W. W. WHEELER
& ASSOCIATES, INC.
Water Resources Engineers
WWW.WWWHEELER.COM

October 2, 2020

Mr. Jon Roorda, Planning Manager
Chaffee County
P.O. Box 699
Salida, CO 81201

RE: Nestlé Waters North America, Inc – Chaffe County 1041 Permit Renewal

Dear Jon:

As requested, I have performed a review of the request by Nestlé Waters North America, Inc (NWNA) for a ten-year renewal of its permit related to Chaffee County 1041 Permit for NWNA's spring water production operations in Chaffee County. The scope of my review on behalf of the County was to consider the hydrology and water rights operations associated with those operations, to confirm if NWNA has complied with conditions related to monitoring and reporting of well pumping, aquifer conditions, spring discharges, and water rights operations, and to identify any potential matters of concern associated with those aspects of the NWNA operations that might be concerning to the County. I understand that NWNA is proposing to renew its 1041 permit for an additional ten years under the same terms and conditions, with no operational changes being requested at this time. My review, however, considered whether any operational changes or additional monitoring might be appropriately implemented in any future operations.

General Project Overview

NWNA pumps water from two wells located near the east bank of the Arkansas River, approximately four miles south of Johnson Village, referred to as the Ruby Mountain Springs site. Such water is piped to a short-term storage facility in Johnson Village, where the water is then loaded into trucks and delivered to a packaging and distribution facility in Aurora. Figure 1.2[1] shows the locations of the subject wells, monitoring wells, and wetlands that are the subject of the NWNA operations and discussed herein. The Bighorn Springs site, located about 3,000 feet from the Ruby Mountain Springs site, also includes natural springs and that

[1] Figure 1.2 was prepared by Papadopulos & Associates, Inc. and is included herein with permission.

3700 S. Inca Street | Englewood, CO 80110-3405
303-761-4130 | fax 303-761-2802

site was intended as an additional pumping location for NWNA in the original permit application in 2008. Thereafter, however, NWNA determined that it would not construct any pumping facilities at Bighorn and it agreed to perform monitoring there to determine whether pumping at the Ruby Mountain Springs site would result in any impacts to the natural wetlands at Bighorn.

The Pinedale outwash aquifer is the source of supply for the Ruby Mountain Springs, the Bighorn Springs, and the two NWNA wells. This is an alluvial aquifer that extends from north to south along the east side of the Arkansas River and terminates at the Ruby Mountain Springs. Water pumped from the NWNA wells is “spring water” in the sense that such water would otherwise naturally discharge at the nearby Ruby Mountain Springs. Water contained in the aquifer is considered to be “tributary” to the Arkansas River, meaning that all water pumped from the aquifer and all water that naturally discharges into the river at the springs is included within the water rights administration system for the Arkansas River basin.

The two NWNA production wells at the Ruby Mountain Springs site are located about 100 feet apart and both of those wells are located roughly 200 feet from natural discharge locations of the Ruby Mountain Springs. Almost all of the water pumped by NWNA has been produced from Well RMBH-3, which has a constructed depth of 55 feet. A second well - RMBH-2 - has a constructed depth of 62 feet. Well RMBH-2 is fully operational, but it has not been used for significant pumping amounts in recent years. The water at each well is metered and chlorinated within the well buildings. There was formerly a private fish hatchery at this site that relied on water flowing from the springs. In 2008-2010, NWNA removed the hatchery facilities and several adjacent buildings, and then regraded the site to re-establish the wetland. One of the springs that flows into the wetlands is monitored by MWNA and the combined discharge from the wetlands to the river is also monitored. NWNA also monitors groundwater levels at numerous locations in the Pinedale Aquifer and spring discharge at the Bighorn Springs site, as more fully discussed in the following section of this report.

The two production wells have “well permits” that have been approved by the Colorado Office of the State Engineer (permit numbers 78192-F and 78196-F). The permits limit withdrawals from the two wells up to a combined maximum of 196 acre-feet per year, 16.6 acre-feet in any month, 200 gallons per minute (gpm), and 0.884 acre-foot per day (which is the amount that produced during 24 hours at 200 gpm). The State Engineer's files for these permits indicate that there was a notice of "violation" in 2015 from the Arkansas River basin Division Engineer for the failure to timely update the flow meter verification (i.e. to confirm that the meter is operating accurately at Well RMBH-3). There was also a notice of "violation" in 2020 that the meter on Well RMBH-3 was turning over (resetting back to zero) in less than three years. Both of those problems were corrected by NWNA and the wells appear to be fully in compliance with State Engineer and Division Engineer requirements at this time.

The subject wells do not have senior water rights priorities and all of the water pumped by the wells is fully consumptive in the sense that it is exported out of the Arkansas River basin. Therefore, in order to prevent injury to other water rights in the Arkansas River basin, all well withdrawals must be fully "replaced" with an equal amount of water that is discharged into the river from other approved sources. Such replacement water is provided on a daily basis pursuant releases of water by the Upper Arkansas Water Conservancy District (UAWCD), as more fully discussed in the following section of this report.

The 1041 Permit includes a detailed Surface and Groundwater Monitoring and Mitigation Plan. I have reviewed, plotted, and summarized the results of such monitoring, as described in the following section of this report and as shown in the attached tables and graphs that we have prepared from such monitoring data.

REVIEW COMMENTS

Water Rights Operations

The following is an annual summary of the daily pumping records provided by NWNA.

Annual pumping per Calendar Year

Year	Acre-Feet	Year	Acre-Feet
2010	52.0	2016	78.4
2011	158.8	2017	62.1
2012	164.5	2018	79.6
2013	156.0	2019	88.7
2014	160.8	2020	52.8
2015	83.2	**Average**	**111.7**

2020 pumping through August.

The pumping is also summarized on a monthly basis in the attached Table 1. All of such pumping has been within the maximum daily, monthly, and annual volume limitations set forth in the well permits and in the 1041 Permit.

All water pumped by the subject wells depletes the Arkansas River at the Ruby Mountain Weir, which is discussed below in more detail. All diversions from the subject wells are replaced to the Arkansas River upstream of the Ruby Mountain Weir pursuant to an agreement between NWNA and UAWCD. Per that agreement, UAWCD provides up to 200 acre-feet per year of transbasin water imported into the Arkansas River basin from the Colorado River basin on a monthly basis to match the amounts pumped by the subject wells, taking into account transit losses and the slightly lagged timing between well pumping and the associated depletion to the Arkansas River because of the distances of the wells to the river. The sources of replacement water to the Arkansas River upstream of the Ruby Mountain Weir include imported Fryingpan-Arkansas Project water and imported Twin Lakes water provided directly by UAWCD. The allowable sources also include imported water provided to UAWCD from the Pueblo Board of Water Works. In accordance with the agreements, such replacement water can be released preferably from Twin Lakes, but it can also be released from Clear Creek Reservoir or Turquoise Reservoir. Stated more simply, the 200 acre-feet of water available to UAWCD that has been imported into the Arkansas River is used to replace, including transit losses, a maximum of 196 acre-feet exported out of Chaffee County by NWNA.

The replacement water to cover the NWNA operations has been released at all times by UAWCD at Twin Lakes Reservoir, with the deliveries traveling a short distance down Lake Creek to the Arkansas River and then traveling down the river to the vicinity of the Ruby Mountain Springs site. Such releases have consisted entirely of water that was imported into the Arkansas River basin from the Colorado River basin. As replacement releases from Twin Lakes enter the mainstem Arkansas River upstream of the Ruby Mountain Springs, water is provided upstream of the point of depletion associated with the subject wells. UAWCD's releases from Twin Lakes also include a small amount of additional water to cover the calculated transit losses as the water flows down the river to the Ruby Mountain Weir's point of discharge to the Arkansas River. All of UAWCD's operations are conducted in accordance with decrees of the Water Court. UAWCD similarly provides replacement water for hundreds of other wells and surface diversions throughout most of Chaffee County and western Fremont County.

The Applegate Group, Inc (an engineering firm providing services to NWNA) provides a monthly report to Chaffee County of the amounts pumped and the replacement water that has been released by UAWCD. Brian Sutton (the Water Commissioner who is responsible for administration of water rights in the upper Arkansas River basin) has confirmed to me that all of the water pumped at the subject wells has been fully replaced each month through releases of water by UAWCD. He confirmed that such operations have resulted in no net reduction of the natural flow of the Arkansas River during any month since the Nestle Waters operations began in 2010. Mr. Sutton is not aware of any injury to other decreed water rights in the Arkansas River basin associated with NWNA's operations. I concur with his opinion concerning to decreed water rights.

Review of Groundwater Elevations at Ruby Mountain Springs Site

NWNA continuously monitors water levels in the Pinedale outwash aquifer at the two production wells and at several monitoring wells in the vicinity of the Ruby Mountain Springs at the locations shown on Figure 1.2. On behalf of NWNA, Applegate maintains the dataloggers and downloads the monitoring data. Papadopulos & Associates, Inc prepares quarterly and annual reports that includes this data. We have obtained the groundwater monitoring data from Papadopulos and prepared graphs of the data. Such graphs are attached herein as Appendix A, including RMBH-1, RMBH-2, RMBH-3, BVMW-11, BVMW-12, and BVMW-13.

The graphs show a clear seasonal trend of water levels, with highest groundwater levels occurring during late summer and fall and the lowest levels during late winter and spring. The monitoring data also shows slightly higher water levels during 2016-2018, years when the groundwater pumping by Nestle Waters was relatively less than in prior years.

Monitoring of Groundwater Elevations at Up-Gradient Locations

NWNA continuously measures groundwater levels at numerous monitoring wells at up-gradient locations in the Pinedale outwash aquifer to monitor the performance of the aquifer, which is the source of water for the Ruby Mountain Springs, the Bighorn Springs, and the subject NWNA production wells. As shown on Figure 1.2, the monitoring wells in this group include Well A, wells BVMW-1 through BVMW-10, and BHMW-1. Graphs for these wells are attached herein as Appendix B. All of the monitoring wells exhibit clear seasonal trends. The northern-most monitoring wells (Well A and BVMW-1 through BMVW-7) are located relatively close to irrigated fields. The water sources used for irrigation of such fields include surface water diverted from Cottonwood Creek and other sources, with thousands of acre-feet delivered for irrigation each year. The monitoring data indicates that the highest groundwater levels at those wells occurs during summer, which is consistent with the recharge of the Pinedale outwash aquifer associated with deep percolation of a portion of the irrigation water during the growing season.

Monitoring of Surface Flows at the Ruby Mountain Springs

As noted in a prior section of this report, there was formerly a private fish hatchery at this site that relied on water flowing from the Ruby Mountain Springs. In 2008-2010, NWNA removed the hatchery facilities and several adjacent buildings, and then regraded the site to "re-establish" the wetland that had presumably existed at that site prior to the fish hatchery. One of the springs that flows into the wetlands is monitored by MWNA (the Ruby Mountain Flume) and the combined discharge from the wetlands to the river is also monitored by MWNA (the Ruby Mountain Weir). Locations of these measurement devices are shown on Figure 1.2. A graph of the spring discharge rates at both locations is included in Appendix C, together with a monthly summary of the discharge volume to the Arkansas River at the Ruby Mountain Weir. The average annual discharge volume to the river is approximately 2,074 acre-feet per year, as measured at the Ruby Mountain Weir, which is measured near the combined discharge point into the Arkansas River for all of the Ruby Mountain Springs after such water has flowed through the re-established wetland. This combined spring discharge represents the amount of spring flow that is in excess of the consumptive requirements at the wetland associated with evaporation and vegetative evapotranspiration. The spring discharge varies seasonally, and the character of the observed variations between periods of low and peak spring flows is consistent with the seasonal variations in the measured water levels at the nearby monitoring wells. In other words, the combined discharge from the springs is generally lowest when water levels in the monitoring wells is lowest. The discharge is generally greatest when the monitoring wells are highest.

It is noted that pumping at the NWNA wells has averaged approximately 112 acre-feet per year, which is obviously much less than the annual amount of discharge by the Ruby Mountain Springs. I conclude that pumping by NWNA has not adversely affected the Ruby Mountain re-established wetland because there has been ample flow-through at the wetland discharging to the river at all times, with such flow-through being in excess of the consumptive requirement of the wetland.

Monitoring of Groundwater Elevations and Spring Discharge at Bighorn Springs Site

As shown on Figure 1.2, the Bighorn Springs site is located about 3,000 feet northwest of the NWNA wells and the Ruby Mountain Springs. During the early planning stages of the NWNA Project prior to 2010, NWNA had initially planned the construction of at least one production well at Bighorn, and there was also concern that the wetland in the vicinity of the Bighorn Springs might be impacted by operation of the production wells at the distant Ruby Mountain Springs site. NWNA is no longer planning to construct any production wells at Bighorn.

Groundwater at the Bighorn Springs site is monitored at wells BHBH-1 through BHBH-3, as summarized in graphs included in Appendix D. Spring discharge at Bighorn is monitored at an upper flume (BHPF-1) and a lower flume (BHPF-3). As shown on the graphs for those flumes, spring discharge is lowest when water levels in the nearby monitoring wells is lowest, and highest when the monitoring wells are highest. Because the springs flow continuously, particularly during the growing season, I conclude that pumping by NWNA has not adversely affected the wetland at the Bighorn site because the NWNA wells are relatively far away and because there has been ample flow-through at the wetland discharging to the river at all times, with such flow-through being in excess of the consumptive requirement of the wetland. Further, in review of aerial photos of the Bighorn site, I am unable to discern any overall change in the wetland's extent.

Water Chemistry

Appendix E includes a summary of the Specific Conductance for several of the monitoring wells, together with a summary of pH for Well RMBH-3. The Specific Conductance at Well RMBH-3 ranged from roughly 360 to 510 µS/cm, which is consistent with good quality water to be used form drinking water supplies. The pH values of roughly 7.5 to 8.0 are within a common neutral range. I am not aware of any adverse impacts to groundwater or surface water resources related to water chemistry of the NWNA Project.

Construction Impacts

I am not aware of any significant future construction activities related to the ongoing operation of the NWNA Project.

Conclusions

1. Operation of the subject wells has been in compliance with the applicable well permits, including the location of the wells, metering requirements and the maximum daily, monthly and annual volumetric limits. During the past ten years, there were two small technical violations of the Division Engineer's measurement rules, but those violations were corrected and there was no material impact on the accounting and reporting.

2. All diversions from the subject wells have been replaced on a daily basis to the Arkansas River by releases of water from Twin Lakes, together with an allowance for transit loss. Releases from Turquoise Reservoir and Clear Creek Reservoir are also authorized. Releases from all of these sources enter the Arkansas River upstream of the Ruby Mountain Weir. Such replacement water is sourced from water that has been introduced into the Arkansas River basin from the Colorado River basin. I conclude that operation of the subject wells has not caused a reduction of the natural flow of the Arkansas River.

3. I conclude that operation of the NWNA wells has not resulted in injury to other decreed water rights.

4. NWNA's monitoring program has provided an excellent long-term set of data to track surface flows at the wetland areas and groundwater level changes in the general area within the Pinedale outwash aquifer and at the production wells site. In my opinion, NWNA has been in compliance with the 1041 Permit with respect to monitoring.

5. I conclude that pumping by NWNA has not adversely affected the Ruby Mountain re-established wetland because there has been ample flow-through at the wetland discharging to the river at all times.

6. I conclude that pumping by NWNA has not adversely affected the wetland at the Bighorn site because the NWNA wells are relatively far away and because there has been ample flow-through at the wetland discharging to the river at all times.

7. I conclude that operation of the NWNA wells has not caused progressive depletion of the groundwater resources of Chaffee County.

8. Seasonal groundwater levels and spring discharge amounts at both Ruby Mountain and Bighorn are influenced by deliveries of surface water for irrigation of fields as shown on Figure 1.2 on the east side of the Arkansas River adjacent to the Pinedale outwash aquifer. I conclude that the terms and conditions included in the 1041 Permit and the Surface Water and Groundwater Monitoring and Mitigation Plan have been adequate to provide timely alerts if conditions change.

9. I am not aware of any potential adverse impacts associated with water chemistry.

10. If the 1041 Permit is to be extended for an additional ten years, I conclude that it would be appropriate to carry forward the Surface Water and Groundwater Monitoring and Mitigation Plan into the new permit.

I appreciate the opportunity to perform this review for Chaffee County. Please contact me if you have any questions or comments.

Very truly yours,
W. W. Wheeler & Associates, Inc.

Gary B Thompson

Gary B. Thompson, P.E.

GARY B. THOMPSON 15588 10-2-20 PROFESSIONAL ENGINEER STATE OF COLORADO

cc: Jennifer Davis, David Shohet

Enclosures:

Figure 1.2	Monitoring Locations in the Ruby Mountain Springs Network
Table 1	NWNA Well Pumping
Graph	RMBH-2/3 Combined Monthly Pumping

Appendix A Monitoring Wells at Ruby Mountain Springs Site

Appendix B Monitoring Wells at Up-Gradient Locations

Appendix C Discharge at Ruby Mountain Springs

Appendix D Monitoring Wells and Spring Discharge at Bighorn Springs Site

Appendix E Water Chemistry

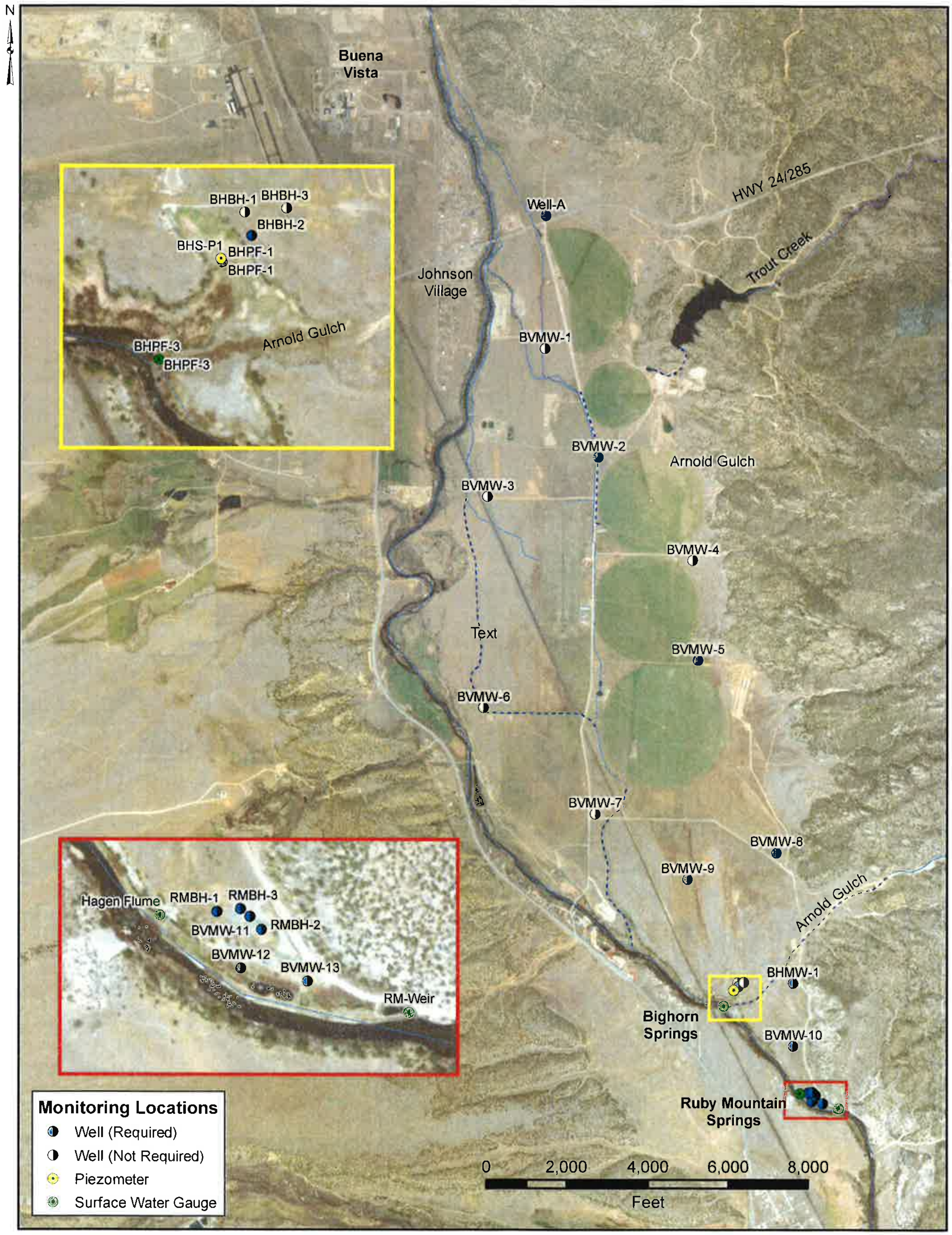
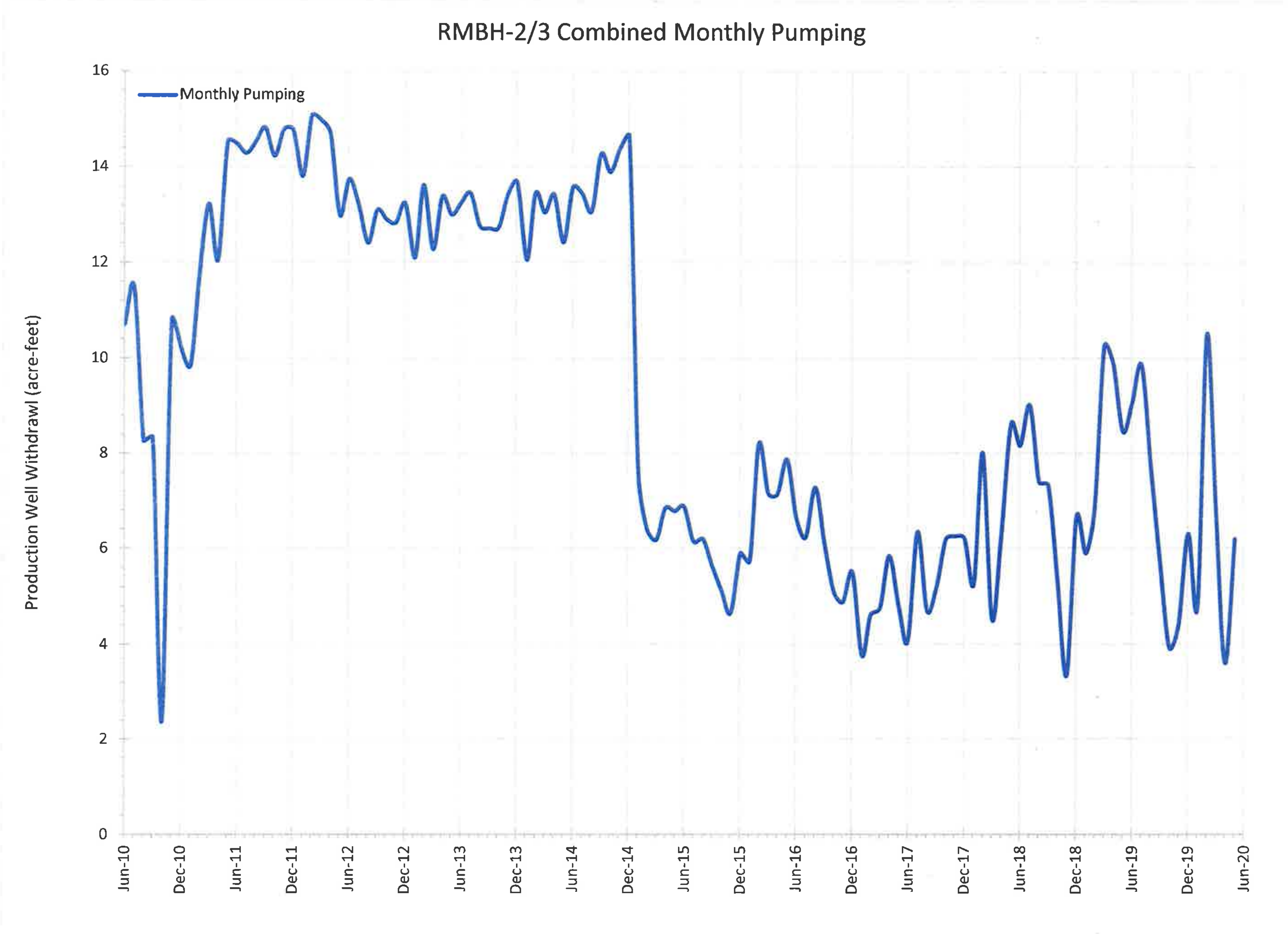


Figure 1.2 Monitoring Locations in the Ruby Mountain Springs Network

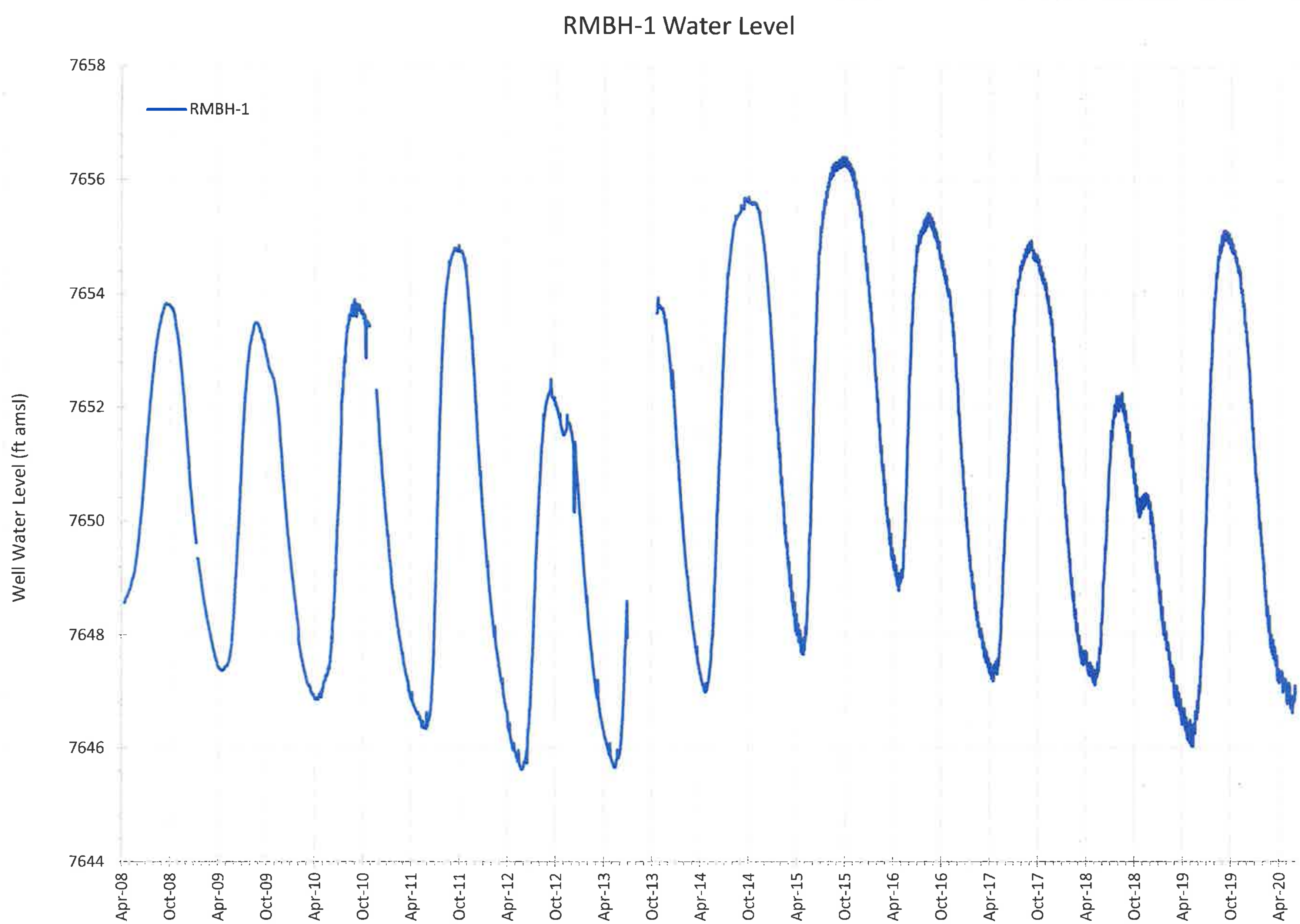
Table 1
NWNA Well Pumping (Combined Pumping at Well RMBH-2 and Well RMBH-3)
(values in acre-feet)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2010							10.71	11.48	8.27	8.34	2.39	10.79	51.98
2011	10.21	9.86	11.71	13.23	12.06	14.54	14.49	14.29	14.53	14.83	14.23	14.79	158.77
2012	14.77	13.81	15.07	14.98	14.70	12.99	13.75	13.22	12.41	13.10	12.90	12.84	164.54
2013	13.24	12.10	13.63	12.28	13.39	13.00	13.25	13.46	12.76	12.72	12.73	13.43	155.99
2014	13.68	12.06	13.46	13.05	13.43	12.42	13.58	13.45	13.08	14.28	13.90	14.37	160.76
2015	14.65	7.62	6.43	6.18	6.85	6.78	6.88	6.15	6.20	5.64	5.12	4.67	83.17
2016	5.91	5.74	8.21	7.16	7.14	7.88	6.67	6.23	7.29	6.13	5.11	4.89	78.36
2017	5.51	3.77	4.62	4.77	5.85	4.81	4.08	6.35	4.72	5.17	6.19	6.26	62.10
2018	6.21	5.27	8.02	4.54	6.26	8.63	8.17	9.03	7.41	7.33	5.33	3.35	79.55
2019	6.65	5.90	6.82	10.26	9.87	8.47	9.08	9.86	7.70	5.70	3.94	4.43	88.68
2020	6.31	4.81	10.51	6.69	3.61	6.20	8.30	6.34					52.77
Average	9.71	8.09	9.85	9.31	9.32	9.57	9.91	9.99	9.44	9.32	8.18	8.98	111.68


RMBH-2/3 Combined Monthly Pumping
Monthly Pumping
Production Well Withdrawl (acre-feet)
16
14
12
10
8
6
4
2
0
Jun-10
Dec-10
Jun-11
Dec-11
Jun-12
Dec-12
Jun-13
Dec-13
Jun-14
Dec-14
Jun-15
Dec-15
Jun-16
Dec-16
Jun-17
Dec-17
Jun-18
Dec-18
Jun-19
Dec-19
Jun-20

APPENDIX A

MONITORING WELLS AT RUBY MOUNTAIN SPRINGS SITE


RMBH-1 Water Level
RMBH-1
Well Water Level (ft amsl)
7658
7656
7654
7652
7650
7648
7646
7644
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
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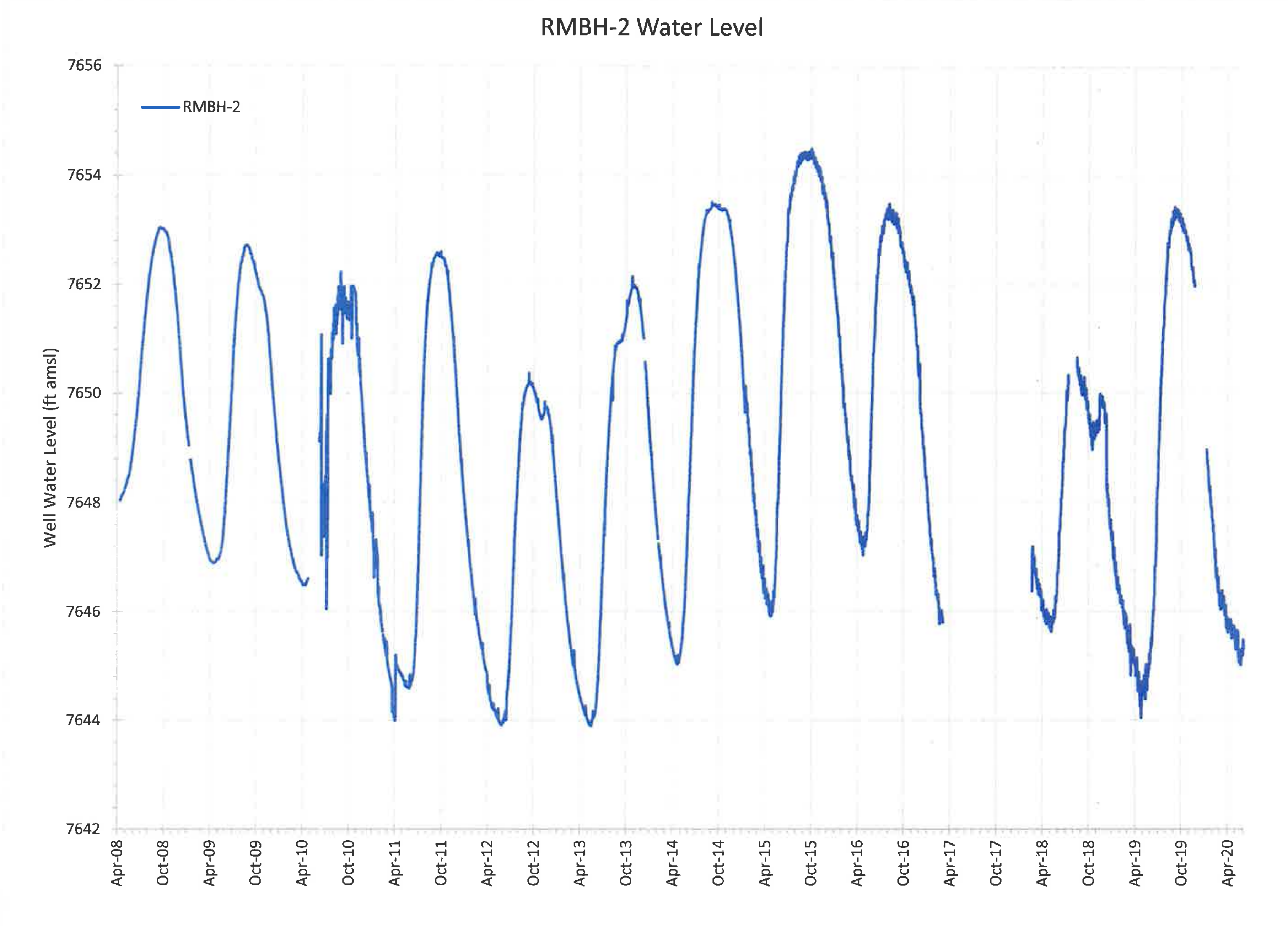
Apr-19
Oct-19
Apr-20



RMBH-2 Water Level
RMBH-2
Well Water Level (ft amsl)
7656
7654
7652
7650
7648
7646
7644
7642
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
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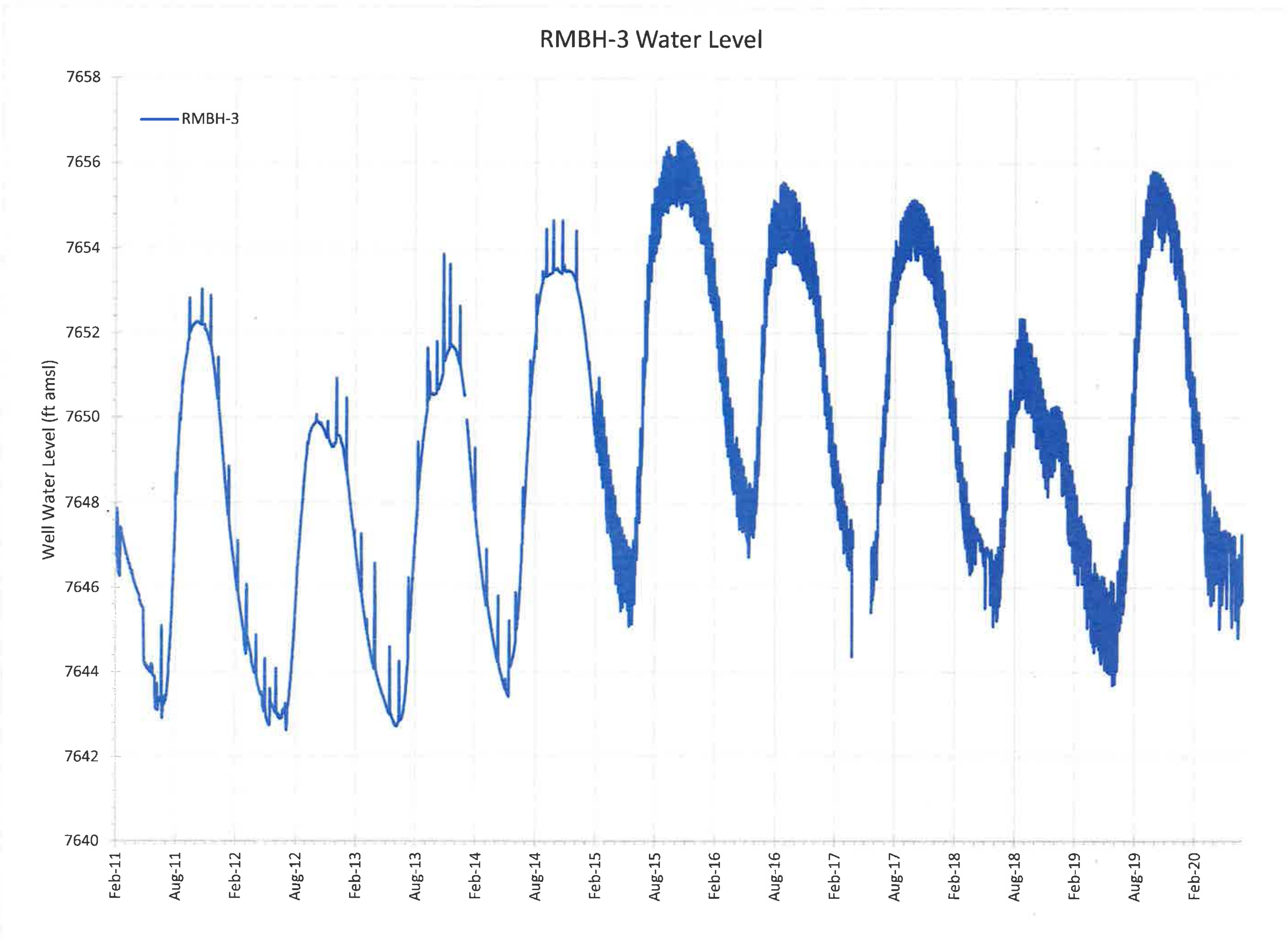
Apr-19
Oct-19
Apr-20


RMBH-3 Water Level
RMBH-3
Well Water Level (ft amsl)
7658
7656
7654
7652
7650
7648
7646
7644
7642
7640
Feb-11
Aug-11
Feb-12
Aug-12
Feb-13
Aug-13
Feb-14
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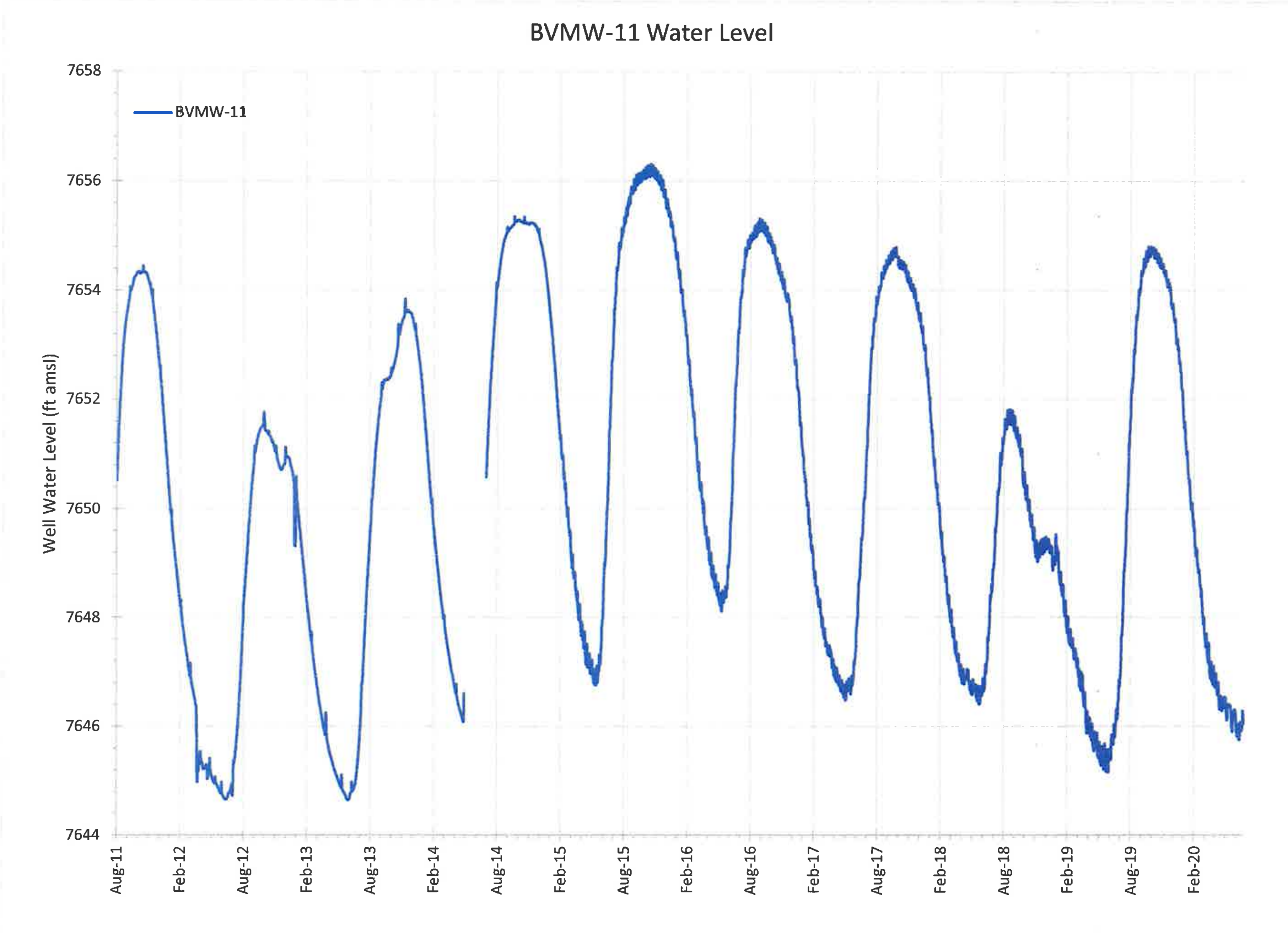
Feb-19
Aug-19
Feb-20


BVMW-11 Water Level
BVMW-11
Well Water Level (ft amsl)
7658
7656
7654
7652
7650
7648
7646
7644
Aug-11
Feb-12
Aug-12
Feb-13
Aug-13
Feb-14
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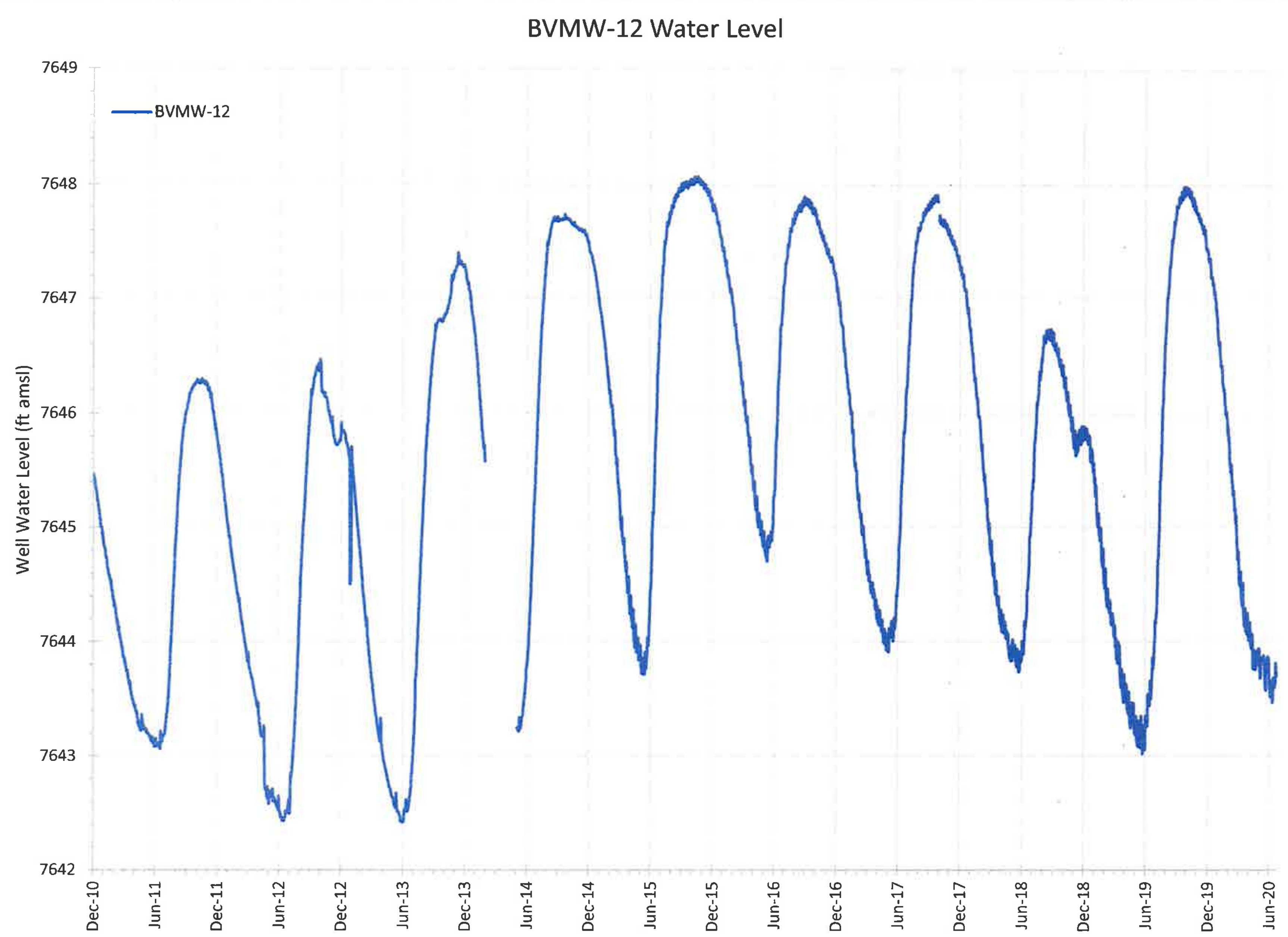
Feb-19
Aug-19
Feb-20


BVMW-12 Water Level
BVMW-12
Well Water Level (ft amsl)
7649
7648
7647
7646
7645
7644
7643
7642
Dec-10
Jun-11
Dec-11
Jun-12
Dec-12
Jun-13
Dec-13
Jun-14
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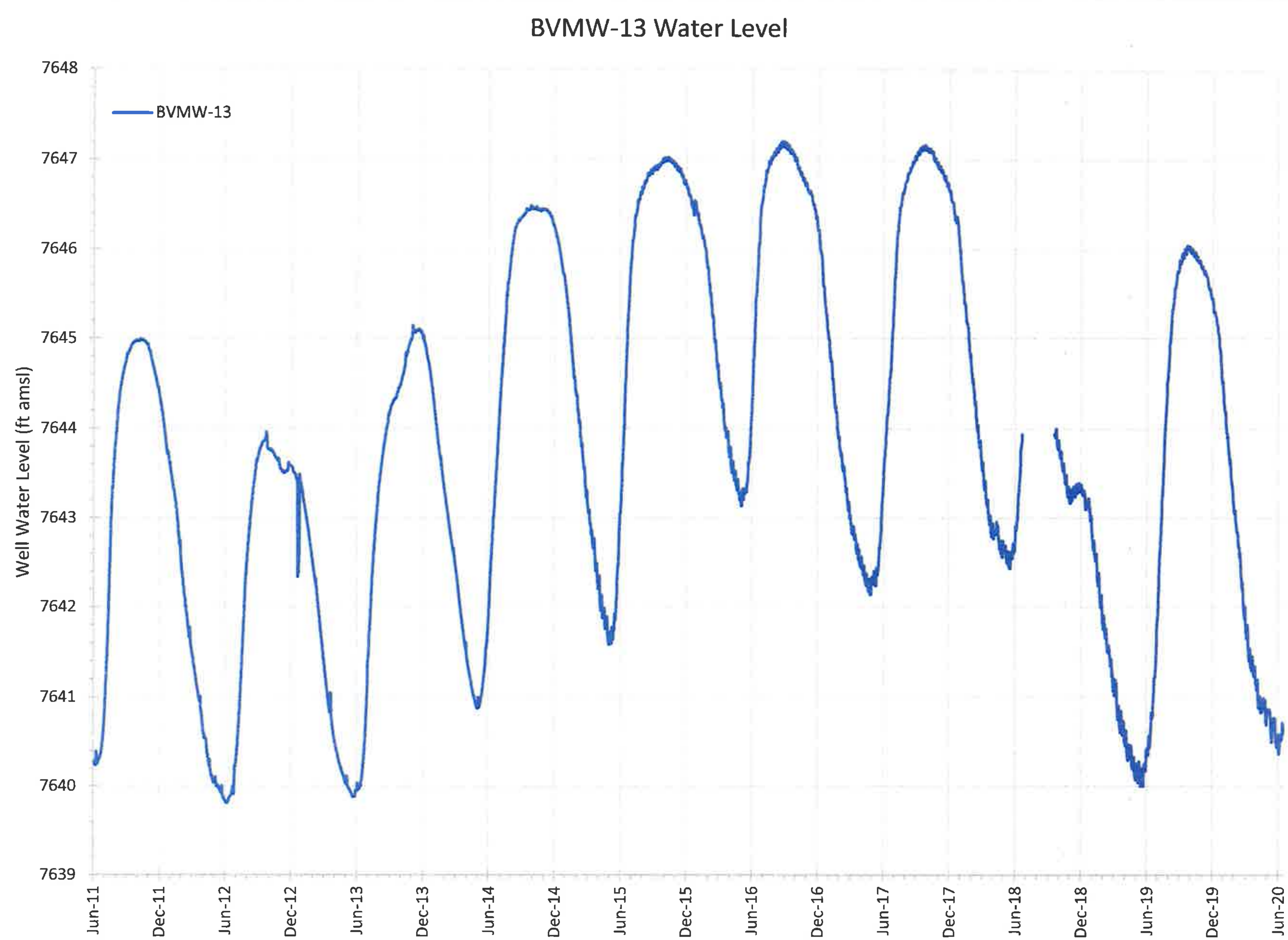
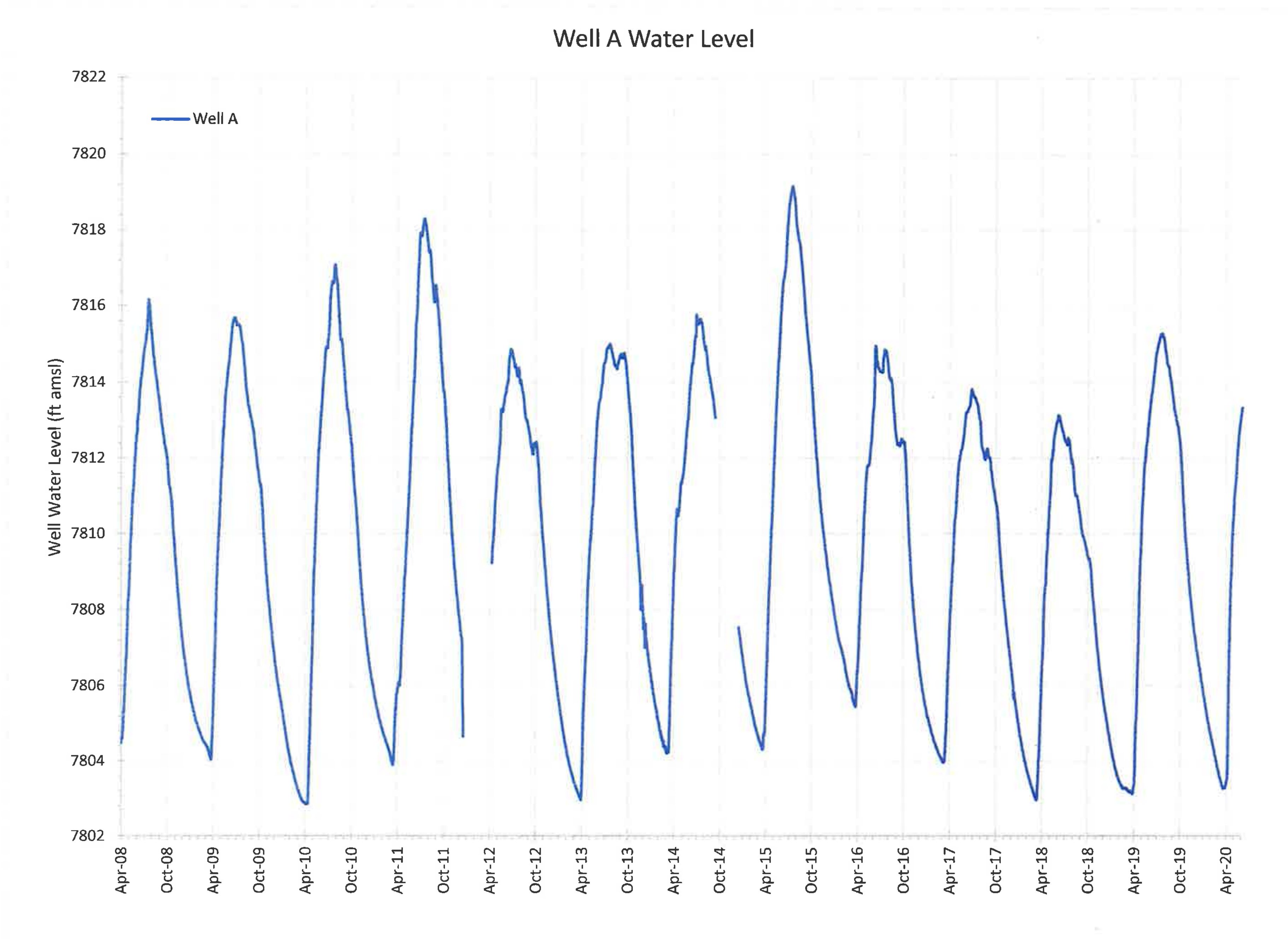
Jun-19
Dec-19
Jun-20


BVMW-13 Water Level
BVMW-13
Well Water Level (ft amsl)
7648
7647
7646
7645
7644
7643
7642
7641
7640
7639
Jun-11
Dec-11
Jun-12
Dec-12
Jun-13
Dec-13
Jun-14
Dec-14
Jun-15
Dec-15
Jun-16
Dec-16
Jun-17
Dec-17
Jun-18
Dec-18
Jun-19
Dec-19
Jun-20

APPENDIX B

MONITORING WELLS AT UP-GRADIENT LOCATIONS



Well A Water Level
Well A
Well Water Level (ft amsl)
7822
7820
7818
7816
7814
7812
7810
7808
7806
7804
7802
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
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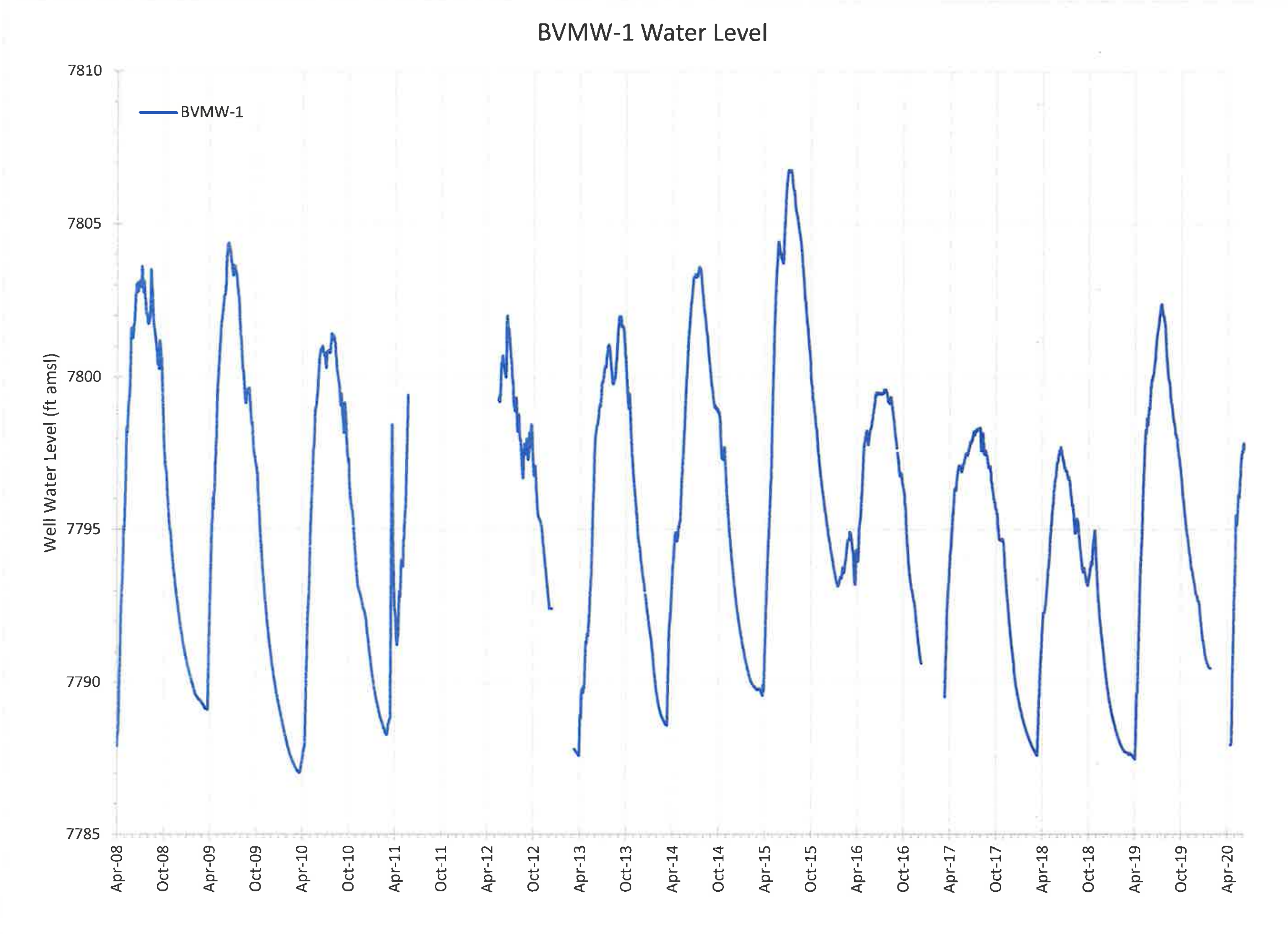
Apr-19
Oct-19
Apr-20


BVMW-1 Water Level
BVMW-1
Well Water Level (ft amsl)
7810
7805
7800
7795
7790
7785
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
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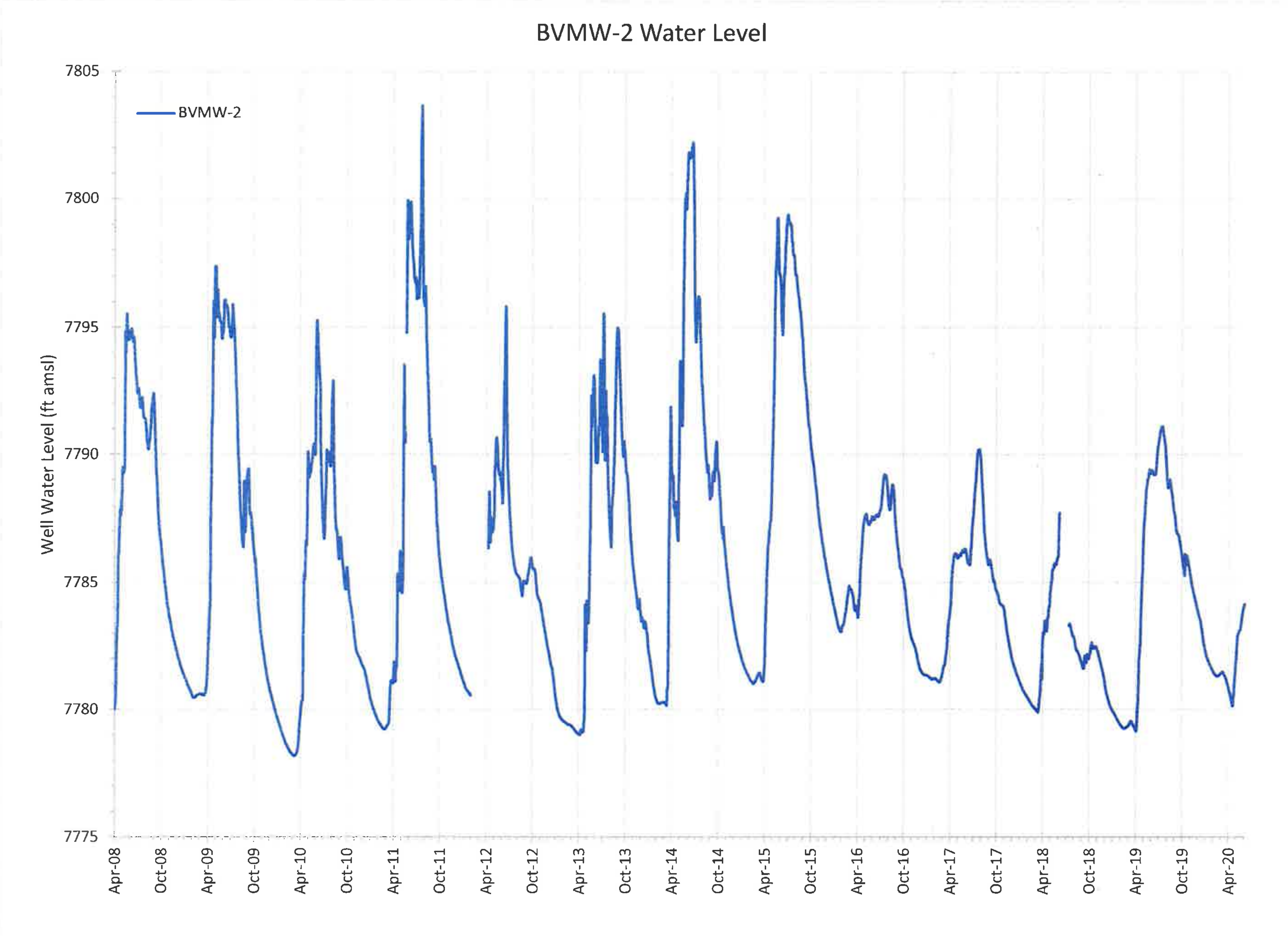
Apr-19
Oct-19
Apr-20


BVMW-2 Water Level
BVMW-2
Well Water Level (ft amsl)
7805
7800
7795
7790
7785
7780
7775
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
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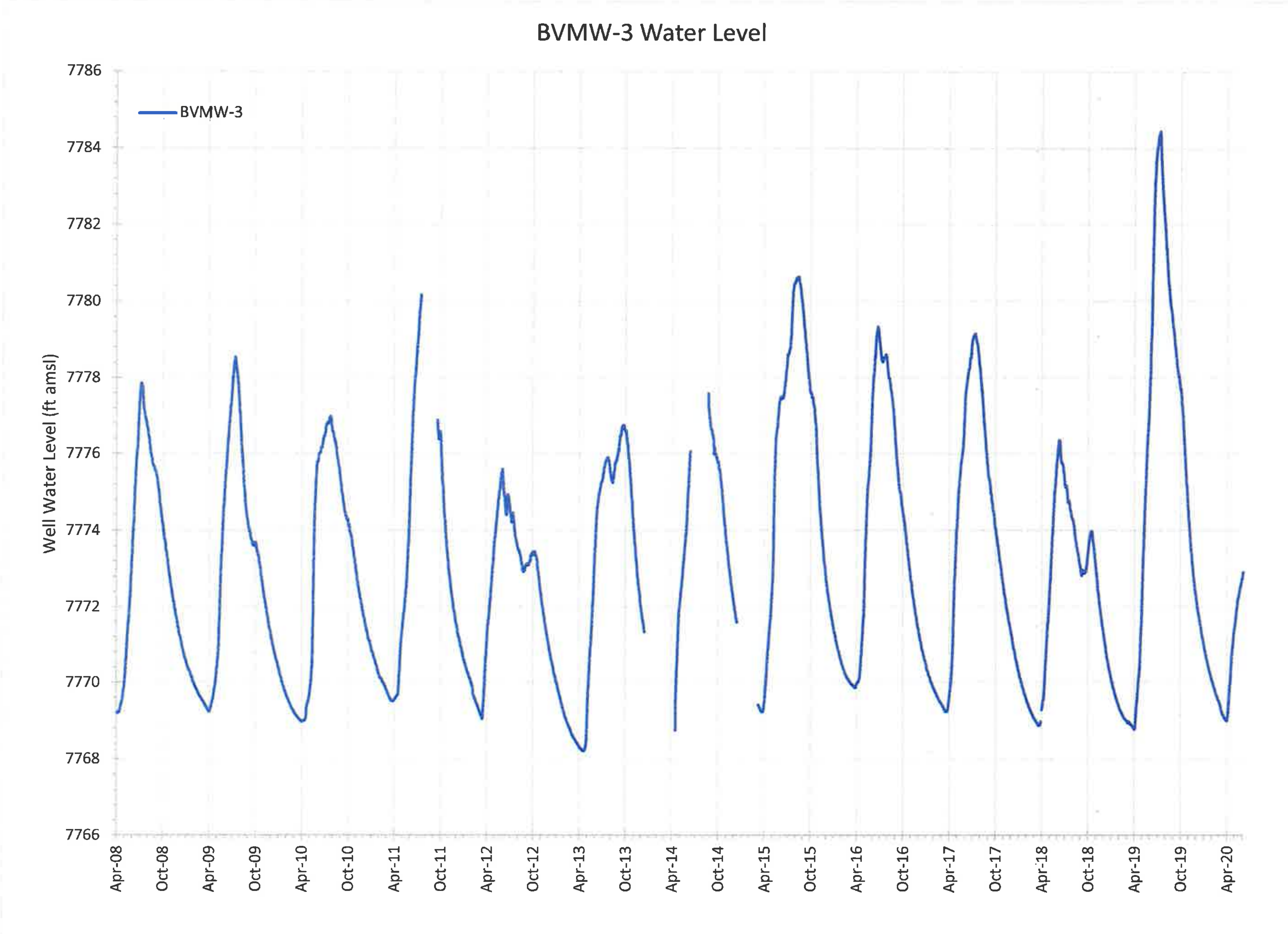
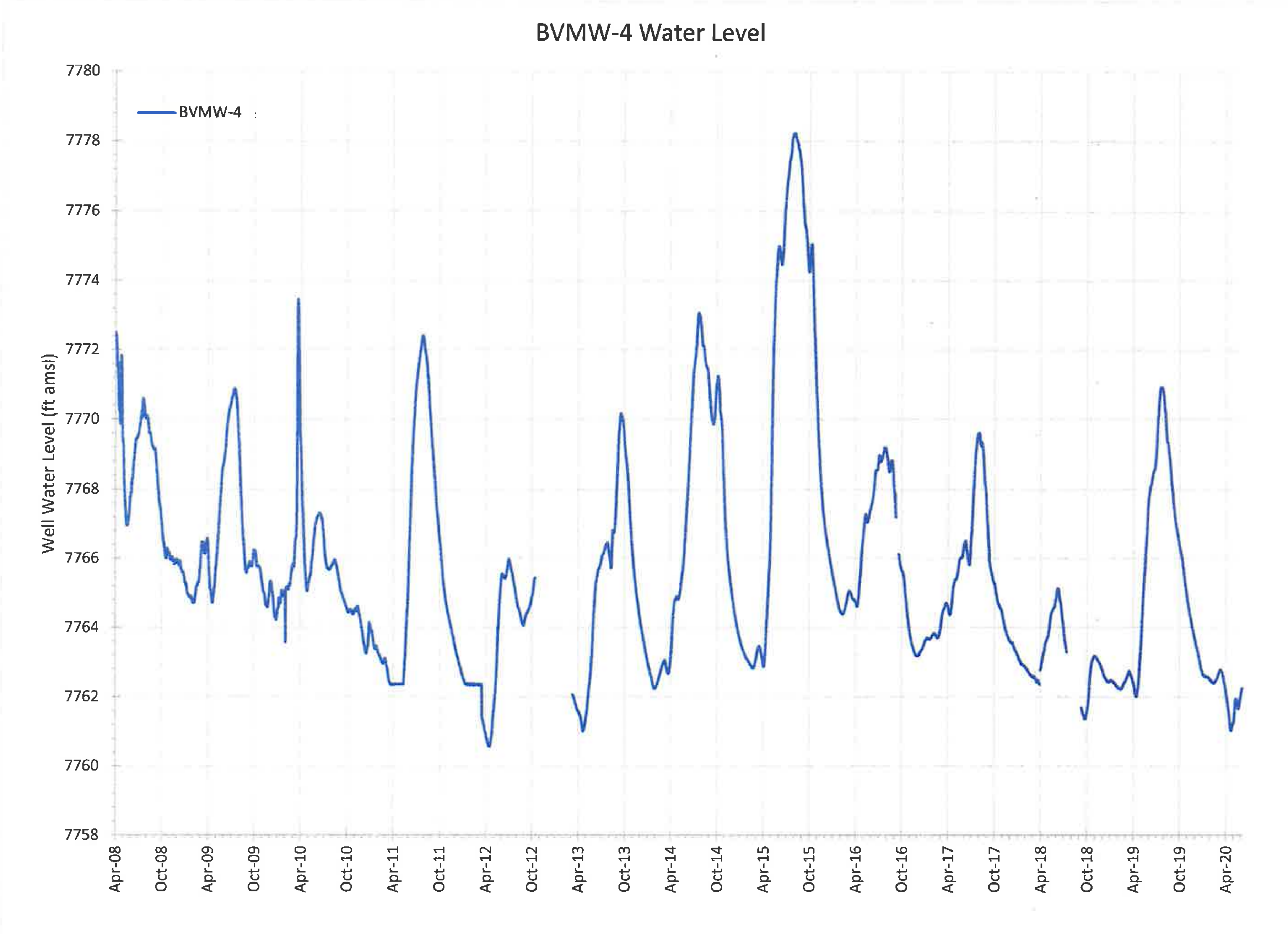
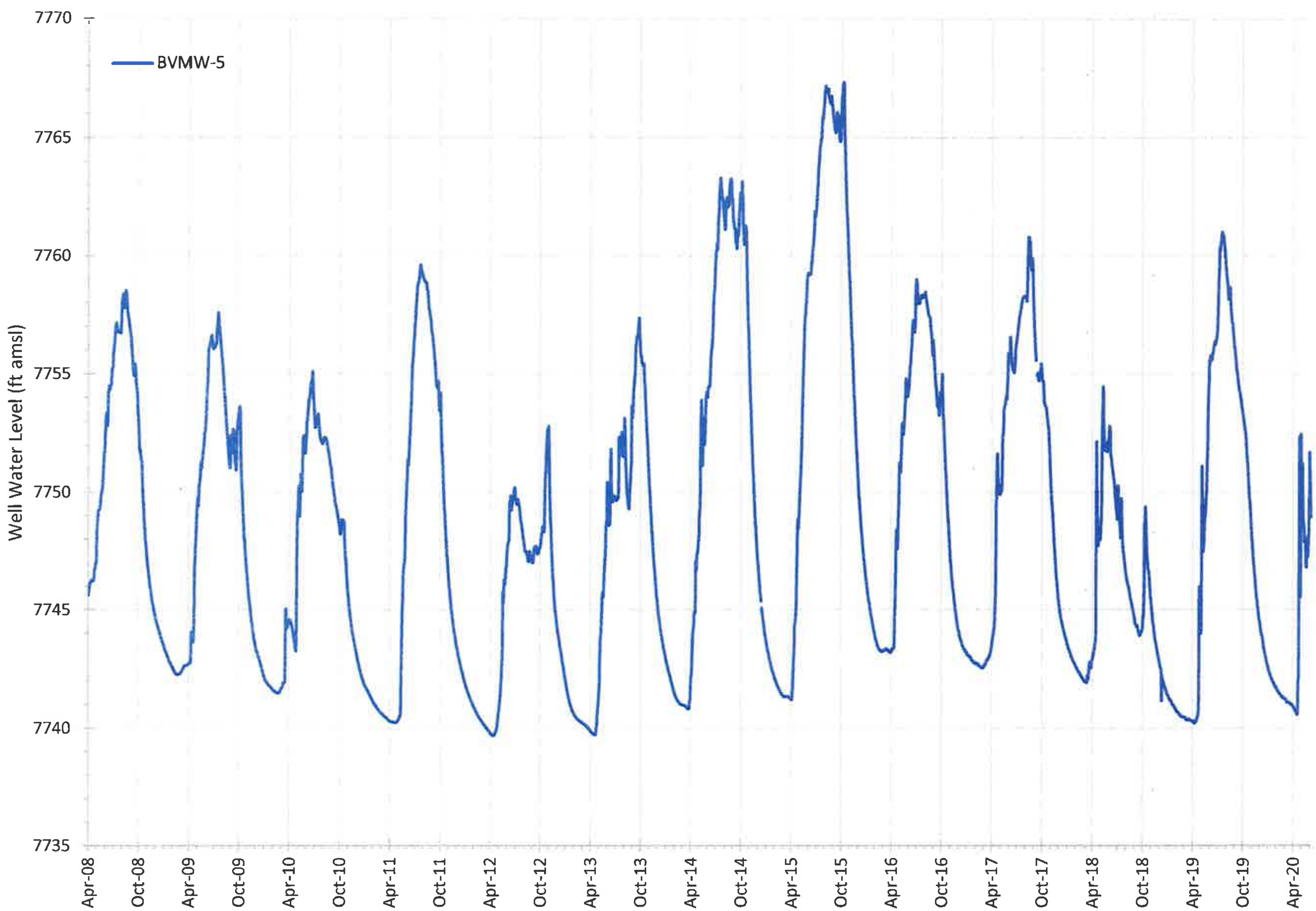
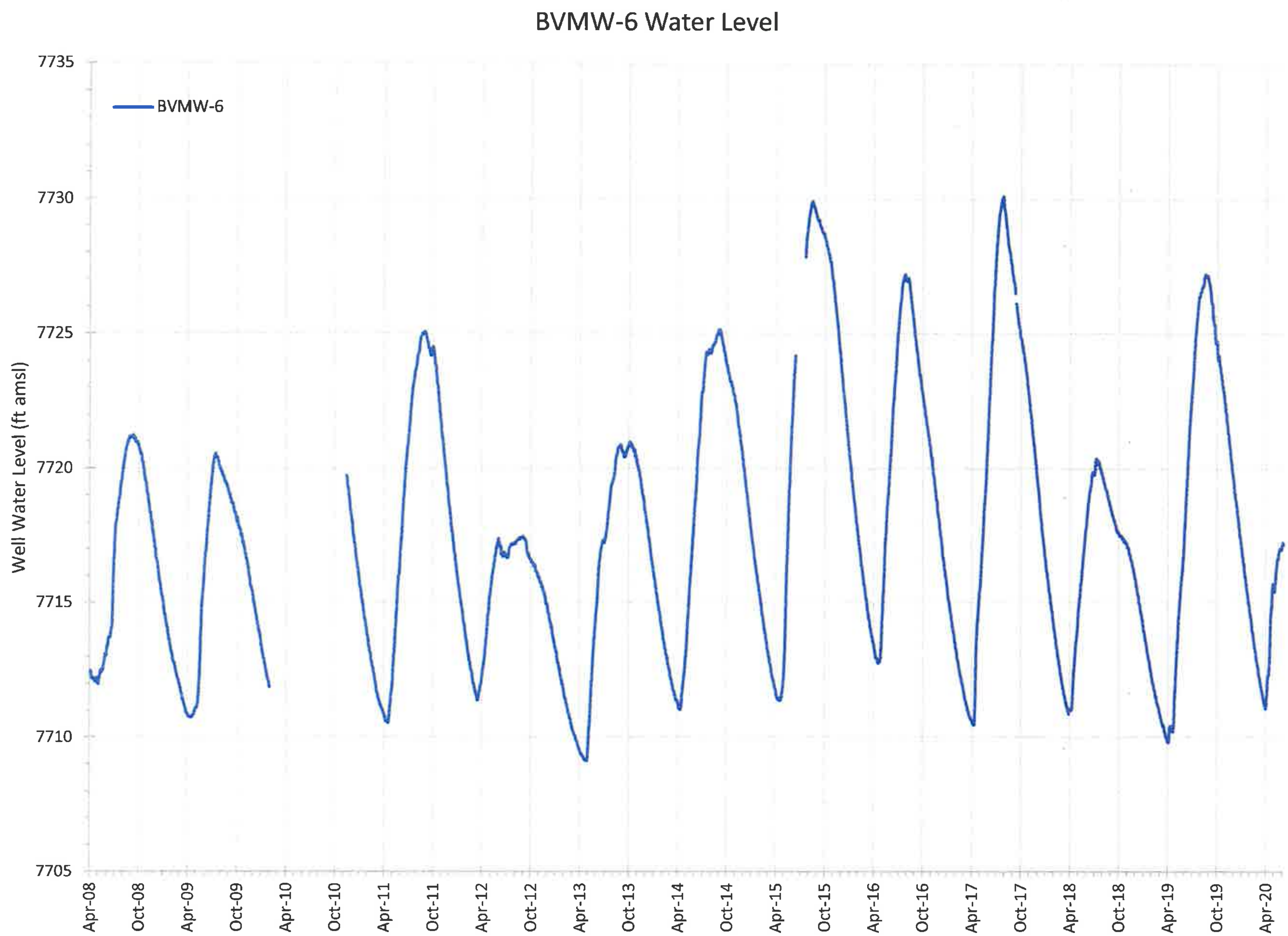
Apr-19
Oct-19
Apr-20

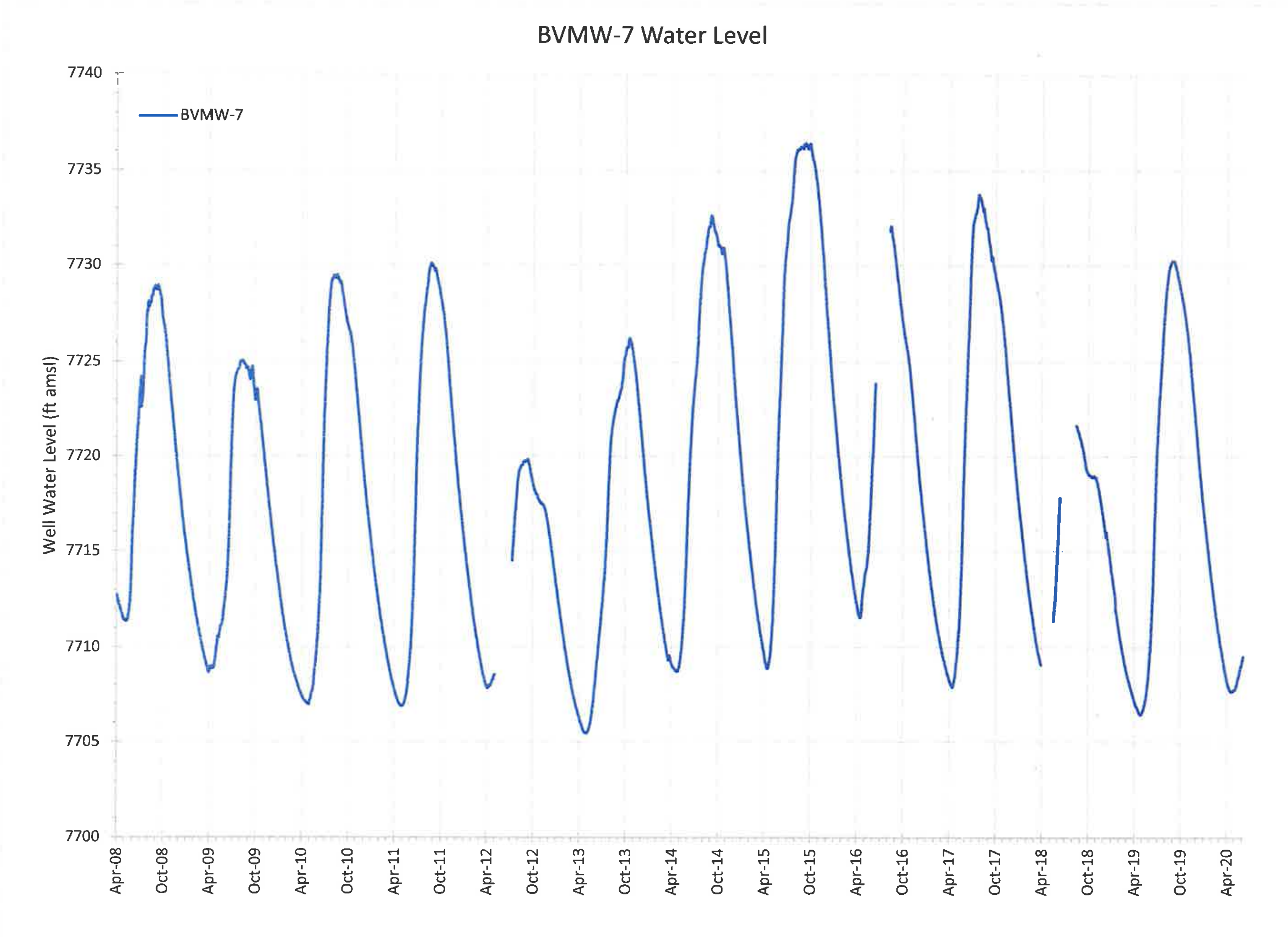

BVMW-3 Water Level
BVMW-3
Well Water Level (ft amsl)
7786
7784
7782
7780
7778
7776
7774
7772
7770
7768
7766
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Oct-15
Apr-16
Oct-16
Apr-17
Oct-17
Apr-18
Oct-18
Apr-19
Oct-19
Apr-20

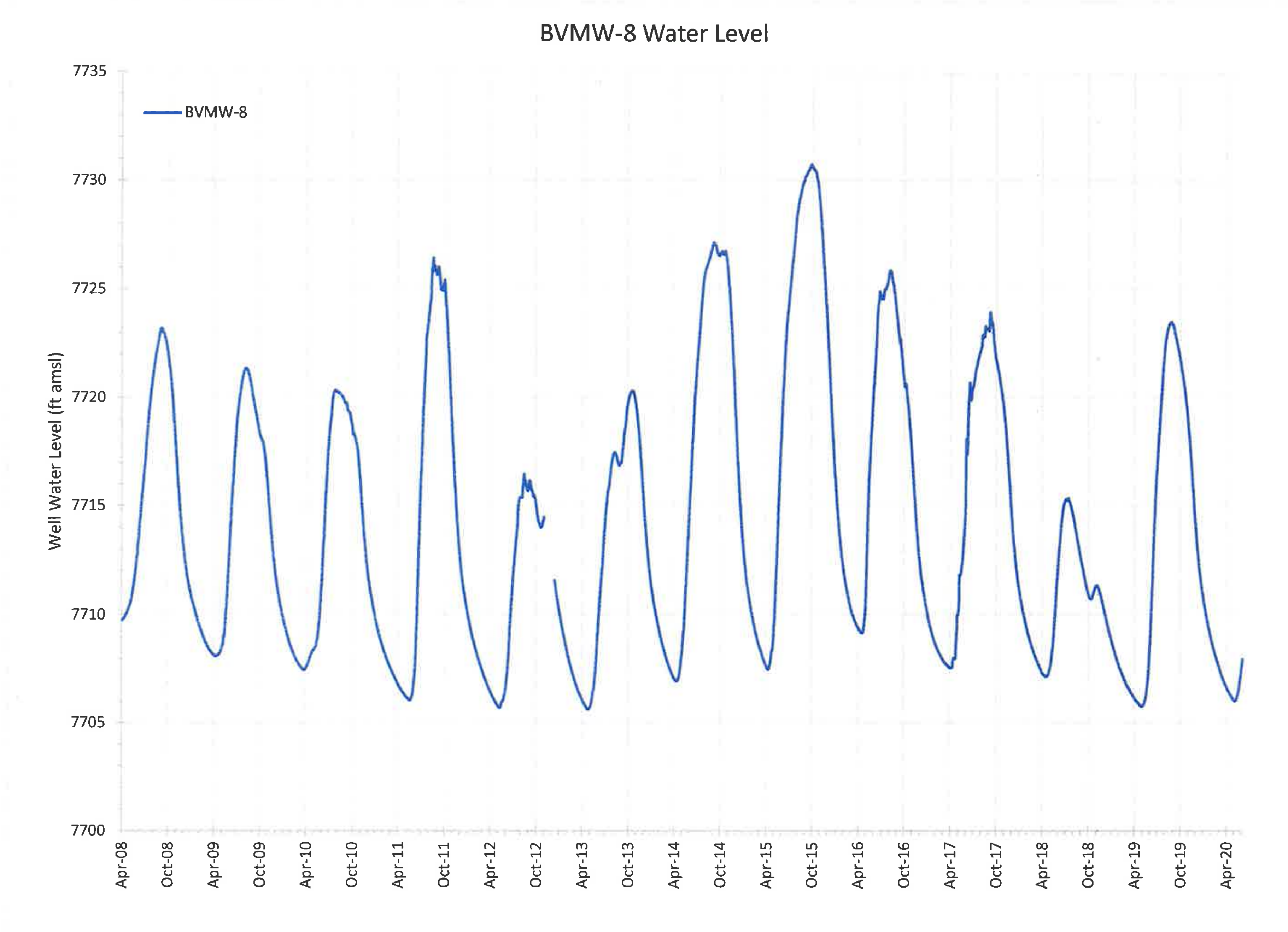

BVMW-4 Water Level
BVMW-4
Well Water Level (ft amsl)
7780
7778
7776
7774
7772
7770
7768
7766
7764
7762
7760
7758
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Oct-15
Apr-16
Oct-16
Apr-17
Oct-17
Apr-18
Oct-18
Apr-19
Oct-19
Apr-20

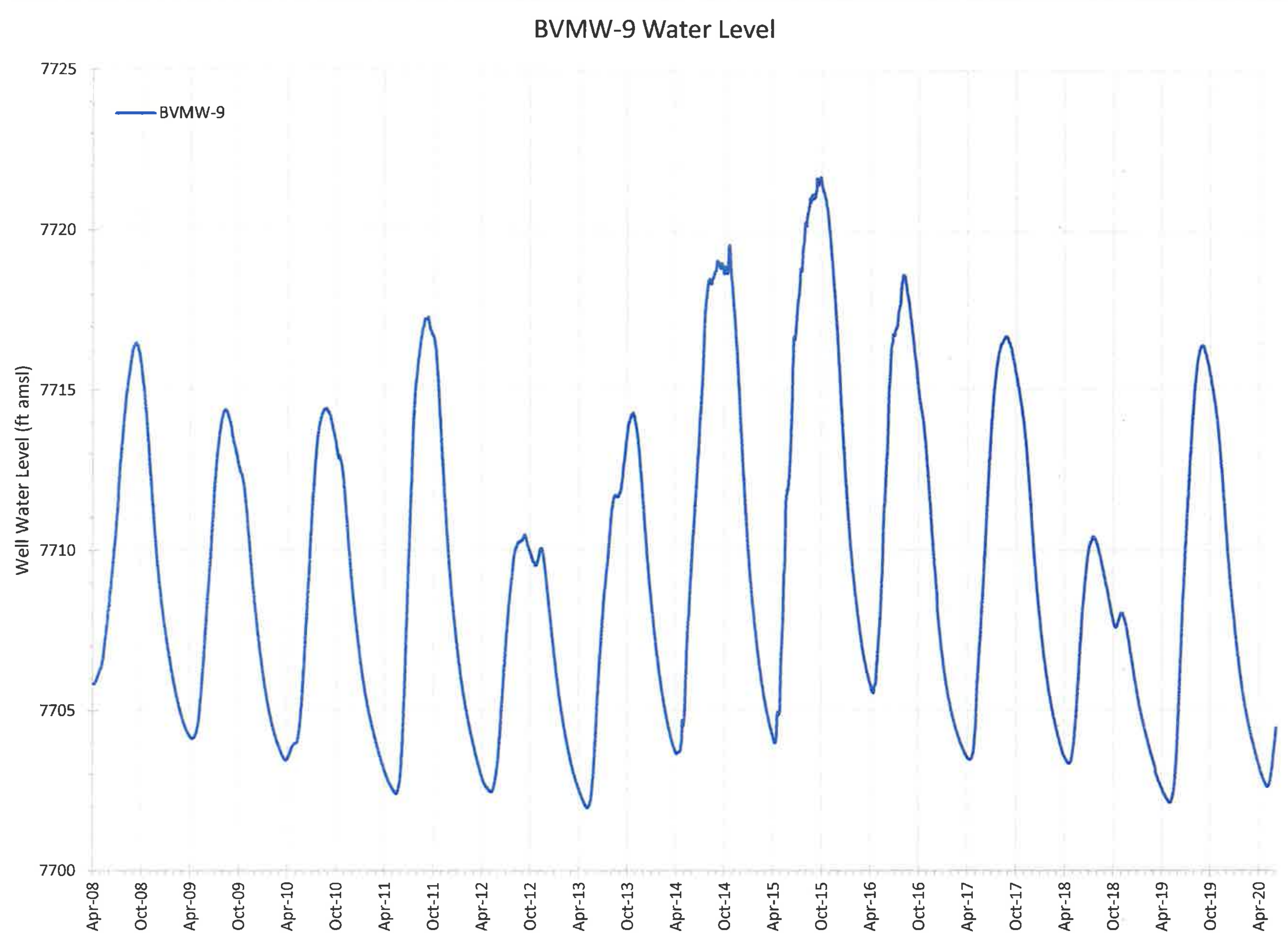
BVMW-5 Water Level

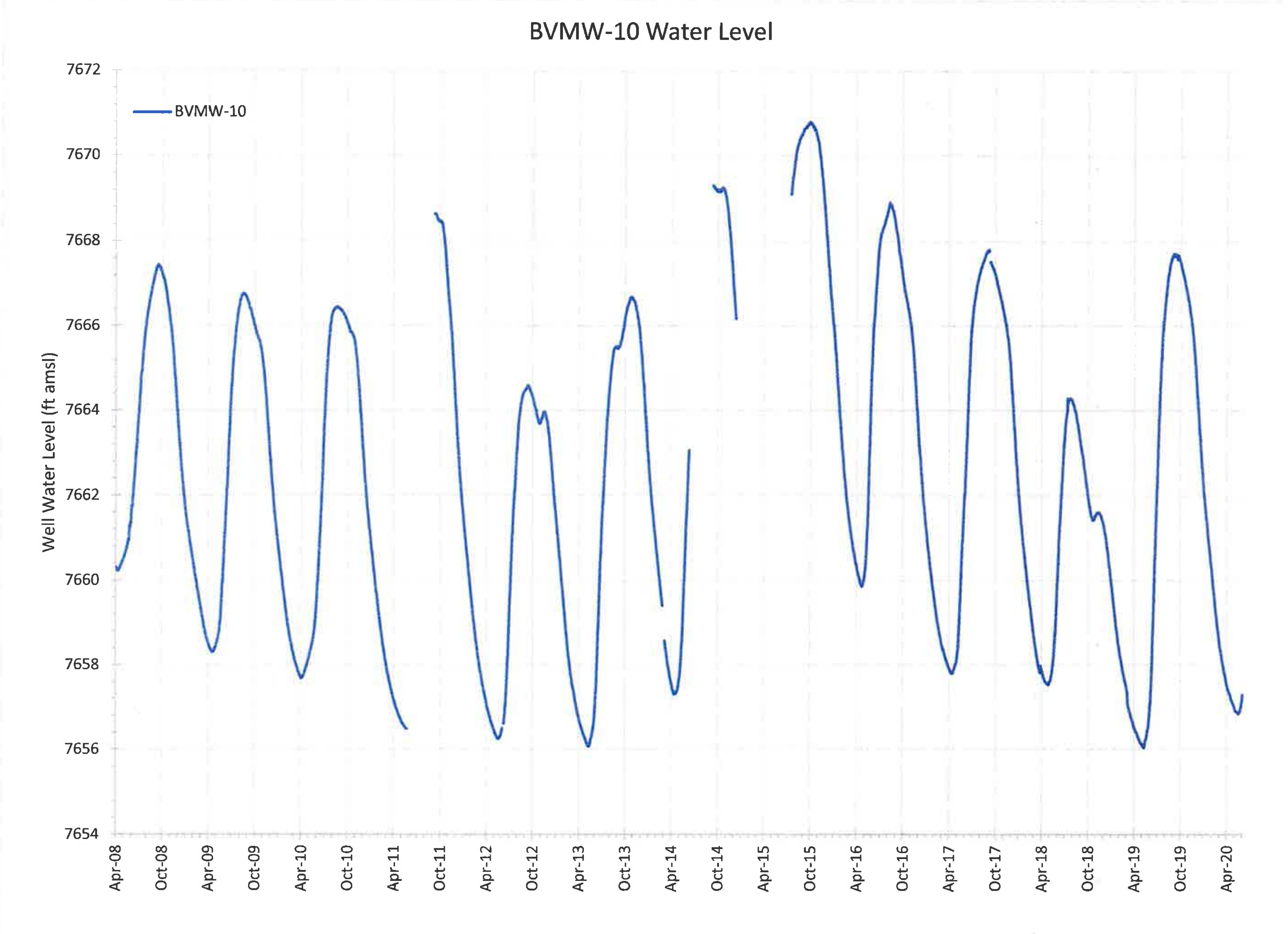



BVMW-6 Water Level
BVMW-6
Well Water Level (ft amsl)
7735
7730
7725
7720
7715
7710
7705
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Oct-15
Apr-16
Oct-16
Apr-17
Oct-17
Apr-18
Oct-18
Apr-19
Oct-19
Apr-20

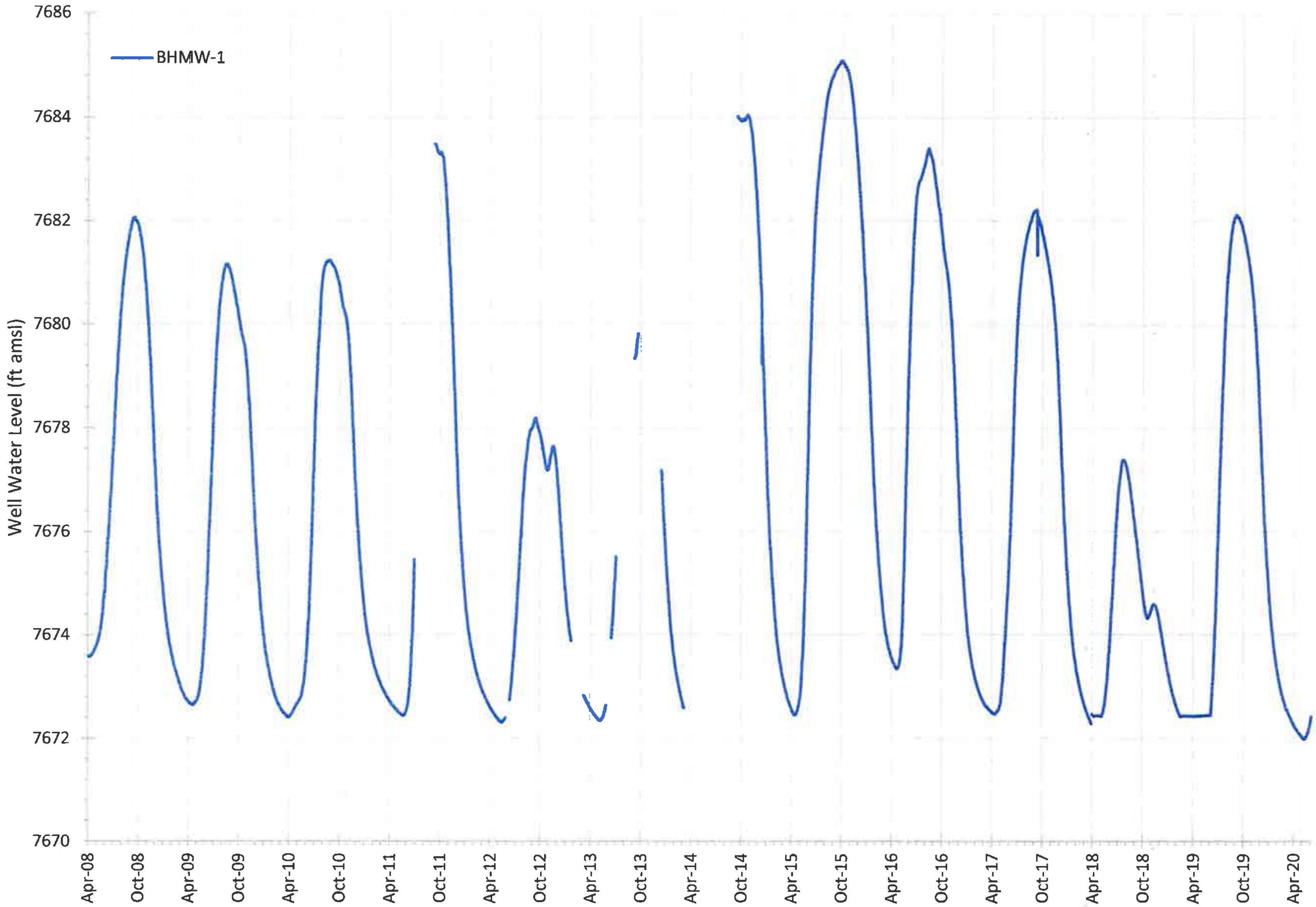

BVMW-7 Water Level
BVMW-7
Well Water Level (ft amsl)
7740
7735
7730
7725
7720
7715
7710
7705
7700
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Oct-15
Apr-16
Oct-16
Apr-17
Oct-17
Apr-18
Oct-18
Apr-19
Oct-19
Apr-20


BVMW-8 Water Level
BVMW-8
Well Water Level (ft amsl)
7735
7730
7725
7720
7715
7710
7705
7700
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Oct-15
Apr-16
Oct-16
Apr-17
Oct-17
Apr-18
Oct-18
Apr-19
Oct-19
Apr-20


BVMW-9 Water Level
BVMW-9
Well Water Level (ft amsl)
7725
7720
7715
7710
7705
7700
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Oct-15
Apr-16
Oct-16
Apr-17
Oct-17
Apr-18
Oct-18
Apr-19
Oct-19
Apr-20


BVMW-10 Water Level
BVMW-10
Well Water Level (ft amsl)
7672
7670
7668
7666
7664
7662
7660
7658
7656
7654
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Oct-15
Apr-16
Oct-16
Apr-17
Oct-17
Apr-18
Oct-18
Apr-19
Oct-19
Apr-20

BHMW-1 Water Level



APPENDIX C

DISCHARGE AT RUBY MOUNTAIN SPRINGS

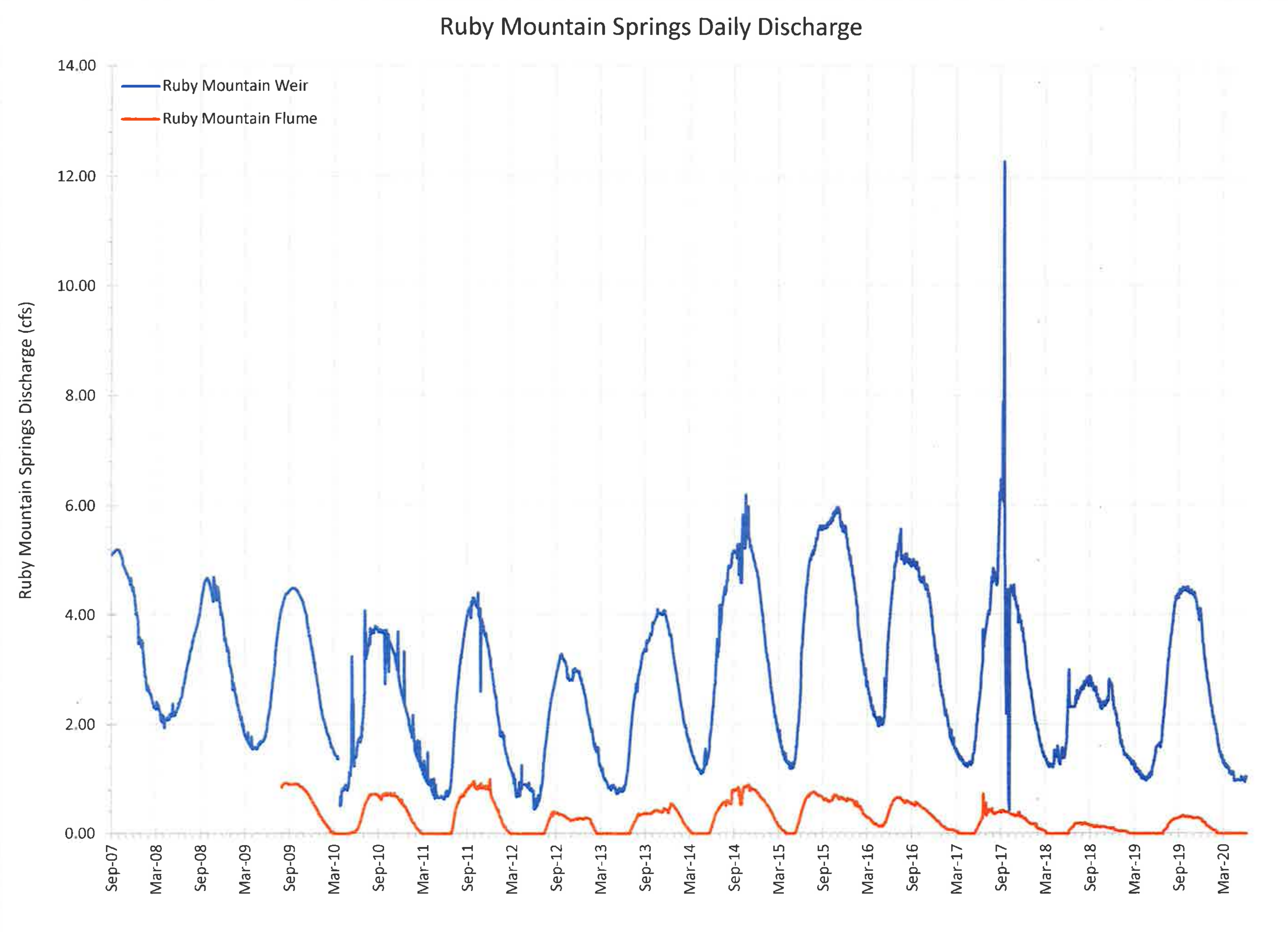

Ruby Mountain Springs Daily Discharge
Ruby Mountain Weir
Ruby Mountain Flume
Ruby Mountain Springs Discharge (cfs)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14
Mar-15
Sep-15
Mar-16
Sep-16
Mar-17
Sep-17
Mar-18
Sep-18
Mar-19
Sep-19
Mar-20

Table 2
Ruby Mountain Weir Summary
(values in acre-feet)

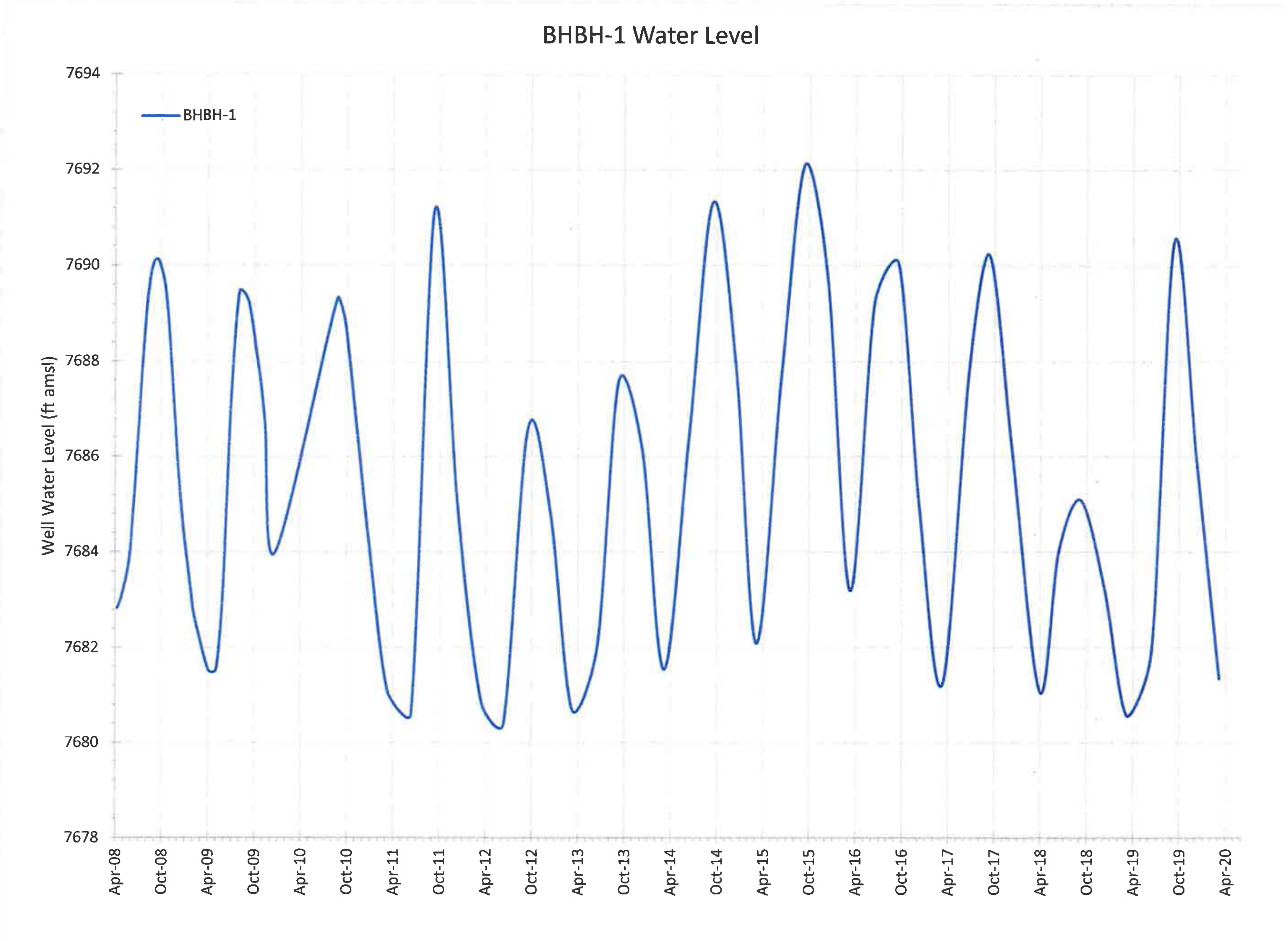
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2007										318.6	303.8	280.5	902.9
2008	230.9	180.6	148.9	131.0	130.4	134.3	163.9	204.6	232.8	281.5	265.7	255.4	2,360.0
2009	204.3	144.4	124.9	99.4	99.1	107.7	162.7	238.2	261.6	275.7	254.3	225.5	2,197.8
2010	175.0	115.9	101.6	*66.6*	54.2	97.9	117.3	215.4	222.2	221.1	204.0	183.8	1,775.0
2011	144.7	99.4	83.5	62.2	46.9	40.3	57.8	157.8	219.8	257.8	235.6	215.1	1,620.9
2012	161.6	113.5	79.4	49.8	55.8	45.7	41.3	107.6	160.1	195.9	173.2	181.9	1,365.8
2013	161.5	109.0	88.6	59.8	52.3	47.2	78.4	155.8	191.5	222.8	237.2	244.4	1,648.5
2014	208.3	141.7	114.3	82.1	73.8	98.2	191.2	266.5	298.5	314.8	329.8	309.3	2,428.5
2015	257.3	170.0	131.5	91.0	78.1	119.2	258.6	317.6	331.3	348.3	349.6	347.2	2,799.7
2016	309.2	249.3	183.0	139.1	126.7	184.8	293.9	317.3	296.5	298.7	272.5	241.7	2,912.7
2017	178.2	120.3	101.7	82.0	79.0	111.9	240.0	271.3	323.5	272.6	261.3	236.3	2,278.1
2018	180.0	117.1	94.5	75.7	88.2	101.0	148.3	159.3	166.5	162.0	141.6	160.3	1,594.5
2019	127.2	84.4	81.7	67.0	63.4	79.7	113.9	196.3	252.3	274.7	263.3	250.9	1,854.8
2020	187.7	134.5	91.9	71.1	63.1	59.8							608.1
Average	194.3	136.9	109.7	82.8	77.8	94.4	155.6	217.3	246.4	265.0	253.2	240.9	2,074.4

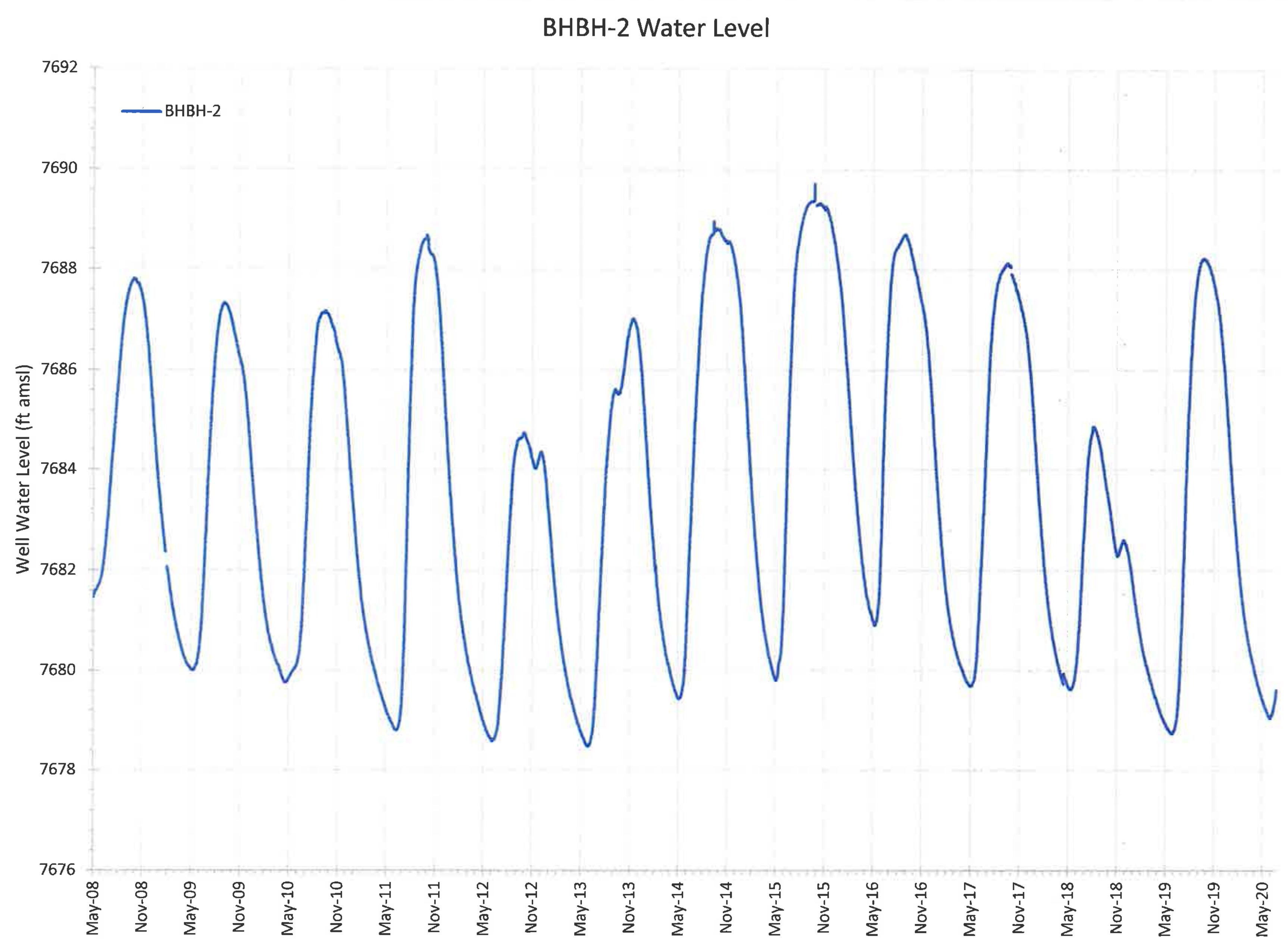
Notes:

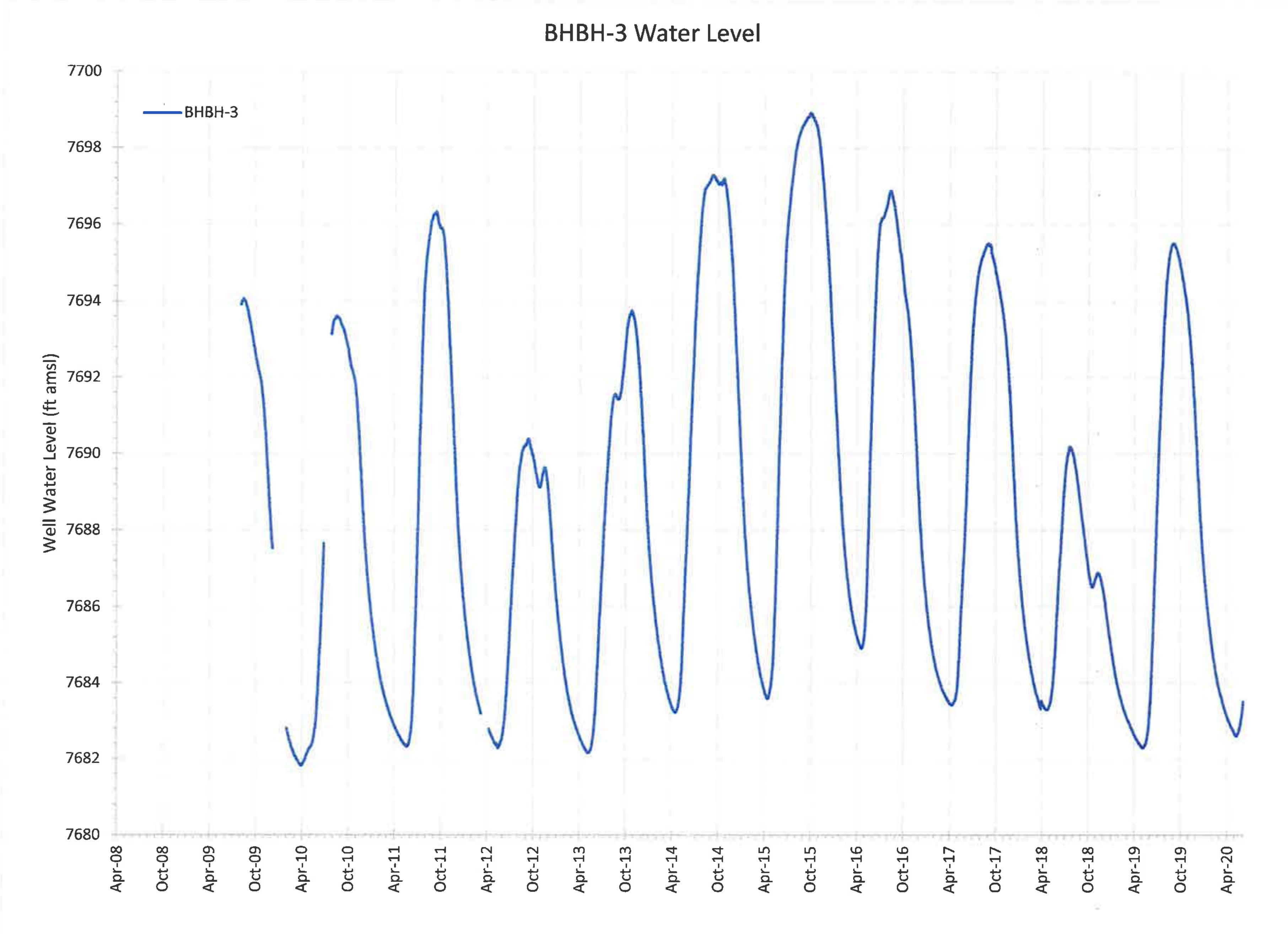
The discharge amount for April 2010 is extrapolated up, based on the 23 days of available data in that month.

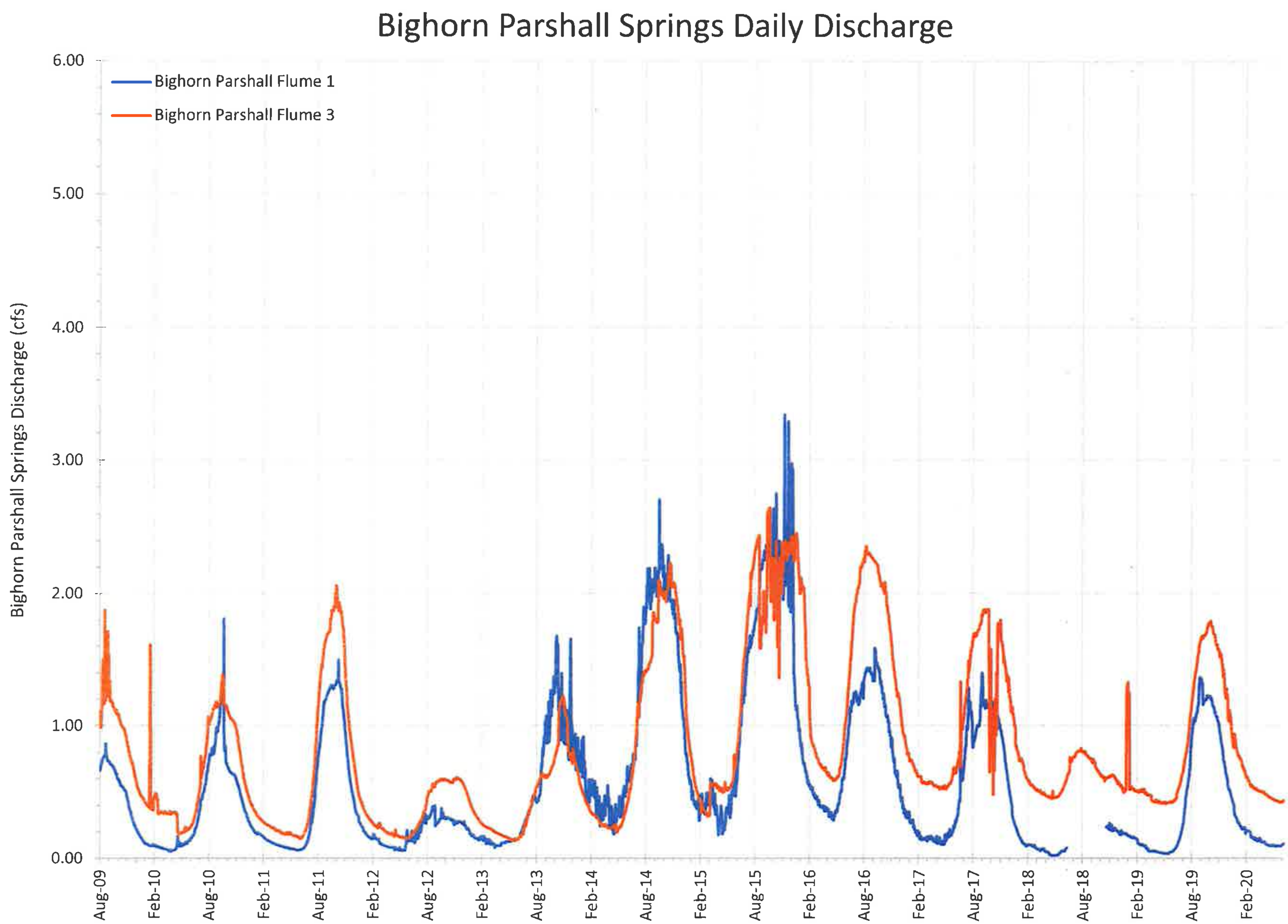
APPENDIX D

MONITORING WELLS AND SPRING DISCHARGE AT BIGHORN SPRINGS SITE


BHBH-1 Water Level
BHBH-1
Well Water Level (ft amsl)
7694
7692
7690
7688
7686
7684
7682
7680
7678
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Oct-15
Apr-16
Oct-16
Apr-17
Oct-17
Apr-18
Oct-18
Apr-19
Oct-19
Apr-20


BHBH-2 Water Level
BHBH-2
Well Water Level (ft amsl)
7692
7690
7688
7686
7684
7682
7680
7678
7676
May-08
Nov-08
May-09
Nov-09
May-10
Nov-10
May-11
Nov-11
May-12
Nov-12
May-13
Nov-13
May-14
Nov-14
May-15
Nov-15
May-16
Nov-16
May-17
Nov-17
May-18
Nov-18
May-19
Nov-19
May-20

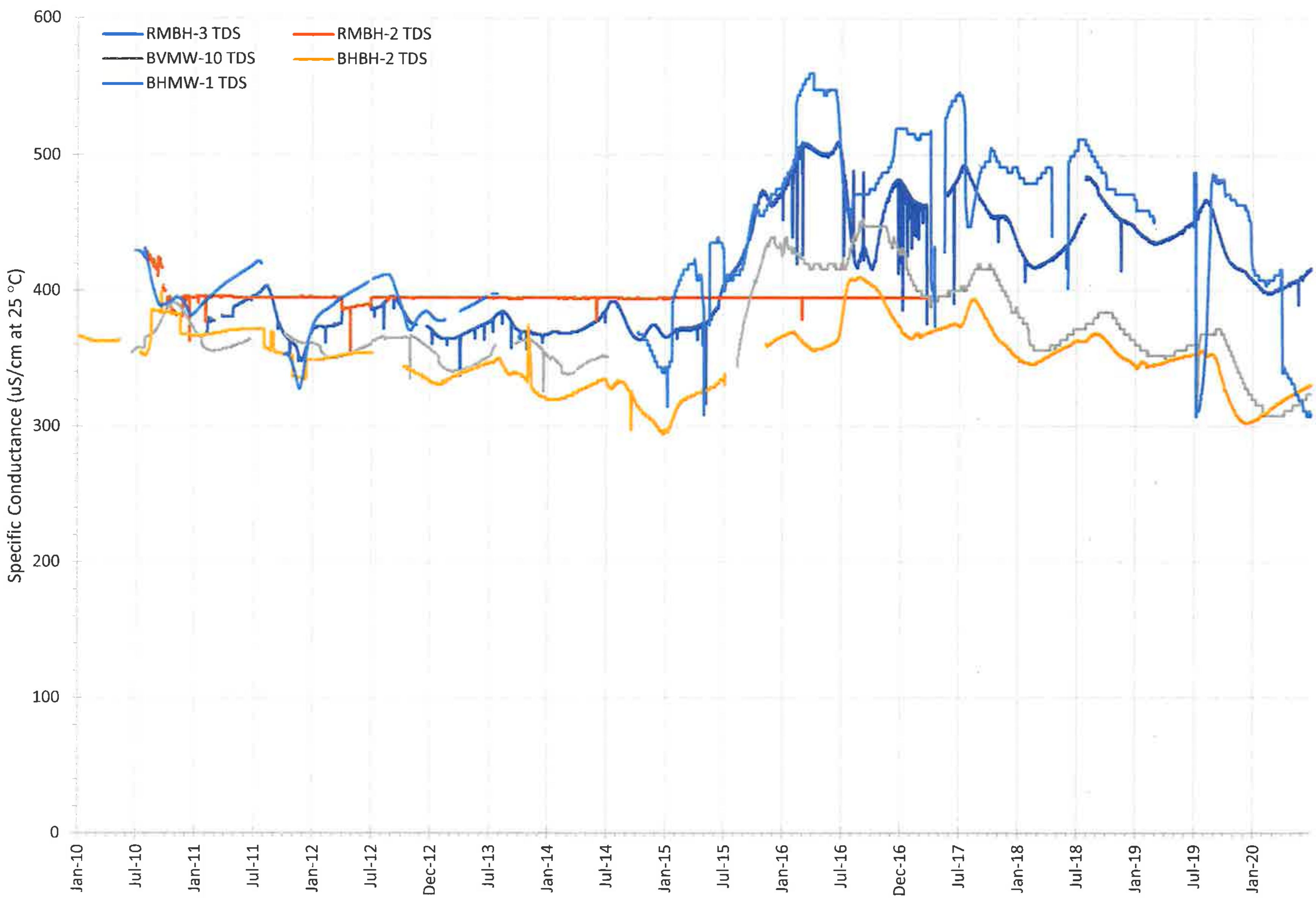

BHBH-3 Water Level
Well Water Level (ft amsl)
7700
7698
7696
7694
7692
7690
7688
7686
7684
7682
7680
BHBH-3
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Oct-15
Apr-16
Oct-16
Apr-17
Oct-17
Apr-18
Oct-18
Apr-19
Oct-19
Apr-20

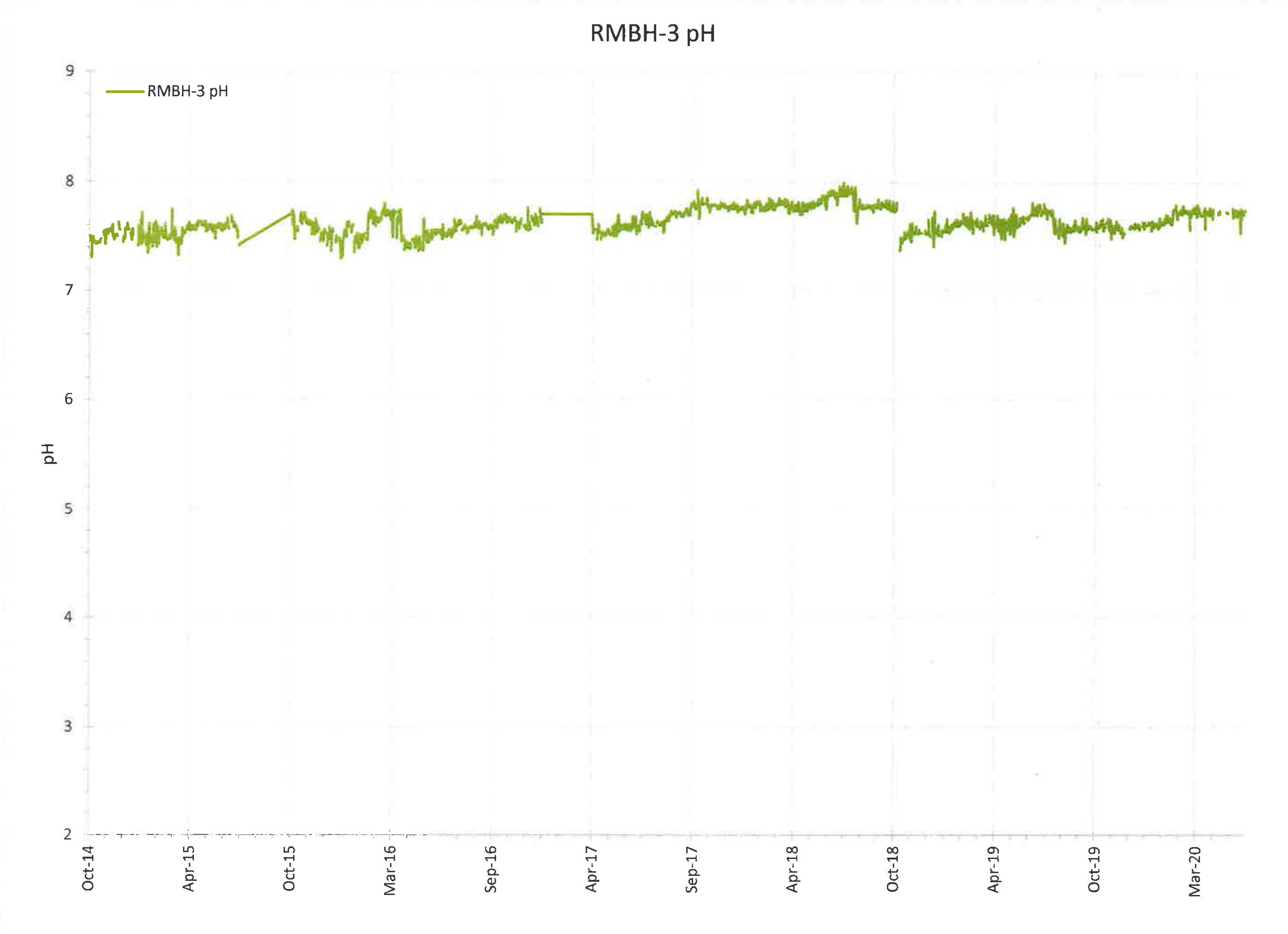


Bighorn Parshall Springs Daily Discharge
Bighorn Parshall Flume 1
Bighorn Parshall Flume 3
Bighorn Parshall Springs Discharge (cfs)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Aug-09
Feb-10
Aug-10
Feb-11
Aug-11
Feb-12
Aug-12
Feb-13
Aug-13
Feb-14
Aug-14
Feb-15
Aug-15
Feb-16
Aug-16
Feb-17
Aug-17
Feb-18
Aug-18
Feb-19
Aug-19
Feb-20

APPENDIX E

WATER CHEMISTRY


RMBH-3 TDS
RMBH-2 TDS
BVMW-10 TDS
BHBH-2 TDS
BHMW-1 TDS
Specific Conductance (uS/cm at 25 °C)
600
500
400
300
200
100
0
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Dec-12
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Dec-16
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20



RMBH-3 pH
RMBH-3 pH
pH
9
8
7
6
5
4
3
2
Oct-14
Apr-15
Oct-15
Mar-16
Sep-16
Apr-17
Sep-17
Apr-18
Oct-18
Apr-19
Oct-19
Mar-20