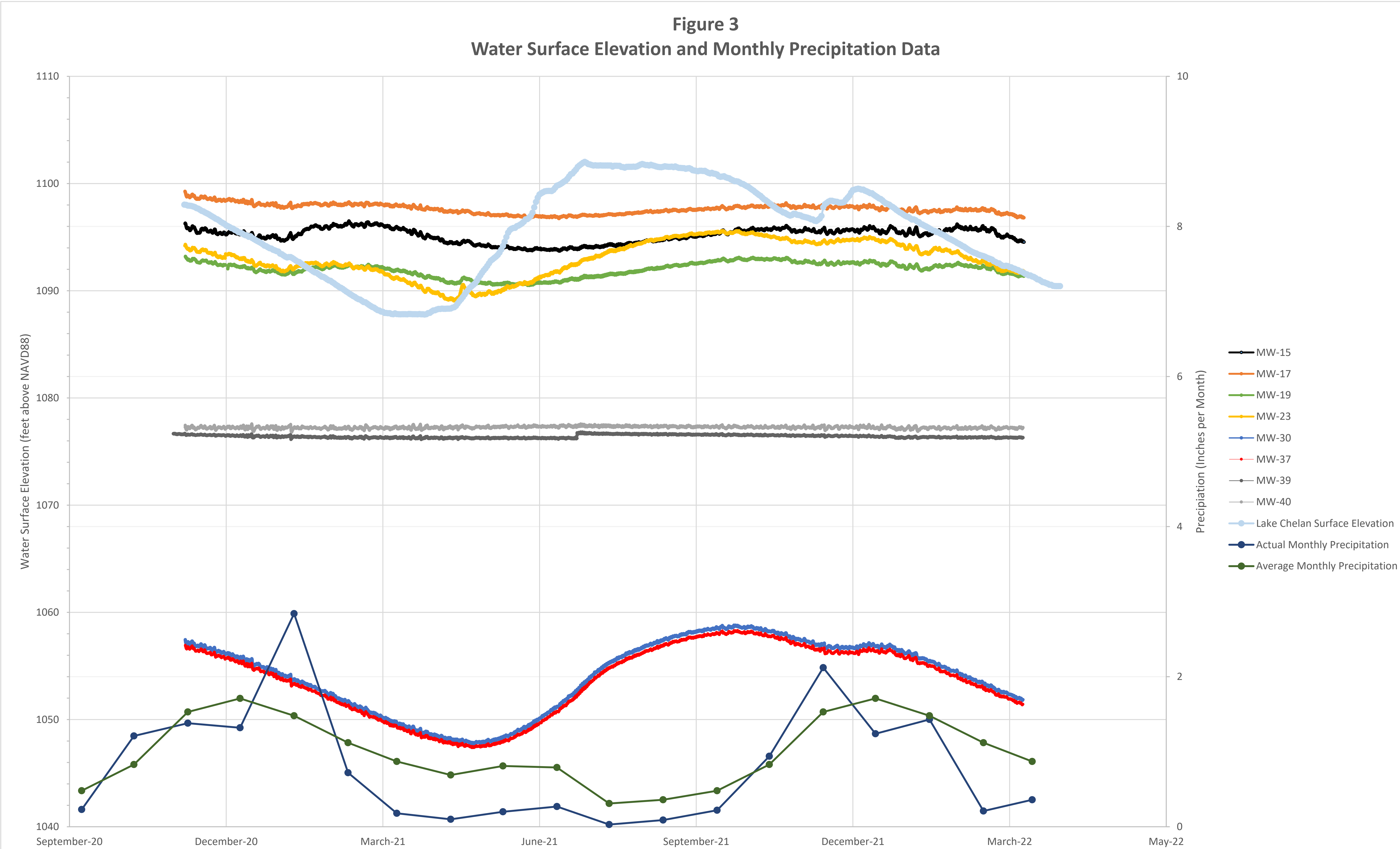
Figure 3
Water Surface Elevation and Monthly Precipitation Data
Water Surface Elevation (feet above NAVD88)
Precipiation (Inches per Month)
1110
1100
1090
1080
1070
1060
1050
1040
10
8
6
4
2
0
September-20
December-20
March-21
June-21
September-21
December-21
March-22
May-22
MW-15
MW-17
MW-19
MW-23
MW-30
MW-37
MW-39
MW-40
Lake Chelan Surface Elevation
Actual Monthly Precipitation
Average Monthly Precipitation