Big Valley Groundwater Basin Advisory Committee (BVAC)

Unapproved Meeting Minutes

BVAC Members:

Lassen County BVAC – Aaron Albaugh, Board Representative; Jeff Hemphill, Alt. Board Representative; Kevin Mitchell, Public Representative; Duane Conner, Public Representative
Modoc County BVAC – Geri Byrne, Board Representative; Ned Coe, Alt. Board Representative; Jimmy Nunn, Public Representative; John Ohm, Public Representative

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Thursday, September 24, 2020 | 4:00 PM | Veterans Memorial Hall, 657-575 Bridge Street, Bieber, CA 96009

BVAC Convene in Special Session.

Present: Committee Members: Albaugh, Mitchell, Conner, Ohm, and Nunn.
Absent: Committee Member: Byrne

Also in attendance: BVAC Secretary Maurice Anderson
BVAC staff Gaylon Norwood
BVAC staff Tiffany Martinez
BVAC Recorder Brooke Suarez
Facilitator Judie Talbott

BVAC Chairman Albaugh called the meeting to order at 4:03 p.m.

Flag Salute: Chairman Albaugh requested Gary Monchamp lead the Pledge of Allegiance.

General Update by Secretary: Secretary Anderson gave the floor to BVAC staff member Gaylon Norwood. G. Norwood handed out packets of the meeting's slide presentation, Exhibit A. He stated that the next meeting will go on as scheduled, November 4, 2020, but it may be in Bieber again because internet is better there. A public workshop will be put on in December. He discussed the next meeting's chapters that the committees will address and that the extension request letter to the governor was mailed out. The letter requested that the BVAC plan due date be extended until January 31, 2022.

Matters Initiated by Committee Members: Chairman Albaugh thanked G. Norwood for the extension request letter G. Norwood wrote to Governor G. Newsom.

Correspondence (unrelated to a specific agenda item): Letter written to Governor Newsom, Exhibit B.

Approval of Minutes (July 1, 2020) –

> **A motion was made by Representative Nunn to approve BVAC meeting minutes from July 1, 2020. The motion was seconded by Representative Mitchell. The motion was carried by the following vote:**
>
> **Aye:** 5 - Albaugh, Mitchell, Conner, Nunn, Ohm

SUBJECT #1:
Continued introduction and discussion of text for Public Draft Chapter 5 (*Groundwater Conditions*) of the Groundwater Sustainability Plan (GSP).

ACTION REQUESTED:

1. Receive report from the BVAC Secretary, Staff, and/or Consultant.
2. Receive public comment.

G. Norwood introduced Chapter 5. He reiterated that California regulations and statutes lockdown what needs to be addressed in Chapter 5 as well as the rest of the Groundwater Sustainability Plan (GSP). He stated that the counties were led to believe that the GSAs would drive the GSP but in reality, it is DWR's regulations that are driving it. The reason the counties are creating the plan instead of the State Water Board, is so that Modoc and Lassen counties can maintain some control and also to help lessen the impact to the counties. G.E.I. is primarily in charge of creating Chapter 5 as the chapter is very scientific.

David Fairman went on to present on groundwater conditions such as water levels, water flow, water storage, and subsidence. Discussion was held on subsidence. D. Fairman talked about subsidence being caused by the lowering of underground water tables and oxidation of peats and organic materials. Subsidence has greater effects on infrastructure like canals, roads, and railroads. Committee members were concerned with the fact that G.E.I. was not accounting for compaction and farming practices as other possible reasons for subsidence and were concerned with how DWR would look at subsidence. It was decided to put wording in GSP that other causes might factor into subsidence.

Rodney Fricke spoke on the groundwater quality which is good to excellent. Groundwater quality was much lower in the 1950s and 1960s which was the start of groundwater development. Water that had been sitting in rock for a long period of time started being replaced with younger water and water quality has been improved greatly. There are 9 sites in Big Valley that will require long term monitoring due to some contamination. The question arose as to why we are testing quality when the issue is quantity of groundwater. R. Fricke stated it is done to show potential issues and the state is requiring quality monitoring on a statewide basis. Representative Mitchell suggested that the water quality improvement be shown on a graph in the GSP.

David Fairman talked about the interconnected surface water. The perennial streams are divided into 9 reaches. These reaches are mostly "losing" and numbers will have to be tested for. The only increasing reach is north of Ash Creek near Adin. The recharge flow from these reaches can be surveyed through measurements at the grouped well sites. The measurements can vary by 100ths of an inch which gives the direction of the flow. The representatives stated that there are a lot of assumptions being made especially with new wells being a main source of information.

Groundwater dependent ecosystems was presented by John Aires. The starting point for identifying groundwater dependent ecosystems came from "Natural Communities Commonly Associated with Groundwater (NCCAG)" dataset. The dataset supplied information that did not correlate to Big Valley and is the reason Chairman Albaugh suggested the GSP contain a comment that the GSAs did not agree with the NCCAG dataset. J. Aires stated that taking a stand will create scrutiny as the GSP will go to other agencies for comment.

Public Comment: Rosemary Nelson wanted clarification on who was driving GSP. She also suggested microphones be used at the meetings. She thought doing a GSP in two years was challenging especially since there is not a lot of historical data. She would also like to see a recap of the meetings in the Modoc Record as well as the meeting schedule.

SUBJECT #2:
Presentation of Revised Draft Chapter 3 (*Description of Plan Area*) of the GSP and;
Presentation of Revised Draft Chapter 4 (*Hydrogeologic Conceptual Model*) of the GSP.

ACTION REQUESTED:

1. Receive report from the BVAC Secretary, Staff, and/or Consultant.
2. Receive public comment.
3. Accept and "set aside" Revised Draft Chapters 3 and 4 for future inclusion in Draft GSP.

Nancy McAllister reviewed changes to text in Chapter 3. Two items were discussed that need to be changed. The term managed wetlands needed to be changed to state wildlife habitat. Also, Lines 398-401 needed to be corrected. The Modoc Water Master doesn't measure Ash Creek in Lassen county. Individuals submit reports to SWRCB and they either purchase measurements from services or take the measurements on their own.

A motion was made by Representative Nunn to "set aside" Chapter 3 with changes on two items and come back to them in the future. The motion was seconded by Representative Ohm. The motion was carried by the following vote:

Aye: 5 - Albaugh, Mitchell, Conner, Nunn, Ohm

Public Comment: None

Laura Snell presented changes to text in Chapter 4. She stated that the caveats to text discussed in the last meeting were added. Discussion was held regarding definition of aquifer versus aquifers. Ian Espinosa from DWR offered an Electro Magnetic Frequency study could be performed at DWR's expense. He asked the GSAs if they wanted it sooner than later as it could shine light on some of the data gaps. Representative Conner asked I. Espinosa about water rights and if water rights still belong to the property owner. The answer was that SGMA is not to take over water rights. Definable bottom of the aquifer discussion was held again and it was agreed that the number needed to be changed it could be changed in the five-year update.

A motion was made by Representative Conner to "set aside" Chapter 4 and come back to them in the future. The motion was seconded by Representative Nunn. The motion was carried by the following vote:

Aye: 5 - Albaugh, Mitchell, Conner, Nunn, Ohm

Public Comment: None

SUBJECT #3
Overview of the Modoc County Round 3 Proposition 68 Grant Funding – Big Valley GSP Water Enhancement Projects

ACTION REQUESTED:

1. Receive report from the BVAC Secretary, Staff, and/or Consultant.
2. Receive public comment.

Tiffany Martinez stated that Modoc County received a grant. The grant will be used to install gages for measuring. She handed out a survey form, Exhibit C, and asked all present to spread the word so that they could find a place to install the gages.

Public Comment: Jim Copp stated that the paper process of the GSAs is necessary but the work process is where the information will come from.

Matters Initiated by the General Public (regarding subjects <u>not</u> on the agenda**):** None

Establish next meeting date: November 4, 2020 at 4:00 pm. Place TBD.

Adjournment: There being no further business, Chairman Albaugh asked for a motion to adjourn.

Chairman Albaugh adjourned the meeting at 8:02 pm.

The motion was carried by the following vote:

Aye: 5 - Albaugh, Mitchell, Conner, Nunn, Ohm

Big Valley Groundwater Sustainability Plan GSP Regulations Checklist (Elements Guide) for Chapter 6

This checklist of the GSP Elements and indicates where in the GSP each element of the regulations is addressed.

Article 5.			Plan Contents for Big Valley Groundwater Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
§ 354.18.			**Water Budget**					
(a)			Each Plan shall include a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical, current and projected water budget conditions, and the change in the volume of water stored. Water budget information shall be reported in tabular and graphical form.	x	6			
(b)			The water budget shall quantify the following, either through direct measurements or estimates based on data:					
	(1)		Total surface water entering and leaving a basin by water source type.	X	6.2	6-4		Also Appendix 6B
	(2)		Inflow to the groundwater system by water source type, including subsurface groundwater inflow and infiltration of precipitation, applied water, and surface water systems, such as lakes, streams, rivers, canals, springs and conveyance systems.	X	6.2	6-7		Also Appendix 6B
	(3)		Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow.	X	6.2	6-7		Also Appendix 6B
	(4)		The change in the annual volume of groundwater in storage between seasonal high conditions.	X	6.2	6-8		Also Appendix 6B
	(5)		If overdraft conditions occur, as defined in Bulletin 118, the water budget shall include a quantification of overdraft over a period of years during which water year and water supply conditions approximate average conditions.	X	6.2	6-7		Also Appendix 6B
	(6)		The water year type associated with the annual supply, demand, and change in groundwater stored.	X	6.2	6-3		
	(7)		An estimate of sustainable yield for the basin.	X	6.2	6-7		
(c)			Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:					
	(1)		Current water budget information shall quantify current inflows and outflows for the basin using the most recent hydrology, water supply, water demand, and land use information.	X	6.3			Also Appendix 6B
	(2)		Historical water budget information shall be used to evaluate availability or reliability of past surface water supply deliveries and aquifer response to water supply and demand trends relative to water year type. The historical water budget shall include the following:					
		(A)	A quantitative evaluation of the availability or reliability of historical surface water supply deliveries as a function of the historical planned versus actual annual surface water deliveries, by surface water source and water year type, and based on the most recent ten years of surface water supply information.					

				GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
		(B)	A quantitative assessment of the historical water budget, starting with the most recently available information and extending back a minimum of 10 years, or as is sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon.	X	6.2	6-4:6-7		Also Appendix 6B
		(C)	A description of how historical conditions concerning hydrology, water demand, and surface water supply availability or reliability have impacted the ability of the Agency to operate the basin within sustainable yield. Basin hydrology may be characterized and evaluated using water year type.					
	(3)		Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:					
		(A)	Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.					
		(B)	Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand. The projected water demand information shall also be applied as the baseline condition used to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.					
		(C)	Projected surface water supply shall utilize the most recent water supply information as the baseline condition for estimating future surface water supply. The projected surface water supply shall also be applied as the baseline condition used to evaluate future scenarios of surface water supply availability and reliability as a function of the historical surface water supply identified in Section 354.18(c)(2)(A), and the projected changes in local land use planning, population growth, and climate.					
(d)			The Agency shall utilize the following information provided, as available, by the Department pursuant to Section 353.2, or other data of comparable quality, to develop the water budget:					
	(1)		Historical water budget information for mean annual temperature, mean annual precipitation, water year type, and land use.	x	6.2	6-3		
	(2)		Current water budget information for temperature, water year type, evapotranspiration, and land use.					
	(3)		Projected water budget information for population, population growth, climate change, and sea level rise.					

"X" indicates that the element has been addressed.
The page number will be filled in once the entire GSP is compiled.

Shaded areas are elements of the regulations that don't have to be addressed in the GSP

Article 5.			**Plan Contents for Big Valley Groundwater Basin**	**GSP Document References**				
				Page Numbers of Plan	**Or Section Numbers**	**Or Figure Numbers**	**Or Table Numbers**	**Notes**
(e)			Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow. If a numerical groundwater and surface water model is not used to quantify and evaluate the projected water budget conditions and the potential impacts to beneficial uses and users of groundwater, the Plan shall identify and describe an equally effective method, tool, or analytical model to evaluate projected water budget conditions.					
(f)			The Department shall provide the California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM) and the Integrated Water Flow Model (IWFM) for use by Agencies in developing the water budget. Each Agency may choose to use a different groundwater and surface water model, pursuant to Section 352.4.	N/A				
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10721, 10723.2, 10727.2, 10727.6, 10729, and 10733.2, Water Code.					

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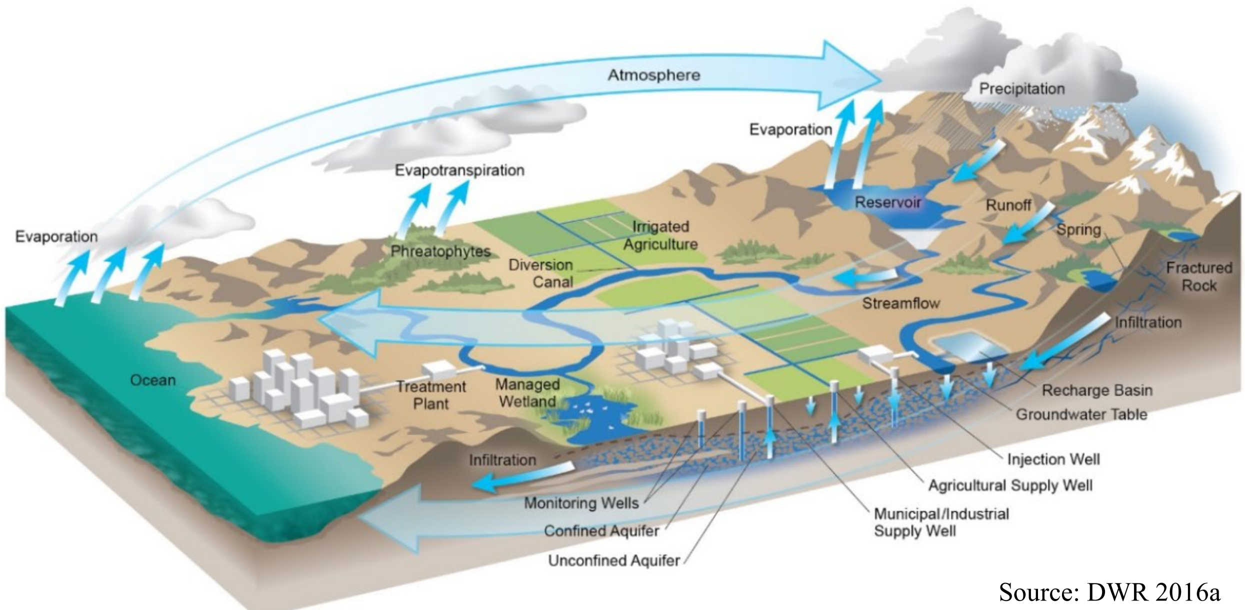
Abbreviations and Acronyms

Basin	Big Valley Groundwater Basin
BVGB	Big Valley Groundwater Basin
CIMIS	California Irrigation Management Information System
CWC	California Water Code
DDW	Division of Drinking Water, State Water Resources Control Board
DWR	Department of Water Resources
ETo	Evapotranspiration
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
USGS	United States Geologic Survey

6. Water Budget (§ 354.18)

The hydrologic cycle describes how water is moved on the earth among the oceans, atmosphere, land, surface water bodies, and groundwater bodies. **Figure 6-1** shows a depiction of the hydrologic cycle.

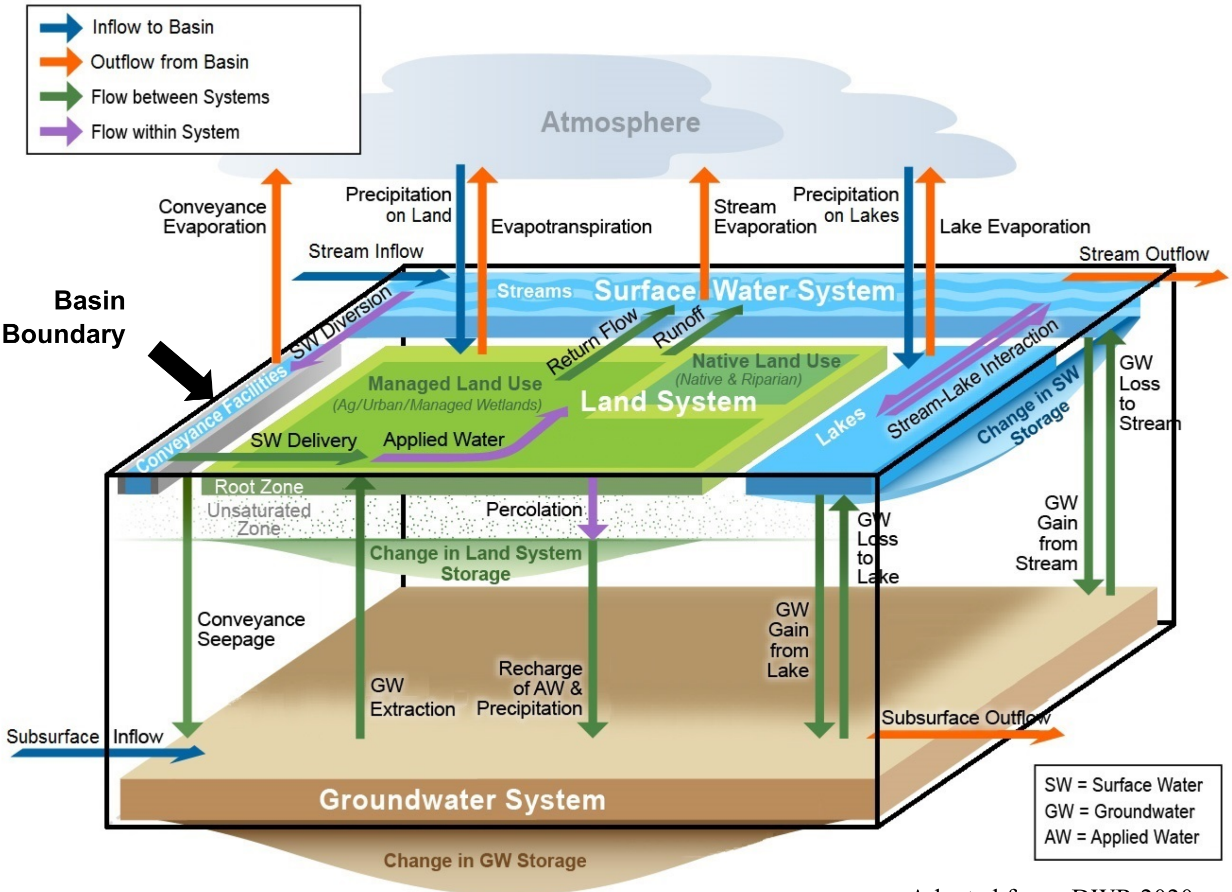


Source: DWR 2016a

Figure 6-1 Hydrologic Cycle

A water budget accounts for the movement of water among the four major systems in Big Valley: atmospheric, land surface, surface water, and groundwater. The Big Valley Groundwater Basin (BVGB) consists of the latter three (land surface, surface water, and groundwater) as shown by the black outline on **Figure 6-2.** This figure demonstrates the specific components of the water budget and exchange between the systems. The systems and the flow arrows are color coded. Inflows to the BVGB are shown with blue arrows and outflows from the BVGB are shown with orange arrows. Flows between the systems are shown with green arrows and flows within a system are shown in purple. The land system, surface water system, and groundwater system are green, blue, and brown respectively.

Like a checking account, a water budget helps the Groundwater Sustainability Agencies (GSAs) and stakeholders better understand the deposits and withdrawals and identify what conditions result in positive and negative balances. It should be noted that, while the development of a water budget is required by the Groundwater Sustainability Plan (GSP) regulations, the regulations don’t require actions based directly on the water budget. Actions are only required based on outcomes related to the six sustainability indicators: groundwater levels, groundwater storage, water quality, subsidence, seawater intrusion, and surface water depletions. Therefore, a water budget should be viewed as a tool to develop a common understanding of the Basin and a basis for making decisions to achieve sustainability and avoid undesirable results (sustainability indicators.



Adapted from: DWR 2020a

Figure 6-2 Water Budget Components and Systems

6.1 Water Budget Data Sources

Each component shown in **Figure 6-2** was estimated using readily available data and assembled into a budget spreadsheet. Most groundwater basins in California utilize a numerical groundwater model, such as MODFLOW or IGSM to calculate the water budget. These models require a specialized hydrogeologist to run them and the methodology by which the water budget is calculated is not readily apparent to the lay person. For the BVGB, a non-modeling (spreadsheet) approach was used so that future iterations of the water budget could be performed by a wider range of hydrology professionals (potentially reducing future GSP implementation costs) and so that the calculations of the specific components could be understood by a broader range of people.

Ideally, each component could be quantified precisely and accurately, and the budget would come out balanced. In practice, many of the components can only be roughly estimated, and in some cases perhaps not at all. Therefore, much of the work to balance the water budget is adjusting some of the unknown or roughly estimated parameters within acceptable ranges until the budget is balanced and all components of the budget are deemed reasonable.

Therefore, the water budget calculations presented here are not unique. Estimation of nearly all components involves assumptions and with more basin-specific data the accuracy and precision of many of the components is improved. This results in a budget that more closely reflects the Basin conditions and allows the GSAs to make more informed decisions to sustainably maintain groundwater resources. **Appendix 6A** show the components of the water budget, their data source(s), assumptions, relative level of precision, and the data needed to refine the estimates.

The major data source for climate data is CIMIS (DWR 2020b), for surface water flows is the National Water Information System (USGS 2020b), and for land use is DWR land use surveys (DWR 2020c). Major data gaps, when addressed, that would improve the water budget include irrigation methods (and efficiencies for the methods) and information about the proportion of surface water vs groundwater used for irrigation.

6.2 Historical Water Budget

The historic water budget presented in this section covers the period of 1984 to 2018. This period was chosen because the period represents an average set of climatic conditions and adequate water level and climate data was available in this time frame. **Figure 6-3** shows the annual precipitation and year type for the period. The criteria for year types were critical dry below 70% of average precipitation, dry between 70 and 85% of average precipitation, normal between 85 and 115% of average precipitation, and wet years greater than 115% of average precipitation. The definition of these year-type categories is similar to those used by DWR for their water year indices for the Sacramento and San Joaquin Valleys.

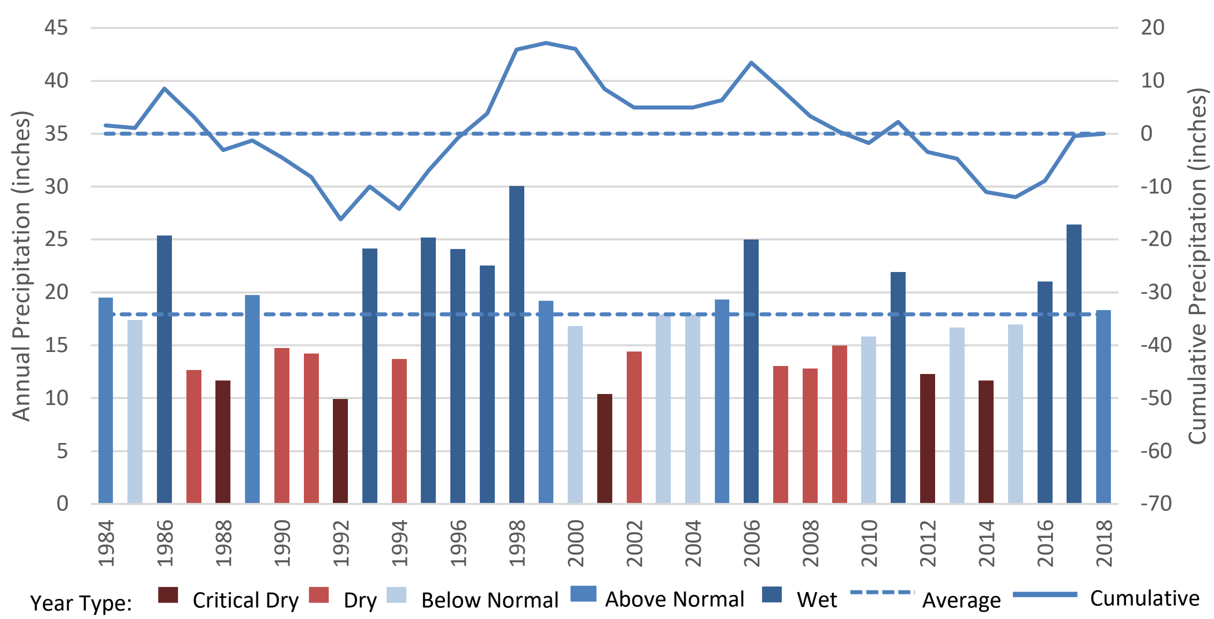


Figure 6-3 Annual and Cumulative Precipitation and Water Year Types 1984 to 2018

The budget was developed using this precipitation and other climate data (evapotranspiration) along with stream flow to estimate the inflows (credits) and outflows (debits) to the total BVGB. The budget was balanced by assuming that the land and surface water systems remain nearly in balance from year to year and allowing the groundwater system to vary. **Figure 6-4** shows the average annual values for the overall water budget. The detailed water budget for each year is included in **Appendix 6B**. **Appendix 6C** shows graphically how the water budget varies over time.

TOTAL BASIN WATER BUDGET (Acre-Feet)

Item	Flow Type	Origin/ Destination	Component	Acre-Feet
(1)	Inflow	Into Basin	Precipitation on Land System	135,134
(14)	Inflow	Into Basin	Precipitation on Lakes	998
(13)	Inflow	Into Basin	Stream Inflow	371,148
(27)	Inflow	Into Basin	Subsurface Inflow	-
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*507,280*
(5)	Outflow	Out of Basin	Evapotranspiration	128,739
(24)	Outflow	Out of Basin	Stream Evaporation	2,128
(23)	Outflow	Out of Basin	Lake Evaporation	1,553
(19)	Outflow	Out of Basin	Conveyance Evaporation	821
(18)	Outflow	Out of Basin	Stream Outflow	379,320
(29)	Outflow	Out of Basin	Subsurface Outflow	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*512,561*
(34)	Storage Change	(32)-(33)	Change in Total System Storage	(5,280)

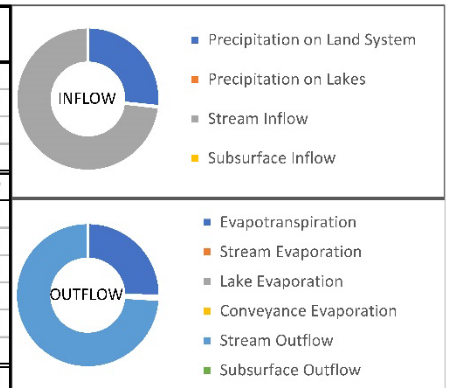


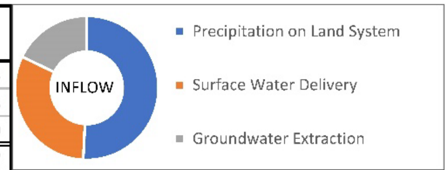
Figure 6-4 Average Annual Total Basin Water Budget

The evapotranspiration value was calculated using land use data (crop acreages) from DWR for 2014 and land use was assumed to be constant throughout the water budget period. Future refinements to the water budget are planned to include land use values from 1997, 2011, 2013, and 2016.

Using the evapotranspiration for irrigated lands, the amount of irrigation from surface water and groundwater was determined using the assumption of 85% irrigation efficiency and a 40%-60% split between surface water and groundwater respectively. The overall water budget could be improved with better estimates of irrigation efficiency (irrigation methods) and the split of surface water vs groundwater use. The water budget for the three systems (land, surface water, and groundwater) are shown in **Figures 6-5** through **6-7.** The detailed water budget for each year is included in **Appendix 6B**. **Appendix 6C** shows graphically how the system water budgets vary over time.

With the land system and surface water system assumed to be in balance, the groundwater system varies and reflects the change in water stored in the Basin. This change in storage is shown in **Figure 6-8** and is analogous to the change in storage presented in Chapter 5 which used groundwater contours to calculate the change. These two approaches show similar trends, but the magnitude of the changes is different. This indicates that further refinement of the budget or assumptions from the contour calculations is needed.

item	LAND SYSTEM			Acre-Feet
	Flow Type	Origin/ Destination	Component	
(1)	Inflow	Into Basin	Precipitation on Land System	135,134
(2)	Inflow	Between Systems	Surface Water Delivery	83,368
(3)	Inflow	Between Systems	Groundwater Extraction	47,590
(4)	Inflow	(1)+(2)+(3)	*Total Inflow*	*266,092*
(5)	Outflow	Out of Basin	Evapotranspiration	128,739
(6)	Outflow	Between Systems	Runoff	114,864
(7)	Outflow	Between Systems	Return Flow	5,800
(8)	Outflow	Between Systems	Recharge of Applied Water	13,923
(9)	Outflow	Between Systems	Recharge of Precipitation	2,703
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-
(11)	Outflow	(5)+(6)+(7)+(8)+(9)+(10)	*Total Outflow*	*266,029*
(12)	Storage Change	(4)-(11)	Change in Land System Storage	64



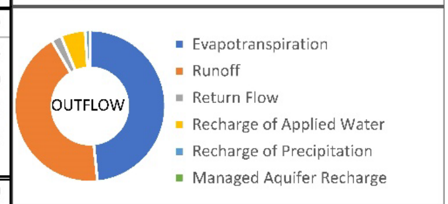
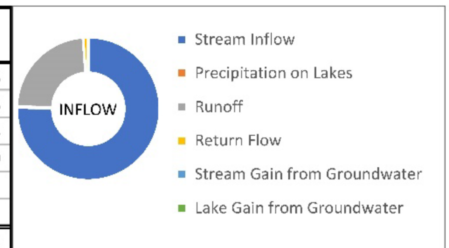


Figure 6-5 Average Annual Land System Water Budget

item	SURFACE WATER SYSTEM			Acre-Feet
	Flow Type	Origin/ Destination	Component	
(13)	Inflow	Into Basin	Stream Inflow	371,148
(14)	Inflow	Into Basin	Precipitation on Lakes	998
(6)	Inflow	Between Systems	Runoff	114,864
(7)	Inflow	Between Systems	Return Flow	5,800
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-
(16)	Inflow	Between Systems	Lake Gain from Groundwater	-
(17)	Inflow	(13)+(14)+(6)+(7)+(15)+(16)	*Total Inflow*	*492,811*
(18)	Outflow	Out of Basin	Stream Outflow	379,320
(19)	Outflow	Out of Basin	Conveyance Evaporation	821
(20)	Outflow	Between Systems	Conveyance Seepage	446
(2)	Outflow	Between Systems	Surface Water Delivery	83,368
(21)	Outflow	Between Systems	Stream Loss to Groundwater	24,037
(22)	Outflow	Between Systems	Lake Loss to Groundwater	1,138
(23)	Outflow	Out of Basin	Lake Evaporation	1,553
(24)	Outflow	Out of Basin	Stream Evaporation	2,128
(25)	Outflow	(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)	*Total Outflow*	*492,811*
(26)	Storage Change	(17)-(25)	Change in Surface Water Storage	-



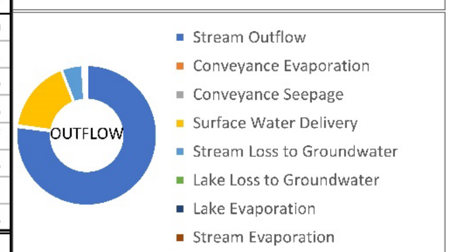
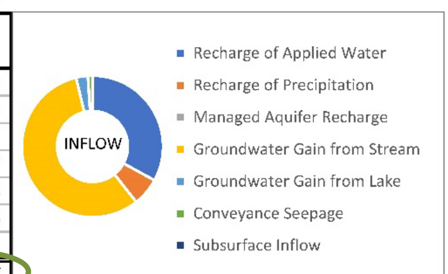


Figure 6-6 Average Annual Surface Water System Water Budget

item	GROUNDWATER SYSTEM			Acre-Feet
	Flow Type	Origin/ Destination	Component	
(8)	Inflow	Between Systems	Recharge of Applied Water	13,923
(9)	Inflow	Between Systems	Recharge of Precipitation	2,703
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-
(21)	Inflow	Between Systems	Groundwater Gain from Stream	24,037
(22)	Inflow	Between Systems	Groundwater Gain from Lake	1,138
(20)	Inflow	Between Systems	Conveyance Seepage	446
(27)	Inflow	Into Basin	Subsurface Inflow	-
(28)	Inflow	(8)+(9)+(10)+(21)+(22)+(20)+(27)	*Total Inflow*	*42,246*
(3)	Outflow	Between Systems	Groundwater Extraction	47,590
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-
(16)	Outflow	Between Systems	Groundwater Loss to Lake	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-
(30)	Outflow	(3)+(15)+(16)+(29)	*Total Outflow*	*47,590*
(31)	Storage Change	(28)-(30)	Change in Groundwater Storage	(5,344)



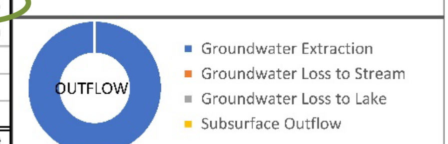


Figure 6-7 Groundwater System Water Budget 1984 to 2018

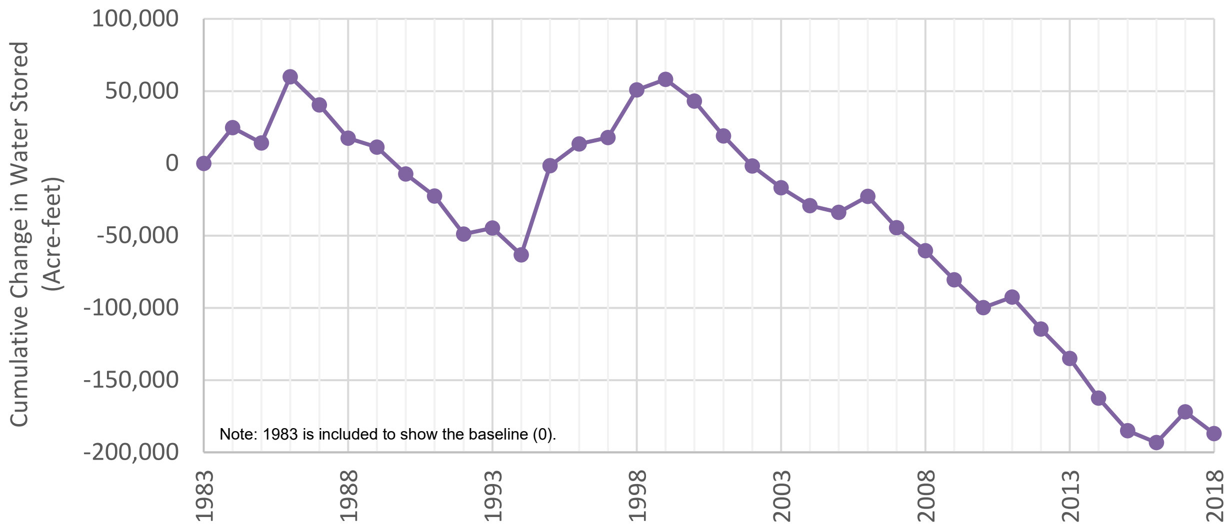


Figure 6-8 Cumulative Groundwater System Change in Storage 1984 to 2018

The GSP regulations require an estimate of the sustainable yield[1] for the basin. (§354.18(b)(7)). This is interpreted as the average annual inflow to the groundwater system, which for the 34-year period of the historic water budget is approximately 42,000 acre-feet, as indicated on **Figure 6-7** by the inflow value (circled in green) for the groundwater system. The estimate of annual average groundwater use is approximately 47,000 acre-feet.

The regulations also require a quantification of overdraft[2]. (§354.18(b)(5)) Overdraft occurs when the groundwater system change in storage is negative over a long period. For the water budget period of 1984 to 2018, this is approximately 5,000 acre-feet, shown as the average groundwater system change in storage, circled in red on **Figure 6-7**.

6.3 Current Water Budget

The current water budget is demonstrated by looking at water year 2018, which is the most recent year with reliable data. The description of the current water budget will be expanded once the historic water budget is refined with locally developed data.

6.4 Projected Water Budget

The projected water budget will be developed once the historic water budget is refined with locally developed data. The projected water budget will use 50 years of climate (precipitation, evapotranspiration, and stream flow) data to estimate future conditions based on estimates of population, land use, and water use changes.

[1] The state defines sustainable yield as, "the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result." (California Water Code §10721(w))
[2] DWR defines overdraft as "the condition of a groundwater basin or Subbasin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years, during which the water supply conditions approximate average conditions." (DWR 2016b)

6.5 References

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Appendix 6A

Water Budget Components

LAND SYSTEM WATER BUDGET

Item	Flow Type	Origin/ Destination	Component	Credit(+)/ Debit(-)	Relationship with Other Systems	Data Source(s)	Assumptions	Relative Level of Precision	Data Needs and Refinements
(1)	**Inflow**	Into Basin	Precipitation on Land System	+		-Monthly precipitation from PRISM Model (NACSE 2020) evaluated at Bieber -Basin Land area from DWR (2018). -Area of rivers, conveyance, and lakes from USGS (2020).	-Precipitation does not vary spatially throughout the Basin	High	-No refinements planned for this component -Variations in precipitation throughout the basin could be estimated with an in-depth analysis of the PRISM model
(2)	**Inflow**	Between Systems	Surface Water Delivery	+	Equal to the *Surface Water Delivery* term in the surface water system outflow	-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Crop Coefficients (Kc) adapted from FAO (1998) -Monthly precipitation from PRISM Model (NACSE 2020) evaluated at Bieber	-Agriculture is the only sector that uses surface water -Irrigation efficiency = 85% -40% of agricultural irrigation uses surface water -98% of riparian demands are met by surface water	Low	-More detailed information on irrigation practices and associated efficiencies More detailed information of agricultural surface water vs groundwater use More detailed information on amount of groundwater pumping to support riparian habitat at the Ash Creek Wildlife Area
(3)	**Inflow**	Between Systems	Groundwater Extraction	+	Equal to the *Groundwater Extraction* term in the groundwater system outflow	-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Crop Coefficients (Kc) adapted from FAO (1998) -Monthly precipitation from PRISM Model (NACSE 2020) evaluated at Bieber Population of Bieber from United States Census Bureau (2020) Population of Big Valley from DWR (2018)	-Irrigation efficiency = 85% -60% of agricultural irrigation uses groundwater -2% of riparian demands are met by groundwater -Per capita water use is 100 gallons/day/person -All domestic users use groundwater	Low	-More detailed information on irrigation practices and associated efficiencies More detailed information of agricultural surface water vs groundwater use More detailed information on amount of groundwater pumping to support riparian habitat at the Ash Creek Wildlife Area
(4)	**Inflow**		*Total Inflow*		*(1)+(2)+(3)*				
(5)	**Outflow**	Out of Basin	Evapotranspiration	-		-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Crop Coefficients (Kc) adapted from FAO (1998) -Land use and crop acreages from DWR (2014)	-ETo does not vary throughout the Basin -The land system remains in balance from year to year (no change in land system storage).	Moderate	-Incorporate changes in crop acreages over time by using DWR land use surveys from 1997, 2011, 2013, and 2016
(6)	**Outflow**	Between Systems	Runoff	-	Equal to the *Runoff* term in Surface Water System*	-Precipitation from PRISM Model (NACSE 2020) evaluated at Bieber	-85% of precipitation results in runoff	Low	-More detailed runoff percentage from evaluation of basin using curve number method
(7)	**Outflow**	Between Systems	Return Flow	-	Equal to the *Return Flow* term in Surface Water System*	-See surface water delivery and groundwater extraction above	-50% of agricultural inefficiency results in return flow (7.5% of applied water)	Low	-More detailed information on irrigation practices and associated efficiencies
(8)	**Outflow**	Between Systems	Recharge of Applied Water	-	Equal to the *Recharge of Applied Water* term in the groundwater system	-See surface water delivery and groundwater extraction above	-50% of agricultural inefficiency results in recharge of grounwater (7.5% of applied water)	Low	-More detailed information on irrigation practices and associated efficiencies
(9)	**Outflow**	Between Systems	Recharge of Precipitation	-	Equal to the *Recharge of Precipitation* term in the groundwater system	-Precipitation from PRISM Model (NACSE 2020) evaluated at Bieber	-2% of precipitation results in recharge to groundwater	Moderate	
(10)	**Outflow**	Between Systems	Managed Aquifer Recharge	-	Equal to the *Managed Aquifer Recharge* term in the groundwater system	No managed recharge currently occurs in the Big Valley Groundwater basin			
(11)	**Outflow**		*Total Outflow*		*(5)+(6)+(7)+(8)+(9)+(10)*				
(12)	**Storage Change**		Change in Land System Storage		*(4)-(11)*				

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	Credit(+)/ Debit(-)	Relationship with Other Systems	Data Source(s)	Assumptions	Relative Level of Precision	Data Needs and Refinements
(13)	**Inflow**	Into Basin	Stream Inflow	+		-Historic and current data from Pit River gage at Canby -Historic data from gage on Pit River north of Lookout (where it enters basin), Ash Creek at Adin, Widow Valley Creek, Willow Creek	-Historic relationship between flow at Canby and flow at historic gages is the same as current. E.g. flow during winter events is about 40% higher than Canby once the Pit River reaches Big Valley -Watershed areas outside of those with historic gage measurements have same runoff per acre as the gaged watersheds	Moderate	-Additional data from new gages
(14)	**Inflow**	Into Basin	Precipitation on Lakes	+		-Monthly precipitation from PRISM Model (NACSE 2020) evaluated at Bieber -Area of rivers, conveyance, and lakes from USGS (2020).	-precipitation does not vary spatially throughout the Basin	High	-No refinements planned for this component
(6)	**Inflow**	Between Systems	Runoff	+	Equal to the *Runoff* term in land system (6)	-Precipitation from PRISM Model (NACSE 2020) evaluated at Bieber		Low	
(7)	**Inflow**	Between Systems	Return Flow	+	Equal to the *Return Flow* term in the land system (7)	-See surface water delivery and groundwater extraction above		Low	
(15)	**Inflow**	Between Systems	Stream Gain from Groundwater	+	Equal to the *Groundwater Loss to Stream* term in the groundwater system	-None	-Assumed to be 0 until further analysis of transducer data from new monitoring wells	Low	-Analysis of transducer data from new monitoring wells and groundwater contours
(16)	**Inflow**	Between Systems	Lake Gain from Groundwater	+	Equal to the *Groundwater Loss to Lake* term in the groundwater system	-None	-Assumed to be 0 because most lakes are above the groundwater levels	High	-No refinements planned for this component
(17)	**Inflow**		*Total Inflow*		*(13)+(14)+(6)+(7)+(15)+(16)*				
(18)	**Outflow**	Out of Basin	Stream Outflow	-		-Estimated based on this water budget -Estimates verified using analysis of historic gage data from Pit River south of Bieber (exit from Basin)	-The surface water system remains in balance from year to year (no change in surface water storage)	Low	-No refinements planned for this component
(19)	**Outflow**	Out of Basin	Conveyance Evaporation	-		-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Area of conveyance from USGS (2020)	-Each year, conveyance is full from May to September and empty from October to April	Moderate	-No refinements planned for this component
(20)	**Outflow**	Between Systems	Conveyance Seepage	-	Equal to the *Conveyance Seepage* term in the groundwater system	-Area of conveyance from USGS (2020)	-Each year, conveyance is full from May to September and empty from October to April -Seepage rate of 0.01 ft/day	Moderate	-No refinements planned for this component
(2)	**Outflow**	Between Systems	Surface Water Delivery	-	Equal to the *Surface Water Delivery* term in land system (2)	-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Crop Coefficients (Kc) adapted from FAO (1998) -Monthly precipitation from PRISM Model (NACSE 2020) evaluated at Bieber		Low	
(21)	**Outflow**	Between Systems	Stream Loss to Groundwater	-	Equal to the *Gain from Stream* term in the groundwater system	-Historic and current data from Pit River gage at Canby -Historic data from gage on Pit River north of Lookout (where it enters Basin), Ash Creek at Adin, Widow Valley Creek, Willow Creek, Pit River at exit from Basin.	-Calculated from the historic inflow - outflow relationship.	Low	-Additional data from new gages
(22)	**Outflow**	Between Systems	Lake Loss to Groundwater	-	Equal to the *Groundwater Gain from Lake* term in the groundwater system	-Area of lakes from USGS (2020)	-Each year, lakes are full (100%) and surface area drops throughout summer to 10% in September, then gradually refill over the winter. -Seepage rate of 0.01 ft/day	Moderate	-No refinements planned for this component
(23)	**Outflow**	Out of Basin	Lake Evaporation	-		-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Area of lakes from USGS (2020)	-Each year, lakes are full (100%) and surface area drops throughout summer to 10% in September, then gradually refill over the winter.	High	
(24)	**Outflow**	Out of Basin	Stream Evaporation	-		-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Area of streams from USGS (2020)		High	
(25)	**Outflow**		*Total Outflow*		*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*				
(26)	**Storage Change**		Change in Surface Water Storage		*(17)-(25)*				

GROUNDWATER SYSTEM WATER BUDGET

Item	Flow Type	Origin/ Destination	Component	Credit(+)/ Debit(-)	Relationship with Other Systems	Data Source(s)	Assumptions	Relative Level of Precision	Data Needs and Refinements
(8)	**Inflow**	Between Systems	Recharge of Applied Water	+	Equal to the *Recharge of Applied Water* term in the land system (8)	-See surface water delivery and groundwater extraction above		Low	
(9)	**Inflow**	Between Systems	Recharge of Precipitation	+	Equal to the *Recharge of Precipitation* term in the land system (9)	-Precipitation from PRISM Model (NACSE 2020) evaluated at Bieber		Low	
(10)	**Inflow**	Between Systems	Managed Aquifer Recharge	+	Equal to the *Managed Aquifer Recharge* term in the land system (10)	No managed recharge currently occurs in the Big Valley Groundwater basin			
(21)	**Inflow**	Between Systems	Groundwater Gain from Stream	+	Equal to the *Stream Loss to Groundwater* term in the surface water system (21)	-Historic and current data from Pit River gage at Canby -Historic data from gage on Pit River north of Lookout (where it enters Basin), Ash Creek at Adin, Widow Valley Creek, Willow Creek, Pit River at exit from Basin.		Low	
(22)	**Inflow**	Between Systems	Groundwater Gain from Lake	+	Equal to the *Lake Loss to Groundwater* term in the surface water system (22)	-Area of lakes from USGS (2020)		Moderate	
(20)	**Inflow**	Between Systems	Conveyance Seepage	+	Equal to the *Conveyance Seepage* term in the surface water system (20)	-Area of conveyance from USGS (2020)		Moderate	
(27)	**Inflow**	Into Basin	Subsurface Inflow	+			-No subsurface inflow occurs in the BVGB	Moderate	-Further analysis of transducer data from new monitoring wells -Analysis of potential inflow near Adin
(28)	**Inflow**		*Total Inflow*		*(8)+(9)+(10)+(21)+(22)+(20)+(27)*				
(3)	**Outflow**	Between Systems	Groundwater Extraction	-	Equal to the *Groundwater Extraction* term in the land system (3)	-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Crop Coefficients (Kc) adapted from FAO (1998) -Monthly precipitation from PRISM Model (NACSE 2020) evaluated at Bieber Population of Bieber from United States Census Bureau (2020) Population of Big Valley from DWR (2018)		Low	
(15)	**Outflow**	Between Systems	Groundwater Loss to Stream	-	Equal to the *Stream Gain from Groundwater* term in the surface water system (15)	-None		Low	
(16)	**Outflow**	Between Systems	Groundwater Loss to Lake	-	Equal to the *Lake Gain from Groundwater* term in the surface water system (16)	-None		High	
(29)	**Outflow**	Out of Basin	Subsurface Outflow	-			-No subsurface outflow occurs in the BVGB	Moderate	-Will revisit this if additional information becomes available to indicated subsurface outflow
(30)	**Outflow**		*Total Outflow*		*(3)+(15)+(16)+(29)*				
(31)	**Storage Change**		Change in Groundwater Storage		(28)-(30)				

TOTAL WATER BUDGET

Item	Flow Type	Origin/ Destination	Component	Credit(+)/ Debit(-)	Relationship with Other Systems	Data Source(s)	Assumptions	Relative Level of Precision	Data Needs and Refinements
(1)	**Inflow**	Into Basin	Precipitation on Land System	+	Equal to the *Precipitation* term in the	-Monthly precipitation from PRISM Model (NACSE		High	
(14)	**Inflow**	Into Basin	Precipitation on Lakes	+	Equal to the *Precipitation on Lakes* term in the surface water system	-Monthly precipitation from PRISM Model (NACSE 2020) evaluated at Bieber -Area of rivers, conveyance, and lakes from USGS (2020).		High	
(13)	**Inflow**	Into Basin	Stream Inflow	+	Equal to the *Stream Inflow* term in the surface water system	-Historic and current data from Pit River gage at Canby -Historic data from gage on Pit River north of Lookout (where it enters basin), Ash Creek at Adin, Widow Valley Creek, Willow Creek		Moderate	
(27)	**Inflow**	Into Basin	Subsurface Inflow	+	Equal to the *Subsurface Inflow* term in the groundwater system			Moderate	
(32)	**Inflow**		*Total Inflow*		*(1)+(14)+(13)+(27)*				
(5)	**Outflow**	Out of Basin	Evapotranspiration	-	Equal to the *Evapotranspiration*	-Reference Evapotranspiration (ETo) from CIMIS		Moderate	
(24)	**Outflow**	Out of Basin	Stream Evaporation	-	Equal to the *Stream Evaporation* term in the surface water system	-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Area of streams from USGS (2020)		High	
(23)	**Outflow**	Out of Basin	Lake Evaporation	-	Equal to the *Lake Evaporation* term in the surface water system	-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Area of lakes from USGS (2020)		High	
(19)	**Outflow**	Out of Basin	Conveyance Evaporation	-	Equal to the *Conveyance Evaporation* term in the surface water system	-Reference Evapotranspiration (ETo) from CIMIS spatial data model evaluated at Bieber (DWR 2020b) -Area of conveyance from USGS (2020)		Moderate	
(18)	**Outflow**	Out of Basin	Stream Outflow	-	Equal to the *Stream Outflow* term in the surface water system	-Estimated based on this water budget -Estimates verified using analysis of historic gage data from Pit River south of Bieber (exit from Basin)		Low	
(29)	**Outflow**	Out of Basin	Subsurface Outflow	-	Equal to the *Subsurface Outflow* term in the groundwater system			Moderate	
(33)	**Outflow**		*Total Outflow*		*(5)+(24)+(23)+(19)+(18)+(29)*				
(34)	**Storage Change**		Change in Total System Storage		(32)-(33)				

Appendix 6B

Historic Water Budget Details

item	Flow Type	Origin/ Destination	Component	Average (1984-2018)	1984	1985	1986	1987	1988
LAND SYSTEM WATER BUDGET									
(1)	Inflow	Into Basin	Precipitation on Land System	135,134	147,084	131,102	191,338	95,141	87,753
(2)	Inflow	Between Systems	Surface Water Delivery	83,368	73,276	83,420	80,966	86,167	93,463
(3)	Inflow	Between Systems	Groundwater Extraction	47,590	41,183	47,063	45,543	49,031	53,443
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*266,092*	*261,543*	*261,585*	*317,847*	*230,338*	*234,659*
(5)	Outflow	Out of Basin	Evapotranspiration	128,739	116,331	127,810	132,234	127,160	136,155
(6)	Outflow	Between Systems	Runoff	114,864	125,022	111,436	162,637	80,870	74,590
(7)	Outflow	Between Systems	Return Flow	5,800	5,014	5,733	5,547	5,976	6,516
(8)	Outflow	Between Systems	Recharge of Applied Water	13,923	12,234	13,919	13,509	14,384	15,600
(9)	Outflow	Between Systems	Recharge of Precipitation	2,703	2,942	2,622	3,827	1,903	1,755
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*266,029*	*261,543*	*261,521*	*317,754*	*230,292*	*234,616*
(12)	Storage Change	**(4)-(11)**	Change in Land System Storage	64	-	64	93	46	43

item	Flow Type	Origin/ Destination	Component	Average (1984-2018)	1984	1985	1986	1987	1988
SURFACE WATER SYSTEM WATER BUDGET									
(13)	Inflow	Into Basin	Stream Inflow	371,148	808,462	310,960	878,565	161,807	162,980
(14)	Inflow	Into Basin	Precipitation on Lakes	998	573	756	1,219	402	545
(6)	Inflow	Between Systems	Runoff	114,864	125,022	111,436	162,637	80,870	74,590
(7)	Inflow	Between Systems	Return Flow	5,800	5,014	5,733	5,547	5,976	6,516
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-
(16)	Inflow	Between Systems	Lake Gain from Groundwater	-	-	-	-	-	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*492,811*	*939,071*	*428,885*	*1,047,968*	*249,054*	*244,631*
(18)	Outflow	Out of Basin	Stream Outflow	379,320	810,919	320,769	888,490	145,199	133,122
(19)	Outflow	Out of Basin	Conveyance Evaporation	821	783	827	813	815	900
(20)	Outflow	Between Systems	Conveyance Seepage	446	446	446	446	446	446
(2)	Outflow	Between Systems	Surface Water Delivery	83,368	73,276	83,420	80,966	86,167	93,463
(21)	Outflow	Between Systems	Stream Loss to Groundwater	24,037	49,085	18,460	72,401	11,524	11,579
(22)	Outflow	Between Systems	Lake Loss to Groundwater	1,138	1,138	1,138	1,138	1,138	1,138
(23)	Outflow	Out of Basin	Lake Evaporation	1,553	1,439	1,643	1,564	1,588	1,668
(24)	Outflow	Out of Basin	Stream Evaporation	2,128	1,983	2,184	2,150	2,177	2,315
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*492,811*	*939,071*	*428,885*	*1,047,968*	*249,054*	*244,631*
(26)	Storage Change	**(17)-(25)**	Change in Surface Water Storage	-	-	-	-	-	-

item	Flow Type	Origin/ Destination	Component	Average (1984-2018)	1984	1985	1986	1987	1988
GROUNDWATER SYSTEM WATER BUDGET									
(8)	Inflow	Between Systems	Recharge of Applied Water	13,923	12,234	13,919	13,509	14,384	15,600
(9)	Inflow	Between Systems	Recharge of Precipitation	2,703	2,942	2,622	3,827	1,903	1,755
(10)	Inflow	Between Systems	Managed Aquifer Recharge						
(21)	Inflow	Between Systems	Groundwater Gain from Stream	24,037	49,085	18,460	72,401	11,524	11,579
(22)	Inflow	Between Systems	Groundwater Gain from Lake	1,138	1,138	1,138	1,138	1,138	1,138
(20)	Inflow	Between Systems	Conveyance Seepage	446	446	446	446	446	446
(27)	Inflow	Into Basin	Subsurface Inflow	-	-	-	-	-	-
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*42,246*	*65,845*	*36,584*	*91,321*	*29,394*	*30,517*
(3)	Outflow	Between Systems	Groundwater Extraction	47,590	41,183	47,063	45,543	49,031	53,443
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-
(16)	Outflow	Between Systems	Groundwater Loss to Lake	-	-	-	-	-	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*47,590*	*41,183*	*47,063*	*45,543*	*49,031*	*53,443*
(31)	Storage Change	**(28)-(30)**	Change in Groundwater Storage	(5,344)	24,662	(10,478)	45,778	(19,636)	(22,925)

item	Flow Type	Origin/ Destination	Component	Average (1984-2018)	1984	1985	1986	1987	1988
TOTAL BASIN WATER BUDGET									
(1)	Inflow	Into Basin	Precipitation on Land System	135,134	147,084	131,102	191,338	95,141	87,753
(14)	Inflow	Into Basin	Precipitation on Lakes	998	573	756	1,219	402	545
(13)	Inflow	Into Basin	Stream Inflow	371,148	808,462	310,960	878,565	161,807	162,980
(27)	Inflow	Into Basin	Subsurface Inflow	-	-	-	-	-	-
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*507,280*	*956,119*	*442,817*	*1,071,121*	*257,350*	*251,278*
(5)	Outflow	Out of Basin	Evapotranspiration	128,739	116,331	127,810	132,234	127,160	136,155
(24)	Outflow	Out of Basin	Stream Evaporation	2,128	1,983	2,184	2,150	2,177	2,315
(23)	Outflow	Out of Basin	Lake Evaporation	1,553	1,439	1,643	1,564	1,588	1,668
(19)	Outflow	Out of Basin	Conveyance Evaporation	821	783	827	813	815	900
(18)	Outflow	Out of Basin	Stream Outflow	379,320	810,919	320,769	888,490	145,199	133,122
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*512,561*	*931,457*	*453,232*	*1,025,251*	*276,940*	*274,161*
(34)	Storage Change	**(32)-(33)**	Change in Total System Storage	(5,280)	24,662	(10,415)	45,871	(19,590)	(22,883)

LAND SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	1989	1990	1991	1992	1993	1994
(1)	Inflow	Into Basin	Precipitation on Land System	148,818	111,048	107,203	74,635	181,839	103,208
(2)	Inflow	Between Systems	Surface Water Delivery	80,214	80,462	85,865	90,902	80,059	84,544
(3)	Inflow	Between Systems	Groundwater Extraction	46,379	45,973	49,539	52,304	46,333	48,114
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*275,411*	*237,484*	*242,607*	*217,841*	*308,231*	*235,866*
(5)	Outflow	Out of Basin	Evapotranspiration	126,799	121,773	128,898	131,311	130,905	126,046
(6)	Outflow	Between Systems	Runoff	126,495	94,391	91,123	63,440	154,563	87,727
(7)	Outflow	Between Systems	Return Flow	5,655	5,603	6,041	6,378	5,650	5,864
(8)	Outflow	Between Systems	Recharge of Applied Water	13,414	13,442	14,349	15,182	13,389	14,115
(9)	Outflow	Between Systems	Recharge of Precipitation	2,976	2,221	2,144	1,493	3,637	2,064
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*275,339*	*237,430*	*242,555*	*217,805*	*308,143*	*235,815*
(12)	Storage Change	**(4)-(11)**	Change in Land System Storage	72	54	52	36	88	50

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	1989	1990	1991	1992	1993	1994
(13)	Inflow	Into Basin	Stream Inflow	390,854	133,594	263,663	76,254	602,999	167,393
(14)	Inflow	Into Basin	Precipitation on Lakes	1,044	911	348	386	1,518	2,017
(6)	Inflow	Between Systems	Runoff	126,495	94,391	91,123	63,440	154,563	87,727
(7)	Inflow	Between Systems	Return Flow	5,655	5,603	6,041	6,378	5,650	5,864
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-
(16)	Inflow	Between Systems	Lake Gain from Groundwater	-	-	-	-	-	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*524,048*	*234,499*	*361,174*	*146,458*	*764,729*	*263,000*
(18)	Outflow	Out of Basin	Stream Outflow	415,719	137,926	253,032	41,694	646,693	160,562
(19)	Outflow	Out of Basin	Conveyance Evaporation	799	785	838	860	816	830
(20)	Outflow	Between Systems	Conveyance Seepage	446	446	446	446	446	446
(2)	Outflow	Between Systems	Surface Water Delivery	80,214	80,462	85,865	90,902	80,059	84,544
(21)	Outflow	Between Systems	Stream Loss to Groundwater	22,175	10,212	16,260	7,546	32,039	11,784
(22)	Outflow	Between Systems	Lake Loss to Groundwater	1,138	1,138	1,138	1,138	1,138	1,138
(23)	Outflow	Out of Basin	Lake Evaporation	1,503	1,493	1,488	1,626	1,492	1,562
(24)	Outflow	Out of Basin	Stream Evaporation	2,054	2,036	2,107	2,246	2,045	2,134
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*524,048*	*234,499*	*361,174*	*146,458*	*764,729*	*263,000*
(26)	Storage Change	**(17)-(25)**	Change in Surface Water Storage	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	1989	1990	1991	1992	1993	1994
(8)	Inflow	Between Systems	Recharge of Applied Water	13,414	13,442	14,349	15,182	13,389	14,115
(9)	Inflow	Between Systems	Recharge of Precipitation	2,976	2,221	2,144	1,493	3,637	2,064
(10)	Inflow	Between Systems	Managed Aquifer Recharge						
(21)	Inflow	Between Systems	Groundwater Gain from Stream	22,175	10,212	16,260	7,546	32,039	11,784
(22)	Inflow	Between Systems	Groundwater Gain from Lake	1,138	1,138	1,138	1,138	1,138	1,138
(20)	Inflow	Between Systems	Conveyance Seepage	446	446	446	446	446	446
(27)	Inflow	Into Basin	Subsurface Inflow	-	-	-	-	-	-
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*40,149*	*27,459*	*34,338*	*25,805*	*50,649*	*29,547*
(3)	Outflow	Between Systems	Groundwater Extraction	46,379	45,973	49,539	52,304	46,333	48,114
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-
(16)	Outflow	Between Systems	Groundwater Loss to Lake	-	-	-	-	-	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*46,379*	*45,973*	*49,539*	*52,304*	*46,333*	*48,114*
(31)	Storage Change	**(28)-(30)**	Change in Groundwater Storage	(6,231)	(18,514)	(15,201)	(26,499)	4,316	(18,567)

TOTAL BASIN WATER BUDGET

item	Flow Type	Origin/ Destination	Component	1989	1990	1991	1992	1993	1994
(1)	Inflow	Into Basin	Precipitation on Land System	148,818	111,048	107,203	74,635	181,839	103,208
(14)	Inflow	Into Basin	Precipitation on Lakes	1,044	911	348	386	1,518	2,017
(13)	Inflow	Into Basin	Stream Inflow	390,854	133,594	263,663	76,254	602,999	167,393
(27)	Inflow	Into Basin	Subsurface Inflow	-	-	-	-	-	-
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*540,716*	*245,553*	*371,214*	*151,275*	*786,355*	*272,617*
(5)	Outflow	Out of Basin	Evapotranspiration	126,799	121,773	128,898	131,311	130,905	126,046
(24)	Outflow	Out of Basin	Stream Evaporation	2,054	2,036	2,107	2,246	2,045	2,134
(23)	Outflow	Out of Basin	Lake Evaporation	1,503	1,493	1,488	1,626	1,492	1,562
(19)	Outflow	Out of Basin	Conveyance Evaporation	799	785	838	860	816	830
(18)	Outflow	Out of Basin	Stream Outflow	415,719	137,926	253,032	41,694	646,693	160,562
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*546,874*	*264,014*	*386,363*	*177,737*	*781,951*	*291,134*
(34)	Storage Change	**(32)-(33)**	Change in Total System Storage	(6,158)	(18,460)	(15,149)	(26,462)	4,404	(18,517)

LAND SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	1995	1996	1997	1998	1999	2000
(1)	Inflow	Into Basin	Precipitation on Land System	189,905	181,537	169,776	226,318	144,747	126,578
(2)	Inflow	Between Systems	Surface Water Delivery	72,909	78,370	82,675	72,108	82,077	84,765
(3)	Inflow	Between Systems	Groundwater Extraction	42,025	44,842	46,927	41,431	47,198	48,547
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*304,839*	*304,750*	*299,378*	*339,857*	*274,022*	*259,890*
(5)	Outflow	Out of Basin	Evapotranspiration	122,209	128,163	132,070	125,740	128,551	129,629
(6)	Outflow	Between Systems	Runoff	161,420	154,307	144,310	192,371	123,035	107,592
(7)	Outflow	Between Systems	Return Flow	5,122	5,465	5,718	5,049	5,754	5,918
(8)	Outflow	Between Systems	Recharge of Applied Water	12,198	13,097	13,802	12,062	13,717	14,158
(9)	Outflow	Between Systems	Recharge of Precipitation	3,798	3,631	3,396	4,526	2,895	2,532
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*304,747*	*304,662*	*299,296*	*339,747*	*273,952*	*259,828*
(12)	Storage Change	**(4)-(11)**	Change in Land System Storage	92	88	82	110	70	61

SURFACE WATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	1995	1996	1997	1998	1999	2000
(13)	Inflow	Into Basin	Stream Inflow	912,444	780,720	614,680	832,300	691,739	240,124
(14)	Inflow	Into Basin	Precipitation on Lakes	1,949	1,474	1,193	2,101	1,011	1,044
(6)	Inflow	Between Systems	Runoff	161,420	154,307	144,310	192,371	123,035	107,592
(7)	Inflow	Between Systems	Return Flow	5,122	5,465	5,718	5,049	5,754	5,918
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-
(16)	Inflow	Between Systems	Lake Gain from Groundwater	-	-	-	-	-	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*1,080,935*	*941,965*	*765,902*	*1,031,820*	*821,539*	*354,677*
(18)	Outflow	Out of Basin	Stream Outflow	916,329	816,120	644,515	897,886	697,247	248,582
(19)	Outflow	Out of Basin	Conveyance Evaporation	741	785	830	749	814	836
(20)	Outflow	Between Systems	Conveyance Seepage	446	446	446	446	446	446
(2)	Outflow	Between Systems	Surface Water Delivery	72,909	78,370	82,675	72,108	82,077	84,765
(21)	Outflow	Between Systems	Stream Loss to Groundwater	86,149	41,575	32,583	56,285	36,166	15,166
(22)	Outflow	Between Systems	Lake Loss to Groundwater	1,138	1,138	1,138	1,138	1,138	1,138
(23)	Outflow	Out of Basin	Lake Evaporation	1,345	1,490	1,569	1,330	1,552	1,586
(24)	Outflow	Out of Basin	Stream Evaporation	1,878	2,040	2,146	1,878	2,100	2,159
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*1,080,935*	*941,965*	*765,902*	*1,031,820*	*821,539*	*354,677*
(26)	Storage Change	**(17)-(25)**	Change in Surface Water Storage	-	-	-	-	-	-

GROUNDWATER SYSTEM WATER BUDGET

item	Flow Type	Origin/ Destination	Component	1995	1996	1997	1998	1999	2000
(8)	Inflow	Between Systems	Recharge of Applied Water	12,198	13,097	13,802	12,062	13,717	14,158
(9)	Inflow	Between Systems	Recharge of Precipitation	3,798	3,631	3,396	4,526	2,895	2,532
(10)	Inflow	Between Systems	Managed Aquifer Recharge						
(21)	Inflow	Between Systems	Groundwater Gain from Stream	86,149	41,575	32,583	56,285	36,166	15,166
(22)	Inflow	Between Systems	Groundwater Gain from Lake	1,138	1,138	1,138	1,138	1,138	1,138
(20)	Inflow	Between Systems	Conveyance Seepage	446	446	446	446	446	446
(27)	Inflow	Into Basin	Subsurface Inflow	-	-	-	-	-	-
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*103,728*	*59,886*	*51,364*	*74,457*	*54,362*	*33,440*
(3)	Outflow	Between Systems	Groundwater Extraction	42,025	44,842	46,927	41,431	47,198	48,547
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-
(16)	Outflow	Between Systems	Groundwater Loss to Lake	-	-	-	-	-	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*42,025*	*44,842*	*46,927*	*41,431*	*47,198*	*48,547*
(31)	Storage Change	**(28)-(30)**	Change in Groundwater Storage	61,703	15,044	4,437	33,026	7,163	(15,107)

TOTAL BASIN WATER BUDGET

item	Flow Type	Origin/ Destination	Component	1995	1996	1997	1998	1999	2000
(1)	Inflow	Into Basin	Precipitation on Land System	189,905	181,537	169,776	226,318	144,747	126,578
(14)	Inflow	Into Basin	Precipitation on Lakes	1,949	1,474	1,193	2,101	1,011	1,044
(13)	Inflow	Into Basin	Stream Inflow	912,444	780,720	614,680	832,300	691,739	240,124
(27)	Inflow	Into Basin	Subsurface Inflow	-	-	-	-	-	-
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*1,104,299*	*963,730*	*785,650*	*1,060,719*	*837,497*	*367,746*
(5)	Outflow	Out of Basin	Evapotranspiration	122,209	128,163	132,070	125,740	128,551	129,629
(24)	Outflow	Out of Basin	Stream Evaporation	1,878	2,040	2,146	1,878	2,100	2,159
(23)	Outflow	Out of Basin	Lake Evaporation	1,345	1,490	1,569	1,330	1,552	1,586
(19)	Outflow	Out of Basin	Conveyance Evaporation	741	785	830	749	814	836
(18)	Outflow	Out of Basin	Stream Outflow	916,329	816,120	644,515	897,886	697,247	248,582
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*1,042,503*	*948,598*	*781,131*	*1,027,583*	*830,264*	*382,792*
(34)	Storage Change	**(32)-(33)**	Change in Total System Storage	61,795	15,132	4,519	33,136	7,234	(15,046)

item	Flow Type	Origin/ Destination	Component	2001	2002	2003	2004	2005	2006
LAND SYSTEM WATER BUDGET									
(1)	**Inflow**	Into Basin	Precipitation on Land System	78,329	108,636	134,947	135,022	145,727	188,398
(2)	**Inflow**	Between Systems	Surface Water Delivery	88,557	87,835	82,497	85,444	77,755	79,668
(3)	**Inflow**	Between Systems	Groundwater Extraction	50,682	50,336	47,185	48,729	44,032	45,803
(4)	**Inflow**	*(1)+(2)+(3)*	*Total Inflow*	*217,569*	*246,807*	*264,628*	*269,195*	*267,514*	*313,869*
(5)	**Outflow**	Out of Basin	Evapotranspiration	128,419	131,436	127,627	131,455	122,313	130,971
(6)	**Outflow**	Between Systems	Runoff	66,580	92,340	114,705	114,769	123,868	160,138
(7)	**Outflow**	Between Systems	Return Flow	6,179	6,137	5,751	5,939	5,364	5,583
(8)	**Outflow**	Between Systems	Recharge of Applied Water	14,787	14,669	13,781	14,266	12,984	13,317
(9)	**Outflow**	Between Systems	Recharge of Precipitation	1,567	2,173	2,699	2,700	2,915	3,768
(10)	**Outflow**	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-
(11)	**Outflow**	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*217,531*	*246,754*	*264,562*	*269,129*	*267,443*	*313,778*
(12)	**Storage Change**	**(4)-(11)**	Change in Land System Storage	38	53	66	66	71	92

item	Flow Type	Origin/ Destination	Component	2001	2002	2003	2004	2005	2006
SURFACE WATER SYSTEM WATER BUDGET									
(13)	**Inflow**	Into Basin	Stream Inflow	100,742	153,035	219,963	295,581	381,347	735,770
(14)	**Inflow**	Into Basin	Precipitation on Lakes	541	742	1,193	1,065	1,108	1,366
(6)	**Inflow**	Between Systems	Runoff	66,580	92,340	114,705	114,769	123,868	160,138
(7)	**Inflow**	Between Systems	Return Flow	6,179	6,137	5,751	5,939	5,364	5,583
(15)	**Inflow**	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-
(16)	**Inflow**	Between Systems	Lake Gain from Groundwater	-	-	-	-	-	-
(17)	**Inflow**	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*174,041*	*252,254*	*341,611*	*417,354*	*511,687*	*902,857*
(18)	**Outflow**	Out of Basin	Stream Outflow	70,489	147,020	238,861	307,951	406,267	778,989
(19)	**Outflow**	Out of Basin	Conveyance Evaporation	868	854	815	832	788	828
(20)	**Outflow**	Between Systems	Conveyance Seepage	446	446	446	446	446	446
(2)	**Outflow**	Between Systems	Surface Water Delivery	88,557	87,835	82,497	85,444	77,755	79,668
(21)	**Outflow**	Between Systems	Stream Loss to Groundwater	8,684	11,116	14,228	17,745	21,733	38,213
(22)	**Outflow**	Between Systems	Lake Loss to Groundwater	1,138	1,138	1,138	1,138	1,138	1,138
(23)	**Outflow**	Out of Basin	Lake Evaporation	1,644	1,629	1,526	1,609	1,487	1,502
(24)	**Outflow**	Out of Basin	Stream Evaporation	2,214	2,215	2,100	2,189	2,073	2,072
(25)	**Outflow**	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*174,041*	*252,254*	*341,611*	*417,354*	*511,687*	*902,857*
(26)	**Storage Change**	**(17)-(25)**	Change in Surface Water Storage	-	-	-	-	-	-

item	Flow Type	Origin/ Destination	Component	2001	2002	2003	2004	2005	2006
GROUNDWATER SYSTEM WATER BUDGET									
(8)	**Inflow**	Between Systems	Recharge of Applied Water	14,787	14,669	13,781	14,266	12,984	13,317
(9)	**Inflow**	Between Systems	Recharge of Precipitation	1,567	2,173	2,699	2,700	2,915	3,768
(10)	**Inflow**	Between Systems	Managed Aquifer Recharge						
(21)	**Inflow**	Between Systems	Groundwater Gain from Stream	8,684	11,116	14,228	17,745	21,733	38,213
(22)	**Inflow**	Between Systems	Groundwater Gain from Lake	1,138	1,138	1,138	1,138	1,138	1,138
(20)	**Inflow**	Between Systems	Conveyance Seepage	446	446	446	446	446	446
(27)	**Inflow**	Into Basin	Subsurface Inflow	-	-	-	-	-	-
(28)	**Inflow**	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*26,622*	*29,541*	*32,292*	*36,295*	*39,215*	*56,882*
(3)	**Outflow**	Between Systems	Groundwater Extraction	50,682	50,336	47,185	48,729	44,032	45,803
(15)	**Outflow**	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-
(16)	**Outflow**	Between Systems	Groundwater Loss to Lake	-	-	-	-	-	-
(29)	**Outflow**	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
(30)	**Outflow**	*(3)+(15)+(16)+(29)*	*Total Outflow*	*50,682*	*50,336*	*47,185*	*48,729*	*44,032*	*45,803*
(31)	**Storage Change**	**(28)-(30)**	Change in Groundwater Storage	(24,060)	(20,795)	(14,893)	(12,433)	(4,817)	11,079

item	Flow Type	Origin/ Destination	Component	2001	2002	2003	2004	2005	2006
TOTAL BASIN WATER BUDGET									
(1)	**Inflow**	Into Basin	Precipitation on Land System	78,329	108,636	134,947	135,022	145,727	188,398
(14)	**Inflow**	Into Basin	Precipitation on Lakes	541	742	1,193	1,065	1,108	1,366
(13)	**Inflow**	Into Basin	Stream Inflow	100,742	153,035	219,963	295,581	381,347	735,770
(27)	**Inflow**	Into Basin	Subsurface Inflow	-	-	-	-	-	-
(32)	**Inflow**	*(1)+(14)+(13)+(27)*	*Total Inflow*	*179,612*	*262,413*	*356,102*	*431,668*	*528,182*	*925,534*
(5)	**Outflow**	Out of Basin	Evapotranspiration	128,419	131,436	127,627	131,455	122,313	130,971
(24)	**Outflow**	Out of Basin	Stream Evaporation	2,214	2,215	2,100	2,189	2,073	2,072
(23)	**Outflow**	Out of Basin	Lake Evaporation	1,644	1,629	1,526	1,609	1,487	1,502
(19)	**Outflow**	Out of Basin	Conveyance Evaporation	868	854	815	832	788	828
(18)	**Outflow**	Out of Basin	Stream Outflow	70,489	147,020	238,861	307,951	406,267	778,989
(29)	**Outflow**	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
(33)	**Outflow**	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*203,634*	*283,155*	*370,929*	*444,036*	*532,928*	*914,363*
(34)	**Storage Change**	**(32)-(33)**	Change in Total System Storage	(24,022)	(20,742)	(14,827)	(12,368)	(4,746)	11,170

item	Flow Type	Origin/ Destination	Component	2007	2008	2009	2010	2011	2012
	LAND SYSTEM WATER BUDGET								
(1)	Inflow	Into Basin	Precipitation on Land System	98,081	96,272	112,782	119,190	165,178	92,352
(2)	Inflow	Between Systems	Surface Water Delivery	87,225	85,939	85,918	79,962	76,188	88,131
(3)	Inflow	Between Systems	Groundwater Extraction	49,544	48,994	49,010	45,501	43,568	49,971
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*234,849*	*231,205*	*247,710*	*244,653*	*284,933*	*230,454*
(5)	Outflow	Out of Basin	Evapotranspiration	128,876	127,082	129,216	122,000	123,105	129,268
(6)	Outflow	Between Systems	Runoff	83,369	81,831	95,865	101,312	140,401	78,499
(7)	Outflow	Between Systems	Return Flow	6,038	5,972	5,974	5,544	5,309	6,090
(8)	Outflow	Between Systems	Recharge of Applied Water	14,557	14,348	14,345	13,355	12,734	14,705
(9)	Outflow	Between Systems	Recharge of Precipitation	1,962	1,925	2,256	2,384	3,304	1,847
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*234,802*	*231,158*	*247,656*	*244,595*	*284,853*	*230,409*
(12)	Storage Change	**(4)-(11)**	Change in Land System Storage	48	47	55	58	80	45

item	Flow Type	Origin/ Destination	Component	2007	2008	2009	2010	2011	2012
	SURFACE WATER SYSTEM WATER BUDGET								
(13)	Inflow	Into Basin	Stream Inflow	127,762	240,456	143,169	103,605	629,359	125,535
(14)	Inflow	Into Basin	Precipitation on Lakes	669	462	739	845	1,122	628
(6)	Inflow	Between Systems	Runoff	83,369	81,831	95,865	101,312	140,401	78,499
(7)	Inflow	Between Systems	Return Flow	6,038	5,972	5,974	5,544	5,309	6,090
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-
(16)	Inflow	Between Systems	Lake Gain from Groundwater	-	-	-	-	-	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*217,838*	*328,720*	*245,746*	*211,306*	*776,191*	*210,752*
(18)	Outflow	Out of Basin	Stream Outflow	114,328	221,343	143,012	116,583	660,855	106,593
(19)	Outflow	Out of Basin	Conveyance Evaporation	855	837	817	805	798	832
(20)	Outflow	Between Systems	Conveyance Seepage	446	446	446	446	446	446
(2)	Outflow	Between Systems	Surface Water Delivery	87,225	85,939	85,918	79,962	76,188	88,131
(21)	Outflow	Between Systems	Stream Loss to Groundwater	9,941	15,181	10,657	8,818	33,265	9,837
(22)	Outflow	Between Systems	Lake Loss to Groundwater	1,138	1,138	1,138	1,138	1,138	1,138
(23)	Outflow	Out of Basin	Lake Evaporation	1,660	1,628	1,589	1,492	1,461	1,582
(24)	Outflow	Out of Basin	Stream Evaporation	2,245	2,208	2,168	2,063	2,040	2,193
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*217,838*	*328,720*	*245,746*	*211,306*	*776,191*	*210,752*
(26)	Storage Change	**(17)-(25)**	Change in Surface Water Storage	-	-	-	-	-	-

item	Flow Type	Origin/ Destination	Component	2007	2008	2009	2010	2011	2012
	GROUNDWATER SYSTEM WATER BUDGET								
(8)	Inflow	Between Systems	Recharge of Applied Water	14,557	14,348	14,345	13,355	12,734	14,705
(9)	Inflow	Between Systems	Recharge of Precipitation	1,962	1,925	2,256	2,384	3,304	1,847
(10)	Inflow	Between Systems	Managed Aquifer Recharge						
(21)	Inflow	Between Systems	Groundwater Gain from Stream	9,941	15,181	10,657	8,818	33,265	9,837
(22)	Inflow	Between Systems	Groundwater Gain from Lake	1,138	1,138	1,138	1,138	1,138	1,138
(20)	Inflow	Between Systems	Conveyance Seepage	446	446	446	446	446	446
(27)	Inflow	Into Basin	Subsurface Inflow	-	-	-	-	-	-
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*28,044*	*33,039*	*28,842*	*26,140*	*50,887*	*27,974*
(3)	Outflow	Between Systems	Groundwater Extraction	49,544	48,994	49,010	45,501	43,568	49,971
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-
(16)	Outflow	Between Systems	Groundwater Loss to Lake	-	-	-	-	-	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*49,544*	*48,994*	*49,010*	*45,501*	*43,568*	*49,971*
(31)	Storage Change	**(28)-(30)**	Change in Groundwater Storage	(21,500)	(15,955)	(20,168)	(19,361)	7,319	(21,997)

item	Flow Type	Origin/ Destination	Component	2007	2008	2009	2010	2011	2012
	TOTAL BASIN WATER BUDGET								
(1)	Inflow	Into Basin	Precipitation on Land System	98,081	96,272	112,782	119,190	165,178	92,352
(14)	Inflow	Into Basin	Precipitation on Lakes	669	462	739	845	1,122	628
(13)	Inflow	Into Basin	Stream Inflow	127,762	240,456	143,169	103,605	629,359	125,535
(27)	Inflow	Into Basin	Subsurface Inflow	-	-	-	-	-	-
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*226,513*	*337,189*	*256,689*	*223,640*	*795,659*	*218,515*
(5)	Outflow	Out of Basin	Evapotranspiration	128,876	127,082	129,216	122,000	123,105	129,268
(24)	Outflow	Out of Basin	Stream Evaporation	2,245	2,208	2,168	2,063	2,040	2,193
(23)	Outflow	Out of Basin	Lake Evaporation	1,660	1,628	1,589	1,492	1,461	1,582
(19)	Outflow	Out of Basin	Conveyance Evaporation	855	837	817	805	798	832
(18)	Outflow	Out of Basin	Stream Outflow	114,328	221,343	143,012	116,583	660,855	106,593
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*247,965*	*353,098*	*276,802*	*242,943*	*788,260*	*240,467*
(34)	Storage Change	**(32)-(33)**	Change in Total System Storage	(21,452)	(15,908)	(20,113)	(19,303)	7,399	(21,952)

item	Flow Type	Origin/ Destination	Component	2013	2014	2015	2016	2017	2018
	LAND SYSTEM WATER BUDGET								
(1)	Inflow	Into Basin	Precipitation on Land System	125,448	87,678	127,785	158,468	199,103	138,264
(2)	Inflow	Between Systems	Surface Water Delivery	86,791	92,729	87,371	85,368	82,968	85,294
(3)	Inflow	Between Systems	Groundwater Extraction	49,519	52,729	49,269	48,625	47,432	48,860
(4)	Inflow	*(1)+(2)+(3)*	*Total Inflow*	*261,757*	*233,135*	*264,425*	*292,462*	*329,502*	*272,418*
(5)	Outflow	Out of Basin	Evapotranspiration	132,031	134,914	132,614	134,339	136,547	131,859
(6)	Outflow	Between Systems	Runoff	106,630	74,526	108,617	134,698	169,237	117,524
(7)	Outflow	Between Systems	Return Flow	6,036	6,427	6,003	5,926	5,781	5,956
(8)	Outflow	Between Systems	Recharge of Applied Water	14,490	15,471	14,573	14,252	13,858	14,246
(9)	Outflow	Between Systems	Recharge of Precipitation	2,509	1,754	2,556	3,169	3,982	2,765
(10)	Outflow	Between Systems	Managed Aquifer Recharge	-	-	-	-	-	-
(11)	Outflow	*(5)+(6)+(7)+(8)+(9)+(10)*	*Total Outflow*	*261,696*	*233,092*	*264,363*	*292,385*	*329,406*	*272,351*
(12)	Storage Change	**(4)-(11)**	Change in Land System Storage	61	43	62	77	97	67

item	Flow Type	Origin/ Destination	Component	2013	2014	2015	2016	2017	2018
	SURFACE WATER SYSTEM WATER BUDGET								
(13)	Inflow	Into Basin	Stream Inflow	142,221	52,739	82,881	374,311	809,028	243,145
(14)	Inflow	Into Basin	Precipitation on Lakes	864	527	910	1,163	1,563	945
(6)	Inflow	Between Systems	Runoff	106,630	74,526	108,617	134,698	169,237	117,524
(7)	Inflow	Between Systems	Return Flow	6,036	6,427	6,003	5,926	5,781	5,956
(15)	Inflow	Between Systems	Stream Gain from Groundwater	-	-	-	-	-	-
(16)	Inflow	Between Systems	Lake Gain from Groundwater	-	-	-	-	-	-
(17)	Inflow	*(13)+(14)+(6)+(7)+(15)+(16)*	*Total Inflow*	*255,751*	*134,220*	*198,411*	*516,099*	*985,609*	*367,570*
(18)	Outflow	Out of Basin	Stream Outflow	152,078	28,669	96,946	403,172	847,439	260,813
(19)	Outflow	Out of Basin	Conveyance Evaporation	834	846	806	832	822	844
(20)	Outflow	Between Systems	Conveyance Seepage	446	446	446	446	446	446
(2)	Outflow	Between Systems	Surface Water Delivery	86,791	92,729	87,371	85,368	82,968	85,294
(21)	Outflow	Between Systems	Stream Loss to Groundwater	10,613	6,452	7,854	21,405	49,248	15,306
(22)	Outflow	Between Systems	Lake Loss to Groundwater	1,138	1,138	1,138	1,138	1,138	1,138
(23)	Outflow	Out of Basin	Lake Evaporation	1,642	1,672	1,640	1,575	1,500	1,568
(24)	Outflow	Out of Basin	Stream Evaporation	2,208	2,268	2,210	2,162	2,048	2,162
(25)	Outflow	*(18)+(19)+(20)+(2)+(21)+(22)+(23)+(24)*	*Total Outflow*	*255,751*	*134,220*	*198,411*	*516,099*	*985,609*	*367,570*
(26)	Storage Change	**(17)-(25)**	Change in Surface Water Storage	-	-	-	-	-	-

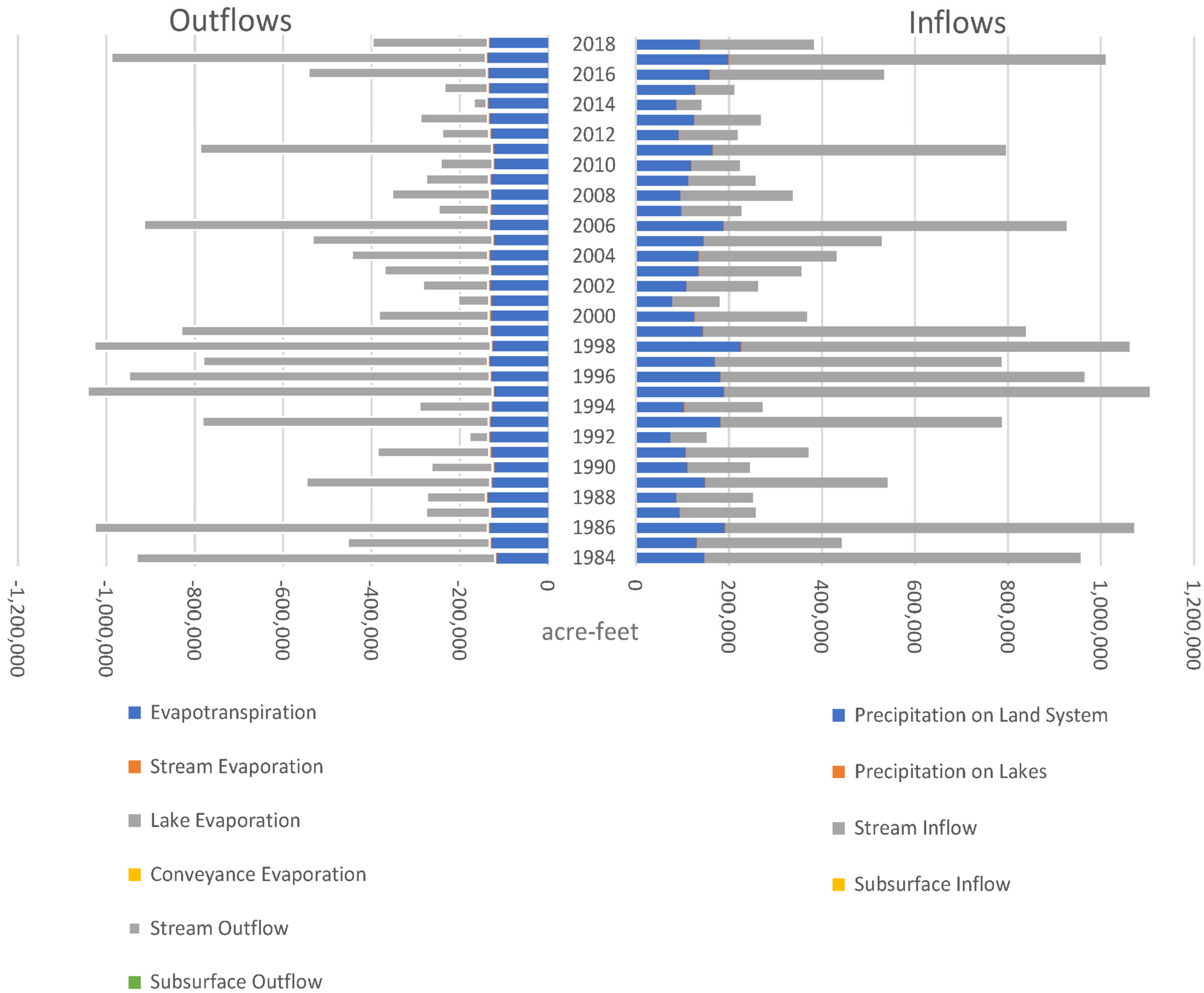
item	Flow Type	Origin/ Destination	Component	2013	2014	2015	2016	2017	2018
	GROUNDWATER SYSTEM WATER BUDGET								
(8)	Inflow	Between Systems	Recharge of Applied Water	14,490	15,471	14,573	14,252	13,858	14,246
(9)	Inflow	Between Systems	Recharge of Precipitation	2,509	1,754	2,556	3,169	3,982	2,765
(10)	Inflow	Between Systems	Managed Aquifer Recharge						
(21)	Inflow	Between Systems	Groundwater Gain from Stream	10,613	6,452	7,854	21,405	49,248	15,306
(22)	Inflow	Between Systems	Groundwater Gain from Lake	1,138	1,138	1,138	1,138	1,138	1,138
(20)	Inflow	Between Systems	Conveyance Seepage	446	446	446	446	446	446
(27)	Inflow	Into Basin	Subsurface Inflow	-	-	-	-	-	-
(28)	Inflow	*(8)+(9)+(10)+(21)+(22)+(20)+(27)*	*Total Inflow*	*29,196*	*25,261*	*26,567*	*40,411*	*68,672*	*33,902*
(3)	Outflow	Between Systems	Groundwater Extraction	49,519	52,729	49,269	48,625	47,432	48,860
(15)	Outflow	Between Systems	Groundwater Loss to Stream	-	-	-	-	-	-
(16)	Outflow	Between Systems	Groundwater Loss to Lake	-	-	-	-	-	-
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
(30)	Outflow	*(3)+(15)+(16)+(29)*	*Total Outflow*	*49,519*	*52,729*	*49,269*	*48,625*	*47,432*	*48,860*
(31)	Storage Change	**(28)-(30)**	Change in Groundwater Storage	(20,322)	(27,468)	(22,703)	(8,214)	21,240	(14,958)

item	Flow Type	Origin/ Destination	Component	2013	2014	2015	2016	2017	2018
	TOTAL BASIN WATER BUDGET								
(1)	Inflow	Into Basin	Precipitation on Land System	125,448	87,678	127,785	158,468	199,103	138,264
(14)	Inflow	Into Basin	Precipitation on Lakes	864	527	910	1,163	1,563	945
(13)	Inflow	Into Basin	Stream Inflow	142,221	52,739	82,881	374,311	809,028	243,145
(27)	Inflow	Into Basin	Subsurface Inflow	-	-	-	-	-	-
(32)	Inflow	*(1)+(14)+(13)+(27)*	*Total Inflow*	*268,532*	*140,944*	*211,576*	*533,943*	*1,009,693*	*382,353*
(5)	Outflow	Out of Basin	Evapotranspiration	132,031	134,914	132,614	134,339	136,547	131,859
(24)	Outflow	Out of Basin	Stream Evaporation	2,208	2,268	2,210	2,162	2,048	2,162
(23)	Outflow	Out of Basin	Lake Evaporation	1,642	1,672	1,640	1,575	1,500	1,568
(19)	Outflow	Out of Basin	Conveyance Evaporation	834	846	806	832	822	844
(18)	Outflow	Out of Basin	Stream Outflow	152,078	28,669	96,946	403,172	847,439	260,813
(29)	Outflow	Out of Basin	Subsurface Outflow	-	-	-	-	-	-
(33)	Outflow	*(5)+(24)+(23)+(19)+(18)+(29)*	*Total Outflow*	*288,794*	*168,369*	*234,217*	*542,080*	*988,356*	*397,244*
(34)	Storage Change	**(32)-(33)**	Change in Total System Storage	(20,262)	(27,425)	(22,641)	(8,137)	21,337	(14,891)

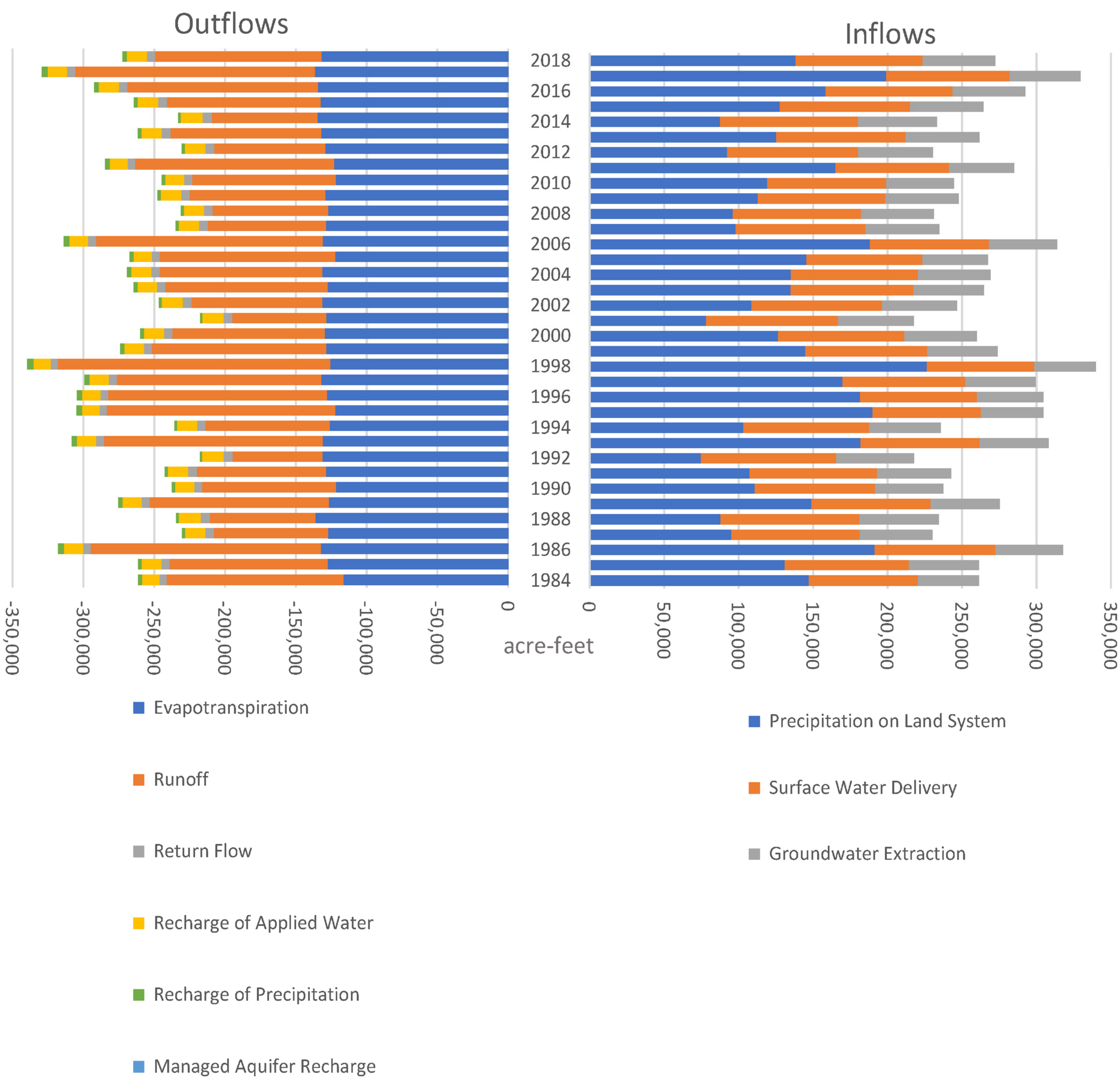
Appendix 6C

Historic Water Budget Bar Charts

TOTAL BASIN

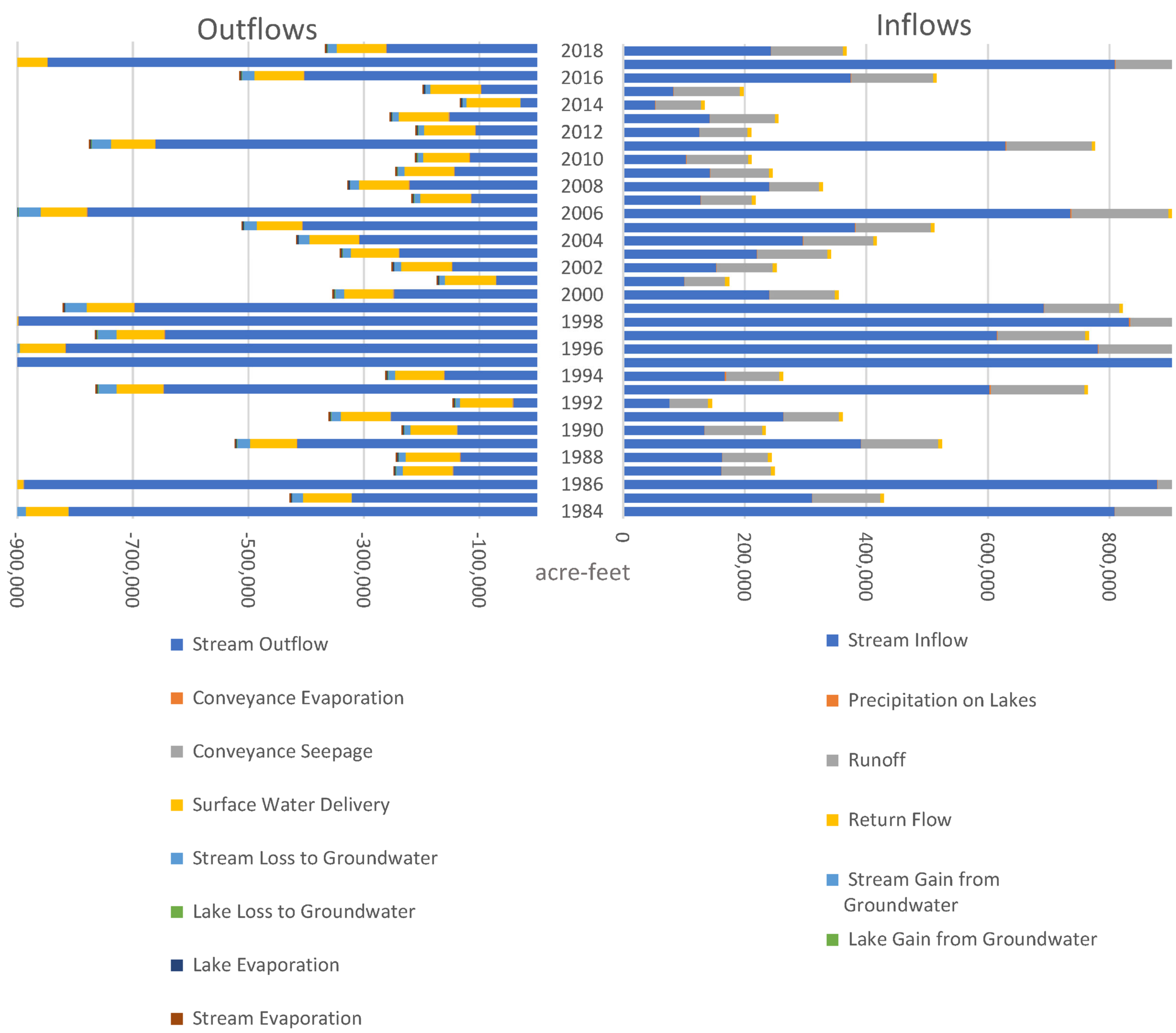

Outflows
Inflows
2018
2016
2014
2012
2010
2008
2006
2004
2002
2000
1998
1996
1994
1992
1990
1988
1986
1984
-1,200,000
-1,000,000
-800,000
-600,000
-400,000
-200,000
0
0
200,000
400,000
600,000
800,000
1,000,000
1,200,000
acre-feet
Evapotranspiration
Stream Evaporation
Lake Evaporation
Conveyance Evaporation
Stream Outflow
Subsurface Outflow
Precipitation on Land System
Precipitation on Lakes
Stream Inflow
Subsurface Inflow

LAND SYSTEM

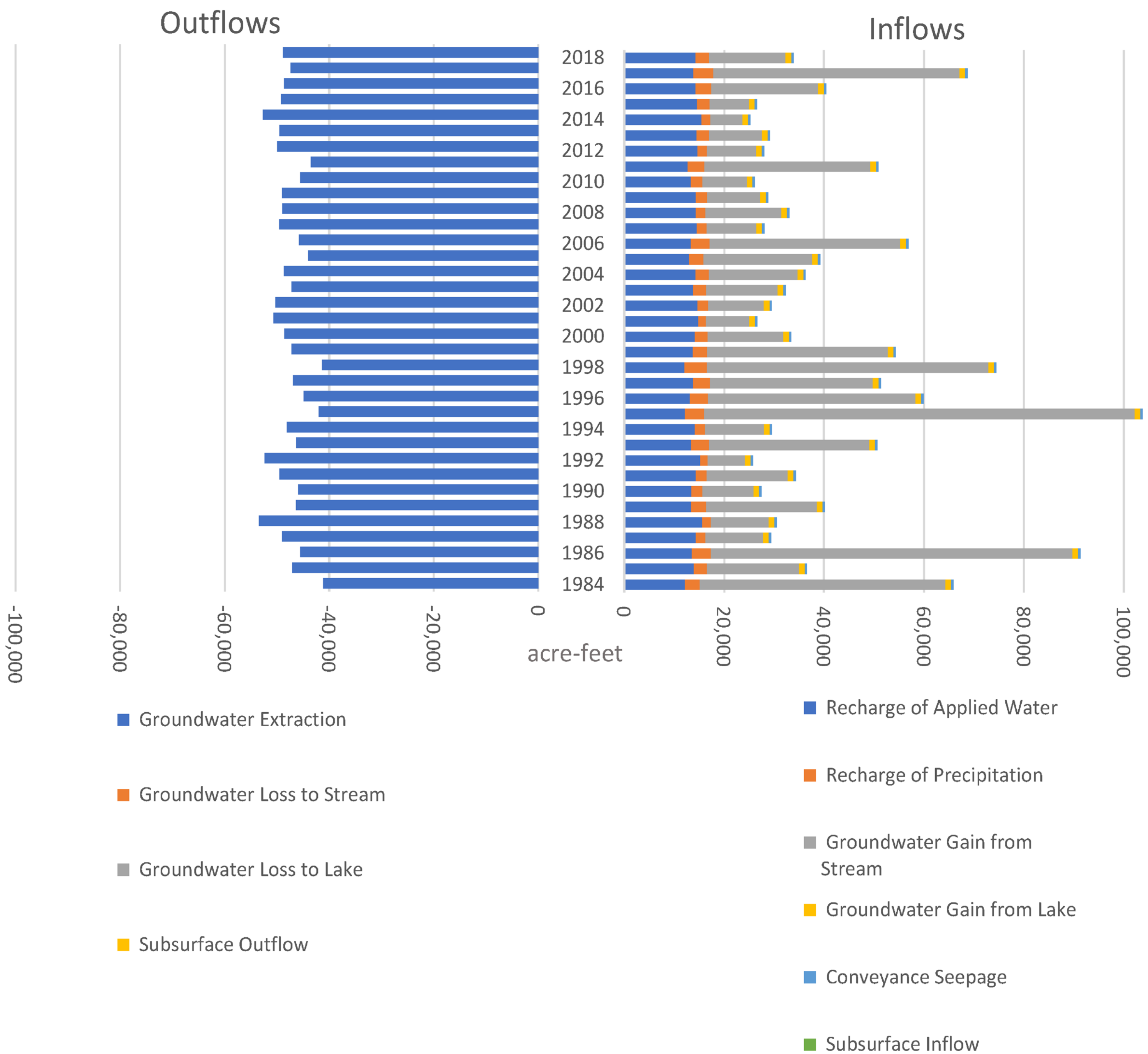


Outflows
Inflows
2018
2016
2014
2012
2010
2008
2006
2004
2002
2000
1998
1996
1994
1992
1990
1988
1986
1984
-350,000
-300,000
-250,000
-200,000
-150,000
-100,000
-50,000
0
acre-feet
0
50,000
100,000
150,000
200,000
250,000
300,000
350,000
Evapotranspiration
Runoff
Return Flow
Recharge of Applied Water
Recharge of Precipitation
Managed Aquifer Recharge
Precipitation on Land System
Surface Water Delivery
Groundwater Extraction

SURFACE WATER SYSTEM



GROUNDWATER SYSTEM



Big Valley Groundwater Sustainability Plan GSP Regulations Checklist (Elements Guide) for Chapter 5

This checklist of the GSP Elements and indicates where in the GSP each element of the regulations is addressed.

Article 5.			Plan Contents for Big Valley Groundwater Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
SubArticle 2.			**Basin Setting**					
§ 354.12.			**Introduction to Basin Setting**					
			This Subarticle describes the information about the physical setting and characteristics of the basin and current conditions of the basin that shall be part of each Plan, including the identification of data gaps and levels of uncertainty, which comprise the basin setting that serves as the basis for defining and assessing reasonable sustainable management criteria and projects and management actions. Information provided pursuant to this Subarticle shall be prepared by or under the direction of a professional geologist or professional engineer.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
§ 354.16.			**Groundwater Conditions**					
			Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:					
(a)			Groundwater elevation data demonstrating flow directions, lateral and vertical gradients, and regional pumping patterns, including:					
	(1)		Groundwater elevation contour maps depicting the groundwater table or potentiometric surface associated with the current seasonal high and seasonal low for each principal aquifer within the basin.	X	5.1.3	5-5,5-6		Also Appendix 5B
	(2)		Hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients between principal aquifers.	X	5.1.1,5.1.2	5-2,5-3,5-4		Also Appendix 5A
(b)			A graph depicting estimates of the change in groundwater in storage, based on data, demonstrating the annual and cumulative change in the volume of groundwater in storage between seasonal high groundwater conditions, including the annual groundwater use and water year type.	X	5.2	5-7	5-2	
(c)			Seawater intrusion conditions in the basin, including maps and cross-sections of the seawater intrusion front for each principal aquifer.	N/A	5.3			Not applicable due to inland location.
(d)			Groundwater quality issues that may affect the supply and beneficial uses of groundwater, including a description and map of the location of known groundwater contamination sites and plumes.	X	5.4	5-8:5-15	5-3,5-4	
(e)			The extent, cumulative total, and annual rate of land subsidence, including maps depicting total subsidence, utilizing data available from the Department, as specified in Section 353.2, or the best available information.	X	5.5	5-16,5-17		
(f)			Identification of interconnected surface water systems within the basin and an estimate of the quantity and timing of depletions of those systems, utilizing data available from the Department, as specified in Section 353.2, or the best available information.	X	5.6	5-18		

"X" indicates that the element has been addressed.
The page number will be filled in once the entire GSP is compiled.

Shaded areas are elements of the regulations that don't have to be addressed in the GSP

				GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
(g)			Identification of groundwater dependent ecosystems within the basin, utilizing data available from the Department, as specified in Section 353.2, or the best available information.	X	5.7	5-19:5-22	5-5	
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.2, 10727.4, and 10733.2, Water Code.					

Table of Contents

Tables

Figures

Appendices

Abbreviations and Acronyms

ACWA	Ash Creek Wildlife Area
AF	Acre-Feet
As	arsenic
Basin	Big Valley Groundwater Basin
BVGB	Big Valley Groundwater Basin
CASGEM	California Statewide Groundwater Elevation Monitoring
CGPS	Continuous Global Positioning System
DTW	Depth to Water
DWR	Department of Water Resources
Fe	iron
ft	feet
GAMA	Groundwater Ambient Monitoring and Assessment (program of the SWRCB and USGS)
GDE	Groundwater Dependent Ecosystem
GIS	Geographic Information System (software)
GMP	Groundwater Management Plan
GPS	Global Positioning System
GSP	Groundwater Sustainability Plan
InSAR	Interferometric Synthetic-Aperture RADAR
LNAPL	Light non-aqueous phase liquid
LUST	Leaking Underground Storage Tank
MCL	Maximum Contaminant Level

Mn	manganese
MTBE	Methyl tert-butyl ether
NWIS	National Water Information System (USGS)
NCCAG	Natural Communities Commonly Associated with Groundwater
PBO	Plate Boundary Observatory
PFAS	per/polyfluoroalkyl substances
RWQCB	Regional Water Quality Control Board
SC	specific conductance
SGMA	Sustainable Groundwater Management Act of 2014
SRI	Sacramento River Index of water year types
SWRCB	State Water Resources Control Board
TBA	tert-Butyl alcohol
TDS	total dissolved solids
USBR	United States Bureau of Reclamation
USGS	United States Geological Survey
WY	Water Year (October 1 – September 30)
yr	year

5. Groundwater Conditions §354.16

This chapter presents available information on the Groundwater Conditions for the Big Valley Groundwater Basin (BVGB or Basin, 5-004) developed by GEI Consultants for the Lassen County and Modoc County groundwater sustainability agencies (GSAs). This chapter provides some of the information needed for the development of the monitoring network and the sustainable management criteria of this Groundwater Sustainability Plan (GSP). The content of this chapter is defined by the regulations of the Sustainable Groundwater Management Act of 2014 (SGMA) – Chapter 1.5, Article 5, Subarticle 2: 354.16. GEI Certified Hydrogeologists provided the content of this chapter and will affix their professional stamps (as required by the regulations) once the chapter is finalized into the GSP.

5.1 Groundwater Elevations

Historic groundwater elevations are available from a total of 22 wells in Big Valley, six located in Modoc County and sixteen in Lassen County as shown on **Figure 5-1** and listed in **Table 5-1**. Twenty of the wells are part of Lassen and Modoc Counties' monitoring network which was approved by the counties in 2011, in compliance with the California Statewide Groundwater Elevation Monitoring (CASGEM) program. The Department of Water Resources (DWR) staff measure water levels in these wells twice annually (spring and fall) on behalf of the counties. Some measurements from wells are missing, which is typically a result of access issues to the wells sites or occasionally a well owner who has removed their well from the monitoring program. These wells may or may not be used as part of the GSP monitoring network, which will be addressed in Chapter 8.

The first water level measurements in the BVGB began in the late 1950s at two wells near Bieber (17K1) and Nubieber (32A2). Regular monitoring of these two wells began in the mid-1960s and monitoring began in most of the other wells during the late 1970s or early 1980s. Three wells located on the Ash Creek Wildlife Area (ACWA) were added to the CASGEM networks in 2016. Of the 22 historically monitored wells one well (12G1) has not been monitored since 1992, and one well (06C1) has no measurements since 2015. Construction details are not available for one well (32R1). Well 32R1 could benefit from 'downhole' video inspection of the well casing to determine the depth interval associated with the water levels.

In addition to these 22 wells, five well clusters were constructed in late 2019 and early 2020 to support the GSP. Their locations are shown on **Figure 5-1**. Each cluster consists of a deep well (200-500 feet) and three shallow wells (60-100 feet). These wells were drilled to explore the geology, with the deep well giving water level information for main portion of the aquifer used at that location. The three shallow wells are screened shallow to determine the direction and magnitude of flow in the shallow subsurface and potentially to give an indication of how groundwater interacts with surface water and possibly the location of groundwater recharge. Water level information is not yet available from these five clusters.

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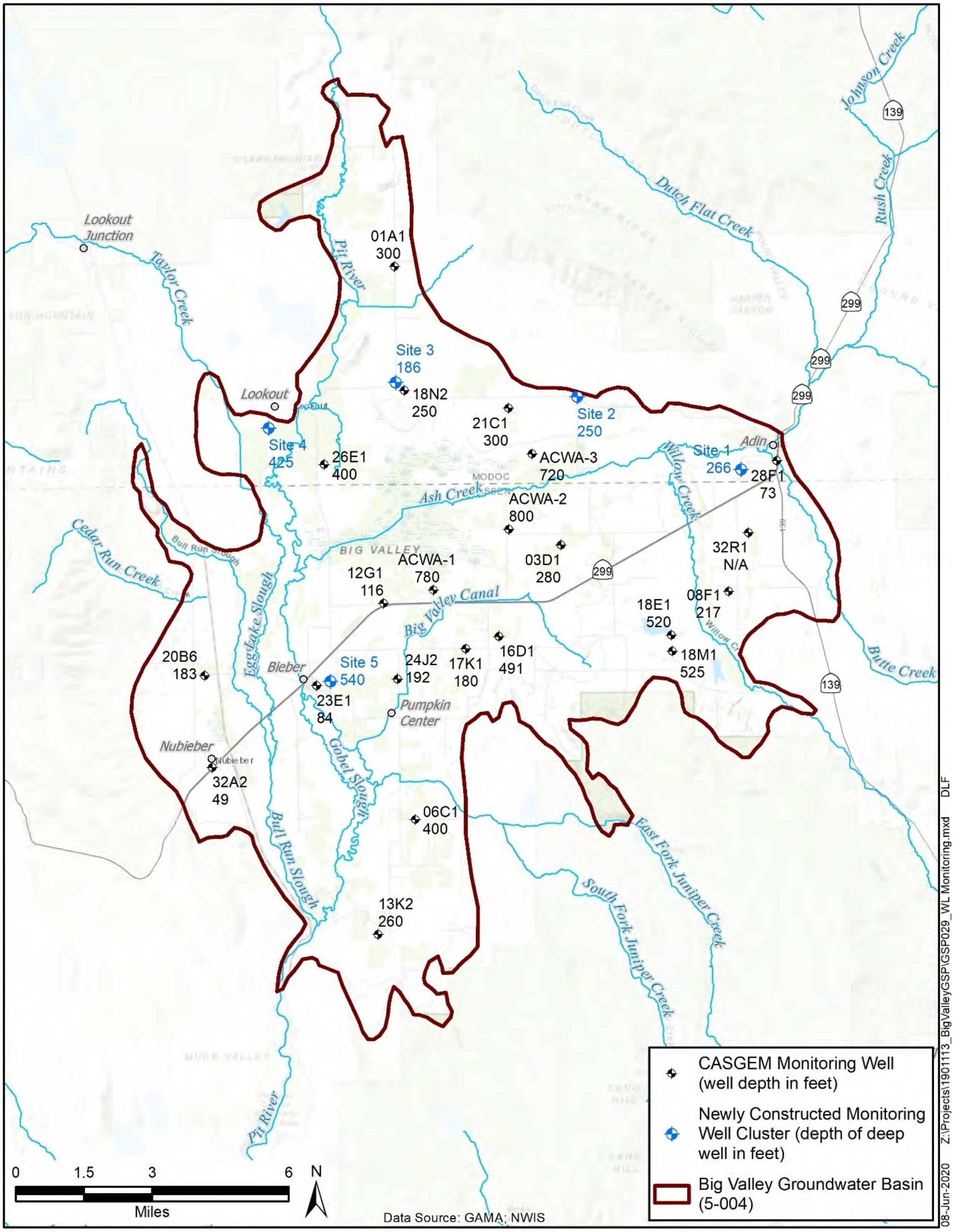

39
40 **Figure 5-1 Water Level Monitoring**

Table 5-1 Historic Water Level Monitoring Wells

Well Name	State Well Number	CASGEM ID	County	Well Use	Well Depth (feet bgs)	Ground Elevation (feet msl)	Reference Point Elevation (feet msl)	Period of Record Start Year	Period of Record End Year	Number of Measurements	Minimum Groundwater Elevation (feet msl)	Maximum Groundwater Elevation (feet msl)
18E1	38N09E18E001M	411356N1209900W001	Lassen	Irrigation	520	4248.40	4249.50	1981	2019	73	4198.20	4234.10
23E1	38N07E23E001M	411207N1211395W001	Lassen	Residential	84	4123.40	4123.40	1979	2020	81	4070.40	4109.10
260	39N07E26E001M	411911N1211354W001	Modoc	Irrigation	400	4133.40	4135.00	1979	2020	79	4088.90	4131.30
01A1	39N07E01A001M	412539N1211050W001	Modoc	Stockwatering	300	4183.40	4184.40	1979	2020	81	4035.40	4163.90
03D1	38N08E03D001M	411647N1210358W001	Lassen	Irrigation	280	4163.40	4163.40	1982	2020	71	4076.60	4148.60
06C1	37N08E06C001M	410777N1210986W001	Lassen	Irrigation	400	4133.40	4133.90	1982	2016	69	4066.20	4126.80
08F1	38N09E08F001M	411493N1209656W001	Lassen	Other	217	4253.40	4255.40	1979	2020	83	4167.90	4229.50
12G1	38N07E12G001M	411467N1211110W001	Lassen	Residential	116	4143.38	4144.38	1979	1993	28	4130.98	4138.68
13K2	37N07E13K002M	410413N1211147W001	Lassen	Irrigation	260	4127.40	4127.90	1982	2018	70	4061.90	4109.70
16D1	38N08E16D001M	411359N1210625W001	Lassen	Irrigation	491	4171.40	4171.60	1982	2020	74	4078.73	4162.40
17K1	38N08E17K001M	411320N1210766W001	Lassen	Residential	180	4153.30	4154.30	1957	2020	146	4115.08	4150.00
18M1	38N09E18M001M	411305N1209896W001	Lassen	Irrigation	525	4288.40	4288.90	1981	2020	74	4192.30	4232.70
18N2	39N08E18N002M	412144N1211013W001	Modoc	Residential	250	4163.40	4164.40	1979	2020	80	4136.60	4160.20
20B6	38N07E20B006M	411242N1211866W001	Lassen	Residential	183	4126.30	4127.30	1979	2019	80	4076.94	4116.60
21C1	39N08E21C001M	412086N1210574W001	Modoc	Irrigation	300	4161.40	4161.70	1979	2020	79	4082.10	4148.50
24J2	38N07E24J002M	411228N1211054W001	Lassen	Irrigation	192	4138.40	4139.40	1979	2019	77	4056.70	4137.70
28F1	39N09E28F001M	411907N1209447W001	Modoc	Residential	73	4206.60	4207.10	1982	2020	76	4194.57	4202.10
32A2	38N07E32A002M	410950N1211839W001	Lassen	Other	49	4118.80	4119.50	1959	2020	133	4106.70	4118.80
32R1	39N09E32R001M	411649N1209569W001	Lassen	Irrigation	unknown	4243.40	4243.60	1981	2020	64	4161.20	4205.50
ACWA-1	38N08E07A001M	411508N1210900W001	Lassen	Irrigation	780	4142.00	4142.75	2016	2020	8	4039.15	4126.35
ACWA-2	39N08E33P002M	411699N1210579W001	Lassen	Irrigation	800	4153.00	4153.20	2016	2020	8	4126.40	4139.35
ACWA-3	39N08E28A001M	411938N1210478W001	Modoc	Irrigation	720	4159.00	4159.83	2016	2020	7	4136.23	4150.58

source: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer

bgs = below ground surface

msl = above mean sea level

5.1.1 *Groundwater Level Trends §354.16(a)(2)*

Figures 5-2 and **5-3** show hydrographs for the two wells with the longest monitoring records along with background colors representing the Water Year (WY) type: wet, normal, dry, and critical dry. These WY types are developed from the Sacramento River Index (SRI), which is calculated from annual runoff of the Sacramento River Watershed, of which the Pit River is a tributary. The SRI (no units) varies between 3.1 and 15.3 (average: 8.1) and are divided into the four WY categories.

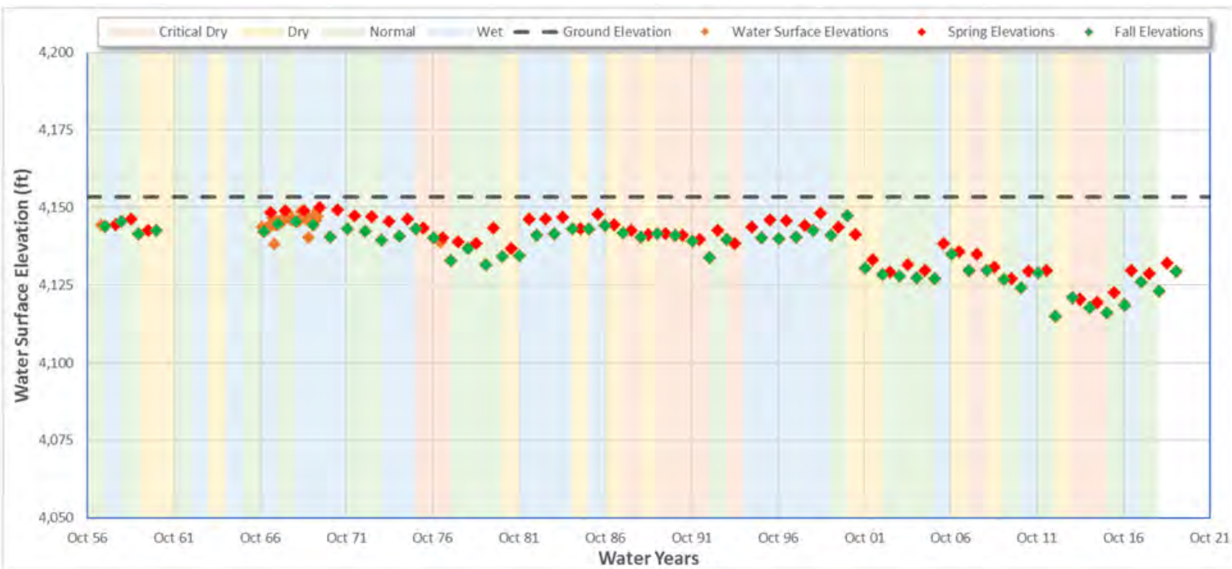

Figure 5-2 Hydrograph of Well 17K1

Figure 5-3 Hydrograph of Well 32A2

The water level record for these two wells illustrates that some areas of the Basin have experienced little to no change in water levels, while other areas have fluctuated more and have shown a measurable decline since about 2000. Hydrographs for all 22 wells are presented in **Appendix 5A**. On each hydrograph in the appendix a red trend line is shown, which is determined from a linear regression[1] of the spring water level measurements between 2000 and 2019. The average water level change during that period, in feet per year, is also shown. Twelve wells show stable (less than -1 ft/yr of decline) or rising water levels and nine wells show declining water from -1 to -3.1 ft/yr. These water level changes are shown graphically on **Figure 5-4** with the stable or rising water levels shown in green and areas with declines in excess of -1 ft/yr in orange and red.

5.1.2 *Vertical Groundwater Gradients §354.16(a)(2)*

Vertical hydraulic gradients are apparent when groundwater levels in wells screened deep in the aquifer differ from water levels measured shallow in the aquifer at the same general location. Vertical gradients indicate that the deep portion of the aquifer is separate from the shallow (e.g. by a very low permeability clay layer) and/or that pumping in one of the aquifers has occurred and the vertical flow between the aquifers is in progress of stabilizing. Chapter 4 contained the Hydrogeologic Conceptual Model which defined a single principal aquifer in the BVGB; therefore, there is no vertical gradient that needs to be described between principal aquifers. However, vertical gradients likely exist, and the five recently constructed well clusters will have data to describe these gradients once water level data is available from those wells. The locations of the clusters are shown on **Figure 5-1**.

5.1.3 *Groundwater Contours §354.16(a)(1)*

Spring and fall 2018 water level measurements from the 21 active CASGEM wells were used to illustrate current groundwater conditions. 2018 was used to illustrate current conditions because there were several wells without data for 2019 or 2020. **Figures 5-5** and **5-6** show the 2018 seasonal high and seasonal low groundwater elevation contours, respectively. Each contour line shows equal groundwater elevation. Groundwater flows from higher elevations to lower elevations, perpendicular to the contour lines. The direction of flow is emphasized on the figures in certain areas with arrows. In general, groundwater is highest in the east, where Willow and Butte Creeks enter the Basin. The general flow of water is to the west and south. The contours do indicate, however, northerly flow from the lower reaches of Ash Creek. In the southern portions of the BVGB, groundwater flows toward the east.

[1] Also known as a line of best fit, which is developed from a mathematical interpretation of the data.

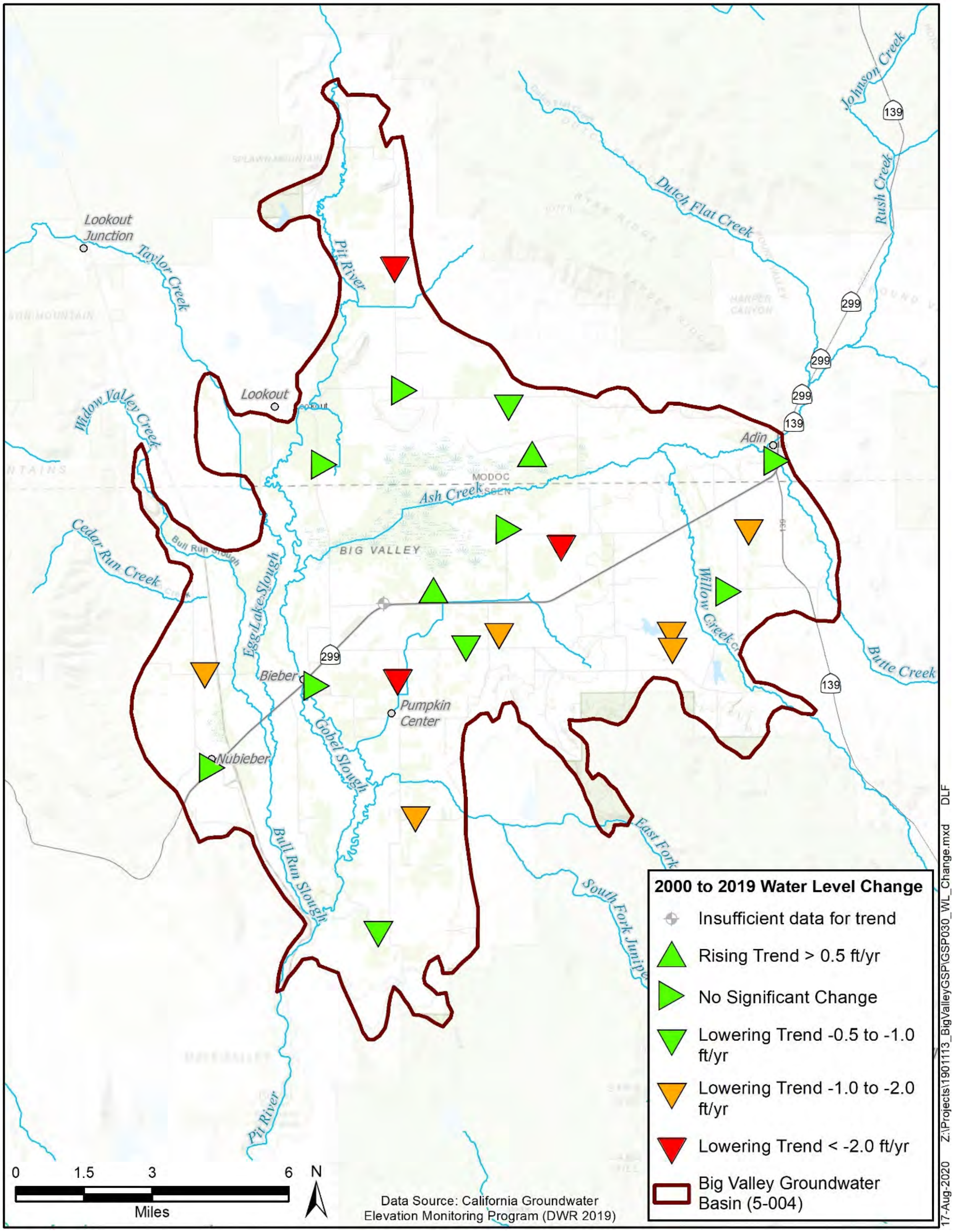

Figure 5-4 Average Water Level Change Since 2000 Using Spring Measurements

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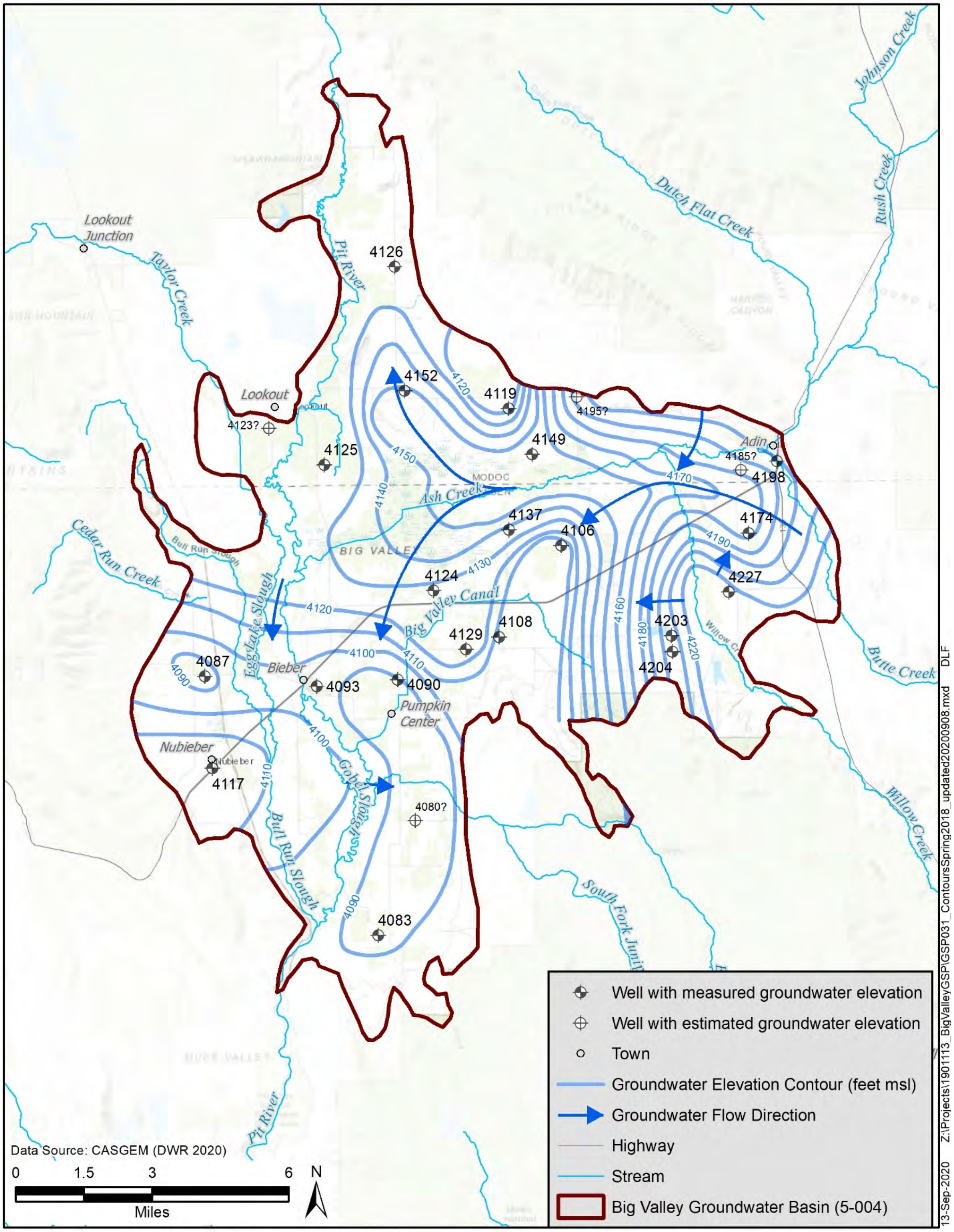

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97 **Figure 5-5 Groundwater Elevation Contours and Flow Direction Spring 2018**
98

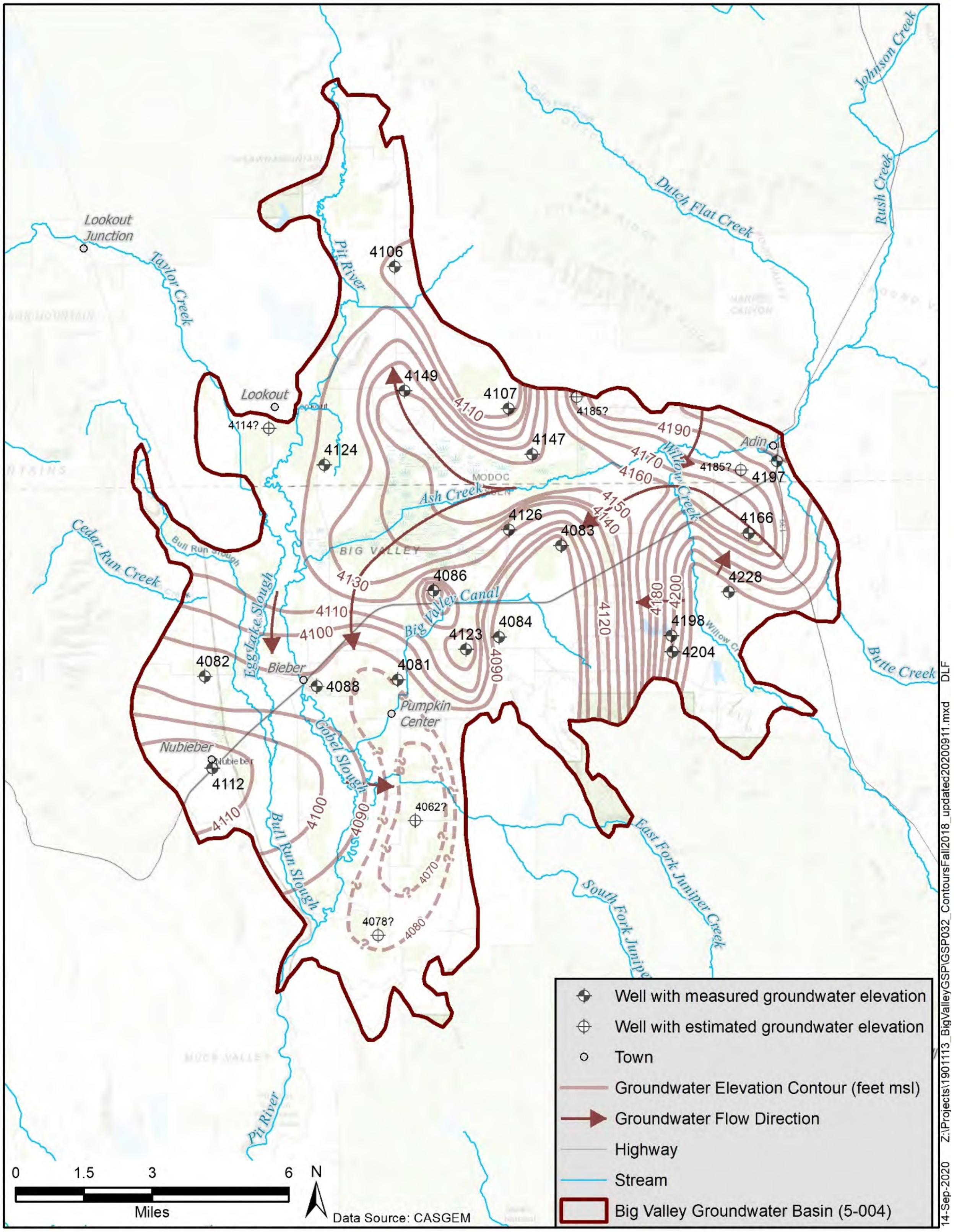

Figure 5-6 Groundwater Elevation Contours and Flow Direction Fall 2018

5.2 Change in Storage §354.16(b)

In order to determine the annual and seasonal change in groundwater storage, groundwater elevation surfaces[2] were developed for spring and fall for each year between 1983 and 2018. These surfaces are included in **Appendix 5B**. The amount of groundwater in storage for each set of contours was calculated. This calculation was performed using Geographic Information System (GIS) software which can subtract the groundwater elevation surface from the ground elevation surface (using a digital elevation model) at each raster cell (pixel) and calculate the average depth to water (DTW) throughout the Basin. This average DTW was then subtracted from the definable bottom of the Basin (1,200 feet), multiplied by the area of the basin, and multiplied by 5%, which is used as the specific yield (the fraction of the aquifer material that contains recoverable water from Chapter 4).
Table 5-2 shows, from 1983 to 2018, the total water in storage, the change in storage from the previous year, and the cumulative change in storage. **Figure 5-7** shows this information graphically, along with the annual precipitation from the McArthur station. This graph shows that groundwater storage generally declines during dry years and stays stable or increases slightly during normal or wet years. During the period from 1983 to 2000, groundwater levels dipped, then returned to the same levels. After 2000, groundwater storage has generally declined by about 96,000 acre-feet (AF) (using spring measurements) which is a slight increase from the historic low of about 116,000 AF in spring 2015. During this same period (2000 to 2015), precipitation has gone through an average cycle of wet and dry years.

Annual groundwater use is not shown on **Figure 5-7** as required by SGMA regulations. Groundwater use will be addressed in Chapter 6 (Water Budget).

5.3 Seawater Intrusion §354.16(c)

The BVGB is not located near the ocean, and therefore seawater intrusion is not applicable to this GSP.

5.4 Groundwater Quality Conditions §354.16(d)

As noted in Chapter 4, previous, historic reports have characterized the water quality in the BVGB as excellent (DWR 1963, USBR 1979). Groundwater is generally suitable for all beneficial uses and only localized contamination plumes have been identified in the BVGB. This section presents an analysis of recent groundwater quality conditions and the distribution of known groundwater contamination sites in compliance with GSP Regulation §354.16(d).

[2] Groundwater elevation surfaces are developed using the known groundwater elevations at wells throughout the Basin and using kriging. Kriging is a mathematical method that predicts (interpolates) what groundwater levels are between known points. The kriging surface consists of a grid (pixels) covering the entire basin that has interpolated groundwater elevation values for each grid cell.

134 **Table 5-2 Change in Storage 1998-2018**

Year	Average Spring Depth to Water[1] (feet)	Spring Storage[2] (Acre-feet)	Spring Cumulative Change in Storage (Acre-feet)	Average Fall Depth to Water[1] (feet)	Fall Storage[2] (Acre-feet)	Fall Cumulative Change in Storage (Acre-feet)
1983	29.3	5,390,192	-	37.1	5,354,430	(35,762)
1984	29.4	5,389,508	(684)	36.4	5,357,352	(32,841)
1985	31.4	5,380,526	(9,666)	38.9	5,346,150	(44,042)
1986	31.0	5,382,539	(7,653)	40.1	5,340,481	(49,711)
1987	32.6	5,375,135	(15,057)	42.1	5,331,386	(58,806)
1988	34.9	5,364,459	(25,733)	43.9	5,323,094	(67,099)
1989	35.2	5,363,150	(27,042)	42.5	5,329,302	(60,890)
1990	35.6	5,360,976	(29,216)	46.2	5,312,610	(77,582)
1991	36.8	5,355,677	(34,515)	43.2	5,326,124	(64,068)
1992	38.0	5,350,297	(39,895)	48.5	5,301,609	(88,583)
1993	36.9	5,355,293	(34,899)	42.1	5,331,046	(59,146)
1994	37.5	5,352,221	(37,971)	43.1	5,326,613	(63,579)
1995	35.3	5,362,737	(27,456)	41.0	5,336,197	(53,996)
1996	32.4	5,375,861	(14,332)	39.6	5,342,700	(47,493)
1997	31.8	5,378,600	(11,592)	39.7	5,342,405	(47,787)
1998	31.1	5,382,014	(8,179)	36.9	5,355,217	(34,975)
1999	29.5	5,389,070	(1,122)	38.7	5,346,921	(43,271)
2000	32.3	5,376,287	(13,905)	46.5	5,310,947	(79,245)
2001	38.0	5,350,015	(40,177)	51.1	5,289,979	(100,213)
2002	39.3	5,344,357	(45,835)	46.6	5,310,695	(79,497)
2003	39.4	5,343,881	(46,311)	48.9	5,299,889	(90,303)
2004	39.2	5,344,515	(45,677)	47.7	5,305,401	(84,791)
2005	41.5	5,334,164	(56,028)	47.8	5,305,141	(85,052)
2006	36.7	5,356,175	(34,017)	46.2	5,312,218	(77,975)
2007	38.8	5,346,641	(43,551)	49.4	5,297,661	(92,531)
2008	41.6	5,333,712	(56,480)	51.7	5,287,070	(103,122)
2009	42.5	5,329,337	(60,856)	53.7	5,277,825	(112,368)
2010	46.4	5,311,440	(78,752)	54.4	5,274,613	(115,580)
2011	45.9	5,313,710	(76,482)	52.5	5,283,348	(106,844)
2012	44.9	5,318,299	(71,893)	56.3	5,265,670	(124,523)
2013	49.3	5,298,013	(92,179)	58.0	5,257,951	(132,242)
2014	51.7	5,287,059	(103,133)	61.6	5,241,427	(148,765)
2015	54.4	5,274,644	(115,548)	67.5	5,214,239	(175,953)
2016	51.3	5,288,702	(101,490)	62.6	5,237,000	(153,193)
2017	49.7	5,296,127	(94,066)	61.1	5,243,879	(146,313)
2018	50.1	5,294,464	(95,728)	59.0	5,253,677	(136,515)

Note: Parentheses indicate negative numbers

[1] From water surface elevation contours - Appendix 5A

135 [2] Calculated from average depth to water, area of basin, 1,200 foot aquifer bottom, and specific yield of 5%

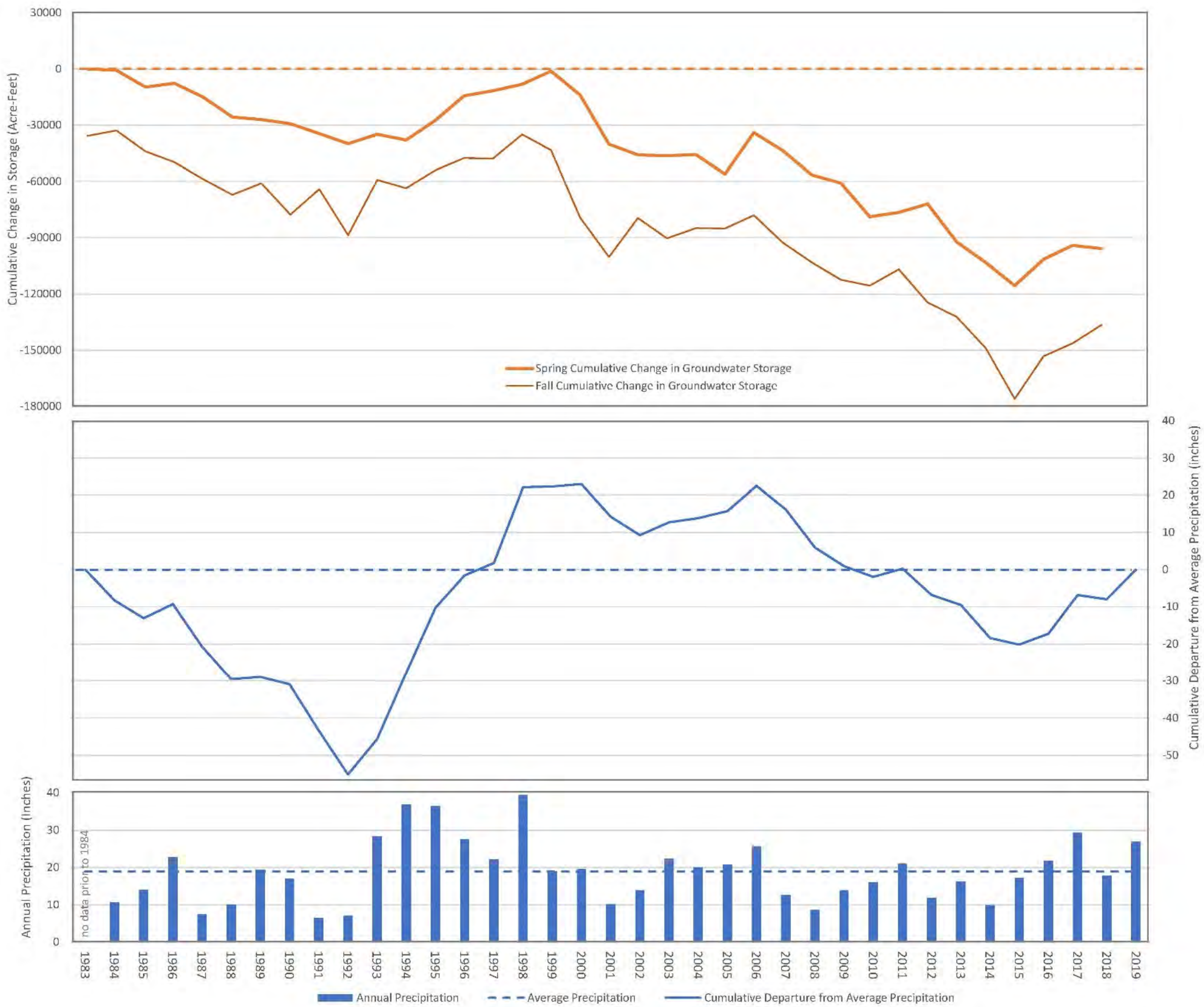

Figure 5-7 Cumulative Change in Storage and Precipitation

5.4.1 *Naturally Occurring Constituents*

The concentration of naturally occurring constituents varies throughout the BVGB. Previous reports have noted the potential elevated concentrations of arsenic, boron, fluoride, iron, manganese, and sulfate. (DWR 1963, USBR 1979) All of these constituents are naturally occurring and in these historic reports, they indicate that most of these constituents are associated with localized thermal waters found in the area of hot springs in the center of the Basin.

More recent conditions were analyzed using a statistical approach using data available from the state's Groundwater Ambient Monitoring and Assessment (GAMA) Groundwater Information System (SWRCB 2020a). The GAMA data provides the most comprehensive, readily available water quality dataset and contains results from numerous programs including:

- Division of Drinking Water (public supply systems)
- Department of Pesticide Regulation
- Department of Water Resources (historic ambient monitoring)
- Environmental Monitoring Wells (regulated facilities and cleanup sites)
- United States Geological Survey (USGS) Groundwater Ambient Monitoring and Assessment (GAMA) program
- USGS National Water Information System (NWIS) data

Water quality results in these datasets go back to the 1950s. Because conditions can change as groundwater is used over time, data prior to the 1983 water year (WY) were eliminated from the statistical analysis of the data. WY 1983 was chosen because the bulk of the historic water level wells (**Figure 5-1**) came online by 1983. In addition, data from the Environmental Monitoring Wells programs were eliminated since water quality issues associated with these regulated sites are typically highly localized, often are associated with isolated, perched groundwater, and are already regulated. The nature and location of groundwater contamination sites are discussed in Section 5.4.2.

Table 5-3 shows the statistical evaluation of the filtered GAMA water quality data along with the water quality results obtained from the five well clusters constructed to support the GSP. The constituents selected to assess the suitability in the Basin based on thresholds for different beneficial uses. For domestic and municipal uses, the inorganic constituents that are regulated under state drinking water standards are shown. Boron and sodium are also shown, since elevated concentrations can affect the suitability of the water for agricultural uses. The suitability threshold concentration for each constituent is shown, using either the maximum contaminant level (MCL) or agricultural threshold, whichever was lower. Because of their elevated concentrations, iron and manganese were evaluated for both drinking water and agricultural thresholds. It is assumed that water suitable for domestic, municipal, and agricultural purposes would also be suitable for environmental and industrial beneficial uses.

Table 5-3 Water Quality Statistics

Constituent Name	Suitability Threshold Concentration	Suitability Threshold Type	Total # of Meas	min	max	# Meas Above Threshold	% of Meas Above Threshold	# Wells With Meas	# Wells with Average Above Threshold	% of Wells with Average Above Threshold	# Wells with Most Recent Meas Above Threshold	% of Wells with Most Recent Meas Above Threshold	Comment
Aluminum	200	DW1	41	0	552	2	5%	18	1	6%	0	0%	Low concern due to only two threshold exceedances and zero recent measurements above MCL
Antimony	6	DW1	45	0	36	1	2%	20	1	5%	0	0%	Low concern due to only one threshold exceedance and zero recent measurements above MCL
Arsenic	10	DW1	53	0	12	4	8%	23	3	13%	3	13%	
Barium	1000	DW1	49	0	600	0	0%	23	0	0%	0	0%	
Beryllium	4	DW1	48	0	1	0	0%	23	0	0%	0	0%	
Cadmium	5	DW1	49	0	1	0	0%	23	0	0%	0	0%	
Chromium (Total)	50	DW1	36	0	20	0	0%	13	0	0%	0	0%	
Chromium (Hexavalent)	10	DW1*	13	0.05	3.29	0	0%	13	0	0%	0	0%	
Copper	1300	DW1	34	0	190	0	0%	21	0	0%	0	0%	
Fluoride	2000	DW1	42	0	500	0	0%	16	0	0%	0	0%	
Lead	15	DW1	28	0	6.2	0	0%	16	0	0%	0	0%	
Mercury	2	DW1	44	0	1	0	0%	19	0	0%	0	0%	
Nickel	100	DW1	46	0	10	0	0%	20	0	0%	0	0%	
Nitrate (as N)	10000	DW1	151	0	4610	0	0%	24	0	0%	0	0%	
Nitrite	1000	DW1	62	0	930	0	0%	20	0	0%	0	0%	
Nitrate + Nitrite (as N)	10000	DW1	2	40	2250	0	0%	2	0	0%	0	0%	
Selenium	50	DW1	49	0	5	0	0%	23	0	0%	0	0%	
Thallium	2	DW1	46	0	1	0	0%	20	0	0%	0	0%	
Chloride	250000	DW2	66	1400	79000	0	0%	43	0	0%	0	0%	
Iron	300	DW2	50	0	11900	26	52%	21	8	38%	9	43%	Low human health concern due to being a secondary MCL for aesthetics
Iron	5000	AG	50	0	11900	2	4%	21	2	10%	2	10%	
Manganese	50	DW2	45	0	807	28	62%	21	12	57%	11	52%	Low human health concern due to being a secondary MCL for aesthetics
Manganese	200	AG	45	0	807	22	49%	21	7	33%	7	33%	
Silver	100	DW2	36	0	20	0	0%	19	0	0%	0	0%	
Specific Conductance	900	DW2	66	125	1220	3	5%	42	1	2%	1	2%	
Sulfate	250000	DW2	60	500	1143000	1	2%	40	0	0%	0	0%	Low concern due to only one threshold exceedance and zero recent measurements above MCL
Total Dissolved Solids (TDS)	500000	DW2	57	131000	492000	0	0%	39	0	0%	0	0%	
Zinc	5000	DW2	34	0	500	0	0%	20	0	0%	0	0%	
Boron	700	AG	40	0	100	0	0%	34	0	0%	0	0%	
Sodium	69000	AG	33	11600	69000	0	0%	21	0	0%	0	0%	

Sources:
GAMA Groundwater Information System, accessed June 5, 2020 (SWRCB 2020)
University of California Cooperative Extension Farm Advisor (UCCE 2020)
Notes:
GAMA data was filtered to remove all measurements before Oct 1, 1982 and all GeoTracker cleanup sites
Constituents listed are all inorganic naturally occurring elements and compounds that have a SWRCB drinking water maximum contaminant limit (MCL), plus Boron, which has a threshold for agricultural use.
All measurements in micrograms per liter, except specific conductance which is measured in microsiemens per centimeter.
Green indicates less than 1%
Yellow indicates between 1% and 10%
Red indicates greater than 10%
Threshold Types:
DW1: Primary drinking water MCL
DW2: Secondary drinking water MCL (for aesthetics such as taste, color, and odor)
AG: Agricultural threshold based on guidelines by the Food and Agricultural Organization of the United Nations (Ayers and Westcot 1985)
* Hexavalent chromium was regulated under a primary drinking water MCL until the MCL was invalidated in 2017. The SWRCB is working to re-establish the MCL.

The subset of water quality data was analyzed to determine which constituents to investigate further. **Table 5-3** shows that most constituents have not had concentrations measured above their corresponding threshold since 1983 and were not investigated further. Sulfate, aluminum, and antimony only had one or two detections above their threshold, and none of these were recent, so these constituents were not investigated further. Arsenic (As), iron (Fe), manganese (Mn), specific conductance (SC), and total dissolved solids (TDS) were investigated further. All of these constituents are naturally occurring.

Arsenic, Iron, and Manganese

As, Fe, and Mn show elevated concentrations in over 10% of the wells. Although iron and manganese are regulated under secondary drinking water standards (for aesthetics such as color taste, and odor) and are not of concern for human health as drinking water, these constituents were still chosen for further investigation because they also have multiple detections above the agricultural suitability threshold. (Ayers and Westcot 1985) **Figures 5-8** through **5-10** show the trends over time. Wells with single measurements are shown as dots, where wells that had multiple measurements shown as lines. These figures indicate that the number of wells with highly elevated concentrations of arsenic and manganese concentrations may have decreased over the last 40 years of groundwater use. Iron concentrations are generally below the agricultural suitability threshold (Ayers and Westcot, 1985), with two recent elevated measurements from the monitoring wells constructed in support of the GSP.

Specific Conductance and Total Dissolved Solids

SC is a measure of the water's ability to conduct electricity. TDS is a measure of the total amount of dissolved materials (i.e. salts) in water. SC and TDS are related to one another (higher TDS results in higher SC) and SC is often used as a proxy for TDS. Although there was only one recent measurement over the MCL for SC, both SC and TDS were investigated further because they are important indicators of general water quality conditions.

Figures 5-11 and **5-12** show the distribution of elevated levels of SC and TDS around the Basin. **Figures 5-13** and **5-14** show the trends over time. Wells with single measurements are shown as dots, where wells that had multiple measurements shown as lines. These figures indicate that the number of wells with highly elevated concentrations of SC and TDS may have decreased over the last 40 years.

5.4.2 *Groundwater Contamination Sites and Plumes*

To determine the location of potential groundwater contamination sites and plumes, the State Water Resources Control Board's (SWRCB's) GeoTracker website was consulted. GeoTracker catalogs known groundwater contamination sites and waste disposal sites. (SWRCB 2020b) A search of GeoTracker identified ten sites where groundwater could potentially be contaminated. These sites are in the vicinity of Bieber and Nubieber as listed in **Table 5-4** and shown on **Figure 5-15**. The sites include leaking underground storage tanks (LUSTs), cleanup program sites, and land disposal sites. Half of the sites are open and subject to on-going regulatory

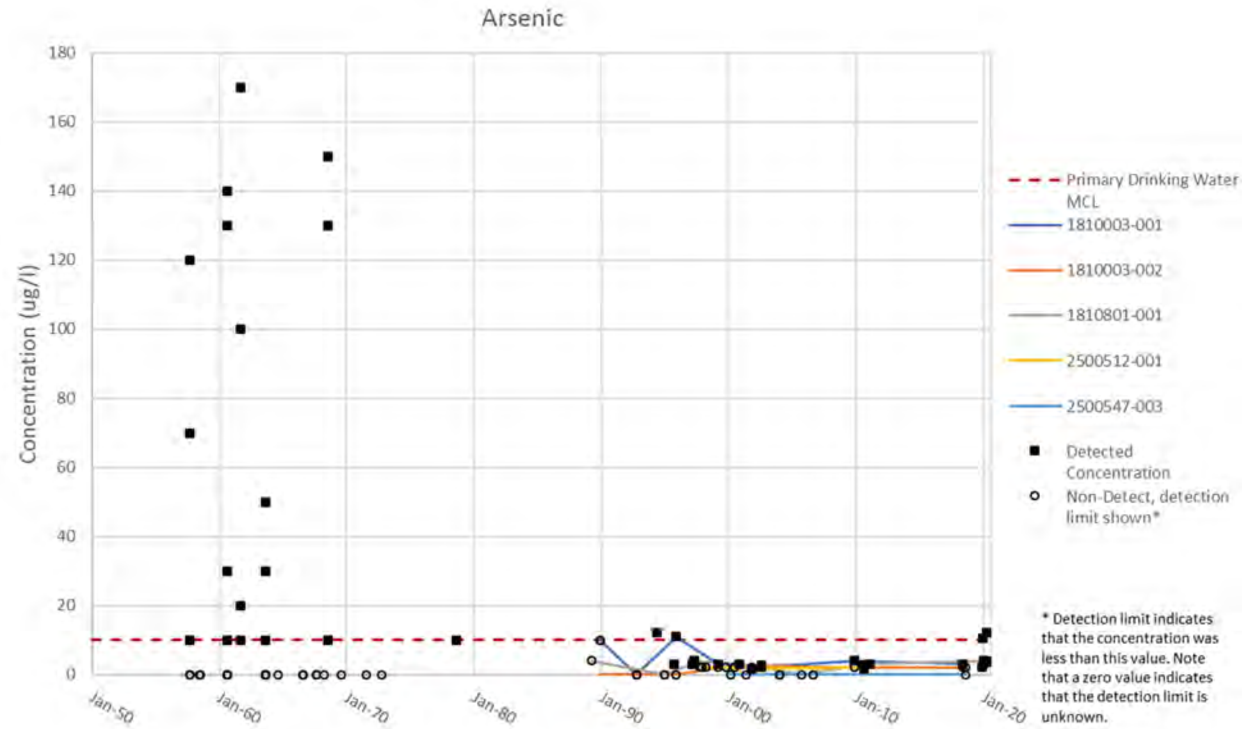

Figure 5-8 Arsenic Trends

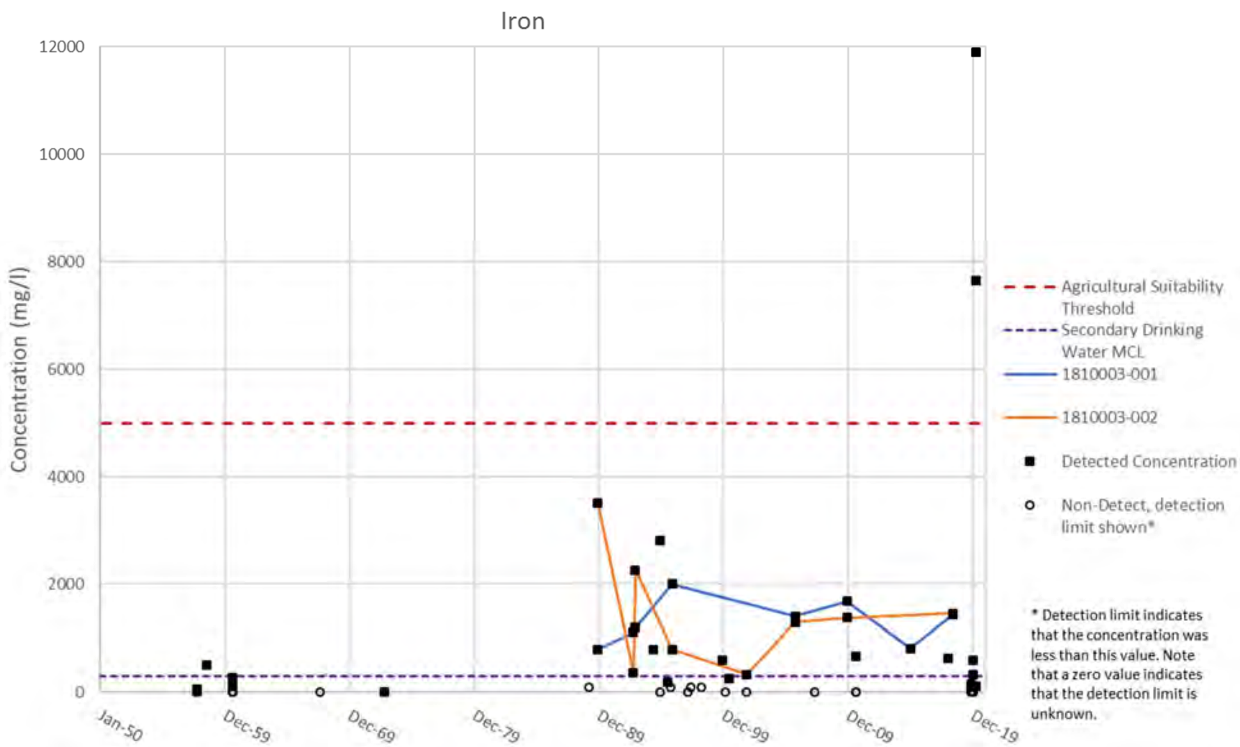

Figure 5-9 Iron Trends

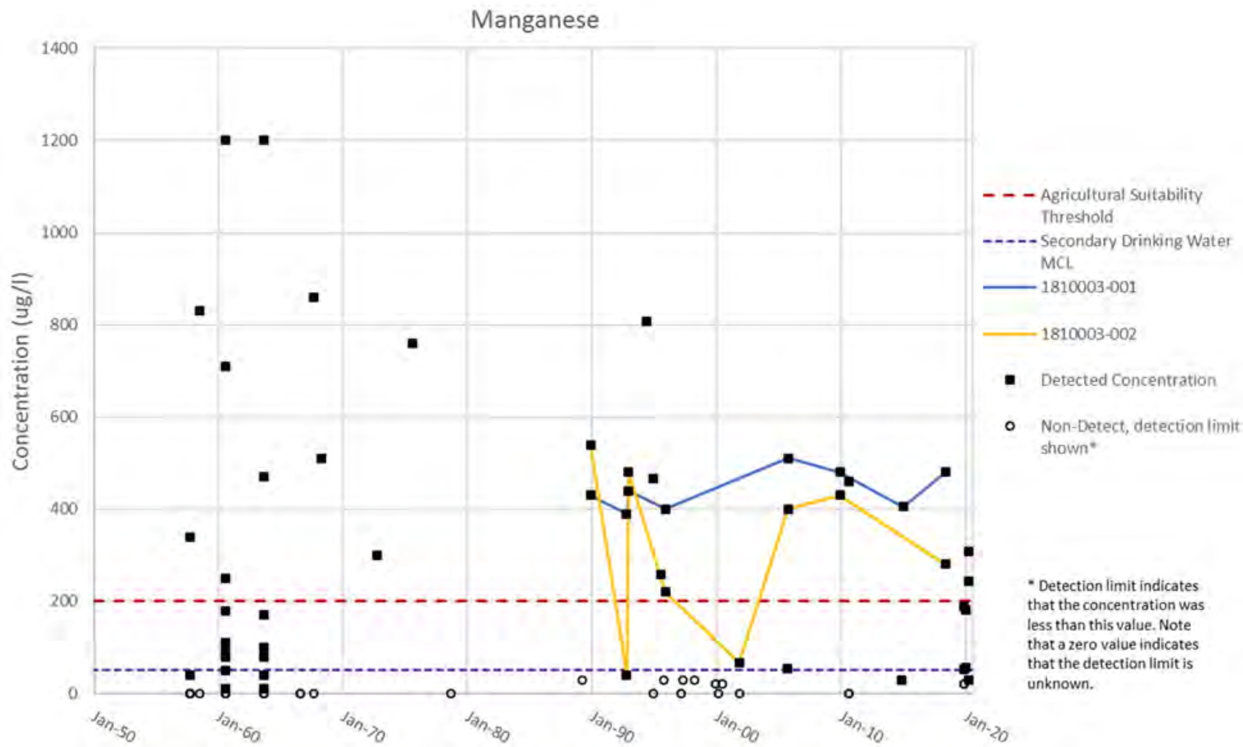

Figure 5-10 Manganese Trends

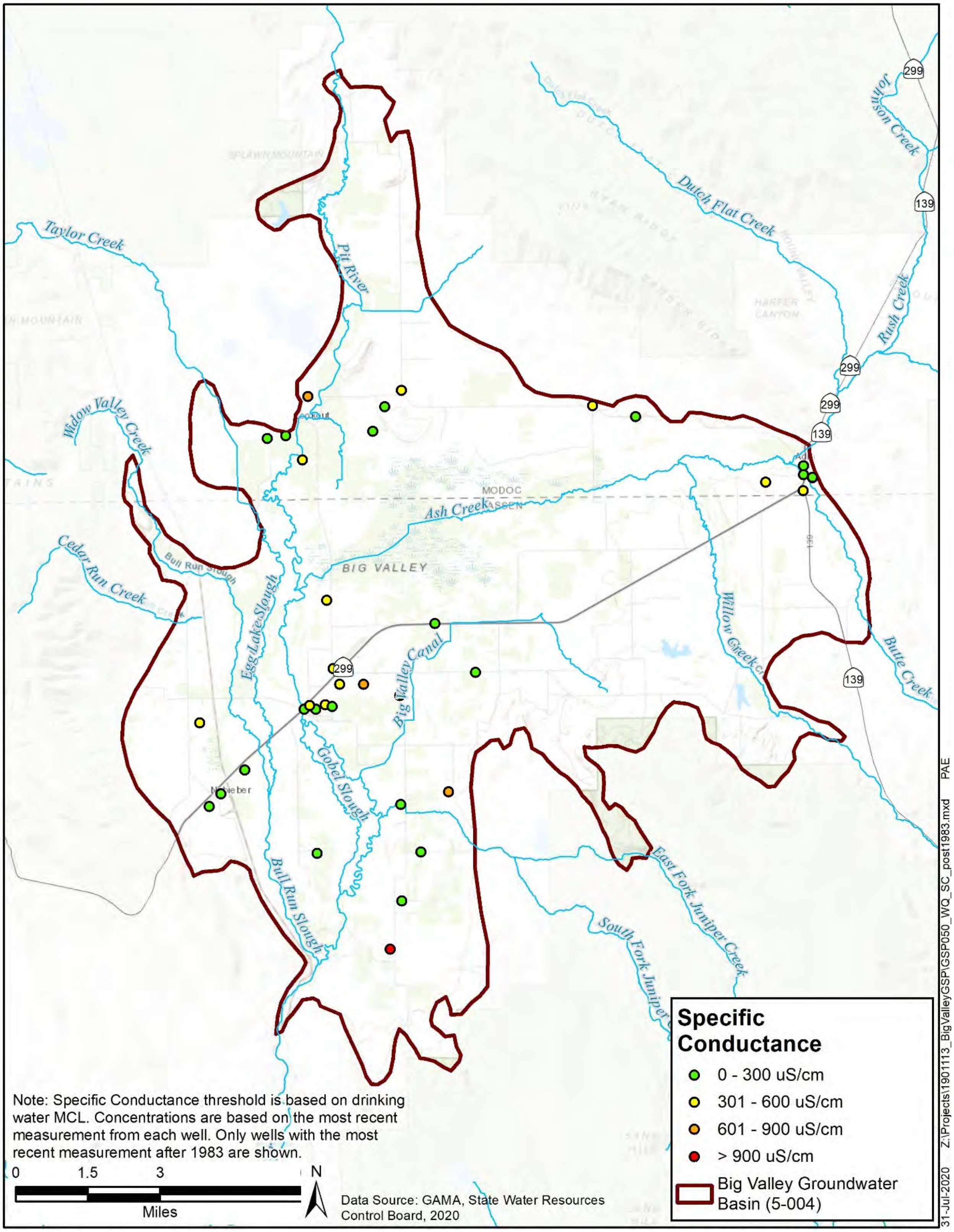

Figure 5-11 Distribution of Elevated Specific Conductance

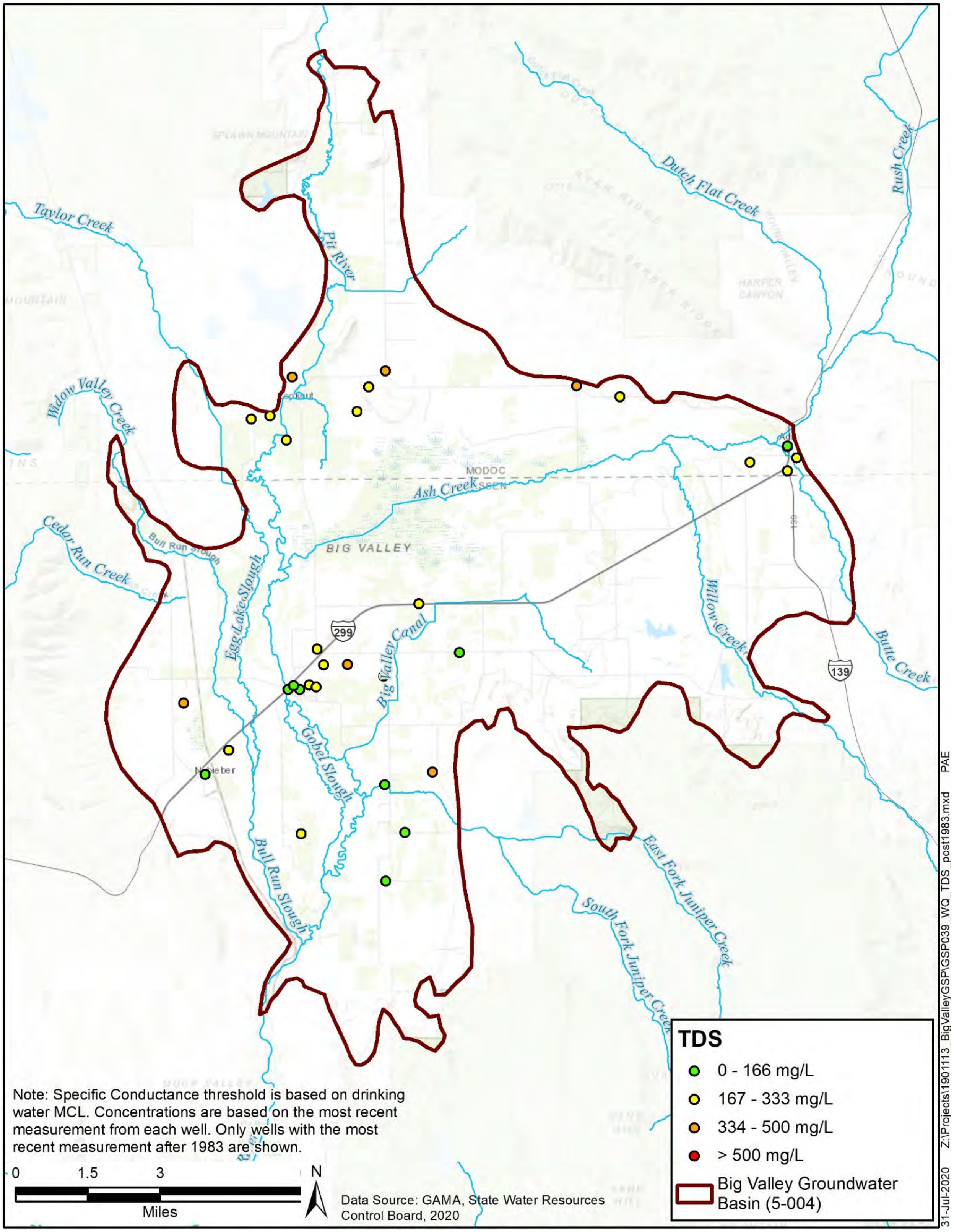

Figure 5-12 Distribution of Elevated TDS Concentrations

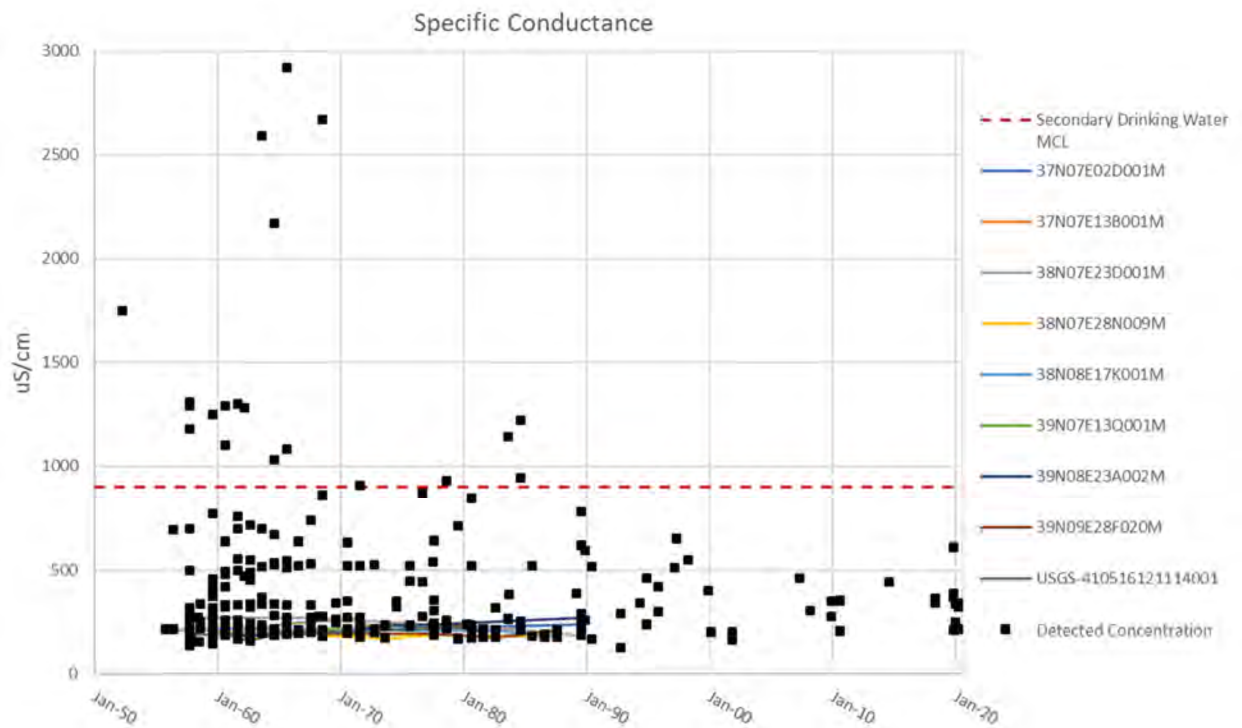

Figure 5-13 Specific Conductance Trends

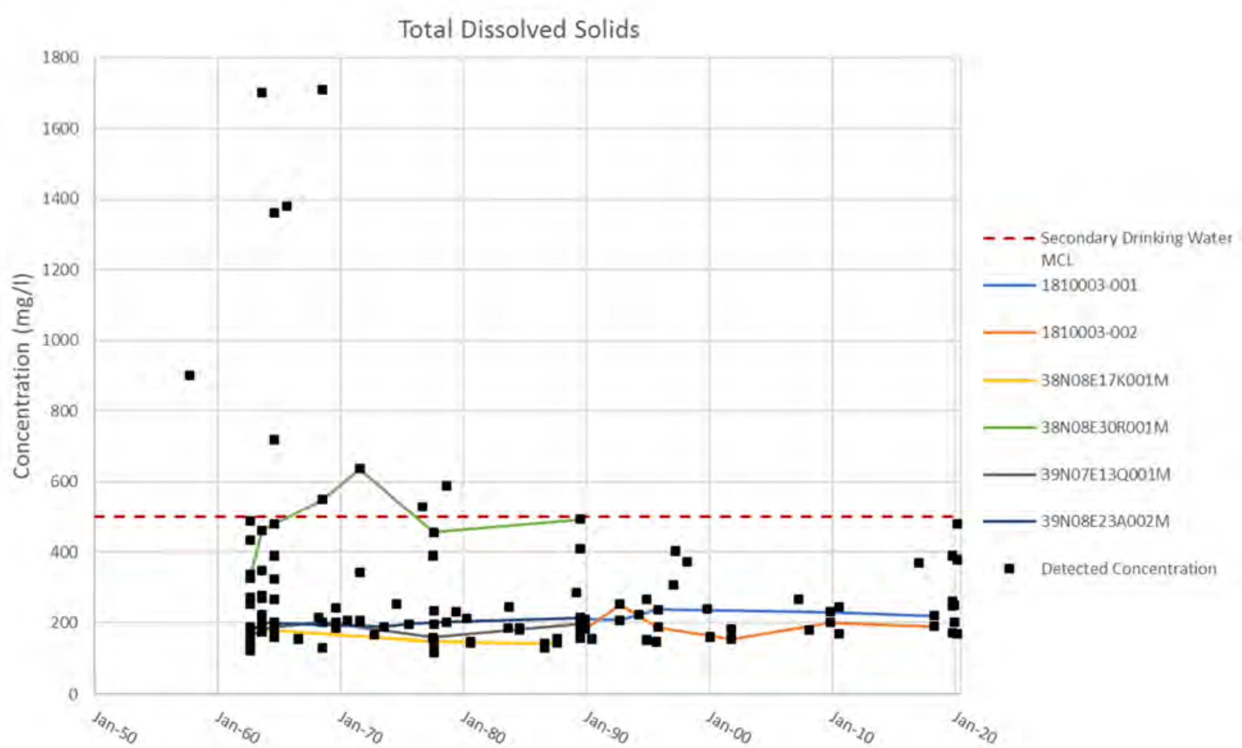

Figure 5-14 TDS Trends

Table 5-4 Known Potential Groundwater Contamination Sites in the BVGB

GeoTracker ID	Latitude	Longitude	Case Type	Status	Last Regulatory Acitivity	Case Begin Date	Potential Contaminants of Concern	Site Summary
T10000003882	41.12050	-121.14605	LUST Cleanup Site	Open - Assessment & Interim Remedial Action	04/16/20	10/17/11	Benzene, Diesel, Ethylbenzene, Total Petroleum Hydrocarbons (TPH), Xylene	The case was opened following an unauthorized release from an underground storage tank(s). Tank removal and further site assessment, including installation of eight monitoring wells, led to remedial actions. Periodic groundwater monitoring started in October 2013 and has been ongoing though March 2020.
T0603593601	41.13230	-121.13070	LUST Cleanup Site	Open - Remediation	07/29/20	03/22/00	Gasoline	Active gas station with groundwater impacts. Full-scale remediation via groundwater extraction and treatment began in September 2013 and was shut-down in April 2017 because it was determined that it was no longer an effective remedy to treat soil and groundwater. At the time of system shutdown, the influent MTBE concentration was 5,650 ug/L which exceeds the Low-Threat Closure Policy criteria. Additionally, high levels of TPHg and sheen/free product are present. A soil vapor extraction (SVE) system operated for a limited time in 2016/2017 but was not effective. In April 2018, it was determined that active remediation is not a cost-effective path to closure given low permeability of site soils. Staff suggested incorporating institutional controls (IC) and risk-based cleanup objectives instead of active remediation of soil and groundwater. The IC approach was dependent on the submittal of several documents related to soil management, deed restriction, and risk modeling plus annual groundwater sampling. This information has not been provided and the RWQCB sent an Order for this information.
T0603500006	41.12241	-121.14128	LUST Cleanup Site	Completed - Case Closed	01/04/00	06/28/99	Diesel	A 2000-gallon underground storage tank was removed and limited contaminated soil was present in the excavation. Petroleum hydrocarbons were not found in the uppermost groundwater. These findings led to the closure of the case.
L10005078943	41.12941	-121.14169	Land Disposal Site	Open - Closed facility with Monitoring*	06/26/20	06/30/08	Higher levels of Inorganic constituents, organic chemicals (synthetic), per/polyfluoroalkyl substances	Disposal activities at Bieber Landfill occurred from the early 1950s until 1994. The landfill was closed during the early 2000s. While active, the site received residential, commercial, and industrial non-hazardous solid waste. Formerly an unlined burn dump, the site was converted to cut-and-cover landfill operation in 1974. Landfill refuse is estimated to occupy less than 13 acres of the 20-acre site. Wastes are estimated to be approximately 10 to 15 feet thick. The Class III landfill was closed in accordance with Title 27 of the California Code of Regulations. A transfer station was established at the site for the transporation of waste to another landfill. Groundwater levels and quality are monitored twice per year at four wells.
T0603500003	41.12124	-121.14061	LUST Cleanup Site	Completed - Case Closed	09/13/94	07/31/91	Heating Oil / Fuel Oil	A 1000-gallon underground storage tank was removed and contaminated soil was present beneath the tank, which led to installation of nine soils borings and three monitoring wells. Contaminated soil was removed but an adjacent building limited the extent of the excavation so contaminated soil remains under the building. Hydrocarbons were initally found in one well but not in subsequent sampling. The RWQCB concurred with a request to close the investigation.
T10000003101	41.13151	-121.13658	Cleanup Program Site	Open - Assessment & Interim Remedial Action	07/22/20	04/03/07	Benzene, Toluene, Xylene, MTBE / TBA / Other Fuel Oxygenates, Gasoline, Other Petroleum	A diesel leak was found in association with an industrial chipper. Corrective action included excavation of diesel-impacted soil, removing contaminated water, and groundwater monitoring. Results of soil and groundwater sampling indicate low concentrations of TPHg and BTEX and that there is no offsite migration. Staff have determined that the case is ready for closure, pending decommissioning of the site monitoring wells.
SL0603581829	41.09251	-121.17904	Cleanup Program Site	Completed - Case Closed	09/01/05	01/08/05	Petroleum - Diesel fuels, Petroleum - Other	Contaminated soil excavated and transported to Forward Landfill for disposal. Contaminated groundwater (7,000 gallons) extracted with vacuum truck for disposal.
T0603500002	41.12188	-121.13546	LUST Cleanup Site	Completed - Case Closed	07/17/06	10/20/86	Gasoline / diesel	Three underground storage tanks were removed and contaminated soil was present beneath the tank, which led to installation of nine monitoring wells and three remediation wells. Natural attenuation of the hydrocarbon impact was acceptable to the RWQCB due to the limited, well-defined extent of the impact and the limited and declining impact to groundwater. The RWQCB concurred with a request to close the site.
T0603500004	41.12134	-121.13547	LUST Cleanup Site	Completed - Case Closed	03/12/99	06/12/97	Diesel	A 5000-gallon underground storage tank was removed and very low levels of petroluem hydrocarbons were detected in the soil, which was allowed to be spread onsite and the case was closed.
T10000002713	41.11993	-121.14271	Cleanup Program Site	Open - Site Assessment	12/30/16	03/10/10	Other Petroleum	The site is an old bulk plant which was built in the 1930's and handled gasoline and diesel. During a routine inspection in March 2010, evidence of petroleum spills were identified at the loading dock area. A follow-up inspection was conducted in April 2010. The ASTs and loading dock were removed but additional contamination was noted under the removed structures. Furthermore, a shallow excavation contained standing water with a sheen. Due to the potential impacts to shallow groundwater, the Central Valley Water Board became the lead agency in December 2010. Additional information was requested in December 2016. A response is not evident.

*This terminology indicates that the landfill is closed (no new material being disposed), but the site is open with regard to ongoing groundwater monitoring.
Source: GeoTracker (SWRCB 2020b)

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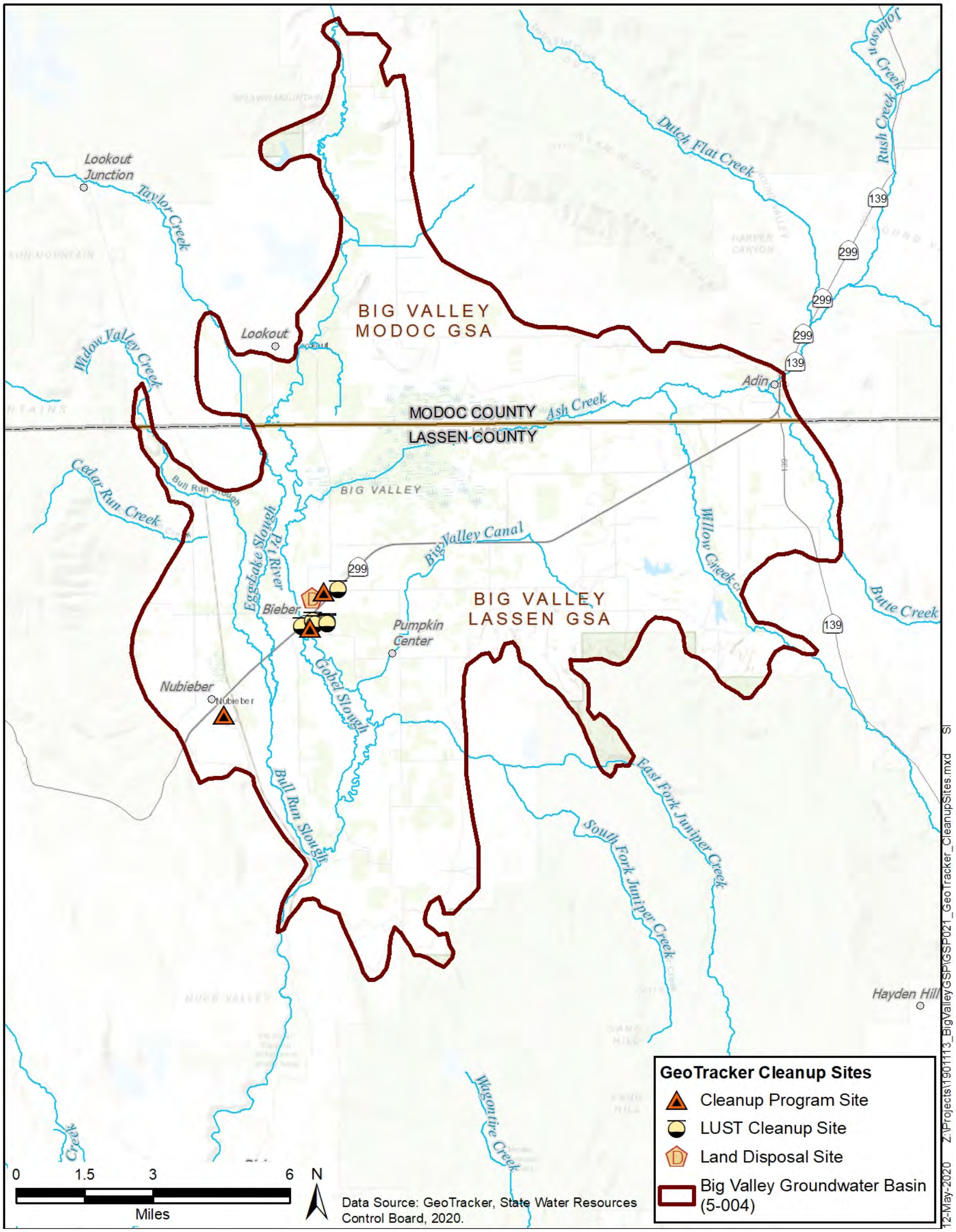

238
239 **Figure 5-15 Location of Known Potential Groundwater Contamination Sites**
240

requirements. The contaminants are listed in **Table 5-4**, which also gives a summary of the case history. Most of the contaminants originated at LUST sites leaking petroleum hydrocarbons which are light non-aqueous phase liquids (LNAPLs). LNAPLs are less dense than water and their solubility is quite low, meaning that if they reach groundwater, they float on top and generally do not migrate into the deeper portions of the aquifer. Moreover, many of the constituents can be degraded by naturally occurring bacteria in soil and groundwater so the hydrocarbons do not migrate far from the LUST sites. However, MTBE[3], TBA[4], and fuel oxygenates are more soluble in water. Two LUST sites and the landfill site are subject to long-term monitoring while a fourth site is ready for case closure.

The Bieber Landfill is subject to on-going semi-annual monitoring of groundwater levels and groundwater quality at four shallow wells. This monitoring is required by the California Regional Water Quality Control Board (RWQCB Order No. R5-2007-0175), after the formal closure of the landfill in the early 2000s. Trace concentrations of several organic constituents[5] have been detected at MW-1, the closest downgradient well to the site, but rarely at the other three wells. Higher concentrations of inorganic constituents (e.g. TDS, SC, others) are also present at MW-1. During 2019, the landfill was also required to analyze groundwater samples from MW-1, MW-2 and MW-4 for per/polyfluoroalkyl substances (PFAS), which are an emerging group of contaminants that are being studied for their effect on human health and may be subject to very low regulatory criteria (parts per trillion). Fifteen of 28 PFASs were detected at MW-1 and nine of 28 PFASs were detected at MW-4 (none at MW-2). The SWRCB/RWQCB evaluation of these data is still pending.

5.5 Subsidence §354.16(e)

Vertical displacement of the land surface (subsidence) is comprised of two components: 1) elastic displacement which fluctuates according to various cycles (daily, seasonally, and annually) due to temporary changes in hydrostatic pressure (e.g. atmospheric pressure and changes in groundwater levels) and 2) inelastic displacement or permanent subsidence which can occur from a variety of natural and human-caused phenomena, including~~when~~ groundwater pumping. Lowering of groundwater levels can cause~~s a~~ prolonged and/or extreme decrease in hydrostatic pressure of the aquifer. This decrease in pressure can allow the aquifer to compress, primarily within fine-grained beds (clays). Inelastic subsidence cannot be restored after the hydrostatic pressure increases. Other causes of inelastic subsidence include natural geologic processes (e.g. faulting) and the oxidation of organic rich (peat) soils as well as human-caused processes such as mining and grading of land surfaces for agricultural use.

[3] Methyl tert-butyl ether (MTBE) is a fuel additive that was used starting in 1979 and was banned in California after 2002. MTBE is sparingly soluble in water and has a primary MCL of 13 ug/l for human health and a secondary MCL of 5 ug/l for aesthetics.
[4] tert-Butyl alcohol (TBA) is also a fuel additive and is used to produce MTBE. TBA does not have a drinking water MCL in California.
[5] 1,1-dichoroethane, 1,4-dichlorobenzene, cis-1,2-dichloroethylene, benzene, chlorobenzene, MTBE, 2,4,5-trichlorophenoxyacetic acid

Subsidence can be measured by a variety of methods, including:

- Regular measurements of any vertical space between the ground surface and the concrete pad surrounding a well. If space is present and increasing over time, subsidence may be occurring at that location. If a space is not present, subsidence may not be occurring, or the well is not deep enough to show that subsidence is occurring because the well and groundwater are subsiding together.
- Terrestrial (ground-based) surveys of paved roads and benchmarks.
- Global Positioning Survey (GPS) of benchmarks. GPS uses a constellation of satellites to measure the 3-dimensional position of a benchmark. The longer the time that the GPS is left to collect measurements, the higher the precision. Big Valley has one continuously-operating GPS (CGPS) station near Adin.
- Monitoring of specially constructed "extensometer" wells. There are no extensometers in the BVGB.
- Use of Interferometric Synthetic-Aperture Radar (InSAR), which is microwave-based satellite technology that has been used to evaluate ground surface elevation and deformation since the early 1990s. InSAR can document changes in ground elevation between successive passes of the satellite. Between 2015 and 2019, InSAR was used to evaluate subsidence throughout California, including Big Valley.

Subsidence was recognized as an important consideration in the 2007 Groundwater Management Plan (GMP) for Lassen County (Brown and Caldwell 2007) but was not identified as an issue for Big Valley specifically. The analysis in the GMP was based on indirect observations (groundwater levels) and anecdotal information. This section presents additional data that has become available since the development of the GMP.

5.5.1 *Continuous GPS Station P347*

A CGPS station (P347) was installed at the CalTrans yard near Adin in September 2007. The station is part of the Plate Boundary Observatory (PBO) which is measuring 3-dimensional changes in the Earth surface due to the movement of tectonic plates (e.g. Pacific and North American plates).

Figure 5-16 is a plot of the vertical displacement at P347 and shows a slight decline (0.6 inches) over the first 11 years of operation, based on the annual mean values (large black open circles). Daily values (blue dots) show substantial variation, as much as an inch, but more typically only 0.1 inch on average. This scattering of daily values around the annual mean provides an indication of the elastic nature of the displacement. The overall decline of 0.6 inches is an indication of inelastic displacement has occurred over an 11-year period, which equates to a rate of -0.05 inches per year at this location near Adin.

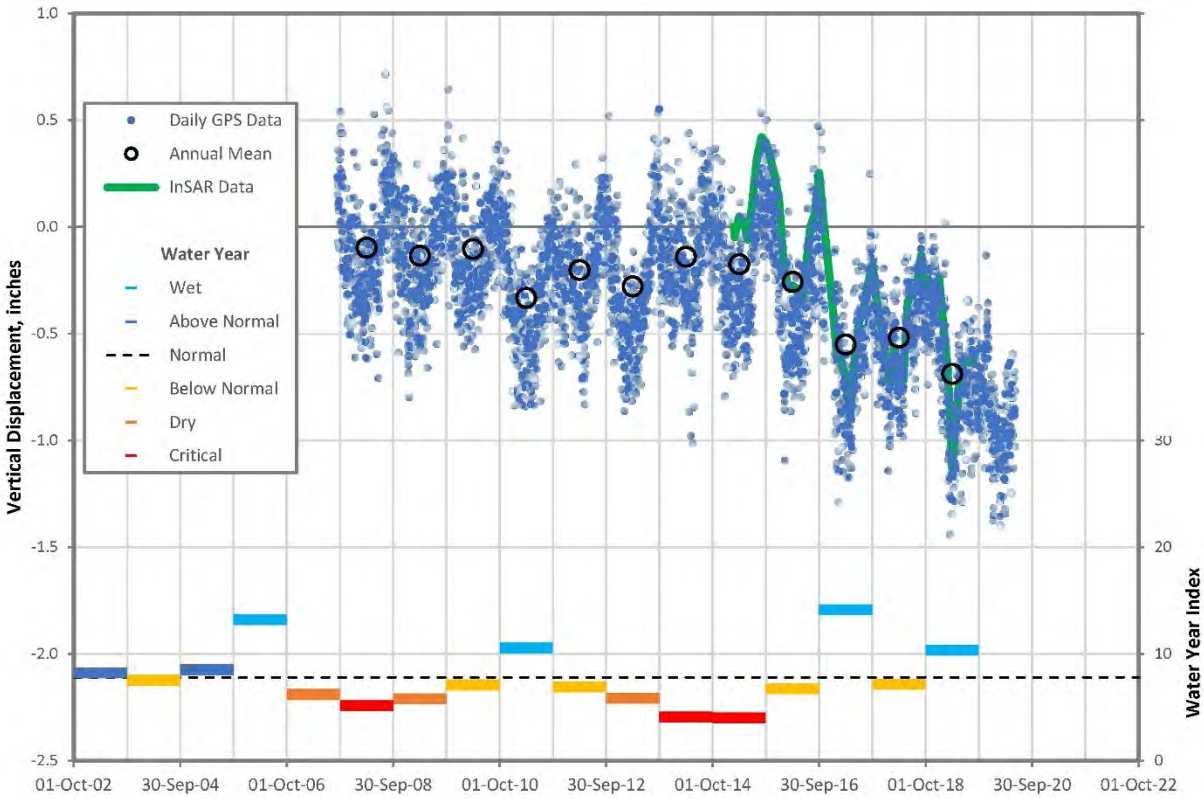

Figure 5-16 Vertical Displacement at CGPS P347

5.5.2 *InSAR Mapping 2015 to 2019*

Figure 5-17 is a map of InSAR data made available by DWR for the 4.3-year period between June 2015 and September 2019. The majority of Big Valley was addressed by this InSAR survey although the survey excludes some areas (shown in white on **Figure 5-17**) including much of the Big Swamp/Ash Creek Wildlife Area, areas along the Pit River near Lookout, and south of Bieber. Most of the survey shows downward displacement (subsidence) between 0 and -1 inches throughout Big Valley. This widespread, small displacement is likely due to natural geologic activities.

Two localized areas of subsidence exceeding -1.5 inches are apparent from this data, one in the east-central portion of the basin north of Highway 299 and one in the southern portion of the Basin between the Pit River and Bull Run Slough. Maximum downward displacement in the Basin is -3.3 inches, or -0.77 inches per year over the 4.3-year period. It is unknown if the subsidence in these areas has been induced by groundwater extraction.

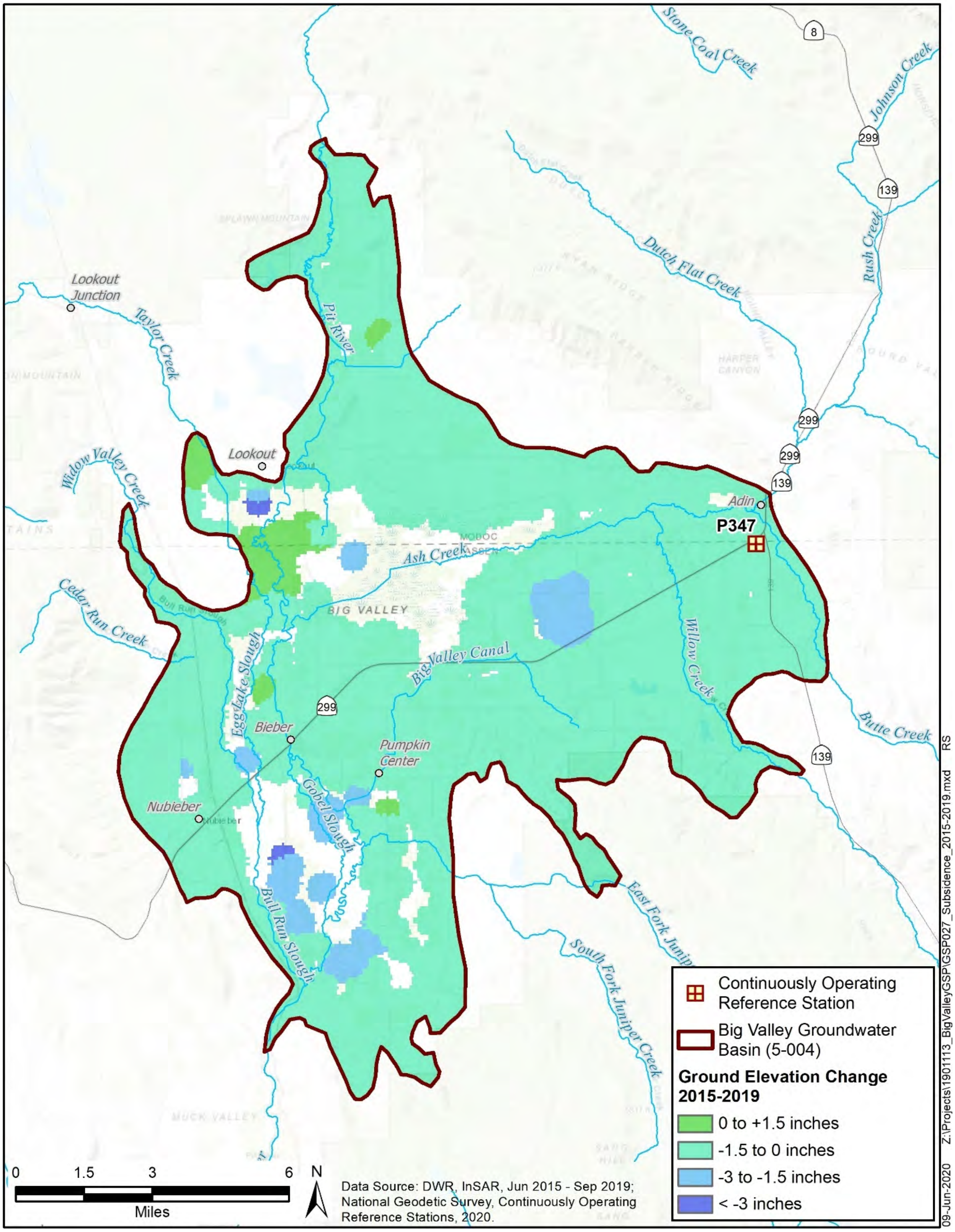

Figure 5-17 InSAR Change in Ground Elevation 2015 to 2019

5.6 Interconnected Surface Water §354.16(f)

Interconnected surface water refers to surface water that is "hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted" (DWR 2016). For the purposes of this GSP, interconnected surface water includes major streams that are known to be perennial[6]. **Figure 5-18** shows all of the major (named) streams from the National Hydrography Dataset (NHD, USGS 2020), excluding several streams that are known to go dry.

Interconnected streams can be gaining (groundwater flowing toward the stream) or losing (groundwater flowing away from the stream). The flow directions from the groundwater contours can indicate whether the stream is gaining or losing, as are shown on **Figure 5-18**. In addition, shallow monitoring well clusters[7] give the direction of shallow groundwater flow as shown by the black arrows on **Figure 5-18**.

- **Reach 1 – Butte Creek:** Butte Creek enters the BVGB on the eastern fringe of the Basin, flowing north to the confluence with Ash Creek in Adin. Groundwater flow indicates that the stream is losing. Throughout its length in the Basin.

- **Reach 2 – Upper Ash Creek:** This reach includes Ash Creek from where it enters the Basin to the confluence with Willow Creek. Based on groundwater contours, groundwater flows toward the creek on the north, but away from the creek on the south side. Shallow groundwater flow indicated by the monitoring well cluster at the Adin Airport is to the south-southwest.

- **Reach 3 – Willow Creek:** Willow Creek enters the BVGB in the southeastern portion of the Basin and flows north into Ash Creek. Groundwater contours indicate that Reach 3 is a losing stream with flow away from the stream both westerly and northeasterly directions. In the lower portions of Reach 3, Willow Creek is fully appropriated and during summer months there is virtually no flow in the channel as most of the flow has been diverted into reservoirs and onto lands adjacent to the river.

- **Reach 4 – Lower Ash Creek:** This reach includes Ash Creek from Willow Creek to the confluence with the Pit River. In this reach surface water velocities slow considerably, and the surface water spreads out to occupy a large freshwater marsh. Groundwater flows away from Reach 4, with contours indicating both northerly and southerly flow away from the marsh.

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[6] With year-round flow, indicating it is not completely depleted.
[7] The clusters are sets of three wells drilled in close proximity to each other for the purpose of determining shallow groundwater flow direction and gradient. At the time of writing this draft chapter, two clusters have enough data to determine flow direction, one cluster near Adin and one near Lookout. Appendix 5C contains data collected at the two clusters and their flow directions.

- **Reach 5 – Hot Springs Slough:** This stream is spring-fed and flows into the marsh in the center of the Basin. Groundwater levels are considerably lower than ground surface in this area, and the upper portions of the slough may be disconnected from groundwater. The slough flows into the marsh area in the center of the basin where it may contribute to groundwater recharge.

- **Reach 6 – Upper Pit River:** Reach 6 includes the Pit River from where it enters the BVGB (at an elevation of about 4160 (msl)) to its confluence with Ash Creek (at an elevation of about 4135 feet msl. The Pit River is generally losing in this portion of the Basin, with groundwater elevations less than 4130 feet msl throughout the reach, as shown in **Figures 5-5** and **5-6**. Just south of lookout, the stream may become gaining based on the well cluster at the Adin Cemetery. This location showed a thick hard-rock basalt layer, which may perch water on top and flow toward the stream. Groundwater beneath basalt may have a different flow direction.

- **Reach 7 – Taylor Creek / Egg Lake Slough:** Taylor Creek enters the BVGB west of Lookout and flows south, parallel to the Pit River and joins Bull Run Slough near the town of Nubieber. This reach may be losing near lookout, but is neither gaining nor losing as it crosses into Lassen County based on groundwater contours.

- **Reach 8 – Widow Valley Creek / Bull Run Slough:** Widow Valley Creek enters the BVGB on the western edge of the Basin and flows southerly into a broad, flat plain joining Egg Lake Slough at Nubieber and the Pit River at the southern edge of the Basin. Groundwater contours are Groundwater contours indicate that the stream is neither gaining, with losing conditions indicated south of Nubieber.

- **Reach 9 – ~~Upper~~ Lower Pit River:** This reach extends from the confluence with Ash Creek to the where the Pit River exits at the southern tip of the Basin and includes Gobel Slough. Similar to Reach 8, conditions are neither gaining nor losing for much of the reach, until the Pit River passes the town of Bieber. South of Bieber groundwater flow is to the east, away from the river.

The descriptions above give a qualitative indication of interactions between surface water and groundwater. Quantitative estimates of flow between the two will be presented in Chapter 6.

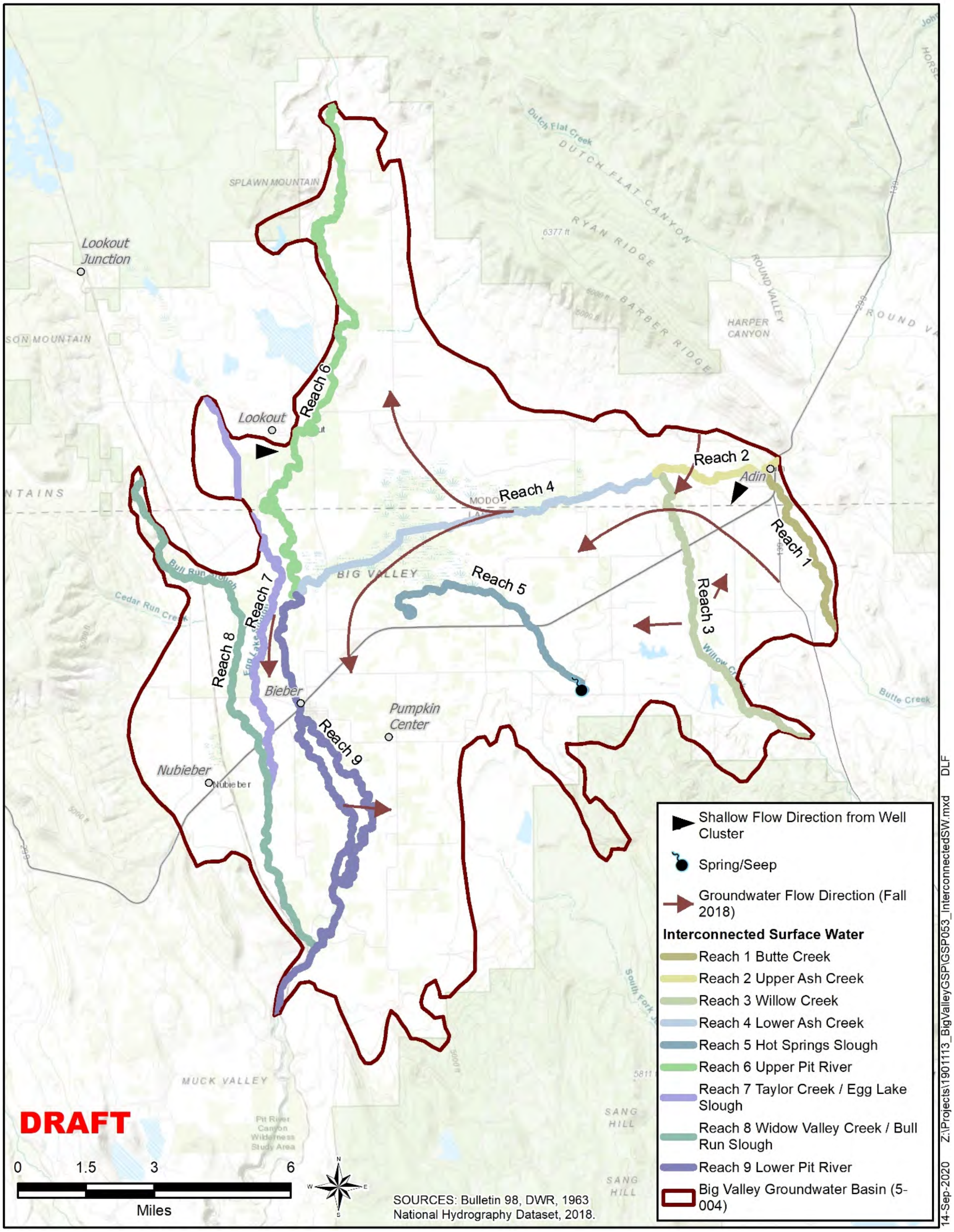

Figure 5-18 Interconnected Surface Water

5.7 Groundwater-Dependent Ecosystems §354.16(g)

SGMA requires GSPs to identify Groundwater Dependent Ecosystems but does not explicitly state the requirements that warrant a GDE designation. SGMA defines a GDE as "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface". (DWR 2016) GDEs are considered a beneficial use of groundwater.

The most comprehensive and readily accessible data to identify GDEs is referred to as the Natural Communities Commonly Associated with Groundwater (NCCAG) dataset. The abstract of the dataset documentation reads:

> *The Natural Communities dataset is a compilation of 48 publicly available State and federal agency datasets that map vegetation, wetlands, springs, and seeps in California. A working group comprised of DWR, the California Department of Fish and Wildlife (CDFW), and The Nature Conservancy (TNC) reviewed the compiled dataset and conducted a screening process to exclude vegetation and wetland types less likely to be associated with groundwater and retain types commonly associated with groundwater, based on criteria described in Klausmeyer et al., 2018.*
>
> *Two habitat classes are included in the Natural Communities dataset: (1) wetland features commonly associated with the surface expression of groundwater under natural, unmodified conditions; and (2) vegetation types commonly associated with the sub-surface presence of groundwater (phreatophytes).*
>
> *The data included in the Natural Communities dataset do not represent DWRs determination of a GDE. However, the Natural Communities dataset can be used by GSAs as a starting point when approaching the task of identifying GDEs within a groundwater basin. (DWR 2018)*

Figures 5-19 and **5-20** show the NCCAG geospatial data, which is separated into two categories: wetlands and vegetation, respectively.

The Wetlands area (12,800 total acres) is subdivided into two primary habitats, palustrine (or freshwater marsh) and riverine, based on setting. Palustrine is dominant at 96% of the total wetland area while riverine is present at 4% and can be seen along river courses. Sixteen springs account for a very small areal component. Most of the springs are in Lassen County (13) although numerous springs are located outside the BVGB boundary.

The Vegetation area (11,500 total acres) is subdivided further into two primary habitats, based on the plant species. Wet Meadows was the largest primary habitat at 59% of the vegetation area but did not include a dominant species. Willow was the second largest habitat at 41% of the vegetation area.

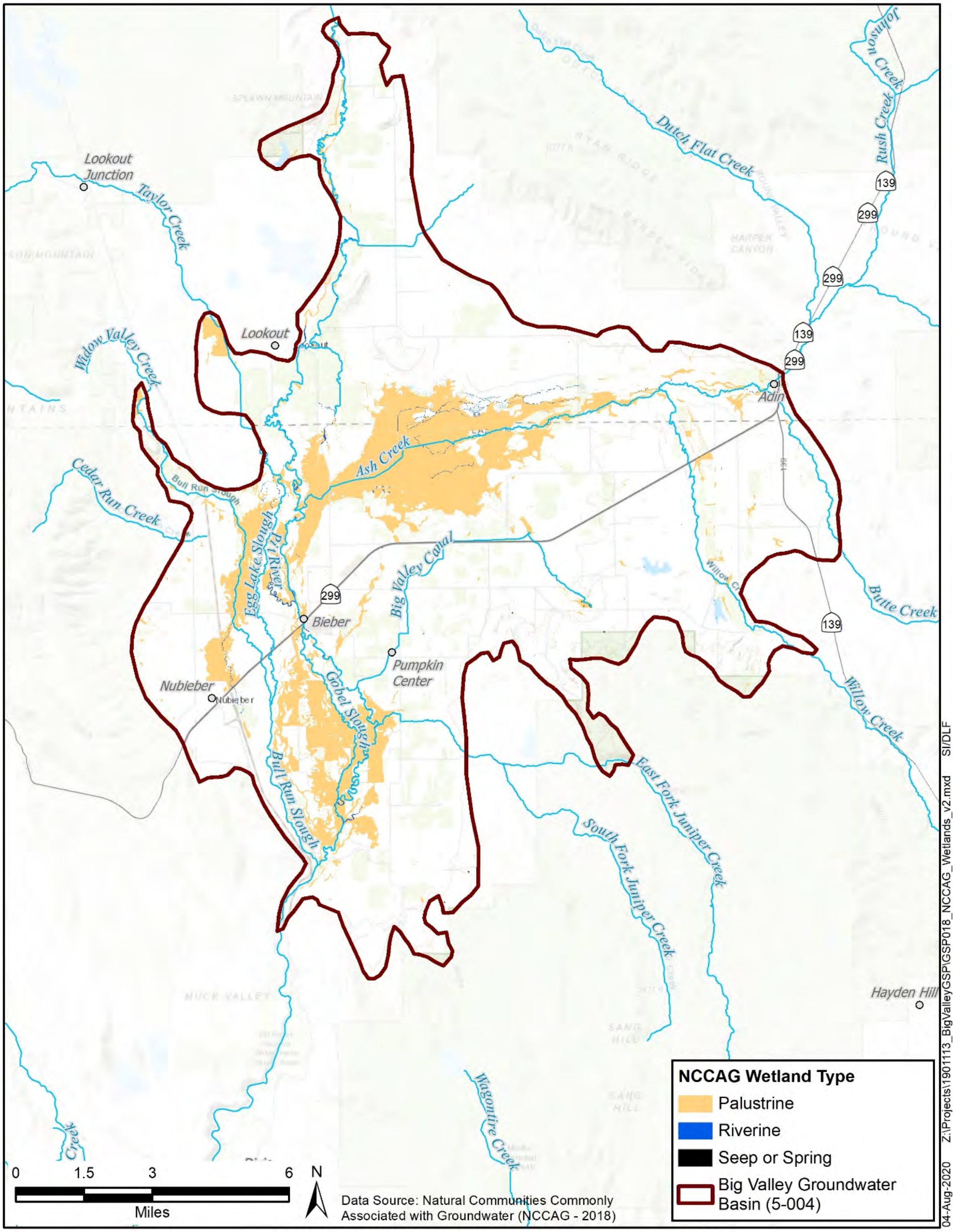

Figure 5-19 NCCAG Wetlands

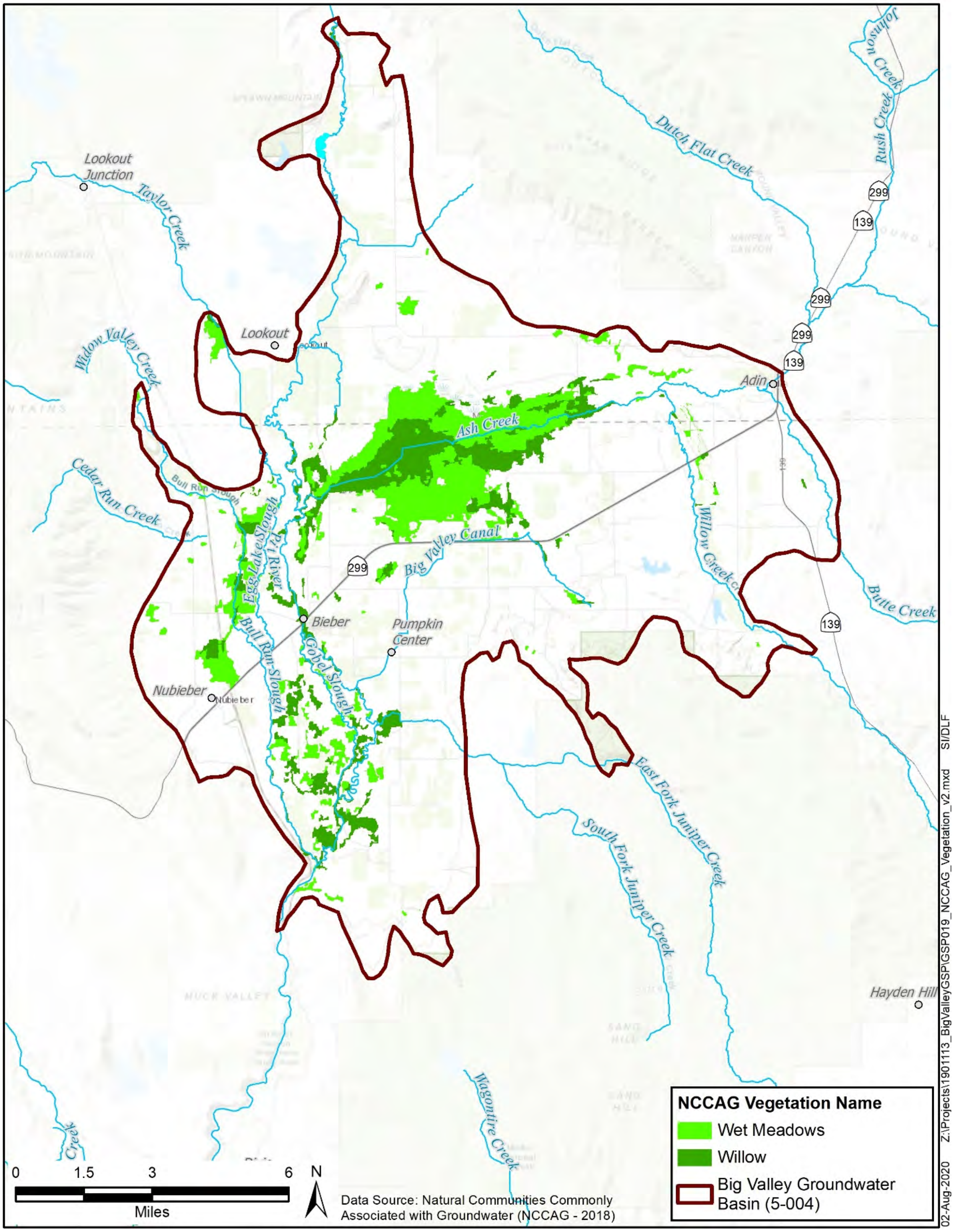

Figure 5-20 NCCAG Vegetation

These two maps identify *potential* GDEs as the NCCAG documentation acknowledges in its abstract. For these areas to be designated as *actual* GDEs, the groundwater level needs to be close enough to the ground surface that it would support the vegetation. **Figure 5-21** shows the depth to water for spring 2015. Spring 2015 is used because that is the SGMA baseline, and SGMA does not require that conditions be returned to a condition pre-2015. Spring is used, as that represents the highest water levels and thus the level that could be accessed by vegetation seasonally.

The depth to water that could potentially be accessed by GDEs depends on the rooting depth of the vegetation. Plant roots can extend up to 30 feet or more (TNC 2020), and 30 has been used by other GSPs as the threshold for GDEs. However, an assessment of native plants present in the Big Valley Groundwater Basin found that maximum rooting depths of species present is 10 feet as shown in **Table 5-5**. However, access to groundwater by plant roots extends above the water table as groundwater seeps upward to fill soil pores. This is known as the capillary fringe and can extend least a few feet or potentially much more depending on the soil type. As a conservative estimate, a capillary fringe of 10 feet is used. Therefore, for the purposes of delineating GDE's, only those areas in the NCCAG datasets that are in areas with groundwater less than 20 feet will be classified as GDEs. **Figure 5-22** shows the GDEs and was generated using the coverages from **Figures 5-19** and **5-20** that have a depth to groundwater less than 20 feet (**Figure 5-21**).

Table 5-5 Big Valley ~~Native~~ Common Plant Species Rooting Depths

Species	Rooting Depth
Carex spp.	Up to 5 ft
Alfalfa	9 feet
Aspen	10 feet and less
Salix spp.	2-10 feet
Elderberry	10 feet and less
Saltgrass	2 feet

Sources: CNPS 2020, TNC 2020, Snell 2020

Species	Rooting Depth
Carex spp.	Up to 5 ft
Alfalfa	9 feet
Aspen	10 feet and less
Willow	2-10 feet
Elderberry	10 feet and less
Saltgrass	2 feet

Sources: CNPS 2020, TNC 2020, Snell 2020

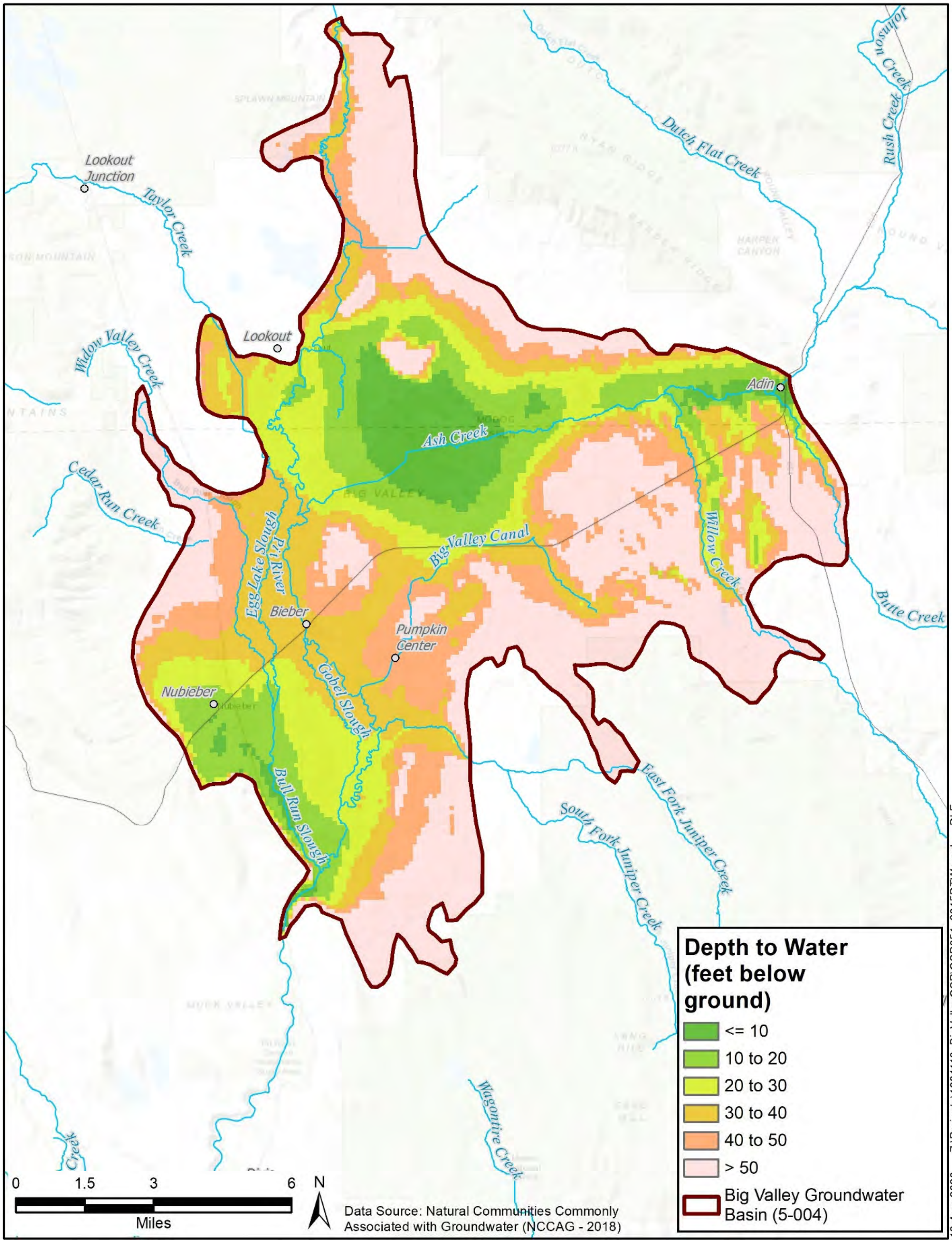

Figure 5-21 Depth to Groundwater Spring 2015

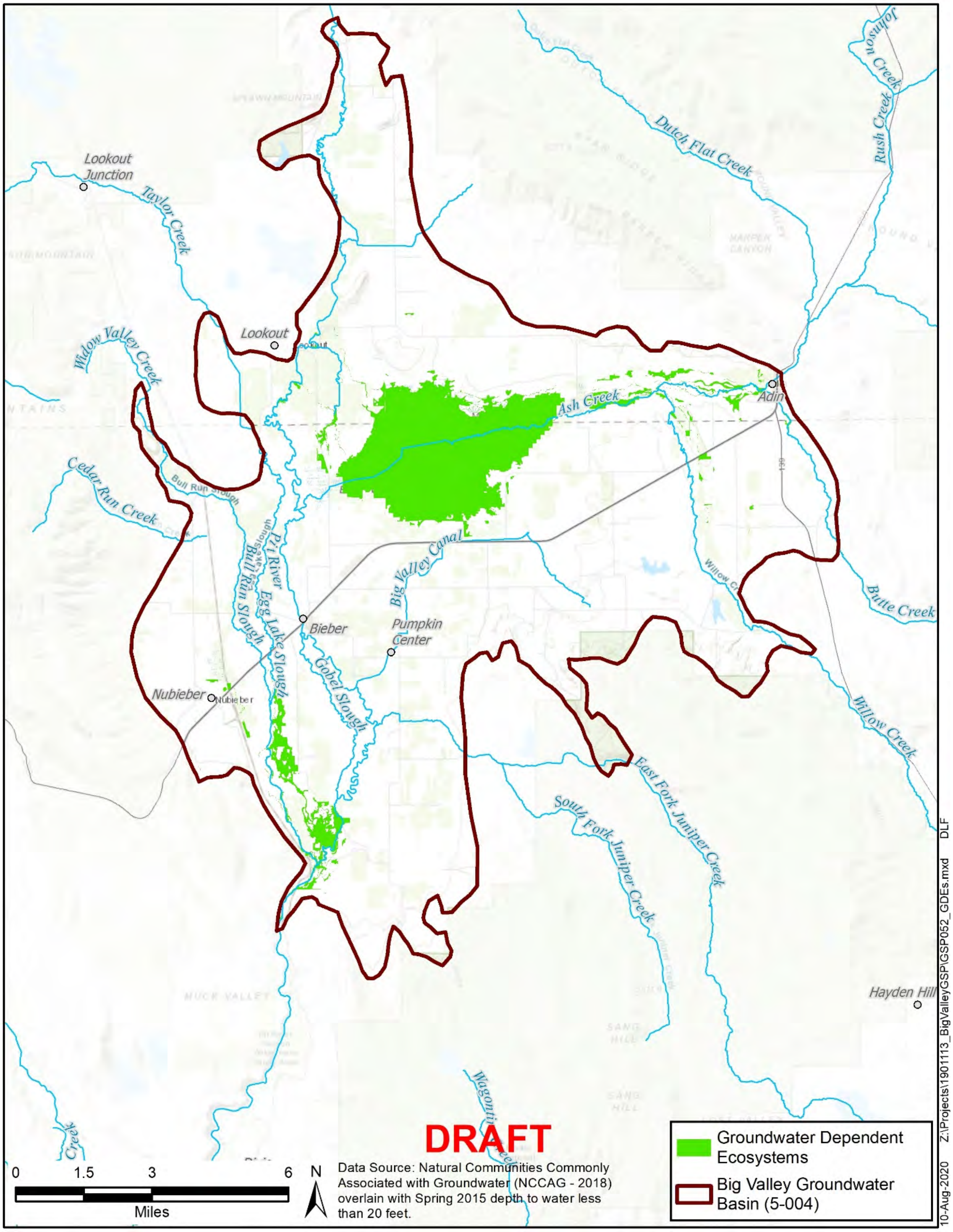

Figure 5-22 Groundwater Dependent Ecosystems

5.8 References

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Appendix 5A

Water Level Hydrographs

Well Water Surface Level Report

Date: 2/19/2020

Well Information

Well ID	087190-38N07E32A002M
Alternate Name	38N07E32A002M
State Number	38N07E32A002M
CASGEM ID	410950N1211839W001

Well Location

County	Lassen
Basin	BIG VALLEY
Sub-Basin	-

Well Type Information

Well Type	-
Well Use	Other
Completion Type	Single

Well Coordinates/Geometry

Location	Lat:	41.0950
	Long:	-121.1839
Well Delth		49.00 ft
Ground Surface Elevation		4118.80 ft
Ref. Point Elevation		4119.50 ft

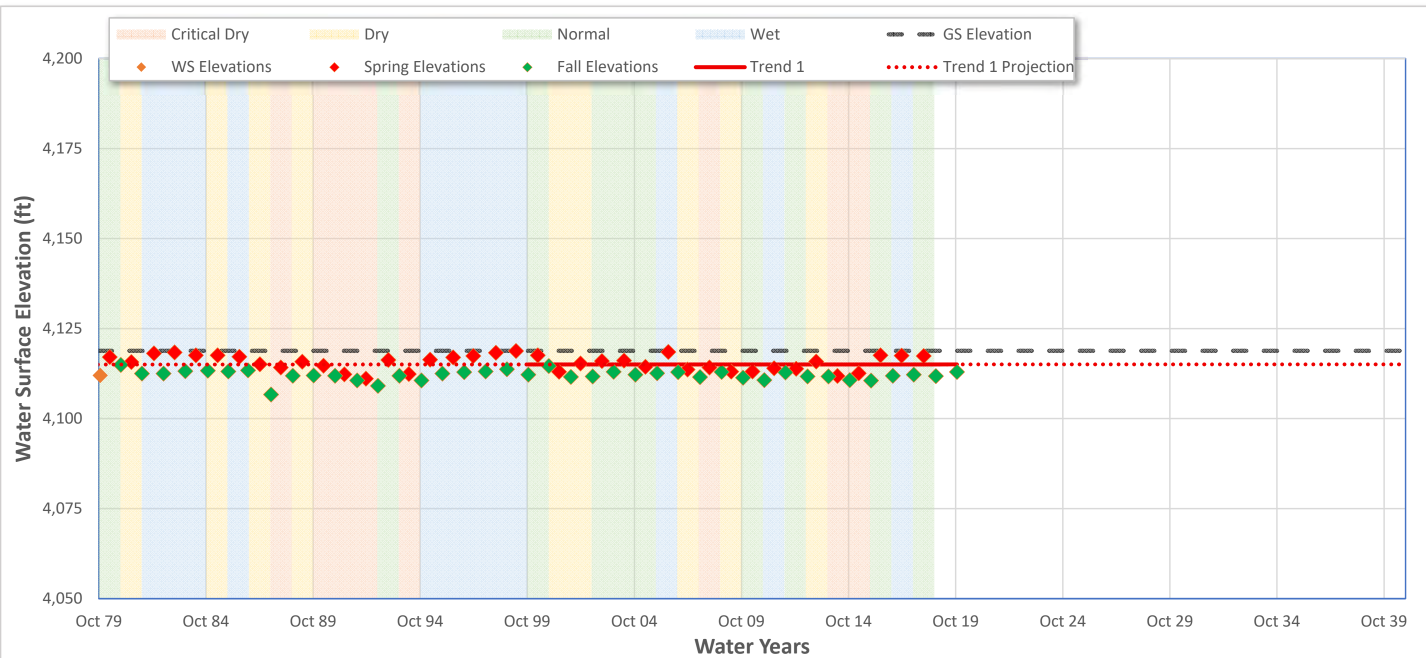
Well Period of Record

Period-of-Record		1959..2020
WS Elev-Range	Min:	4106.7 ft
	Max	4118.8 ft

Trend Analysys

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	0.001 ft/yr
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

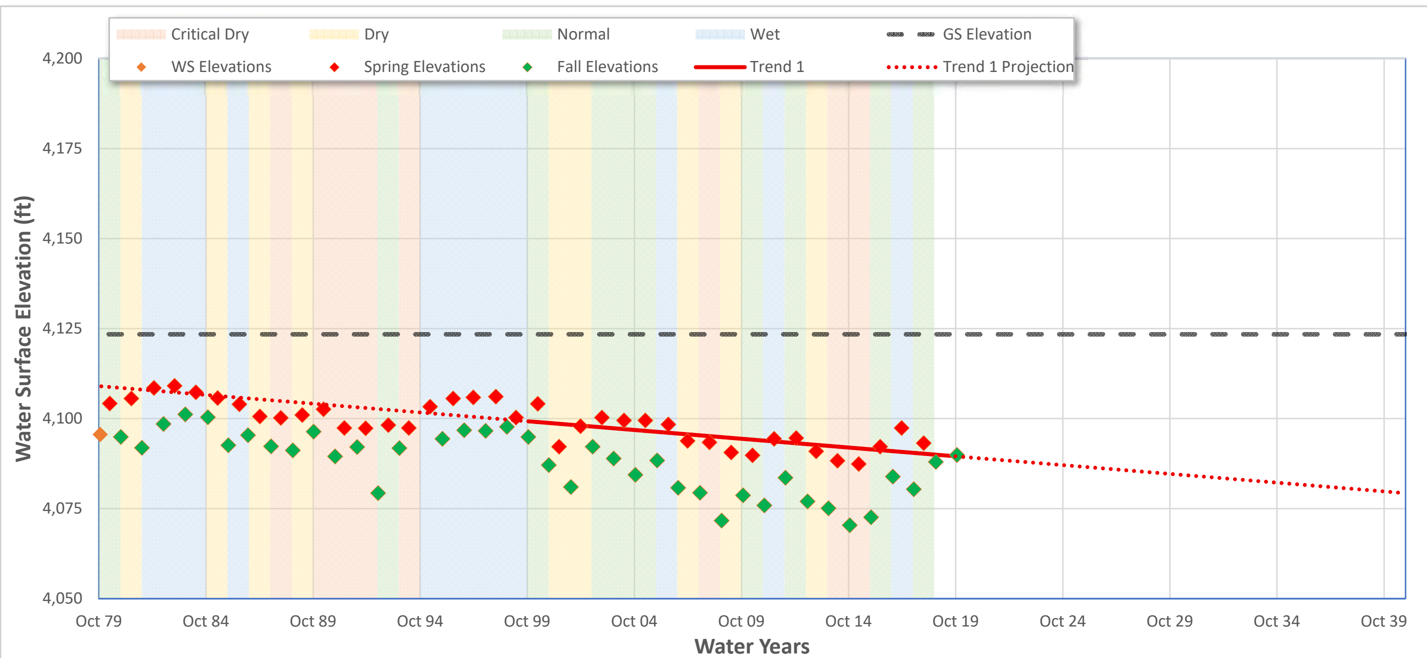
Date: 2/19/2020

Well Information	
Well ID	087188-38N07E23E001M
Alternate Name	38N07E23E001M
State Number	38N07E23E001M
CASGEM ID	411207N1211395W001
Well Location	
County	Lassen
Basin	BIG VALLEY
Sub-Basin	-
Well Type Information	
Well Type	-
Well Use	Residential
Completion Type	Single

Well Coordinates/Geometry		
Location	Lat:	41.1207
	Long:	-121.1395
Well Delth		84.00 ft
Ground Surface Elevation		4123.40 ft
Ref. Point Elevation		4123.40 ft
Well Period of Record		
Period-of-Record		1979..2020
WS Elev-Range	Min:	4070.4 ft
	Max	4109.1 ft

Trend Analysys		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	(0.487 ft/yr)
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

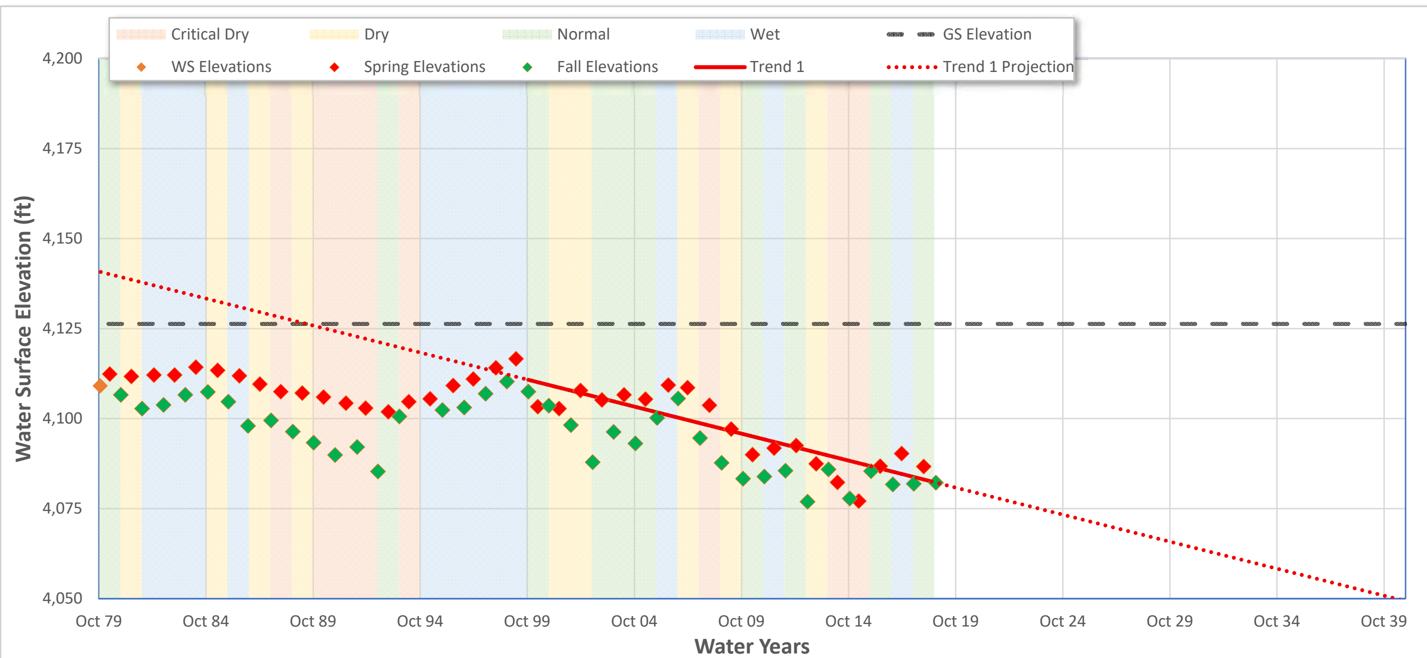
Date: 2/19/2020

Well Information	
Well ID	086510-38N07E20B006M
Alternate Name	38N07E20B006M
State Number	38N07E20B006M
CASGEM ID	411242N1211866W001
Well Location	
County	Lassen
Basin	BIG VALLEY
Sub-Basin	-
Well Type Information	
Well Type	-
Well Use	Residential
Completion Type	Single

Well Coordinates/Geometry		
Location	Lat:	41.1242
	Long:	-121.1866
Well Delth		183.00 ft
Ground Surface Elevation		4126.30 ft
Ref. Point Elevation		4127.30 ft
Well Period of Record		
Period-of-Record		1979..2019
WS Elev-Range	Min:	4076.9 ft
	Max	4116.6 ft

Trend Analysys		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	(1.501 ft/yr)
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

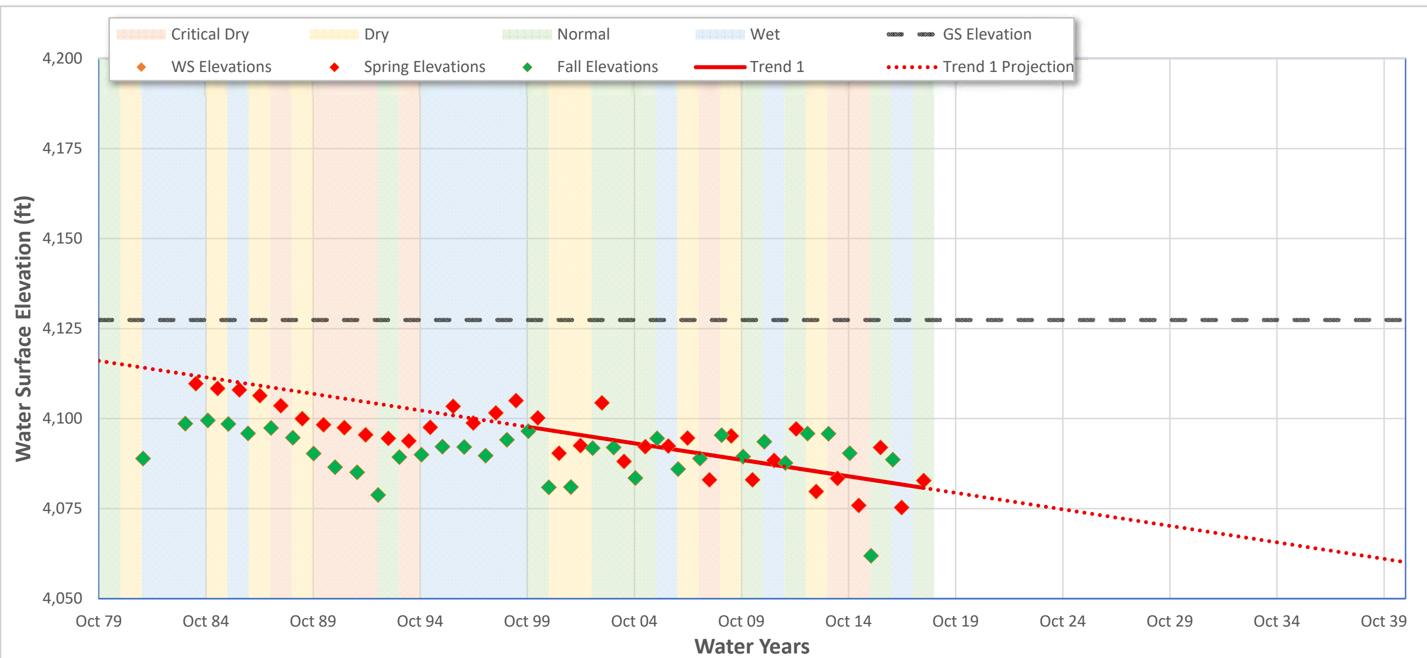
Date: 2/19/2020

Well Information	
Well ID	087331-37N07E13K002M
Alternate Name	37N07E13K002M
State Number	37N07E13K002M
CASGEM ID	410413N1211147W001
Well Location	
County	Lassen
Basin	BIG VALLEY
Sub-Basin	-
Well Type Information	
Well Type	-
Well Use	Irrigation
Completion Type	Single

Well Coordinates/Geometry		
Location	Lat:	41.0413
	Long:	-121.1147
Well Delth		260.00 ft
Ground Surface Elevation		4127.40 ft
Ref. Point Elevation		4127.90 ft
Well Period of Record		
Period-of-Record		1982..2018
WS Elev-Range	Min:	4061.9 ft
	Max	4109.7 ft

Trend Analysys		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	(0.917 ft/yr)
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

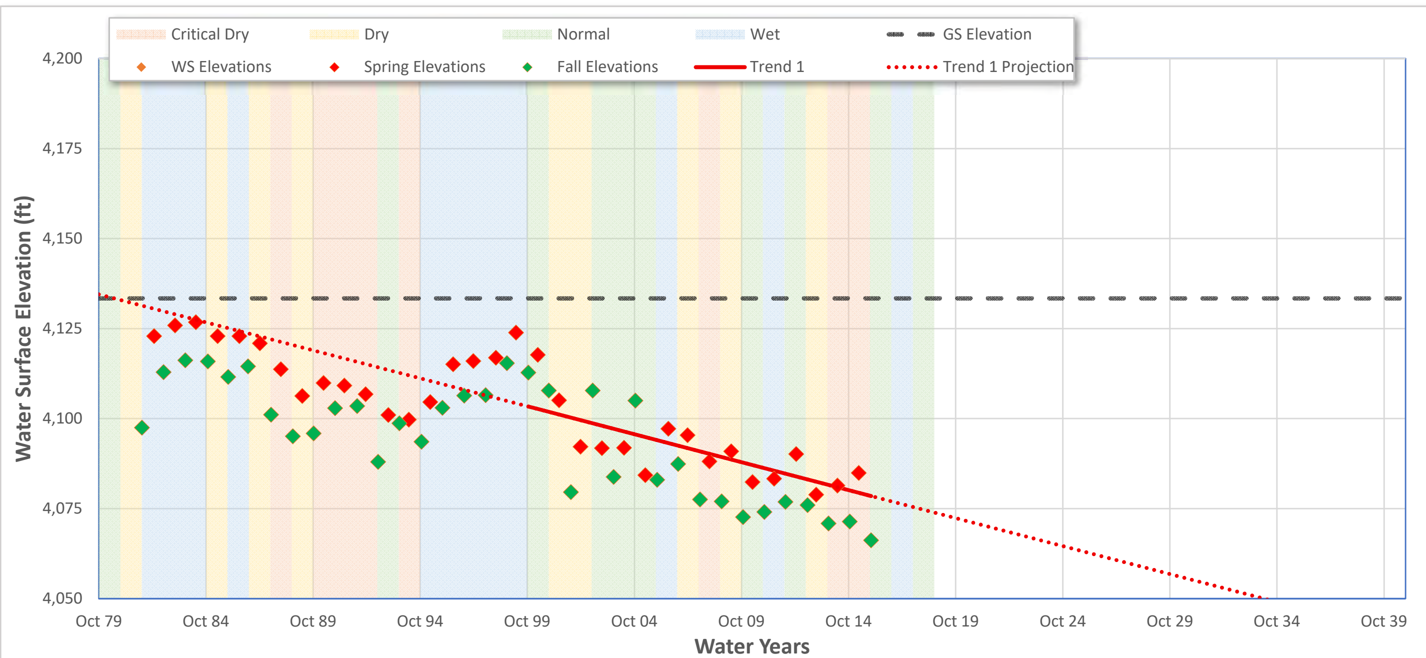
Date: 2/19/2020

Well Information	
Well ID	087332-37N08E06C001M
Alternate Name	37N08E06C001M
State Number	37N08E06C001M
CASGEM ID	410777N1210986W001
Well Location	
County	Lassen
Basin	BIG VALLEY
Sub-Basin	-
Well Type Information	
Well Type	-
Well Use	Irrigation
Completion Type	Single

Well Coordinates/Geometry		
Location	Lat:	41.0777
	Long:	-121.0986
Well Delth		400.00 ft
Ground Surface Elevation		4133.40 ft
Ref. Point Elevation		4133.90 ft
Well Period of Record		
Period-of-Record		1982..2016
WS Elev-Range	Min:	4066.2 ft
	Max	4126.8 ft

Trend Analysys		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	(1.553 ft/yr)
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

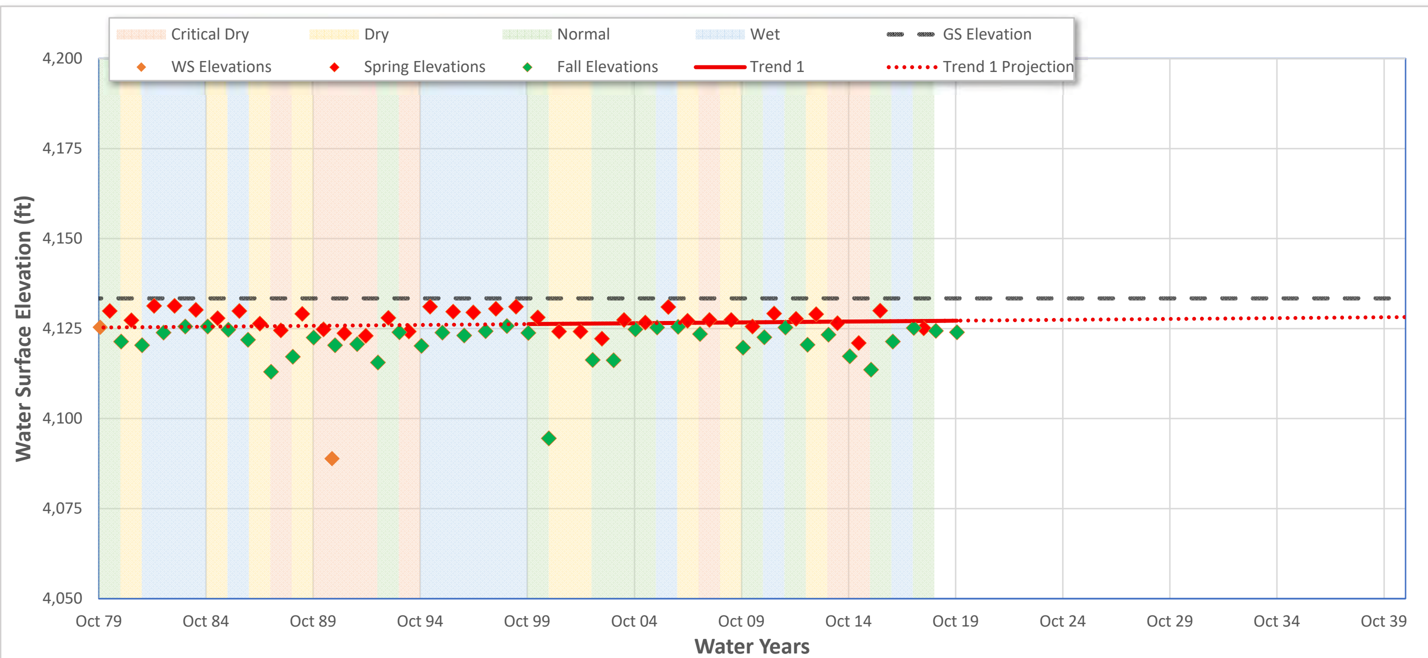
Date: 2/19/2020

Well Information	
Well ID	087199-39N07E26E001M
Alternate Name	39N07E26E001M
State Number	39N07E26E001M
CASGEM ID	411911N1211354W001
Well Location	
County	Modoc
Basin	BIG VALLEY
Sub-Basin	-
Well Type Information	
Well Type	-
Well Use	Irrigation
Completion Type	Single

Well Coordinates/Geometry		
Location	Lat:	41.1911
	Long:	-121.1354
Well Delth		400.00 ft
Ground Surface Elevation		4133.40 ft
Ref. Point Elevation		4135.00 ft
Well Period of Record		
Period-of-Record		1979..2020
WS Elev-Range	Min:	4088.9 ft
	Max	4131.3 ft

Trend Analysys		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	0.048 ft/yr
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

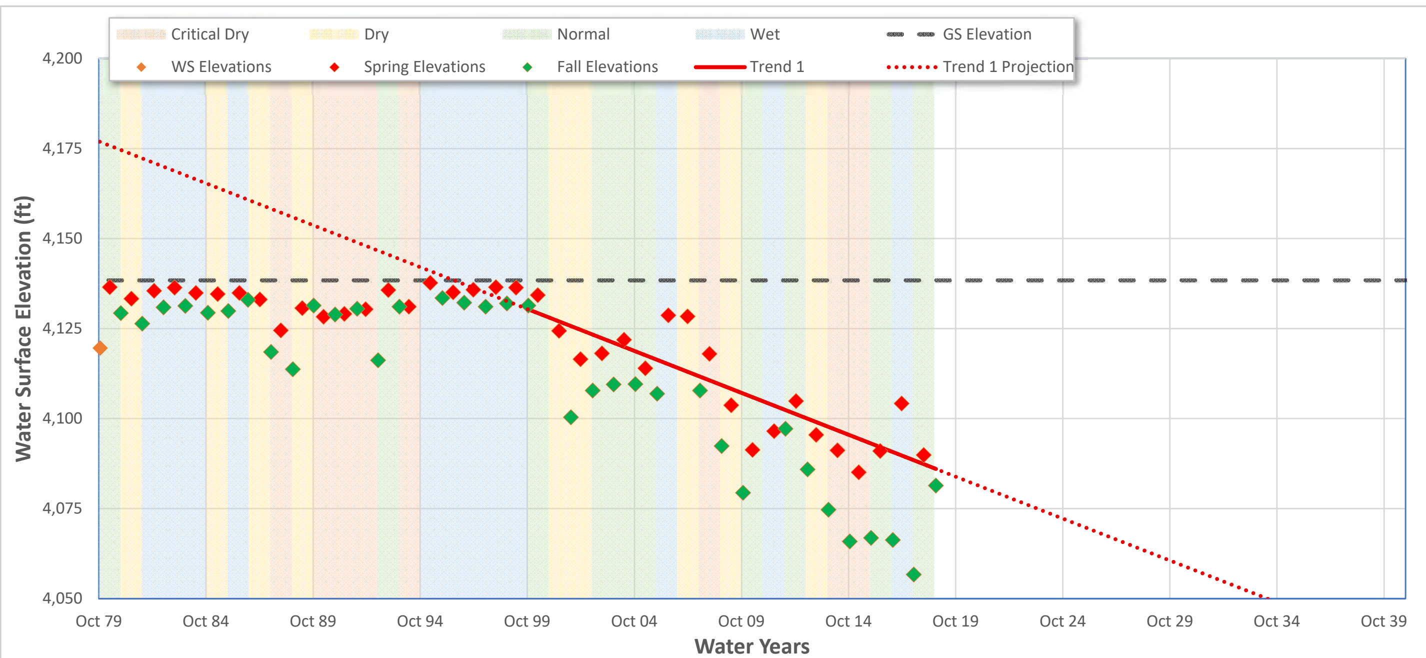
Date: 2/19/2020

Well Information	
Well ID	087189-38N07E24J002M
Alternate Name	38N07E24J002M
State Number	38N07E24J002M
CASGEM ID	411228N1211054W001
Well Location	
County	Lassen
Basin	BIG VALLEY
Sub-Basin	-
Well Type Information	
Well Type	-
Well Use	Irrigation
Completion Type	Single

Well Coordinates/Geometry		
Location	Lat:	41.1226
	Long:	-121.1054
Well Delth		192.00 ft
Ground Surface Elevation		4138.40 ft
Ref. Point Elevation		4139.40 ft
Well Period of Record		
Period-of-Record		1979..2019
WS Elev-Range	Min:	4056.7 ft
	Max	4137.7 ft

Trend Analysys		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	(2.328 ft/yr)
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

Date: 2/19/2020

Well Information

Well ID	087403-ACWA-1
Alternate Name	ACWA-1
State Number	38N08E07A001M
CASGEM ID	411508N1210900W001

Well Location

County	Lassen
Basin	BIG VALLEY
Sub-Basin	-

Well Type Information

Well Type	-
Well Use	Irrigation
Completion Type	Single

Well Coordinates/Geometry

Location	Lat:	41.1508
	Long:	-121.0900
Well Delth		780.00 ft
Ground Surface Elevation		4142.00 ft
Ref. Point Elevation		4142.75 ft

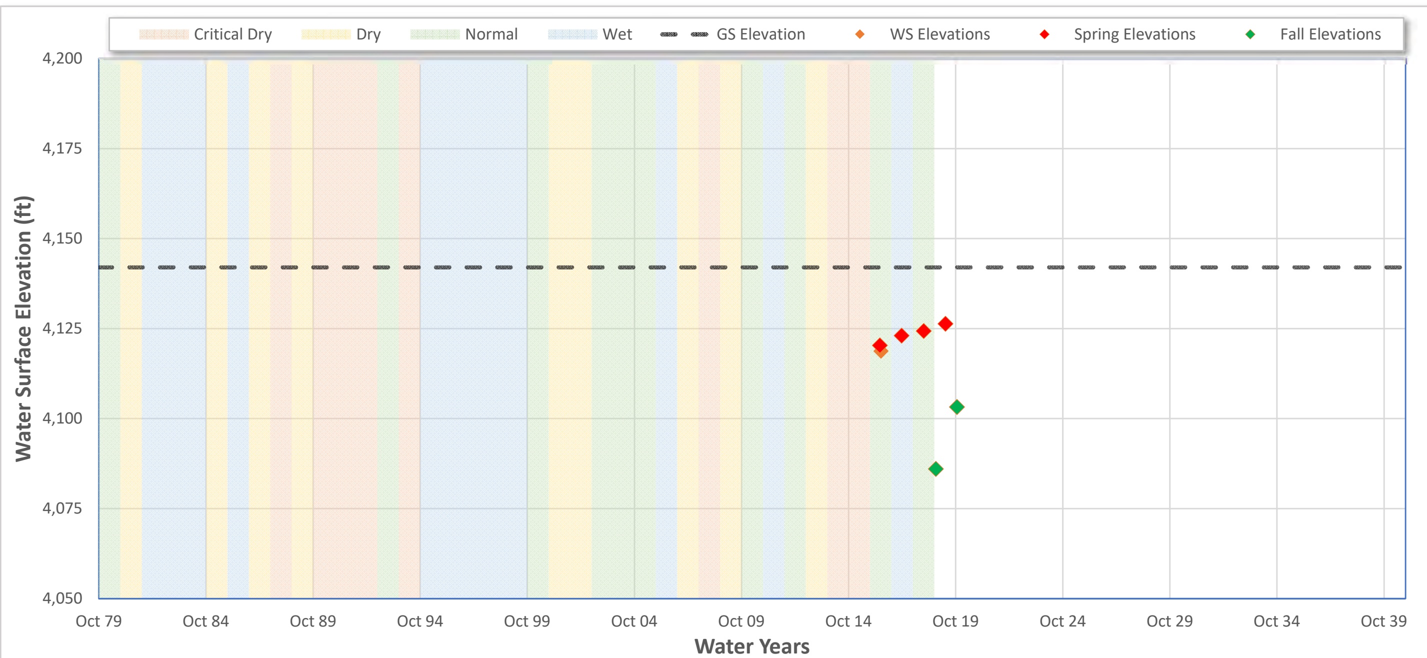
Well Period of Record

Period-of-Record		2016..2020
WS Elev-Range	Min:	4039.2 ft
	Max	4126.4 ft

Trend Analysys

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	1.889 ft/yr
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

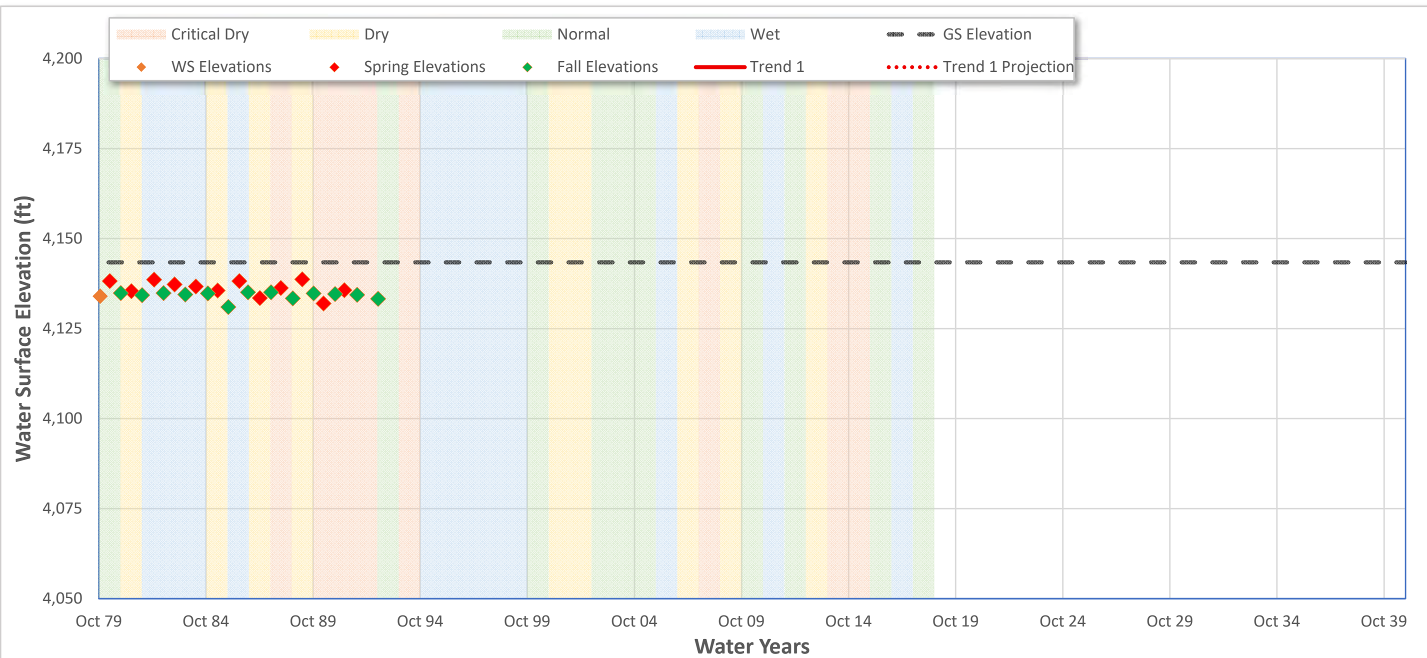
Date: 2/19/2020

Well Information	
Well ID	086615-38N07E12G001M
Alternate Name	38N07E12G001M
State Number	38N07E12G001M
CASGEM ID	411467N1211110W001
Well Location	
County	Lassen
Basin	BIG VALLEY
Sub-Basin	-
Well Type Information	
Well Type	-
Well Use	Residential
Completion Type	Single

Well Coordinates/Geometry		
Location	Lat:	41.1467
	Long:	-121.1110
Well Delth		116.00 ft
Ground Surface Elevation		4143.38 ft
Ref. Point Elevation		4144.38 ft
Well Period of Record		
Period-of-Record		1979..1993
WS Elev-Range	Min:	4131.0 ft
	Max	4138.7 ft

Trend Analysys		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	-
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

Date: 2/19/2020

Well Information	
Well ID	086206-ACWA-2
Alternate Name	ACWA-2
State Number	39N08E33P002M
CASGEM ID	411699N1210579W001

Well Location	
County	Lassen
Basin	BIG VALLEY
Sub-Basin	-

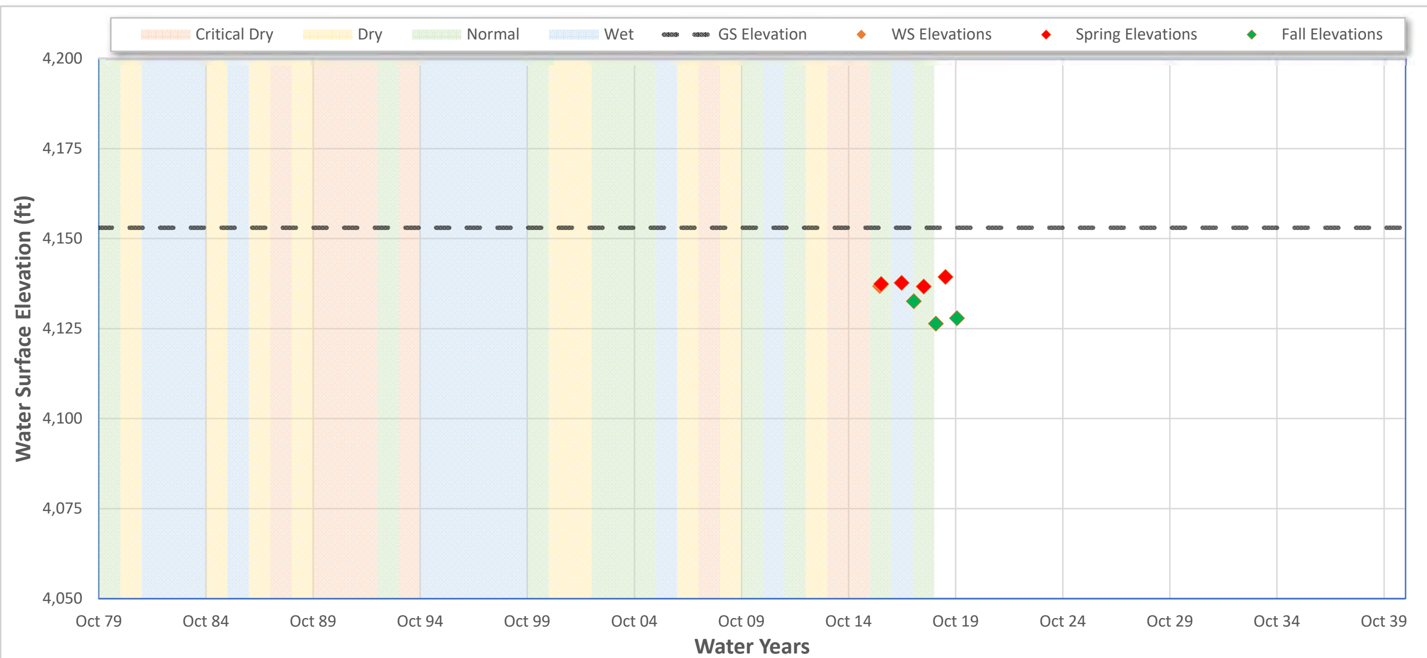
Well Type Information	
Well Type	-
Well Use	Irrigation
Completion Type	Single

Well Coordinates/Geometry		
Location	Lat:	41.1699
	Long:	-121.0579
Well Delth		800.00 ft
Ground Surface Elevation		4153.00 ft
Ref. Point Elevation		4153.20 ft

Well Period of Record		
Period-of-Record		2016..2020
WS Elev-Range	Min:	4126.4 ft
	Max	4139.4 ft

Trend Analysys		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	0.484 ft/yr
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

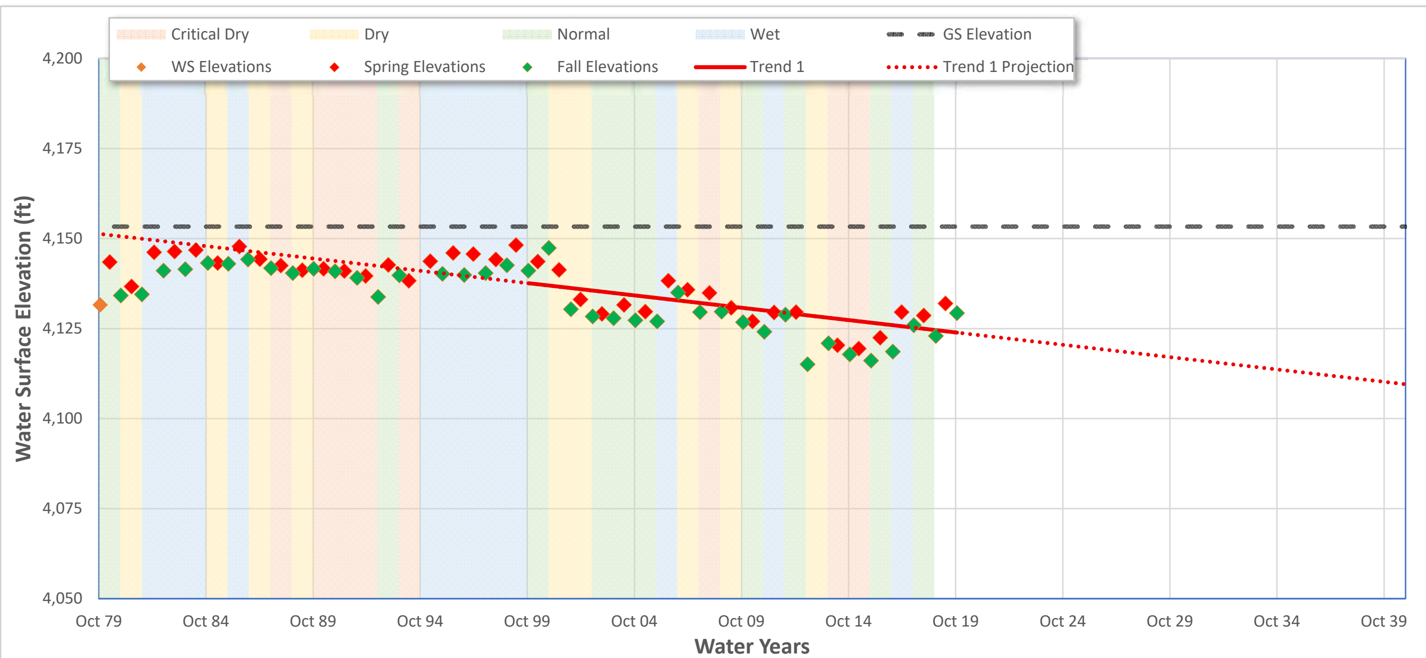
Date: 2/19/2020

Well Information	
Well ID	087193-38N08E17K001M
Alternate Name	38N08E17K001M
State Number	38N08E17K001M
CASGEM ID	411320N1210766W001
Well Location	
County	Lassen
Basin	BIG VALLEY
Sub-Basin	-
Well Type Information	
Well Type	-
Well Use	Residential
Completion Type	Single

Well Coordinates/Geometry		
Location	Lat:	41.1320
	Long:	-121.0766
Well Delth		180.00 ft
Ground Surface Elevation		4153.30 ft
Ref. Point Elevation		4154.30 ft
Well Period of Record		
Period-of-Record		1957..2020
WS Elev-Range	Min:	4115.1 ft
	Max	4150.0 ft

Trend Analysys		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	(0.685 ft/yr)
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

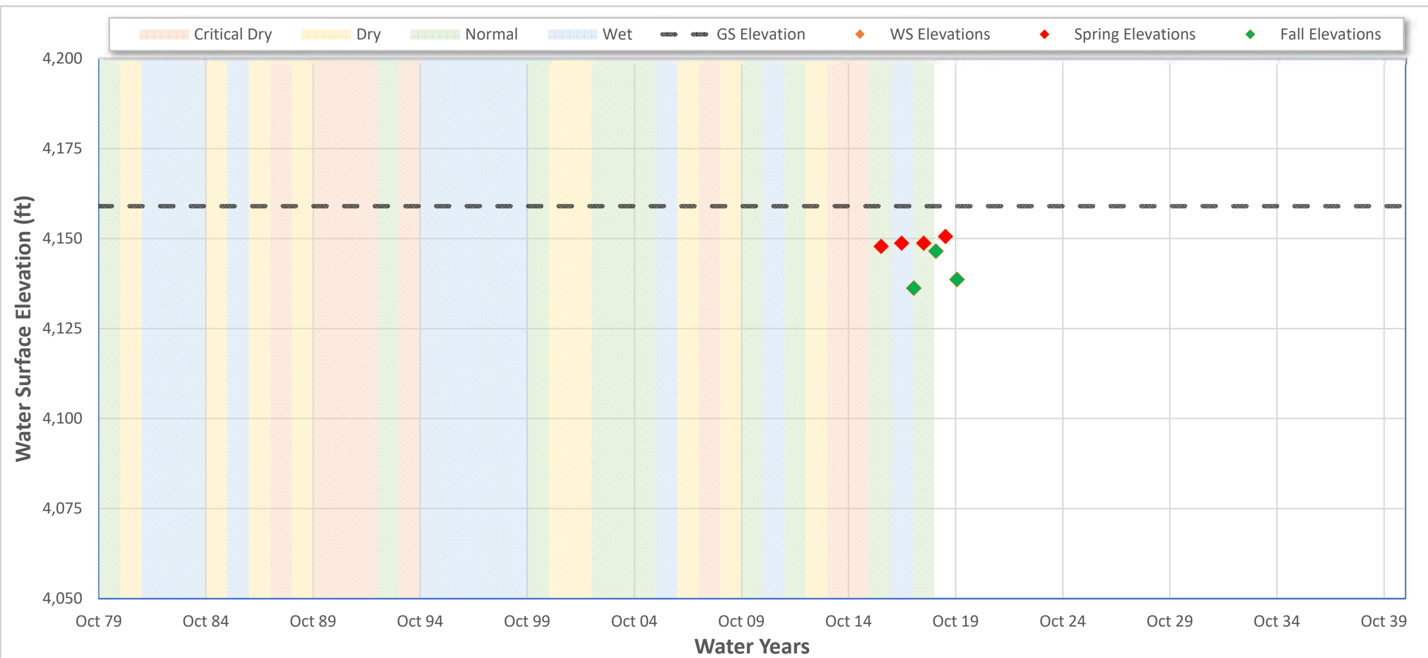
Date: 2/19/2020

Well Information	
Well ID	087526-ACWA-3
Alternate Name	ACWA-3
State Number	39N08E28A001M
CASGEM ID	411938N1210478W001
Well Location	
County	Modoc
Basin	BIG VALLEY
Sub-Basin	-
Well Type Information	
Well Type	-
Well Use	Irrigation
Completion Type	Single

Well Coordinates/Geometry		
Location	Lat:	41.1938
	Long:	-121.0478
Well Delth		720.00 ft
Ground Surface Elevation		4159.00 ft
Ref. Point Elevation		4159.83 ft
Well Period of Record		
Period-of-Record		2016..2020
WS Elev-Range	Min:	4136.2 ft
	Max	4150.6 ft

Trend Analysys		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	0.821 ft/yr
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

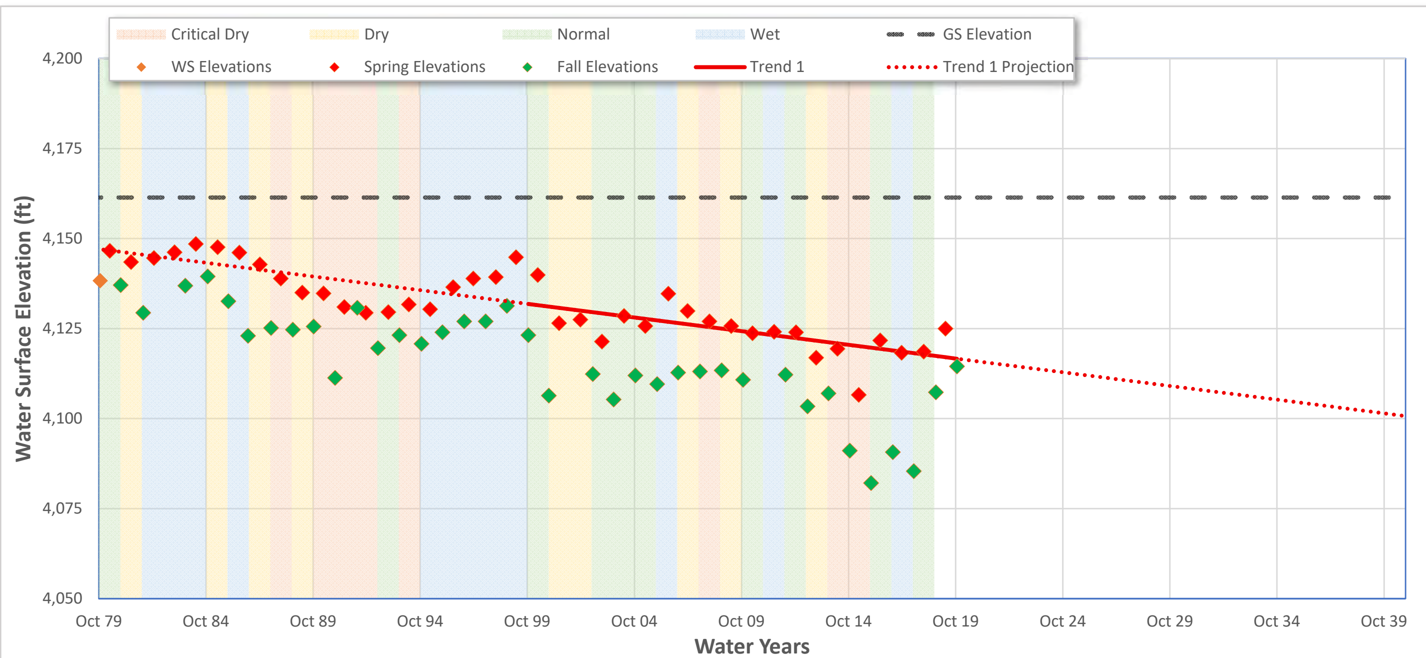
Date: 2/19/2020

Well Information	
Well ID	087201-39N08E21C001M
Alternate Name	39N08E21C001M
State Number	39N08E21C001M
CASGEM ID	412086N1210574W001
Well Location	
County	Modoc
Basin	BIG VALLEY
Sub-Basin	-
Well Type Information	
Well Type	-
Well Use	Irrigation
Completion Type	Single

Well Coordinates/Geometry		
Location	Lat:	41.2084
	Long:	-121.0576
Well Delth		300.00 ft
Ground Surface Elevation		4161.40 ft
Ref. Point Elevation		4161.70 ft
Well Period of Record		
Period-of-Record		1979..2020
WS Elev-Range	Min:	4082.1 ft
	Max	4148.5 ft

Trend Analysys		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	(0.760 ft/yr)
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

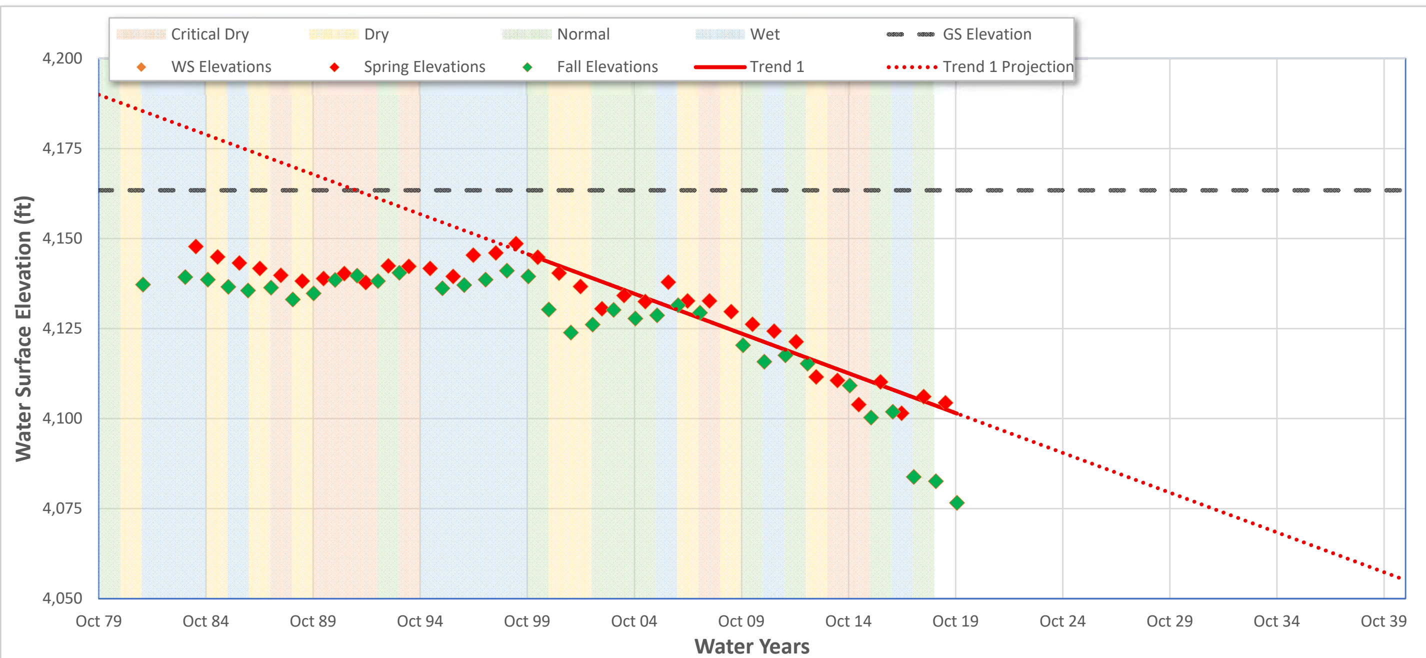
Date: 2/19/2020

Well Information	
Well ID	087191-38N08E03D001M
Alternate Name	38N08E03D001M
State Number	38N08E03D001M
CASGEM ID	411647N1210358W001
Well Location	
County	Lassen
Basin	BIG VALLEY
Sub-Basin	-
Well Type Information	
Well Type	-
Well Use	Irrigation
Completion Type	Single

Well Coordinates/Geometry		
Location	Lat:	41.1646
	Long:	-121.0360
Well Delth		280.00 ft
Ground Surface Elevation		4163.40 ft
Ref. Point Elevation		4163.40 ft
Well Period of Record		
Period-of-Record		1982..2020
WS Elev-Range	Min:	4076.6 ft
	Max	4148.6 ft

Trend Analsys		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	(2.210 ft/yr)
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

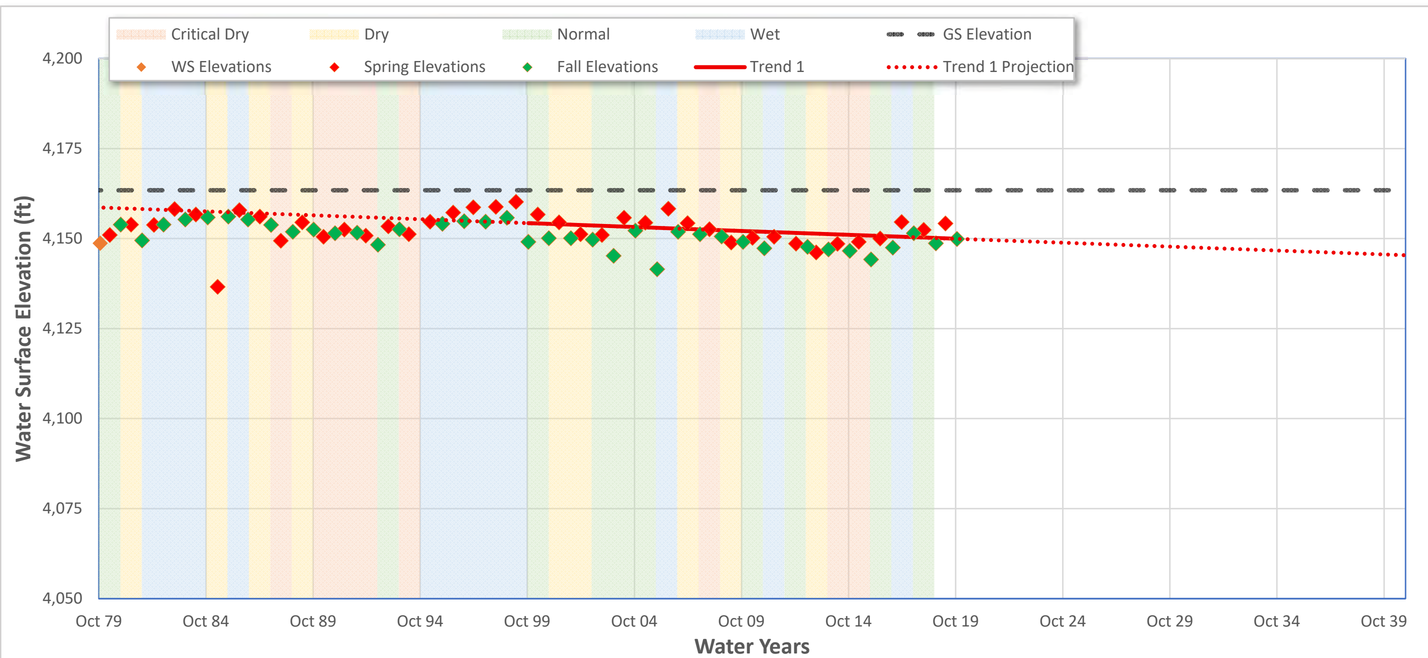
Date: 2/19/2020

Well Information	
Well ID	087200-39N08E18N002M
Alternate Name	39N08E18N002M
State Number	39N08E18N002M
CASGEM ID	412144N1211013W001
Well Location	
County	Modoc
Basin	BIG VALLEY
Sub-Basin	-
Well Type Information	
Well Type	-
Well Use	Residential
Completion Type	Single

Well Coordinates/Geometry		
Location	Lat:	41.2144
	Long:	-121.1013
Well Delth		250.00 ft
Ground Surface Elevation		4163.40 ft
Ref. Point Elevation		4164.40 ft
Well Period of Record		
Period-of-Record		1979..2020
WS Elev-Range	Min:	4136.6 ft
	Max	4160.2 ft

Trend Analysys		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	(0.217 ft/yr)
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

Date: 2/19/2020

Well Information

Well ID	087192-38N08E16D001M
Alternate Name	38N08E16D001M
State Number	38N08E16D001M
CASGEM ID	411359N1210625W001

Well Location

County	Lassen
Basin	BIG VALLEY
Sub-Basin	-

Well Type Information

Well Type	-
Well Use	Irrigation
Completion Type	Single

Well Coordinates/Geometry

Location	Lat:	41.1358
	Long:	-121.0625
Well Delth		491.00 ft
Ground Surface Elevation		4171.40 ft
Ref. Point Elevation		4171.60 ft

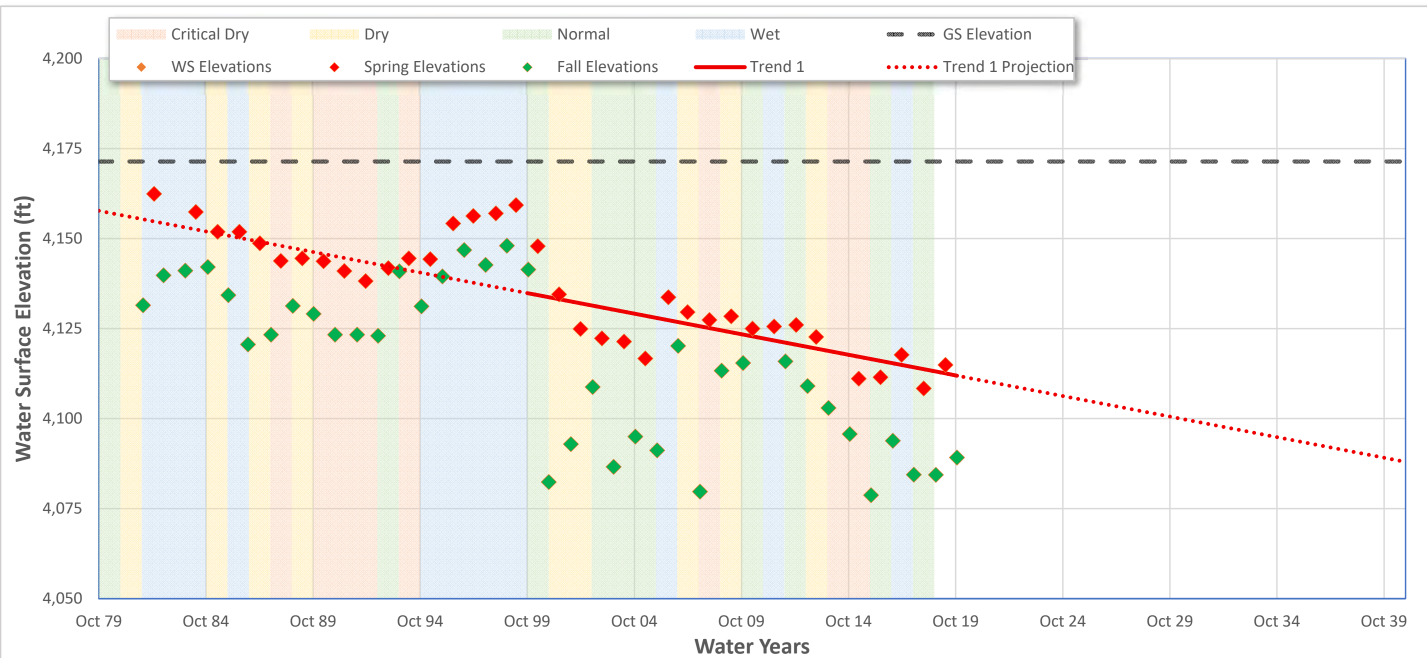
Well Period of Record

Period-of-Record		1982..2020
WS Elev-Range	Min:	4078.7 ft
	Max	4162.4 ft

Trend Analysys

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	(1.143 ft/yr)
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

Date: 2/19/2020

Well Information

Well ID	087197-39N07E01A001M
Alternate Name	39N07E01A001M
State Number	39N07E01A001M
CASGEM ID	412539N1211050W001

Well Location

County	Modoc
Basin	BIG VALLEY
Sub-Basin	-

Well Type Information

Well Type	-
Well Use	Stockwatering
Completion Type	Single

Well Coordinates/Geometry

Location	Lat:	41.2539
	Long:	-121.1050
Well Delth		300.00 ft
Ground Surface Elevation		4183.40 ft
Ref. Point Elevation		4184.40 ft

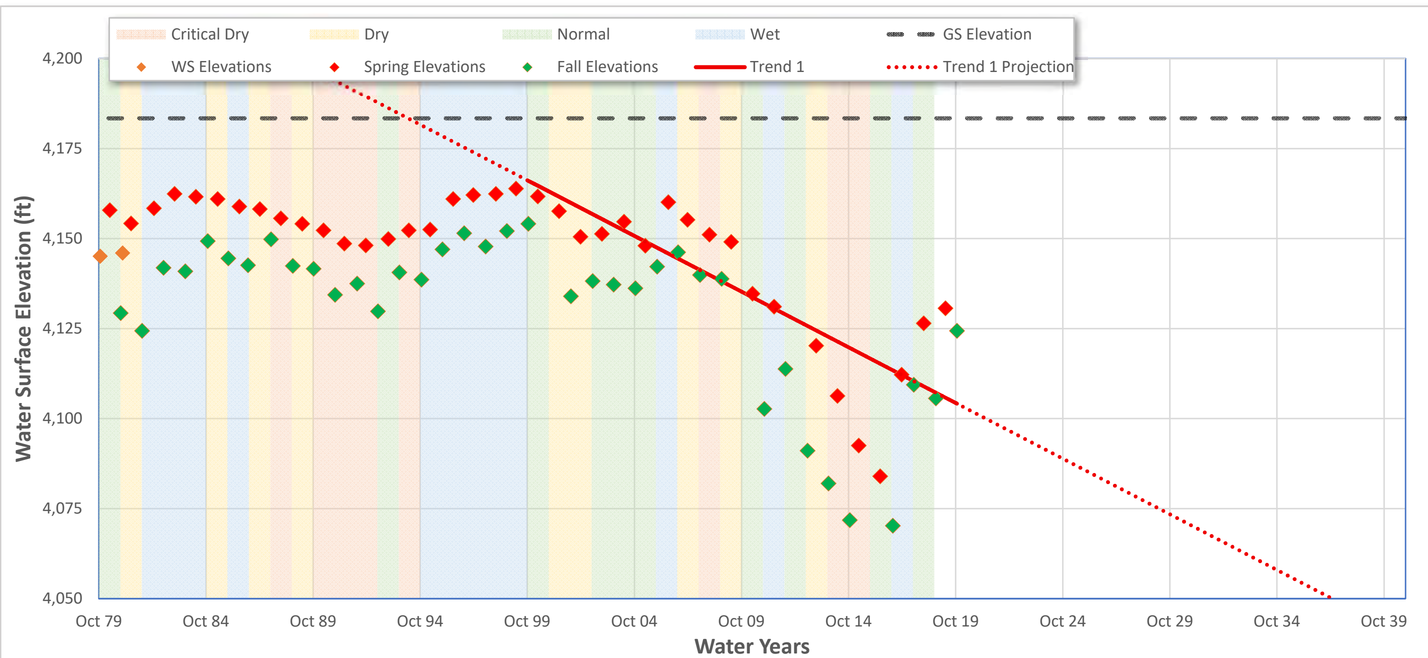
Well Period of Record

Period-of-Record		1979..2020
WS Elev-Range	Min:	4035.4 ft
	Max	4163.9 ft

Trend Analysys

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	(3.092 ft/yr)
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

Date: 2/19/2020

Well Information

Well ID	087204-39N09E28F001M
Alternate Name	39N09E28F001M
State Number	39N09E28F001M
CASGEM ID	411907N1209447W001

Well Location

County	Modoc
Basin	BIG VALLEY
Sub-Basin	-

Well Type Information

Well Type	-
Well Use	Residential
Completion Type	Single

Well Coordinates/Geometry

Location	Lat:	41.1907
	Long:	-120.9447
Well Delth		73.00 ft
Ground Surface Elevation		4206.60 ft
Ref. Point Elevation		4207.10 ft

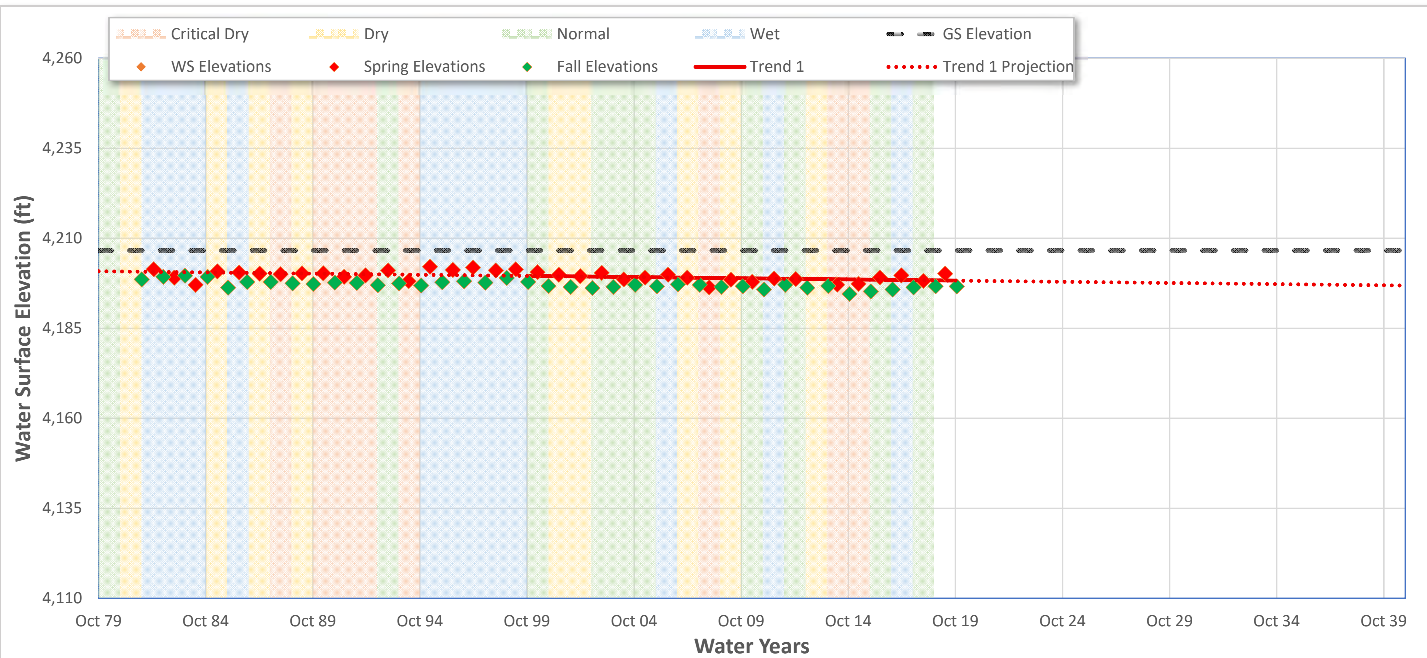
Well Period of Record

Period-of-Record		1982..2020
WS Elev-Range	Min:	4194.6 ft
	Max	4202.1 ft

Trend Analsys

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	(0.065 ft/yr)
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

Date: 2/19/2020

Well Information	
Well ID	087205-39N09E32R001M
Alternate Name	39N09E32R001M
State Number	39N09E32R001M
CASGEM ID	411649N1209569W001

Well Location	
County	Lassen
Basin	BIG VALLEY
Sub-Basin	-

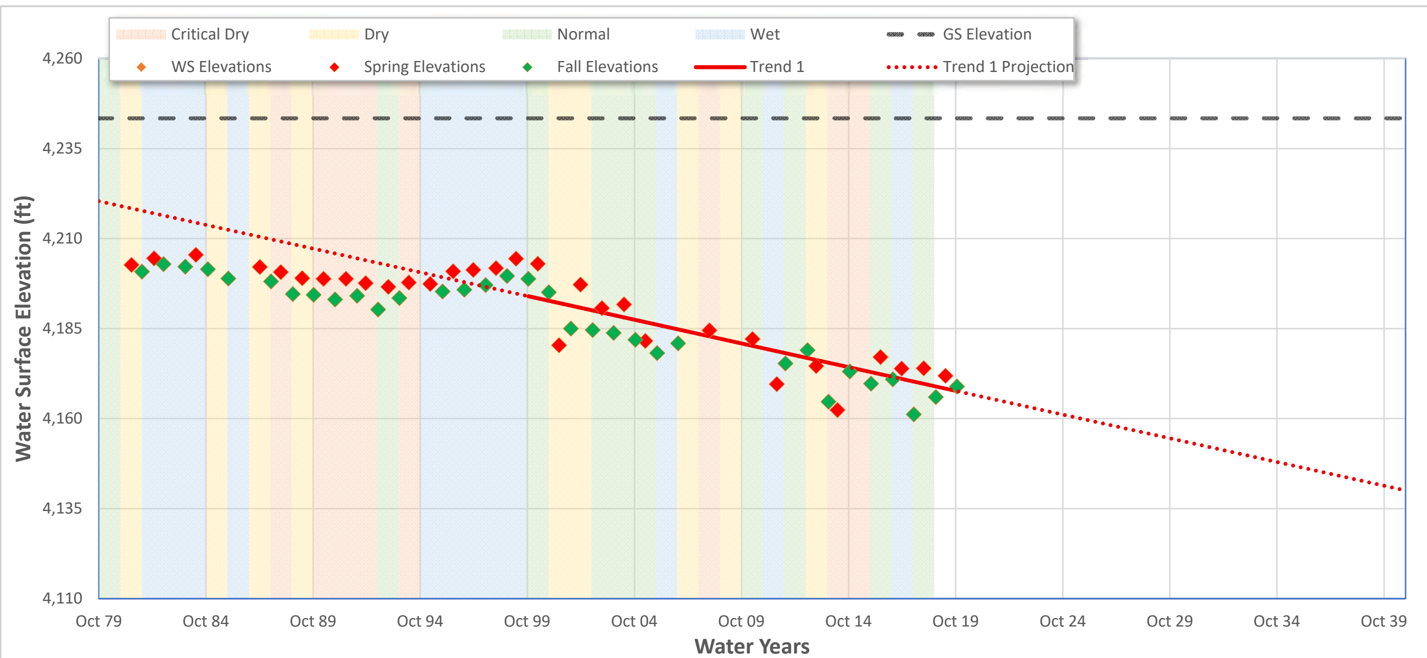
Well Type Information	
Well Type	-
Well Use	Irrigation
Completion Type	Single

Well Coordinates/Geometry		
Location	Lat:	41.1680
	Long:	-120.9570
Well Delth		-
Ground Surface Elevation		4243.40 ft
Ref. Point Elevation		4243.60 ft

Well Period of Record		
Period-of-Record		1981..2020
WS Elev-Range	Min:	4161.2 ft
	Max	4205.5 ft

Trend Analysys		
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	(1.317 ft/yr)
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

Date: 2/19/2020

Well Information

Well ID	087195-38N09E18E001M
Alternate Name	38N09E18E001M
State Number	38N09E18E001M
CASGEM ID	411356N1209900W001

Well Location

County	Lassen
Basin	BIG VALLEY
Sub-Basin	-

Well Type Information

Well Type	-
Well Use	Irrigation
Completion Type	Single

Well Coordinates/Geometry

Location	Lat:	41.1356
	Long:	-120.9900
Well Delth		520.00 ft
Ground Surface Elevation		4248.40 ft
Ref. Point Elevation		4249.50 ft

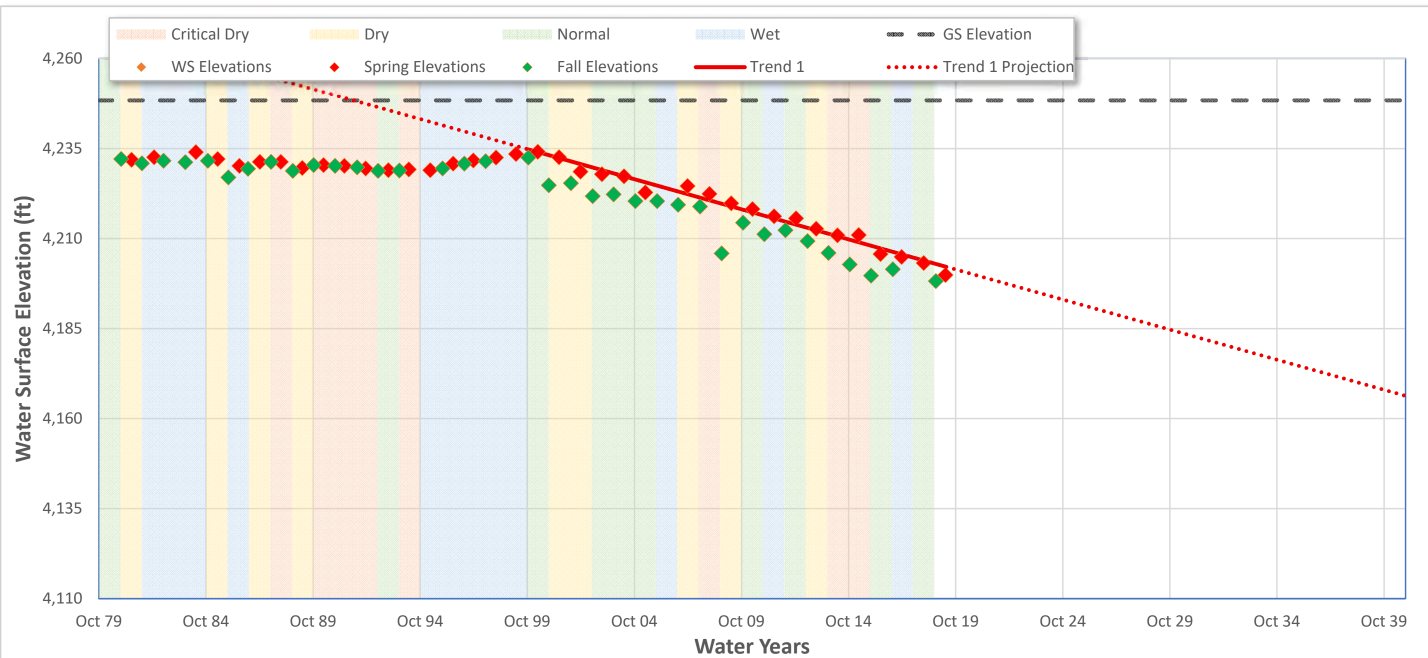
Well Period of Record

Period-of-Record		1981..2019
WS Elev-Range	Min:	4198.2 ft
	Max	4234.1 ft

Trend Analysys

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	(1.671 ft/yr)
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

Date: 2/19/2020

Well Information

Well ID	087194-38N09E08F001M
Alternate Name	38N09E08F001M
State Number	38N09E08F001M
CASGEM ID	411493N1209656W001

Well Location

County	Lassen
Basin	BIG VALLEY
Sub-Basin	-

Well Type Information

Well Type	-
Well Use	Other
Completion Type	Single

Well Coordinates/Geometry

Location	Lat:	41.1493
	Long:	-120.9656
Well Delth		217.00 ft
Ground Surface Elevation		4253.40 ft
Ref. Point Elevation		4255.40 ft

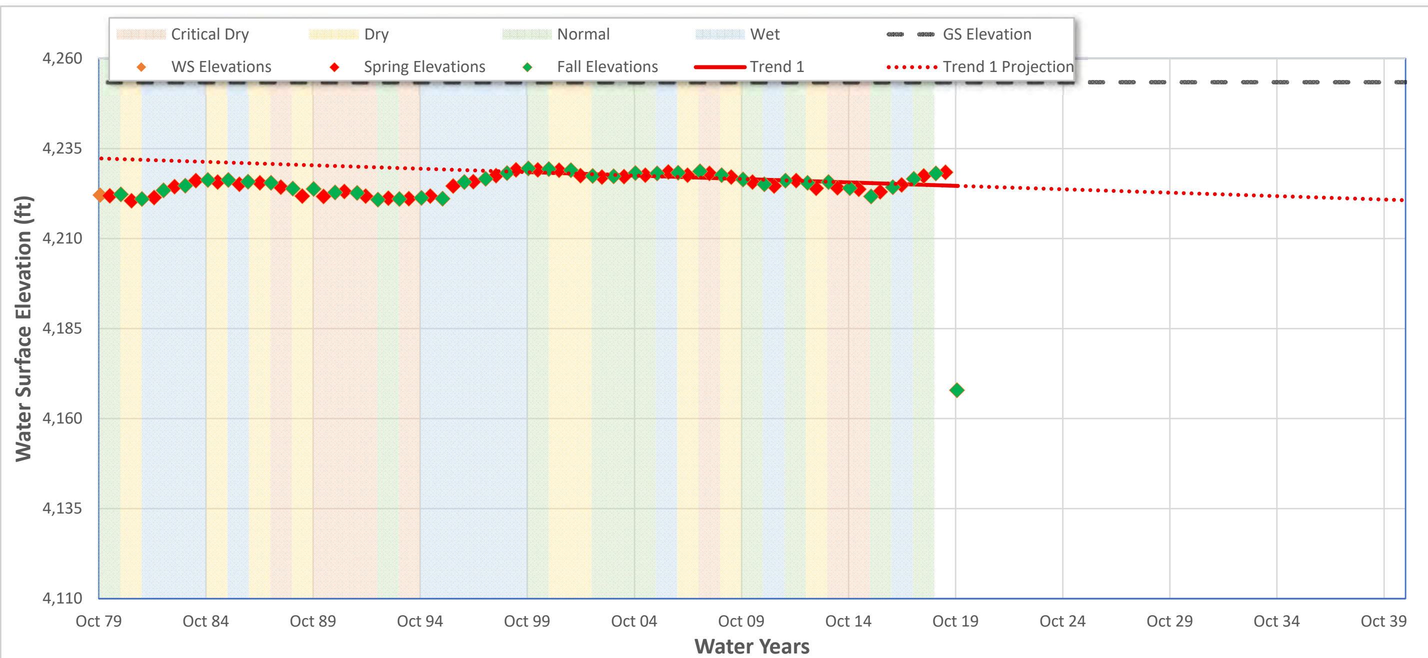
Well Period of Record

Period-of-Record		1979..2020
WS Elev-Range	Min:	4167.9 ft
	Max	4229.5 ft

Trend Analysys

Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	(0.190 ft/yr)
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Well Water Surface Level Report

Date: 2/19/2020

Well Information

Well ID	087196-38N09E18M001M
Alternate Name	38N09E18M001M
State Number	38N09E18M001M
CASGEM ID	411305N1209896W001

Well Location

County	Lassen
Basin	BIG VALLEY
Sub-Basin	-

Well Type Information

Well Type	-
Well Use	Irrigation
Completion Type	Single

Well Coordinates/Geometry

Location	Lat:	41.1305
	Long:	-120.9897
Well Delth		525.00 ft
Ground Surface Elevation		4288.40 ft
Ref. Point Elevation		4288.90 ft

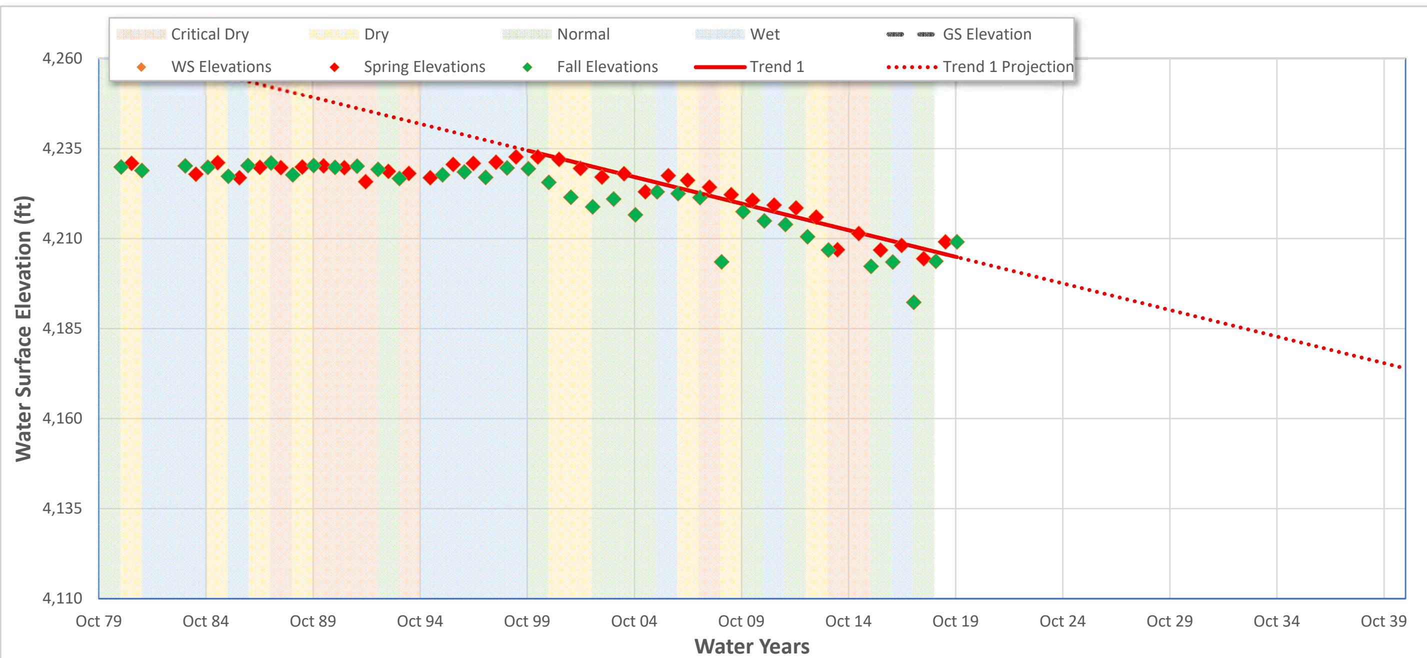
Well Period of Record

Period-of-Record		1981..2020
WS Elev-Range	Min:	4192.3 ft
	Max	4232.7 ft

Trend Analysys

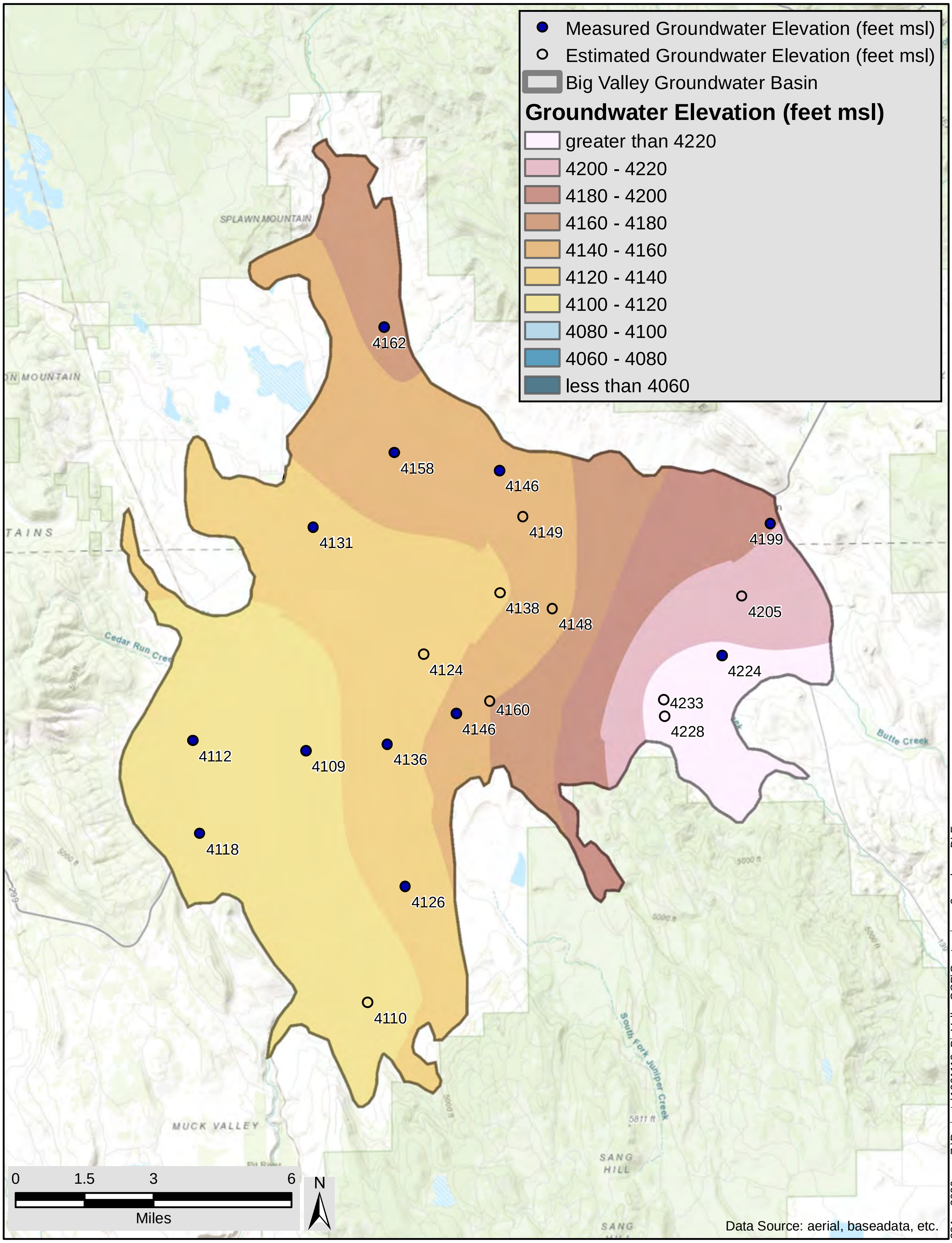
Seasonal Data Method		Max/Min
Show Trend 1		Spring Data
Date Range	Start WY:	2000
	End WY:	2040
Extend Trend Line		Yes
Trend Results	Slope	(1.477 ft/yr)
Show Trend 2		None
Date Range	Start WY:	
	End WY:	
Extend Trend Line		No
Trend Results	Slope	

Water Surface Elevation (WSE) Hydrograph



Appendix 5B

Groundwater Elevation Contours 1983 to 2018



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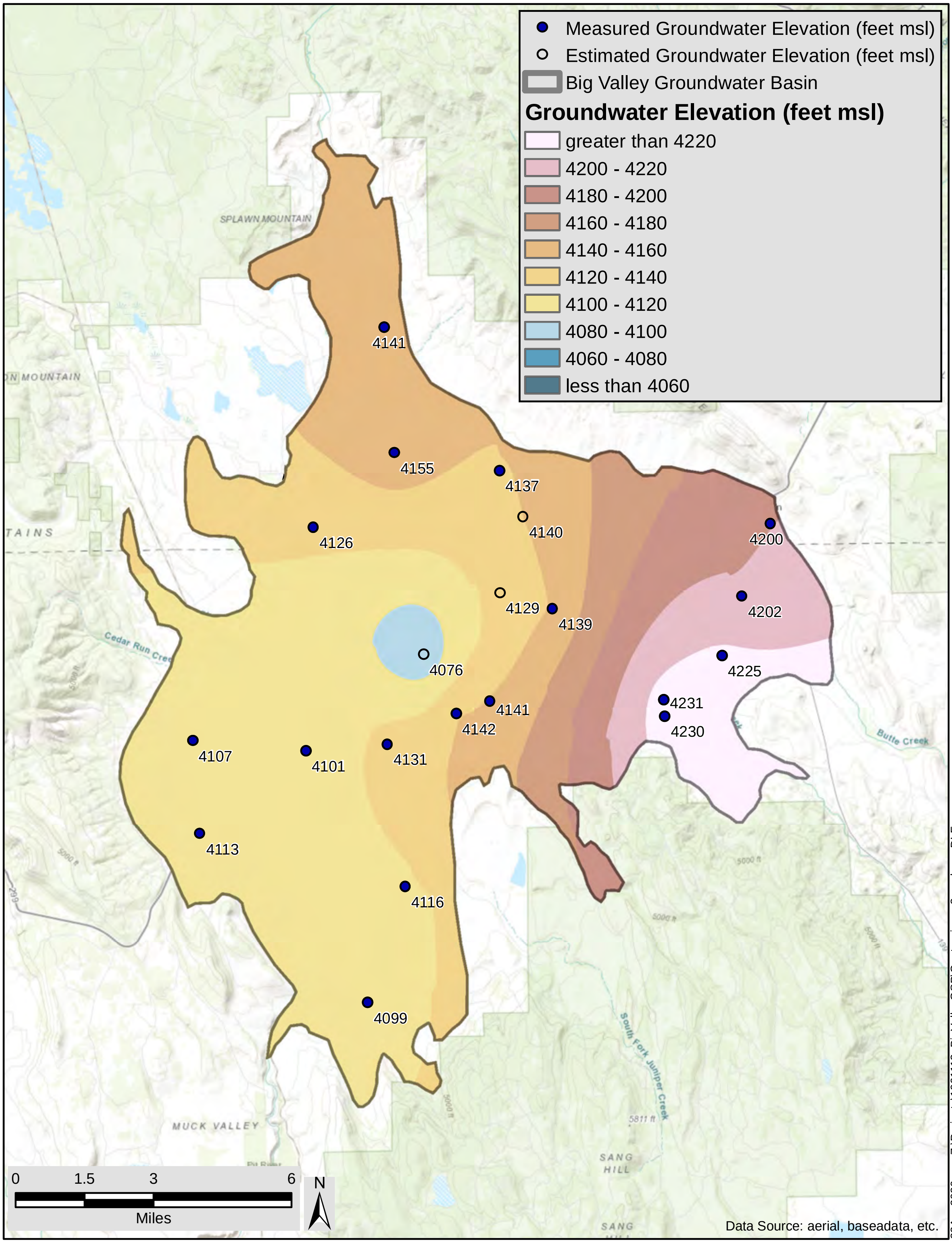
Big Valley Basin Groundwater Sustainability Plan Modoc and Lassen Counties, California	GEI Consultants	Groundwater Elevations Spring 1983
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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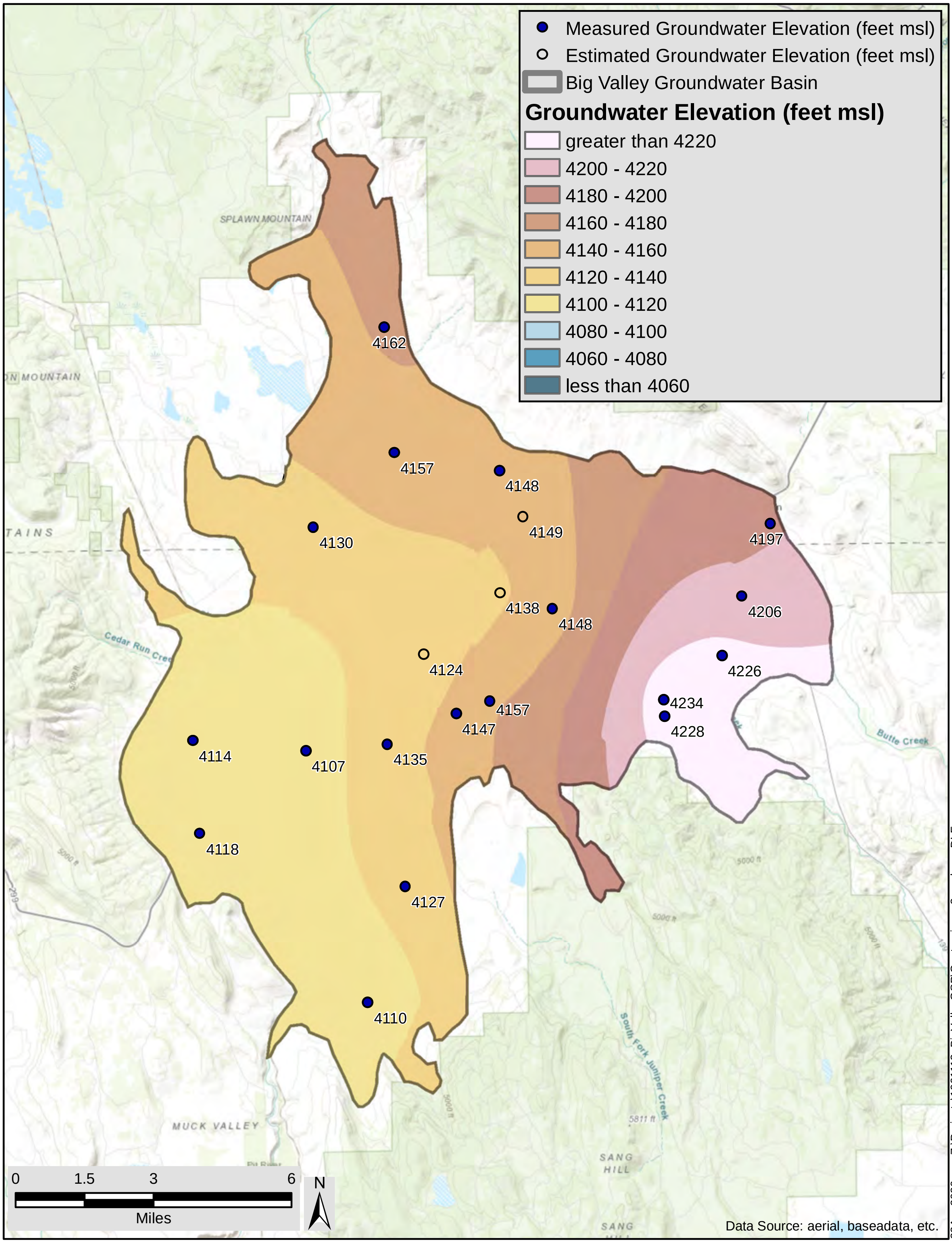
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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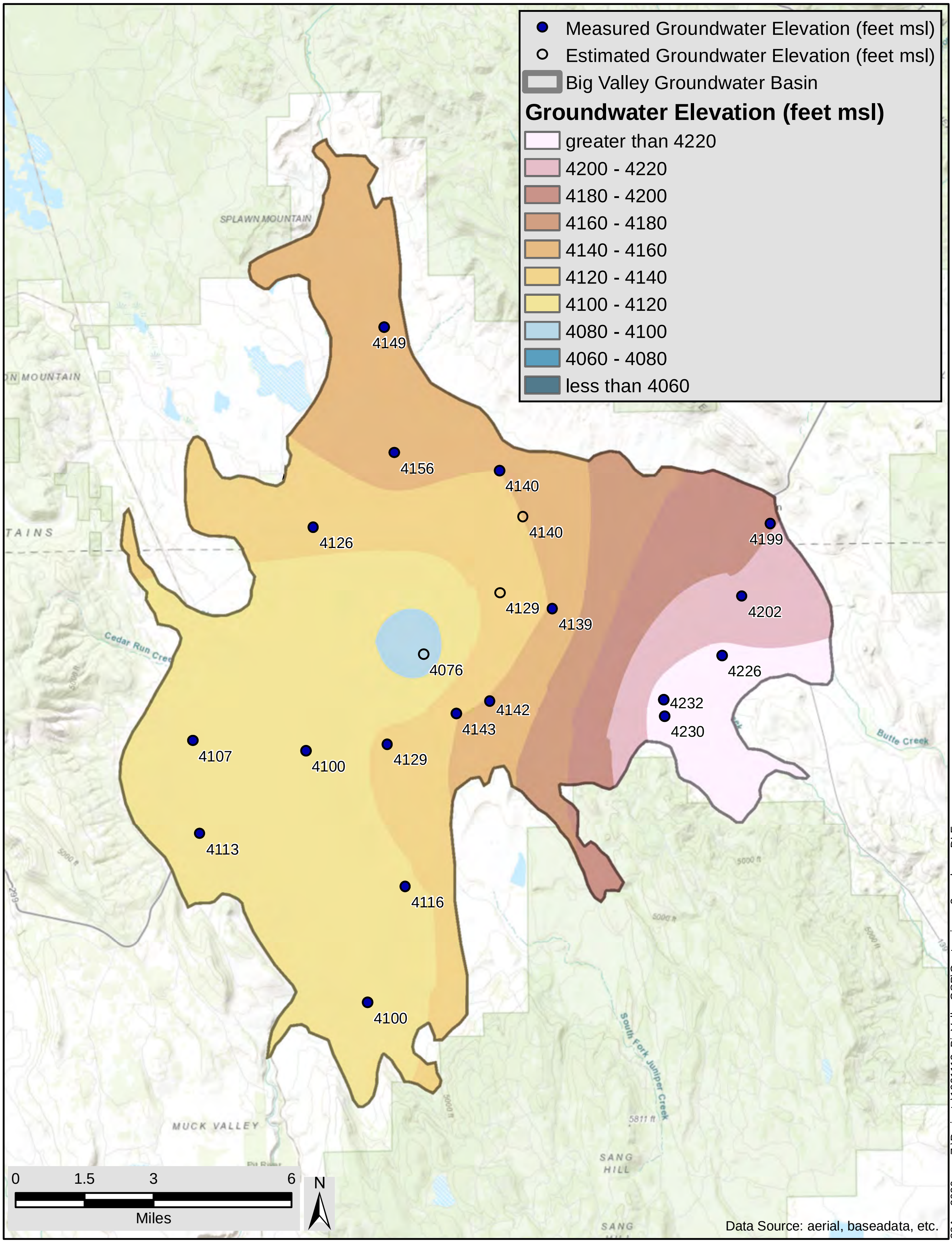
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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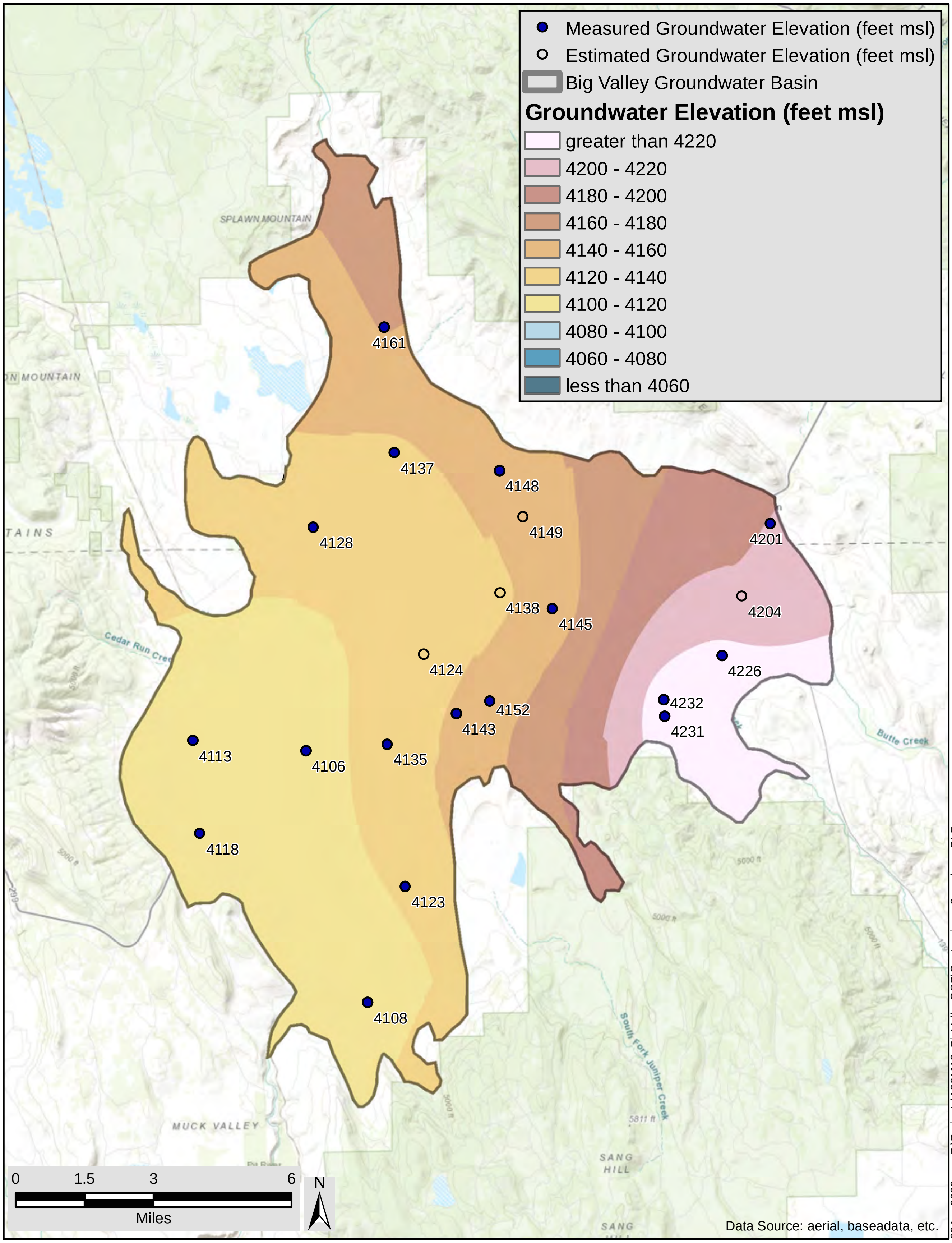
Big Valley Basin Groundwater Sustainability Plan Modoc and Lassen Counties, California	GEI Consultants	Groundwater Elevations Fall 1984
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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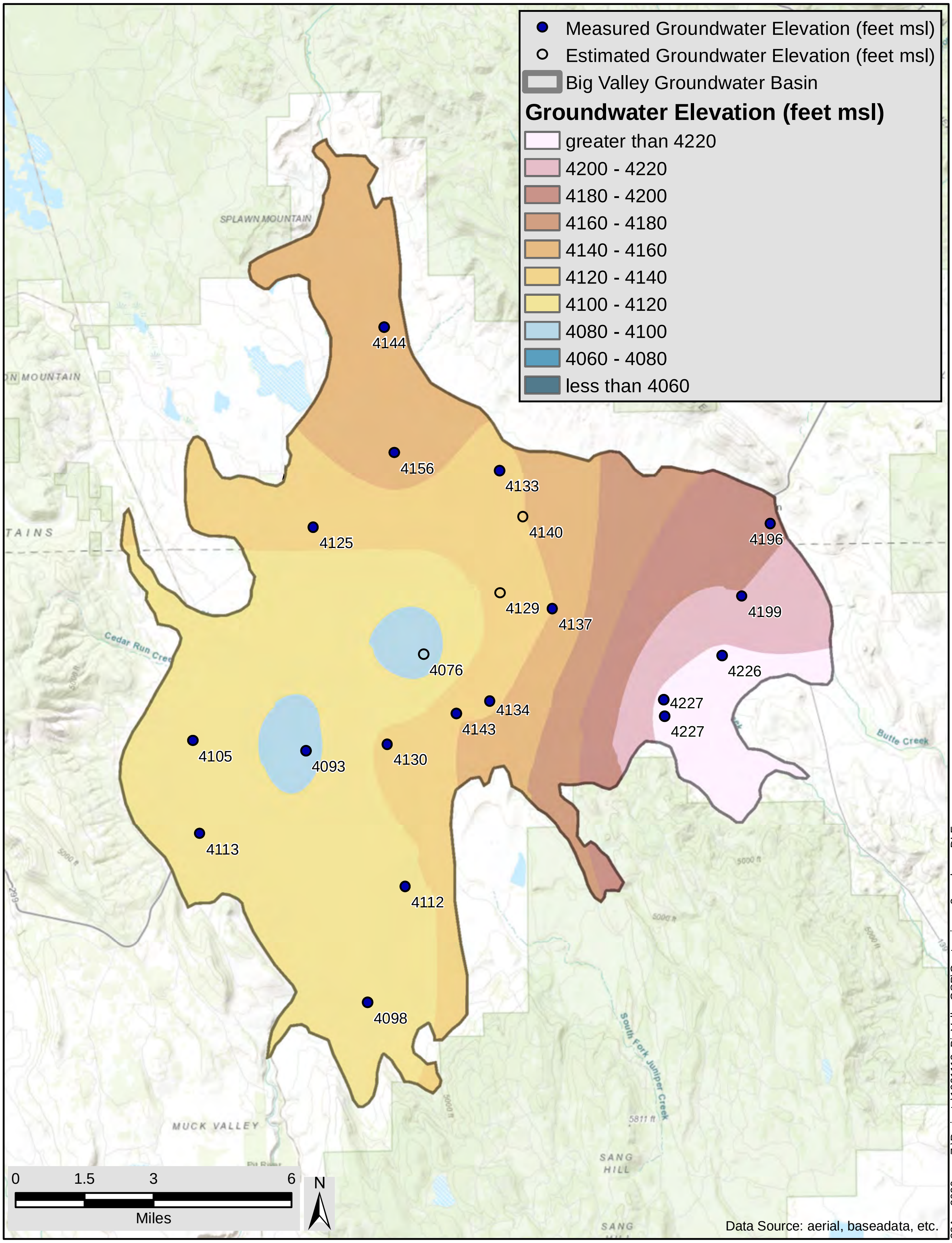
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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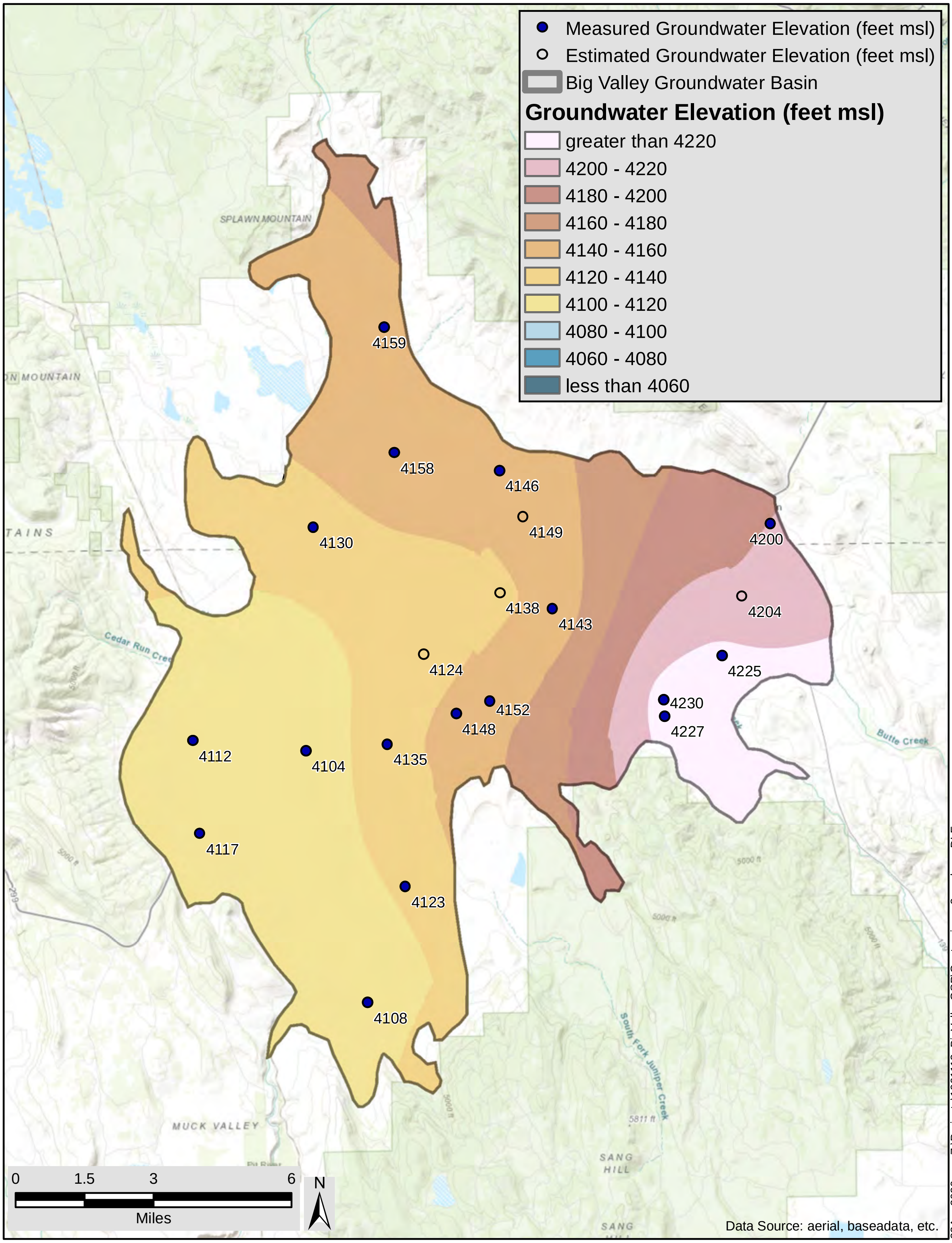
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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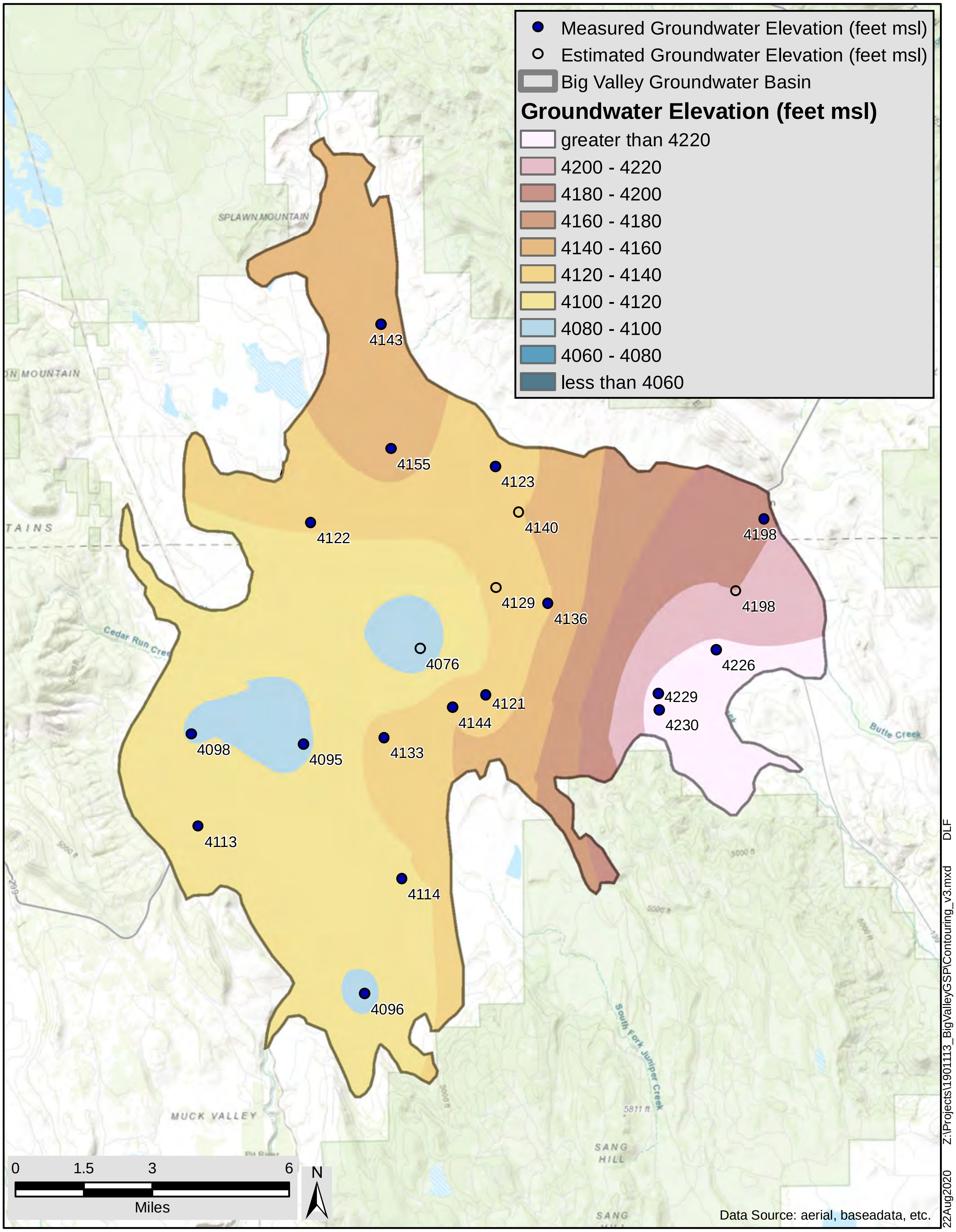
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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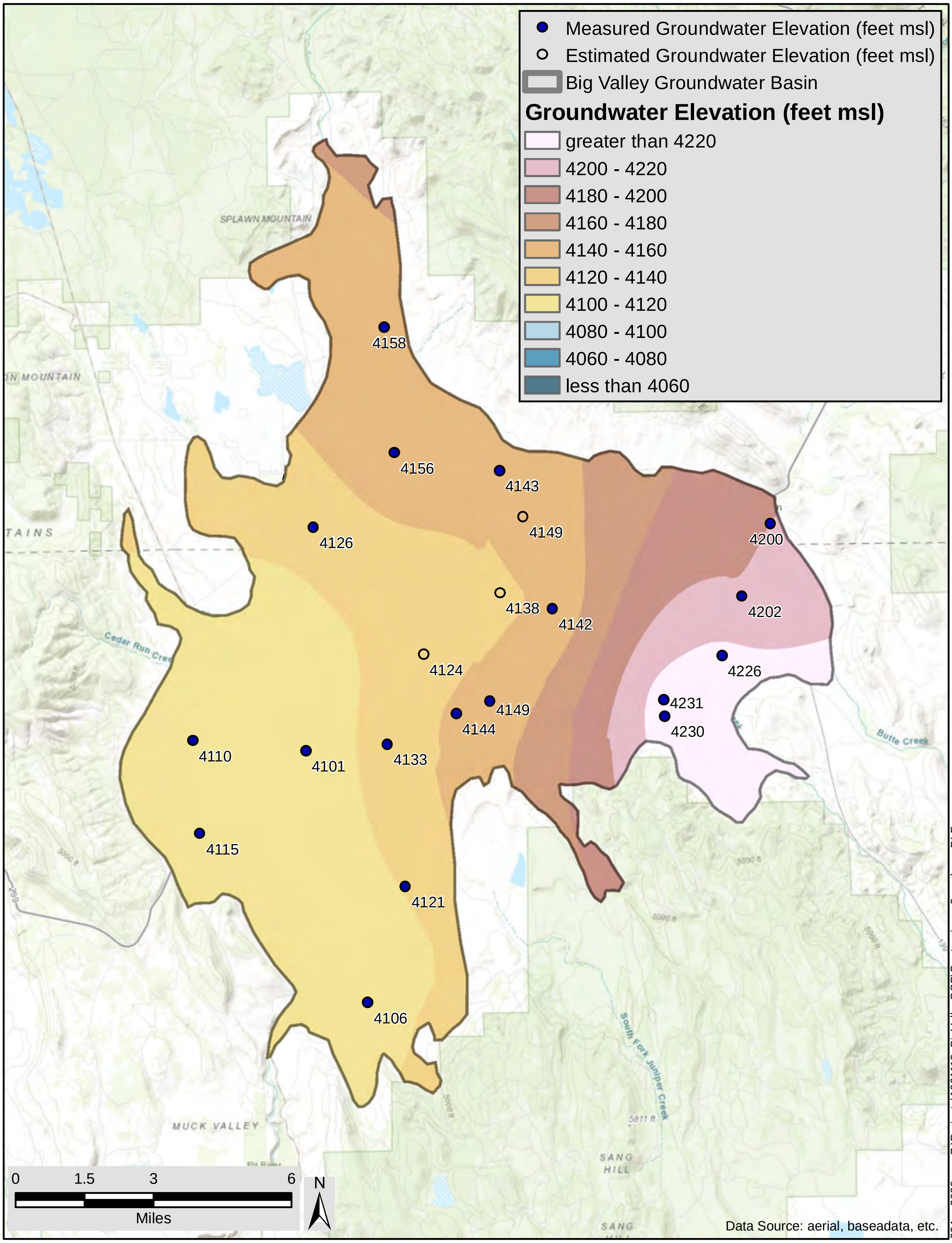

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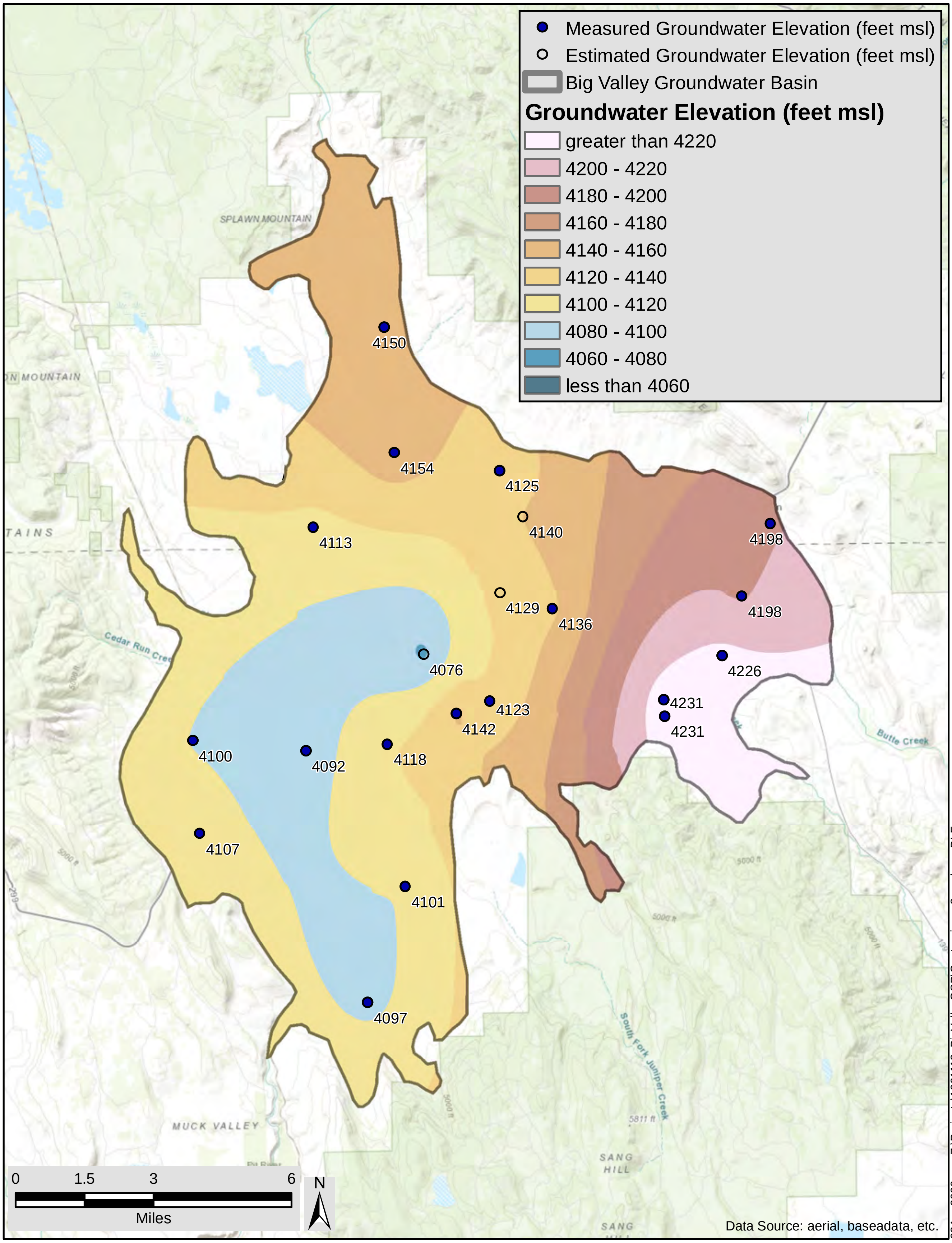

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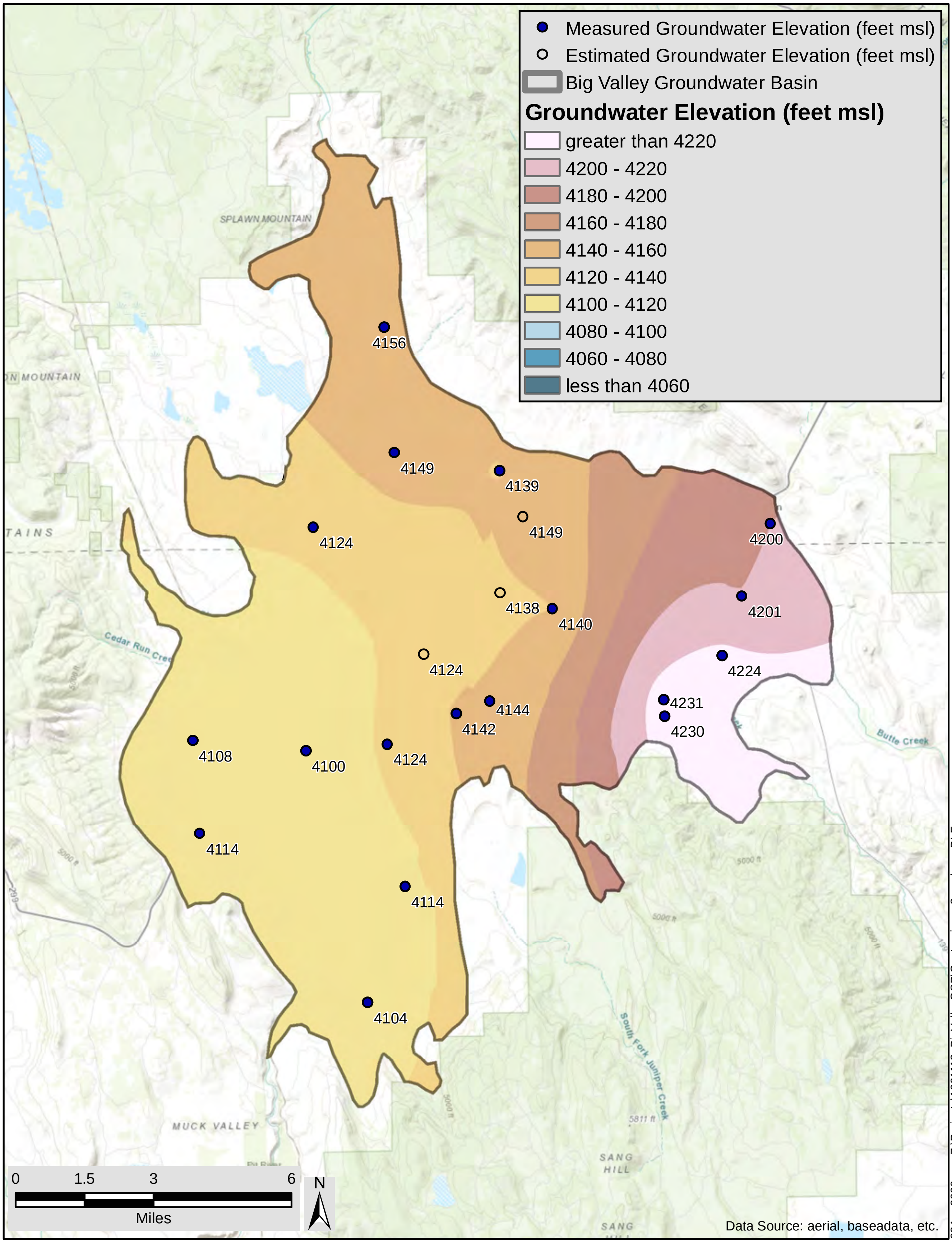
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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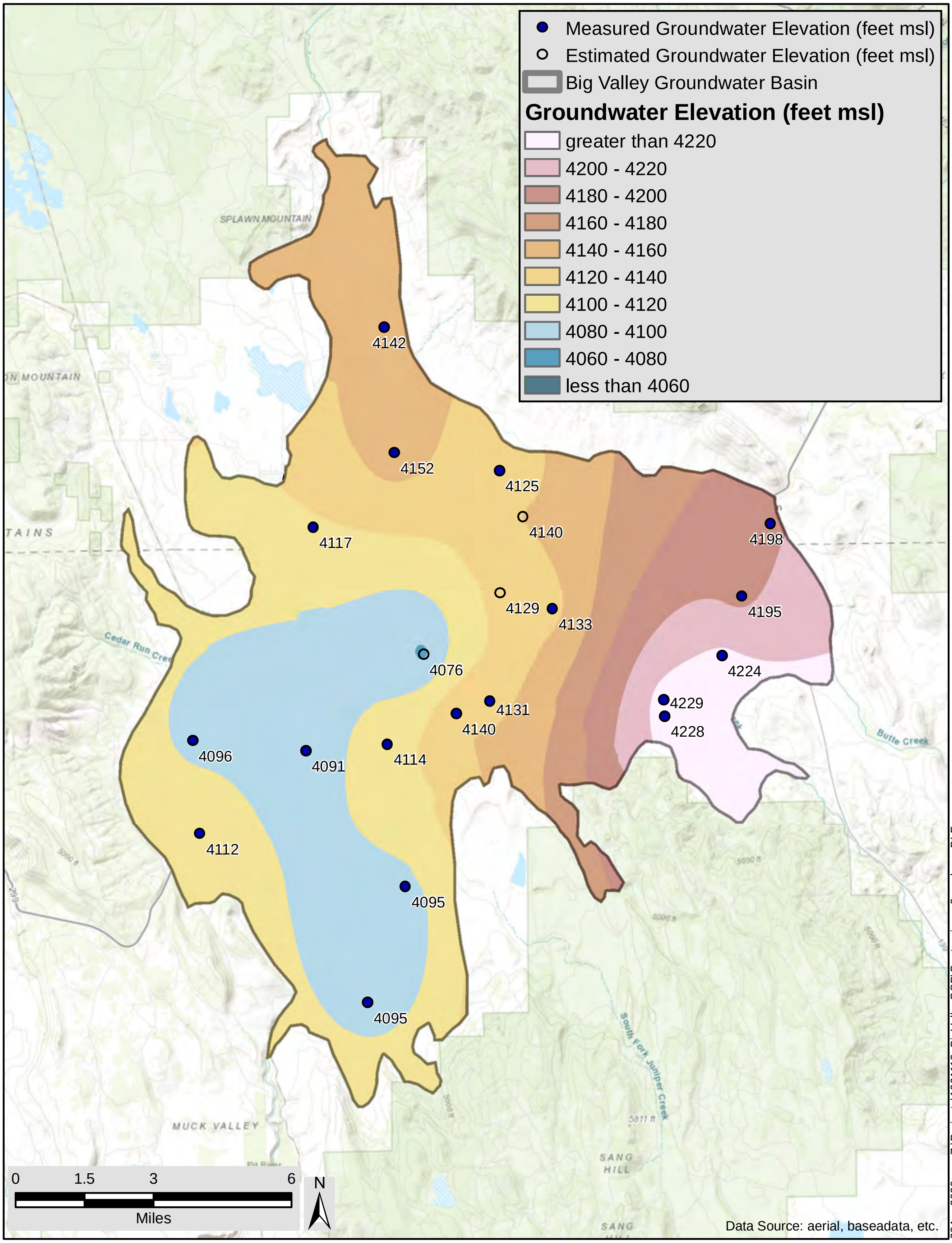

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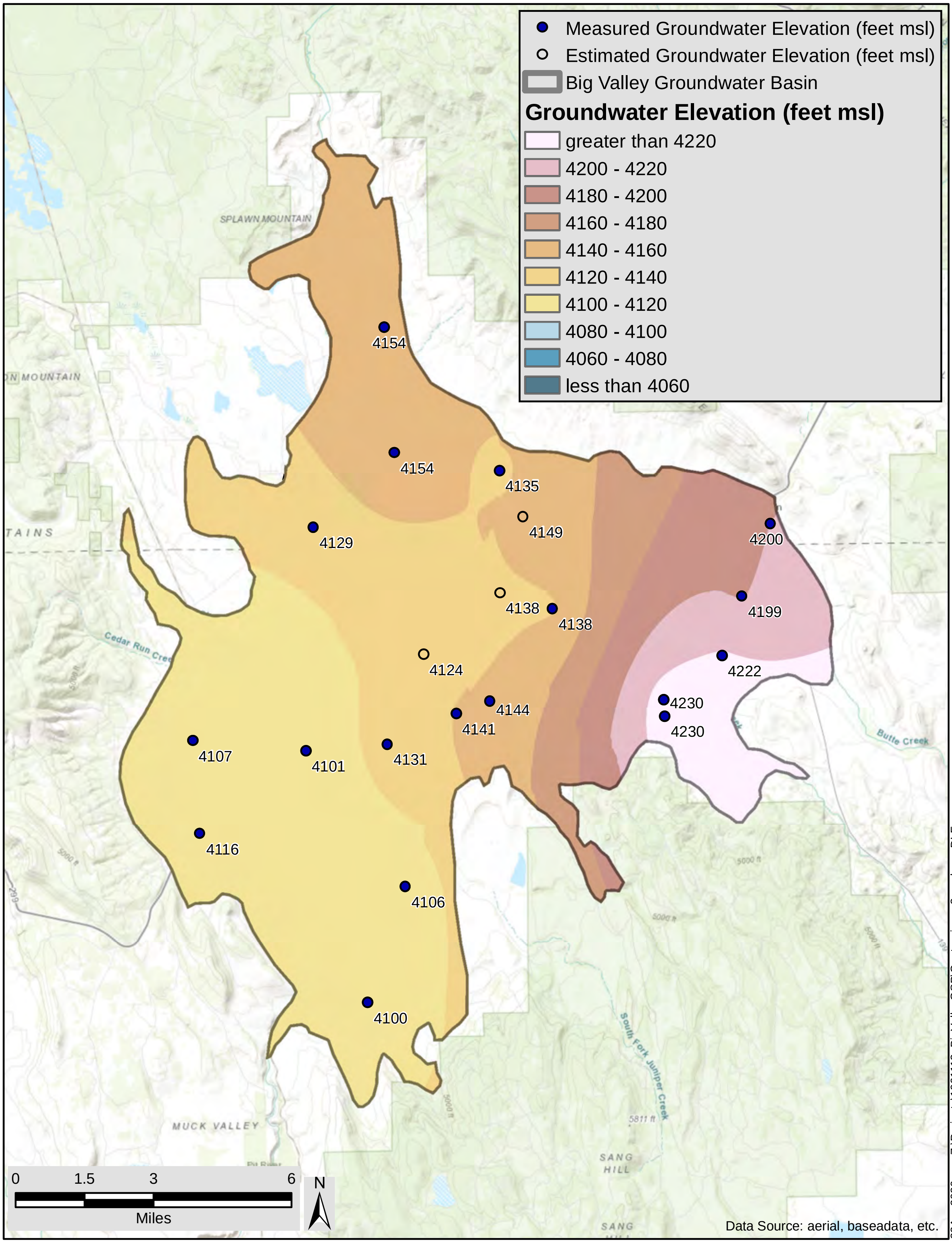
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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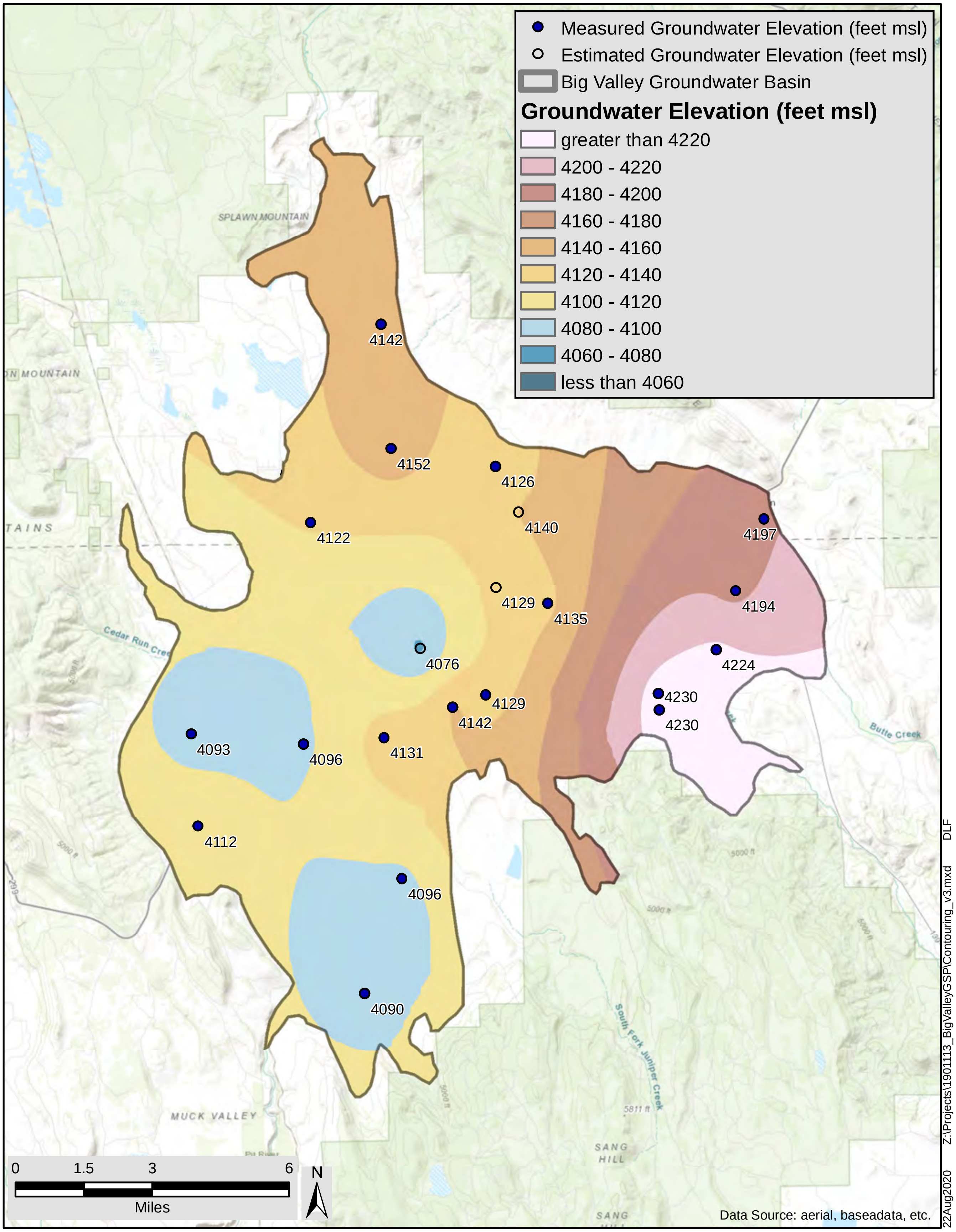
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



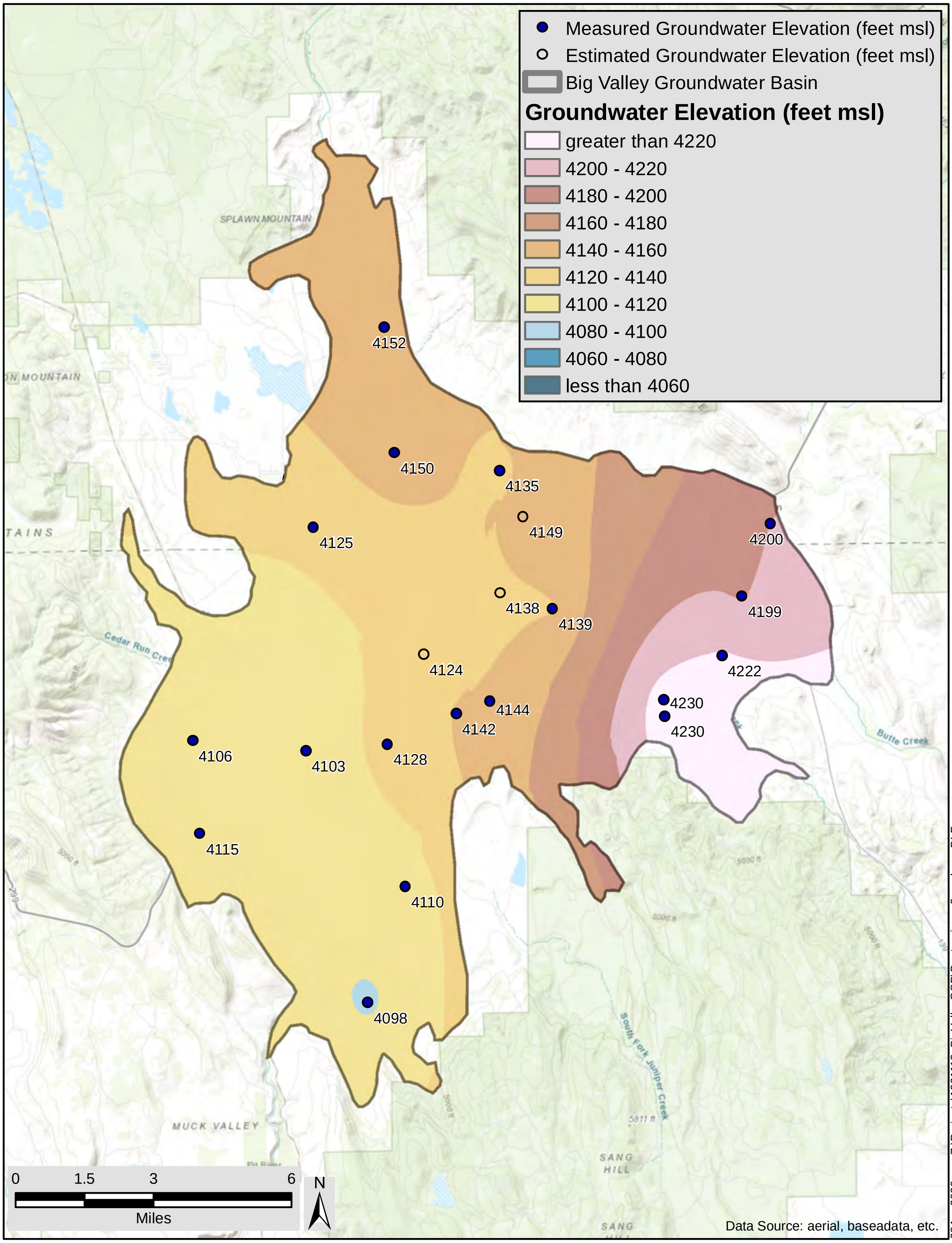
Big Valley Basin Groundwater Sustainability Plan
Modoc and Lassen Counties, California

Big Valley Groundwater Basin GSAs

GEI Consultants

Groundwater Elevations
Fall 1989

AUGUST 2020 DRAFT FIGURE



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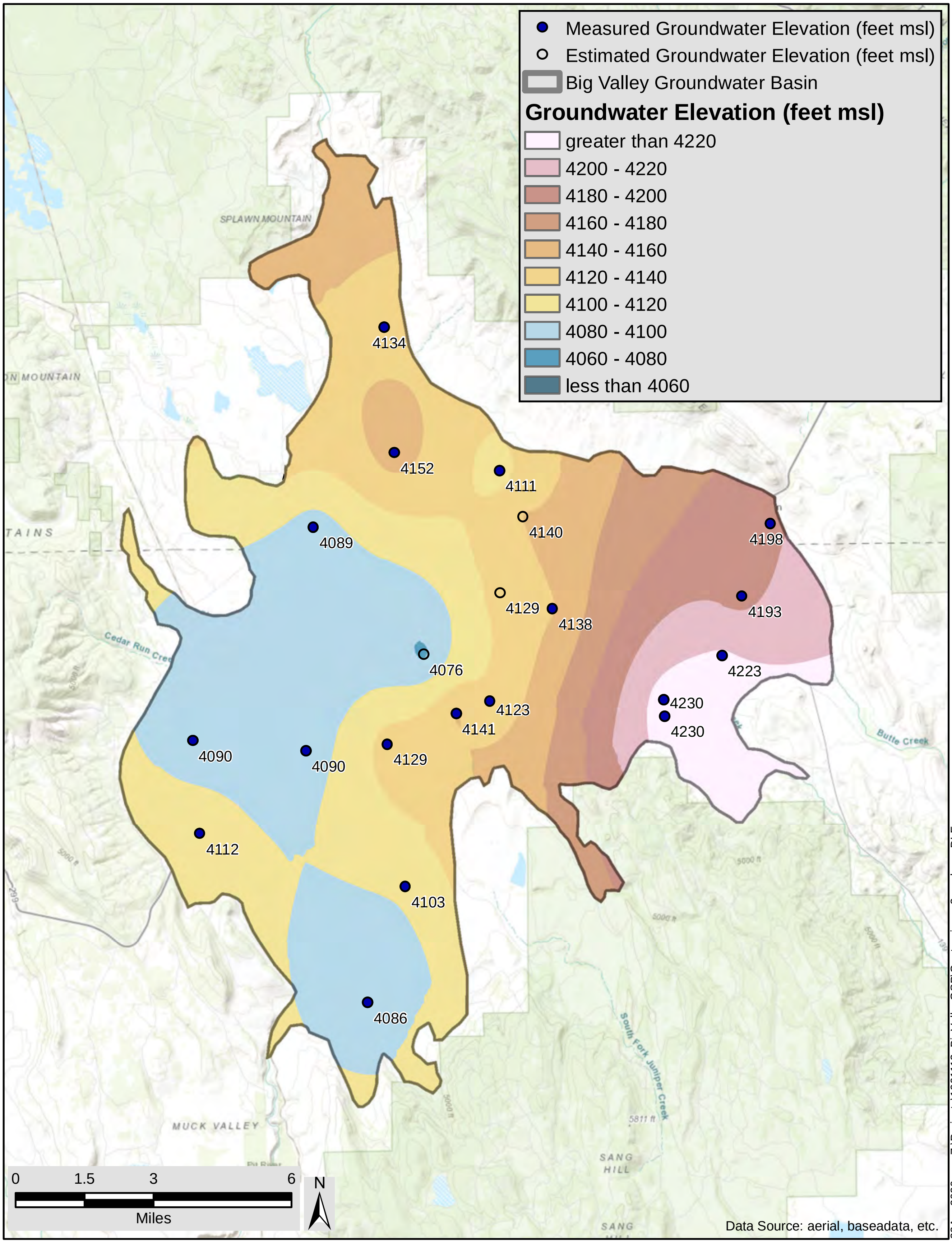

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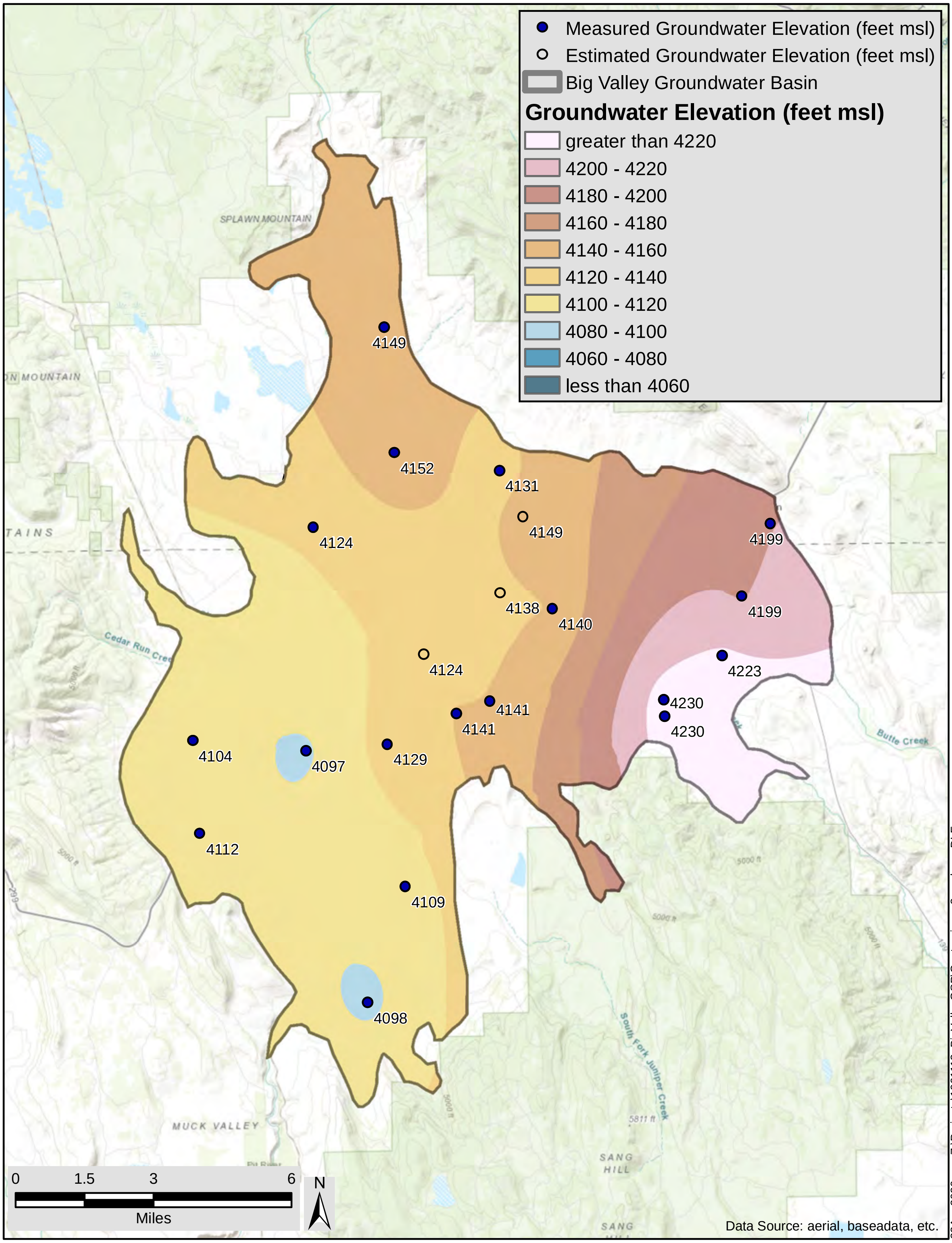

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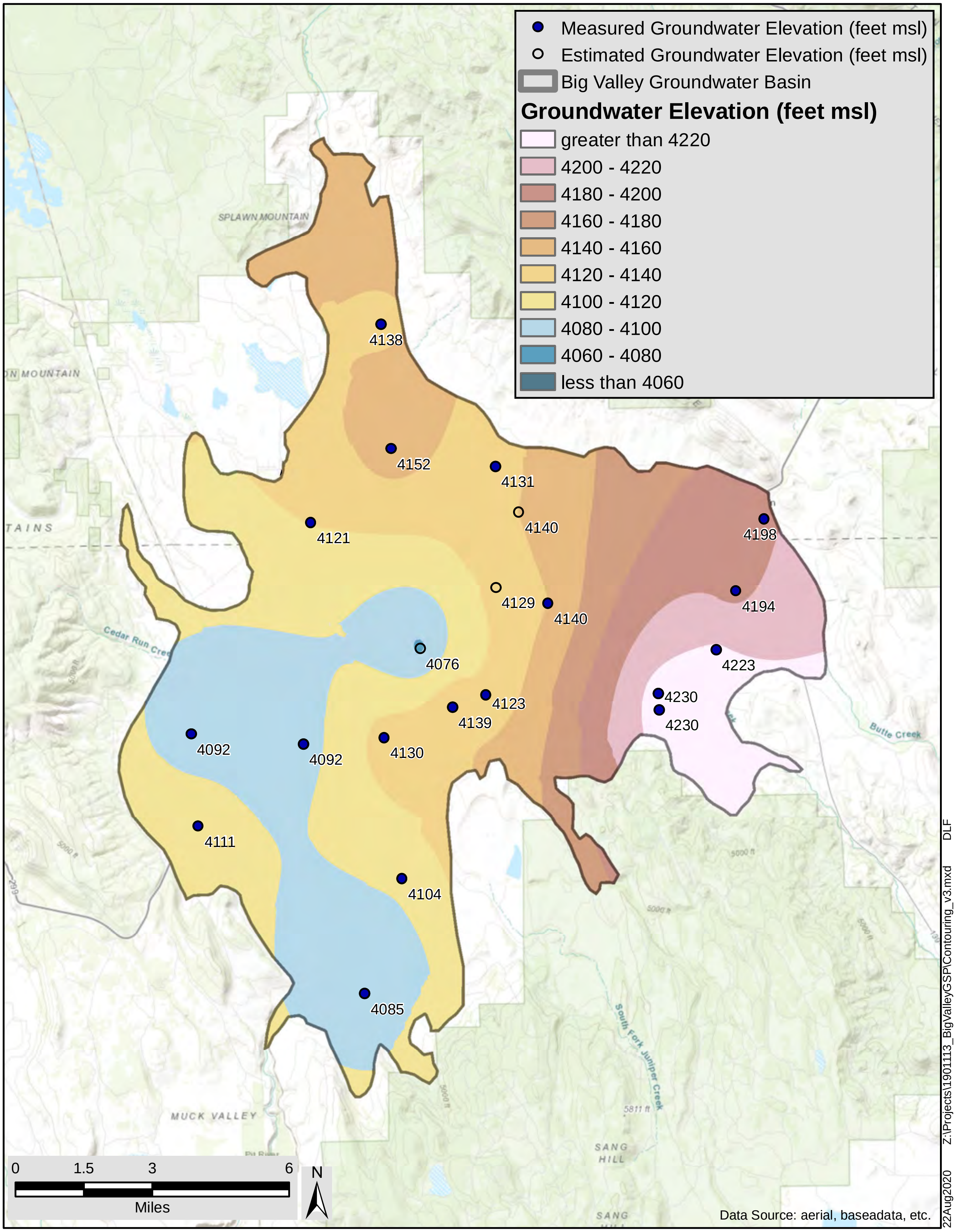
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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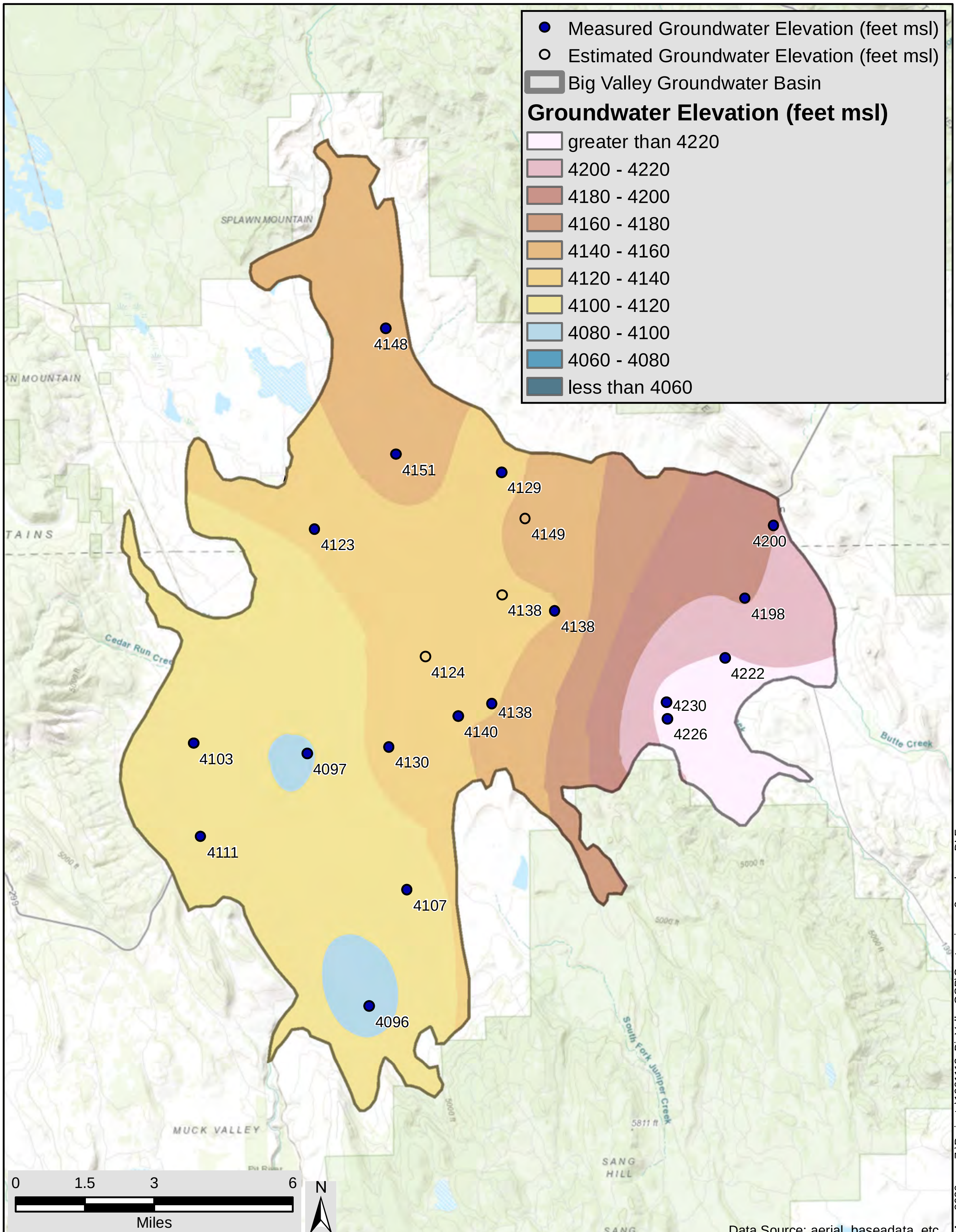

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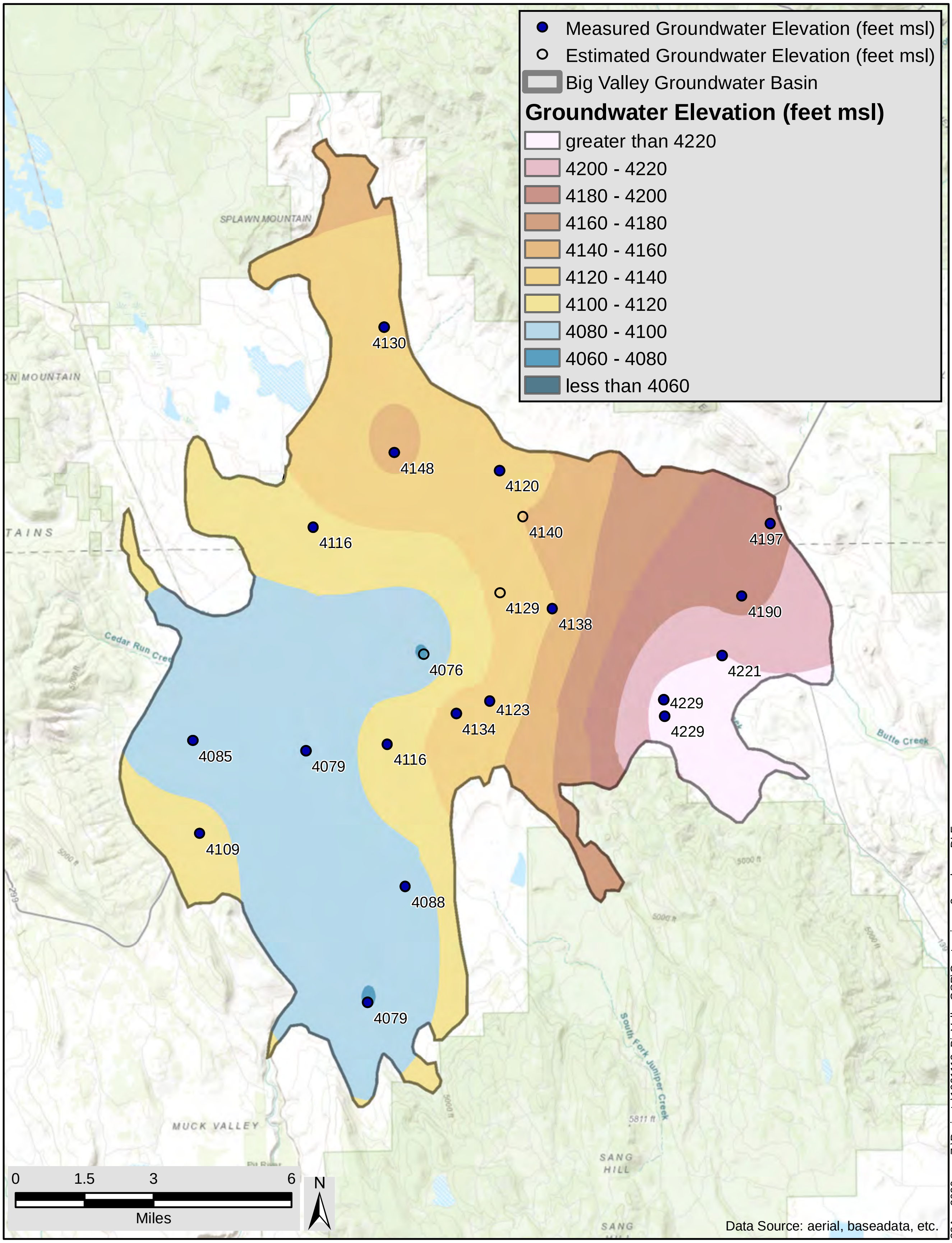

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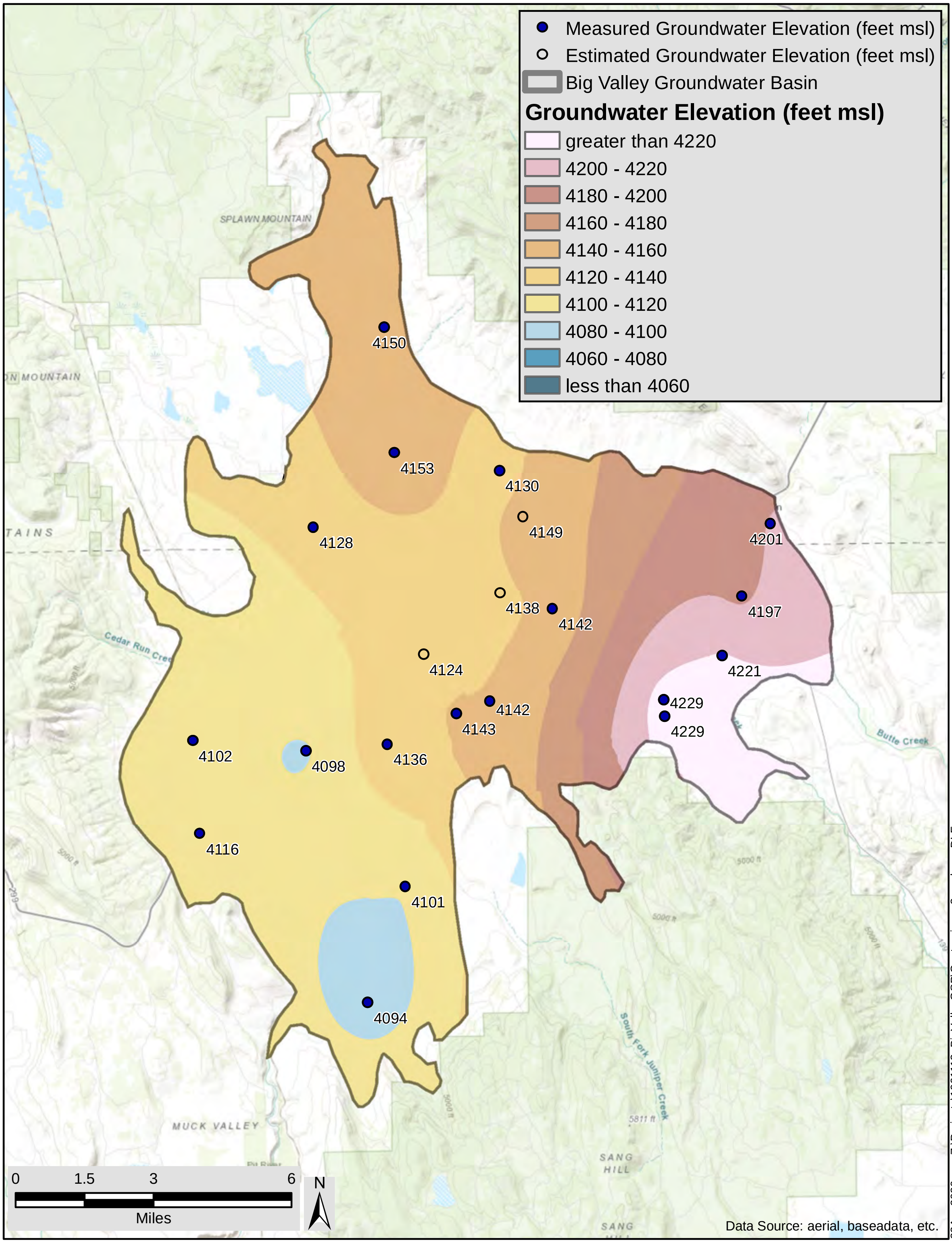

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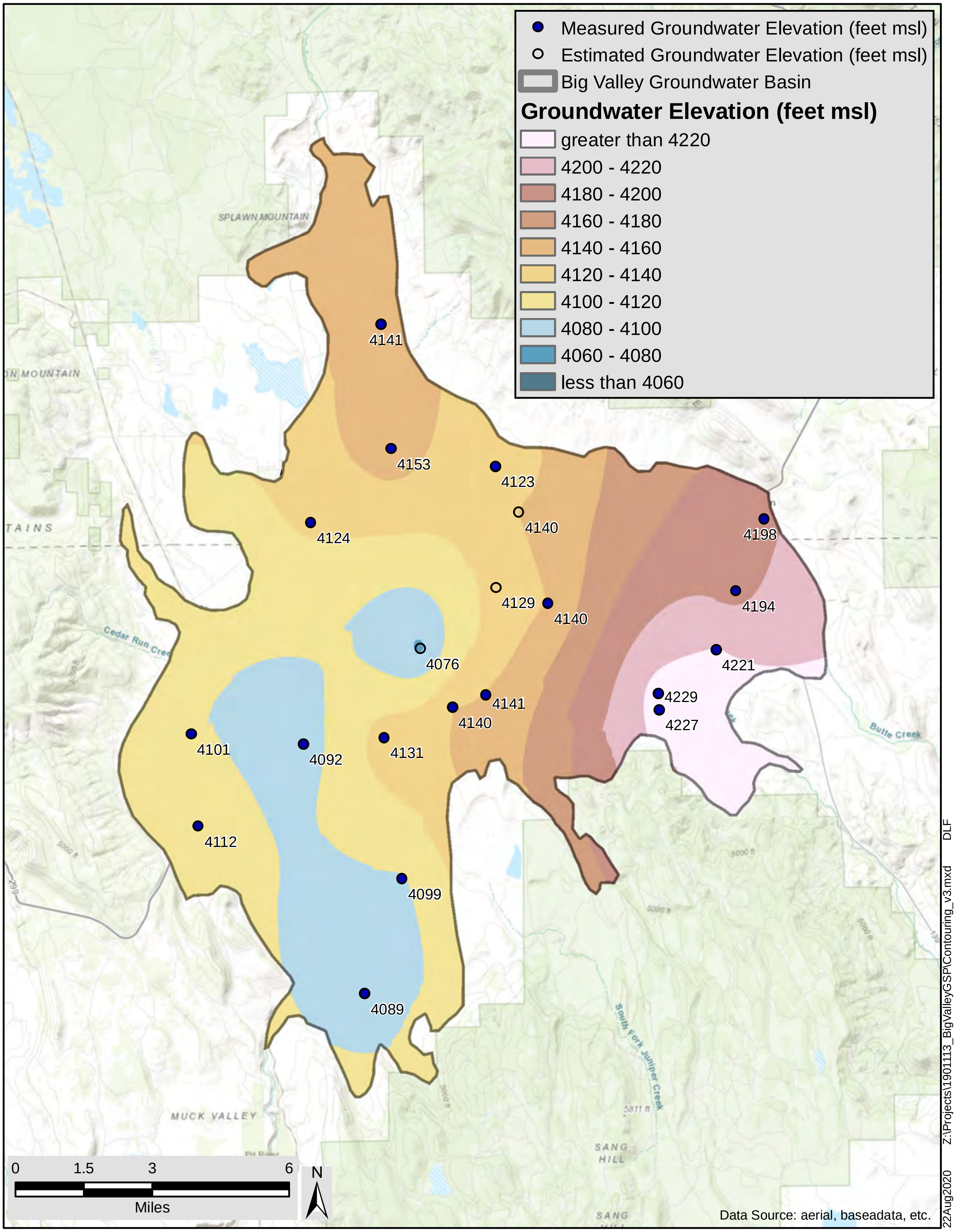

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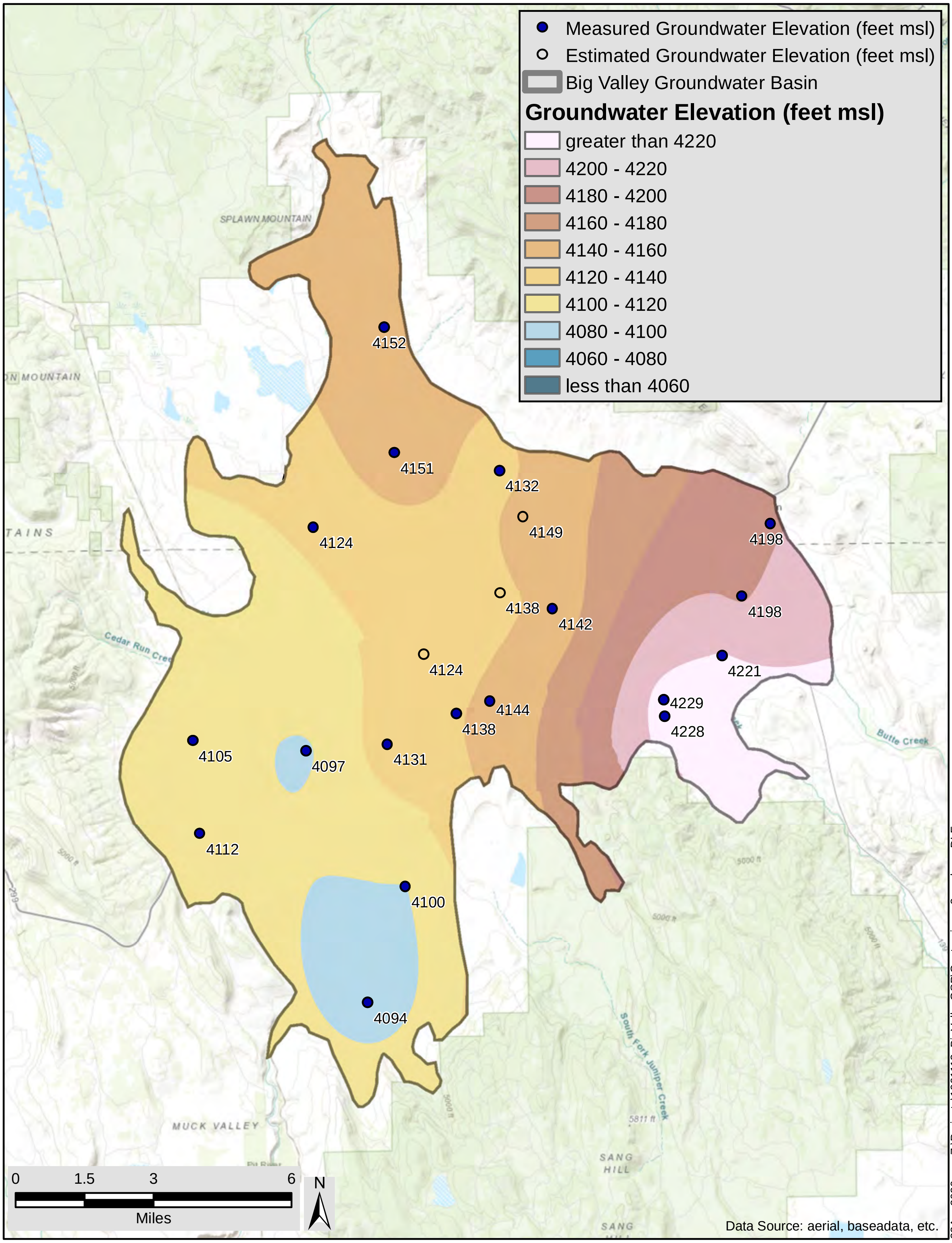

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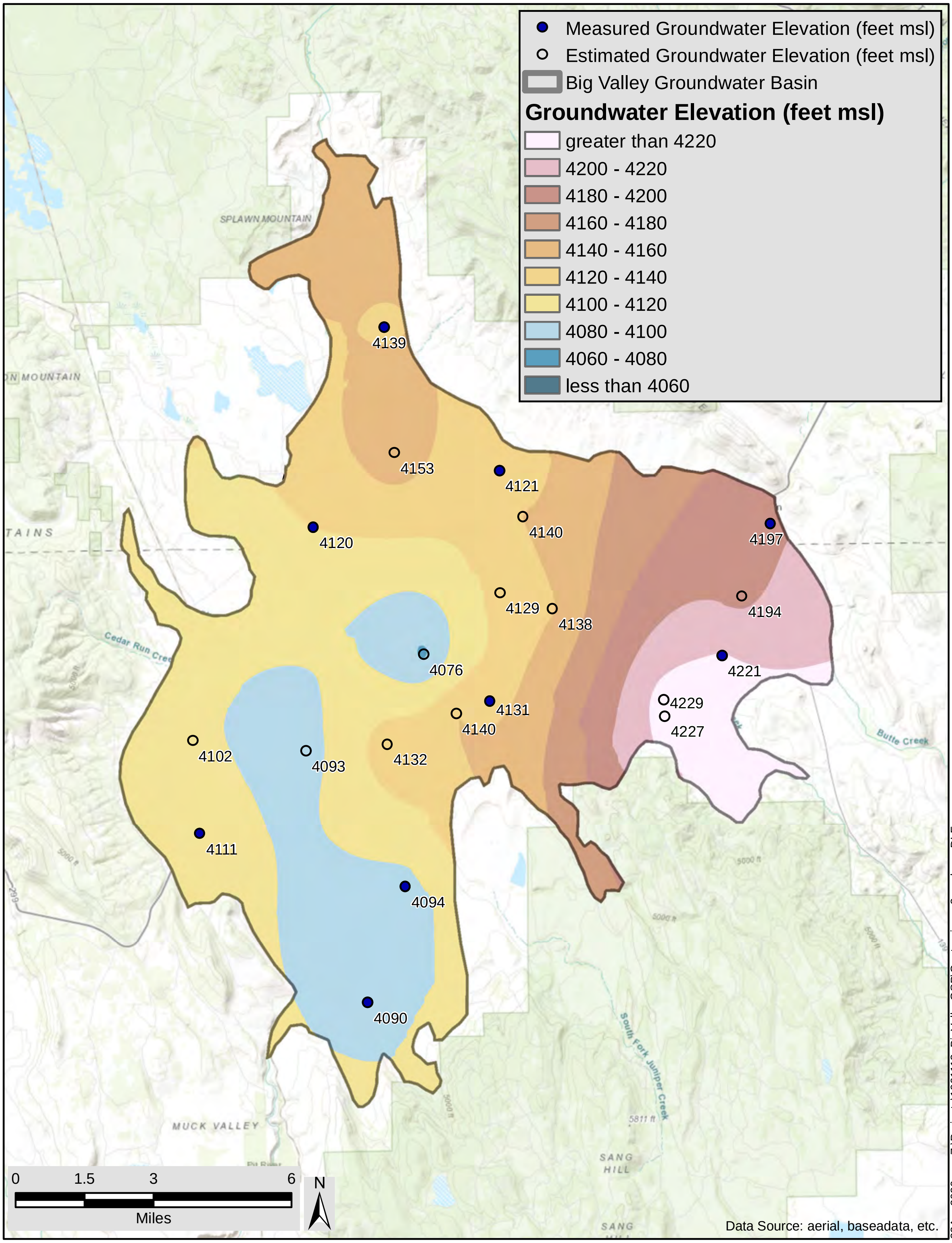

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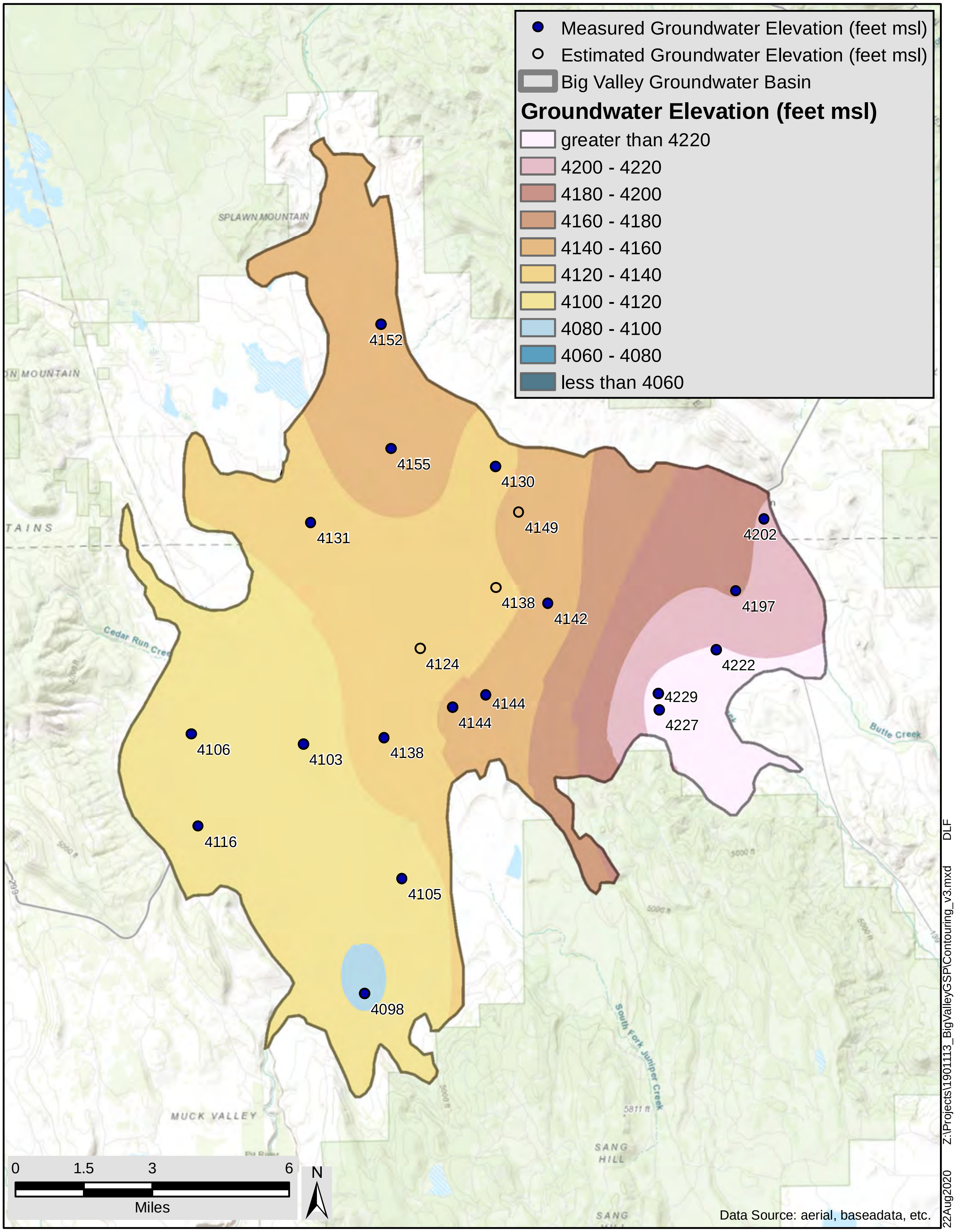

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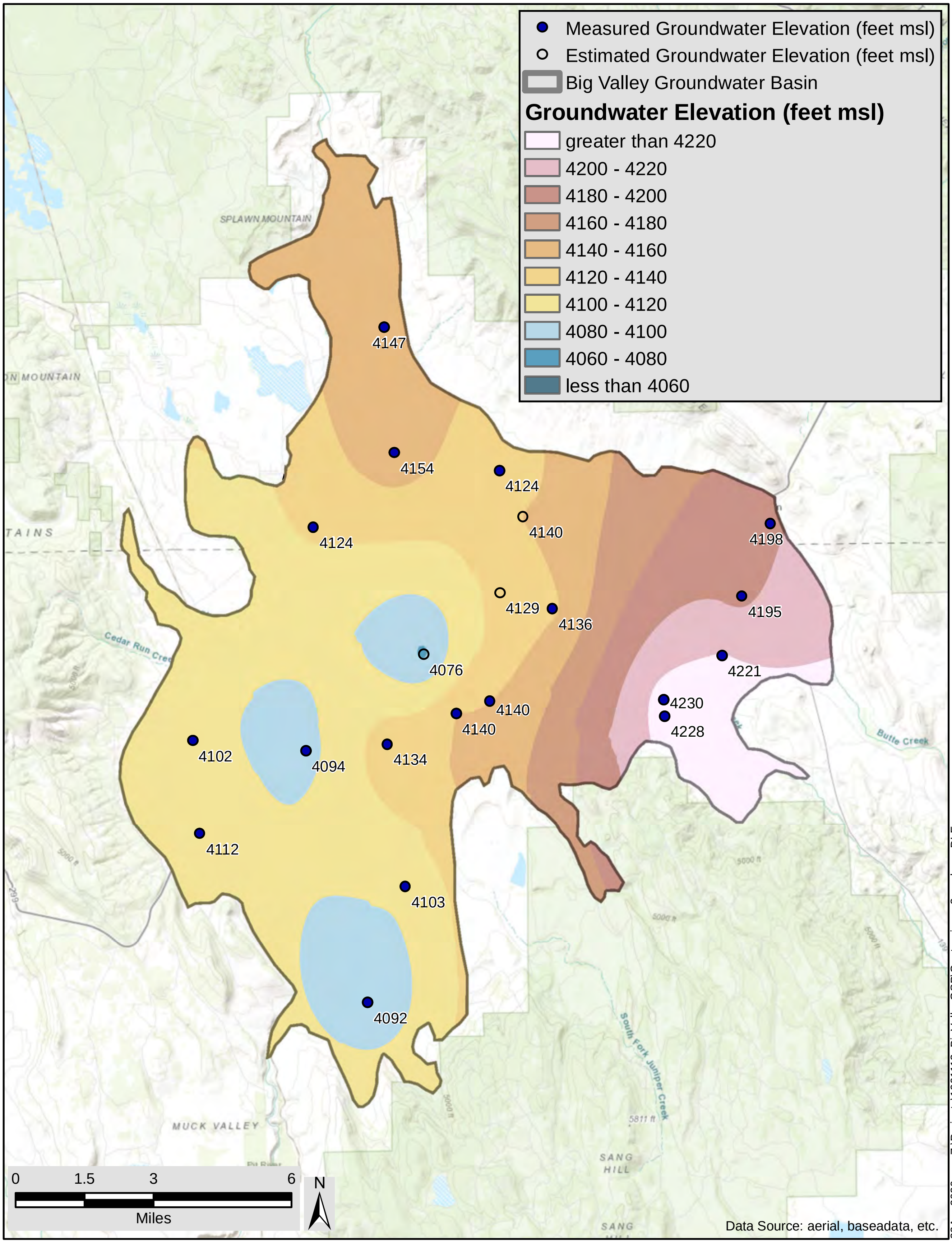
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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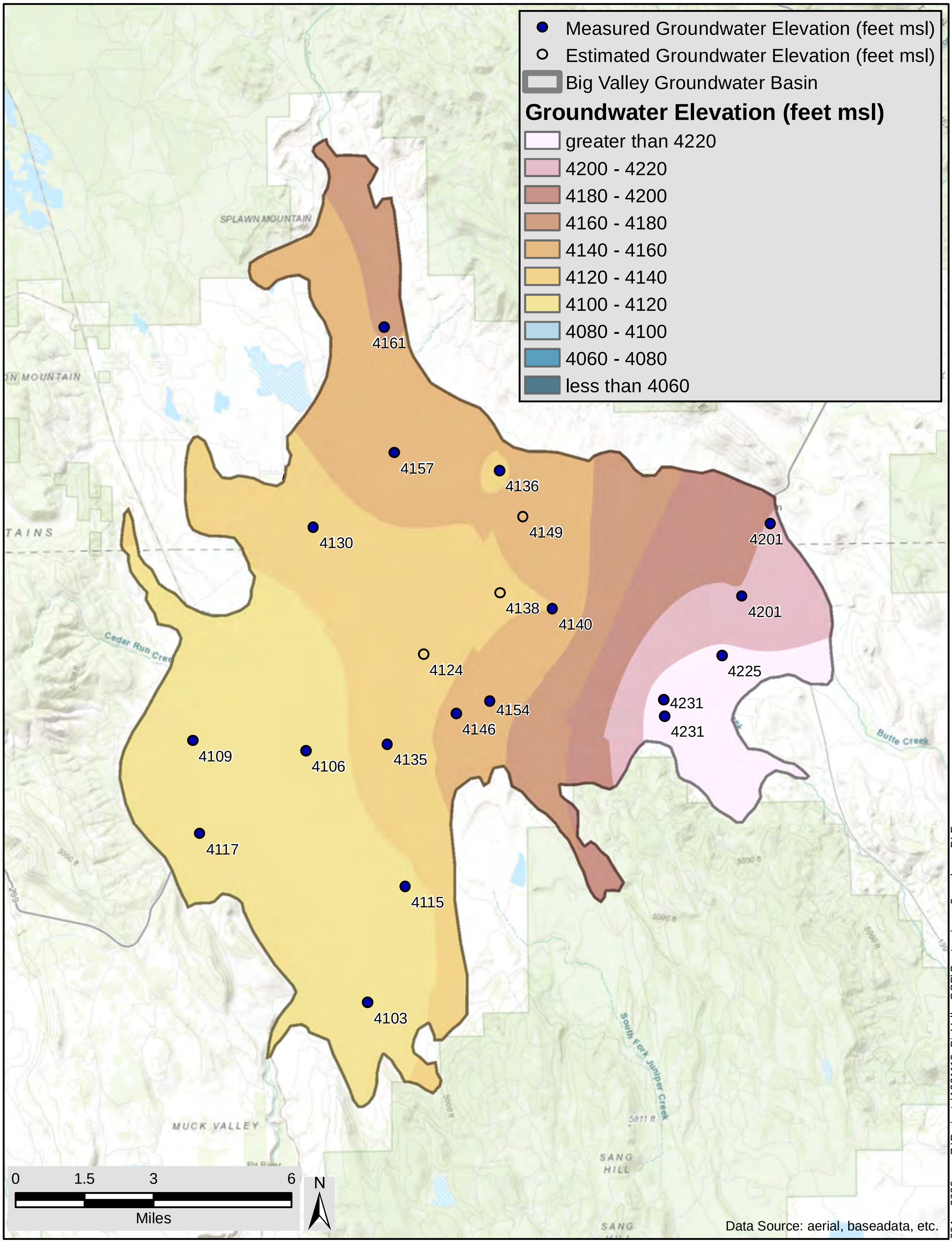

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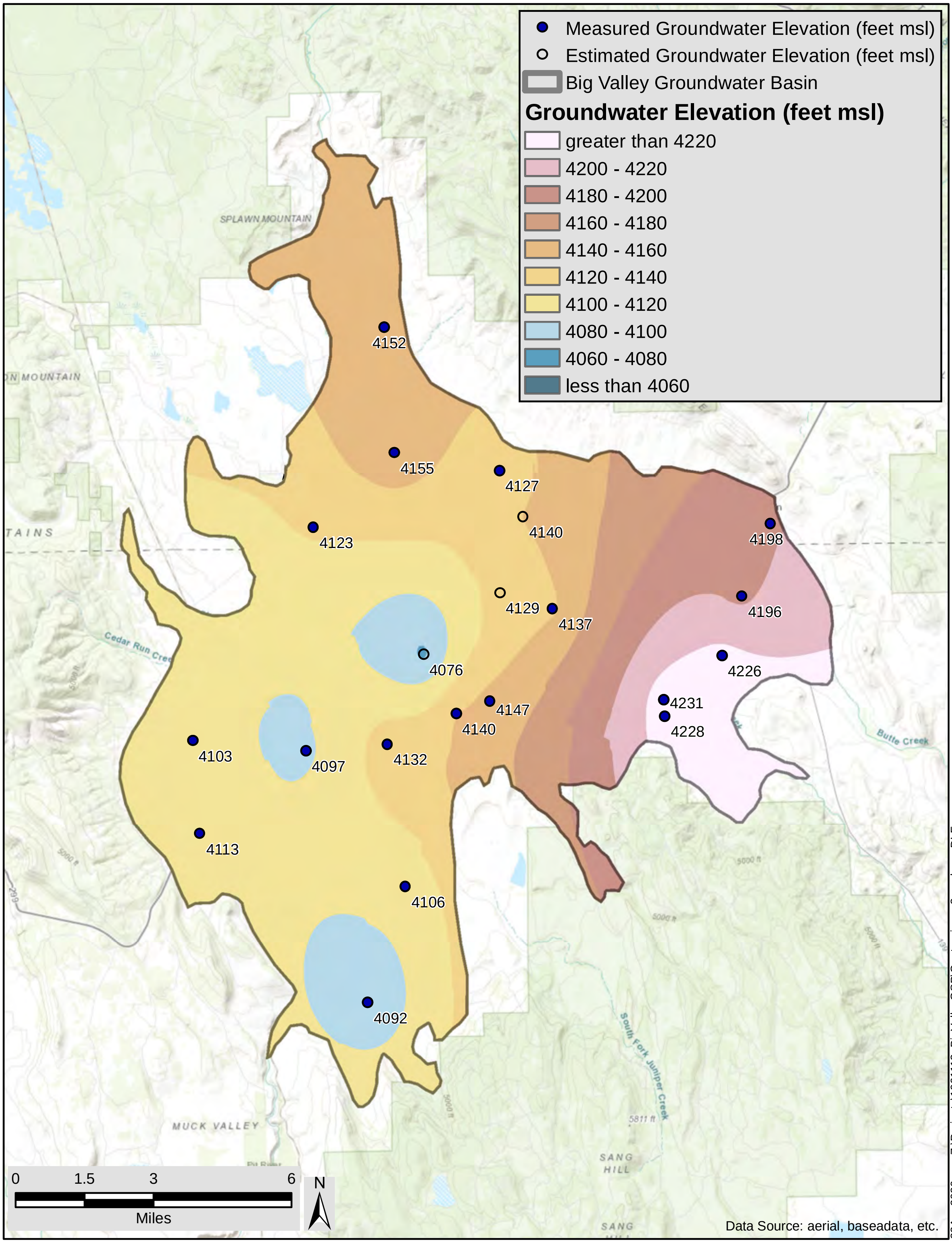
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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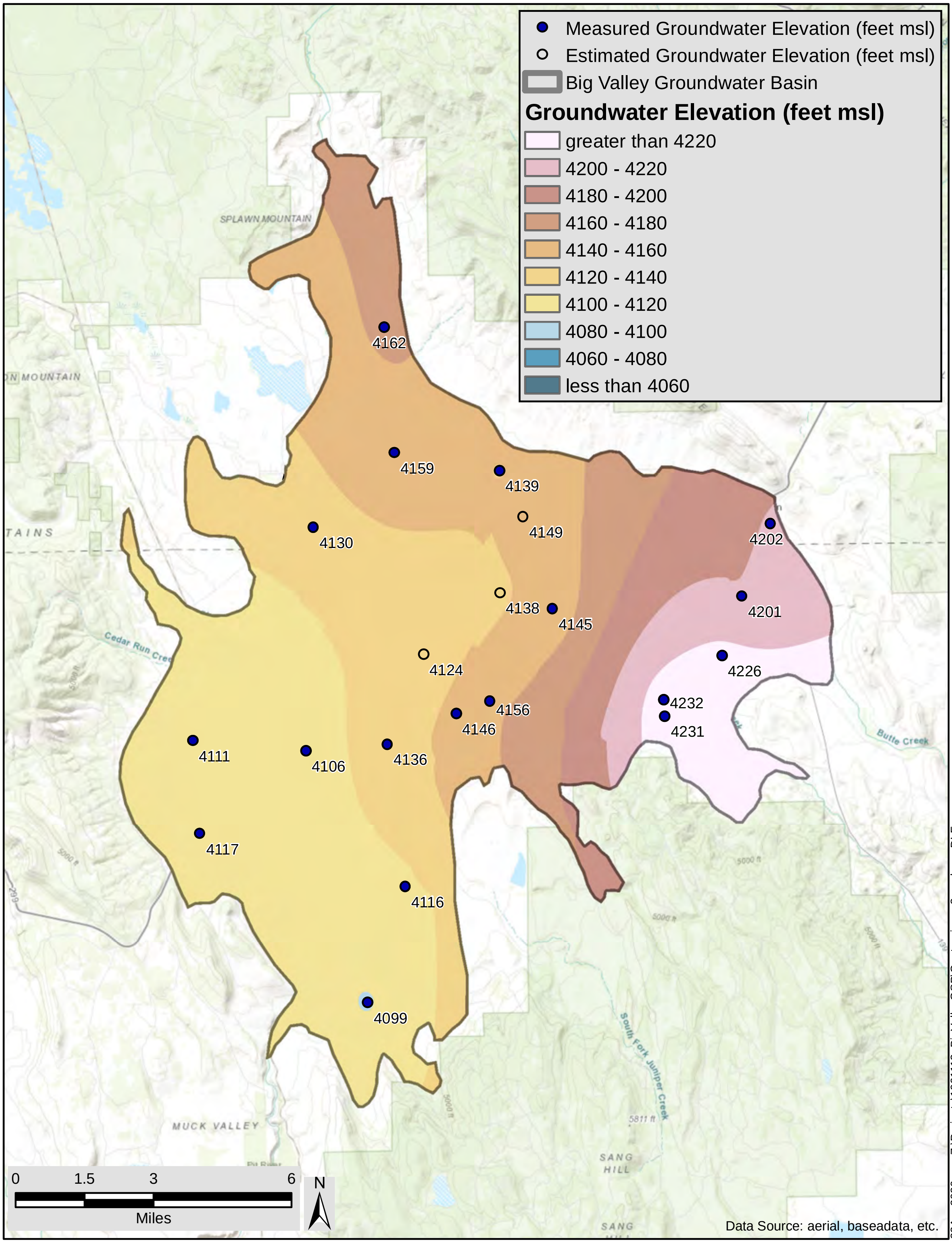
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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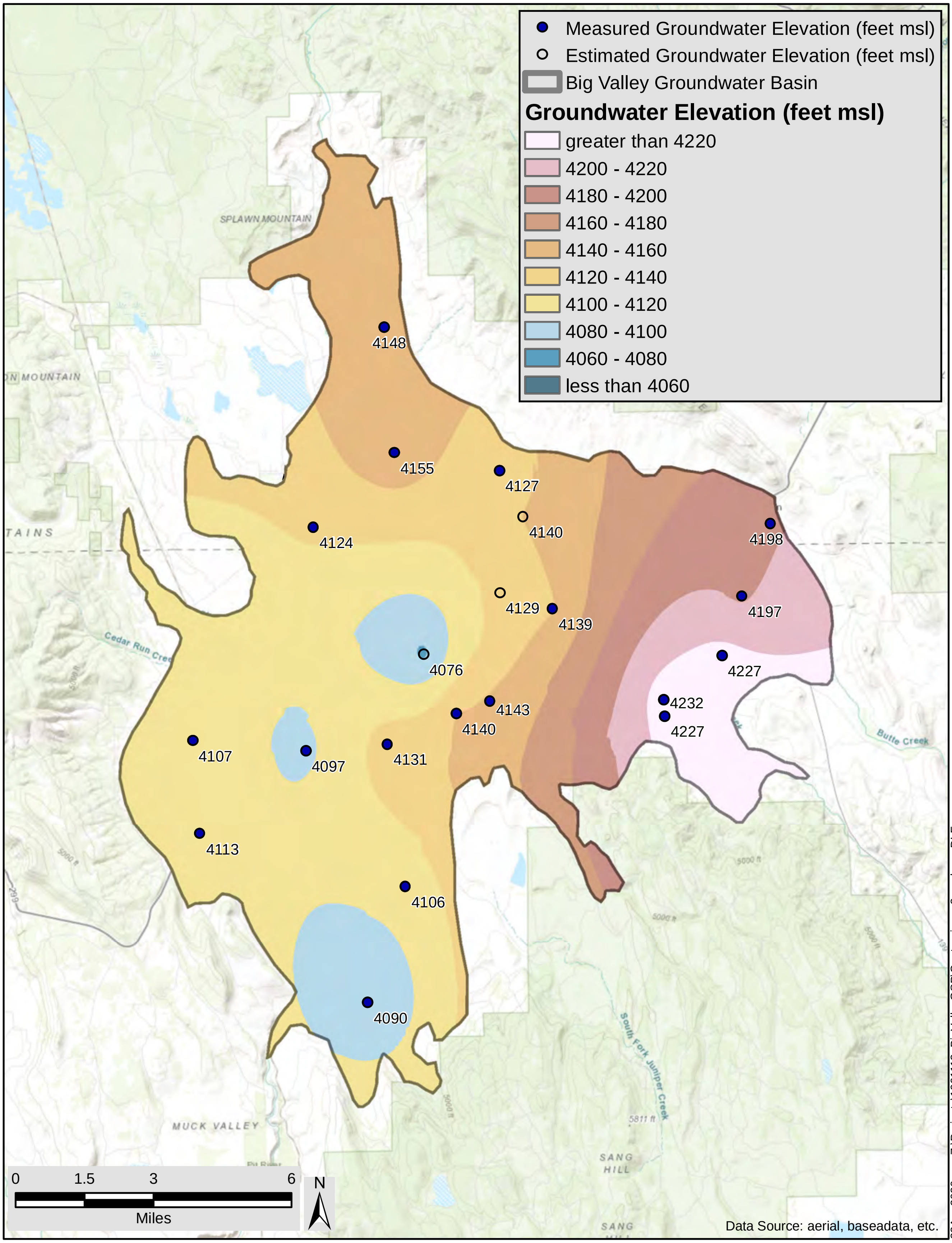

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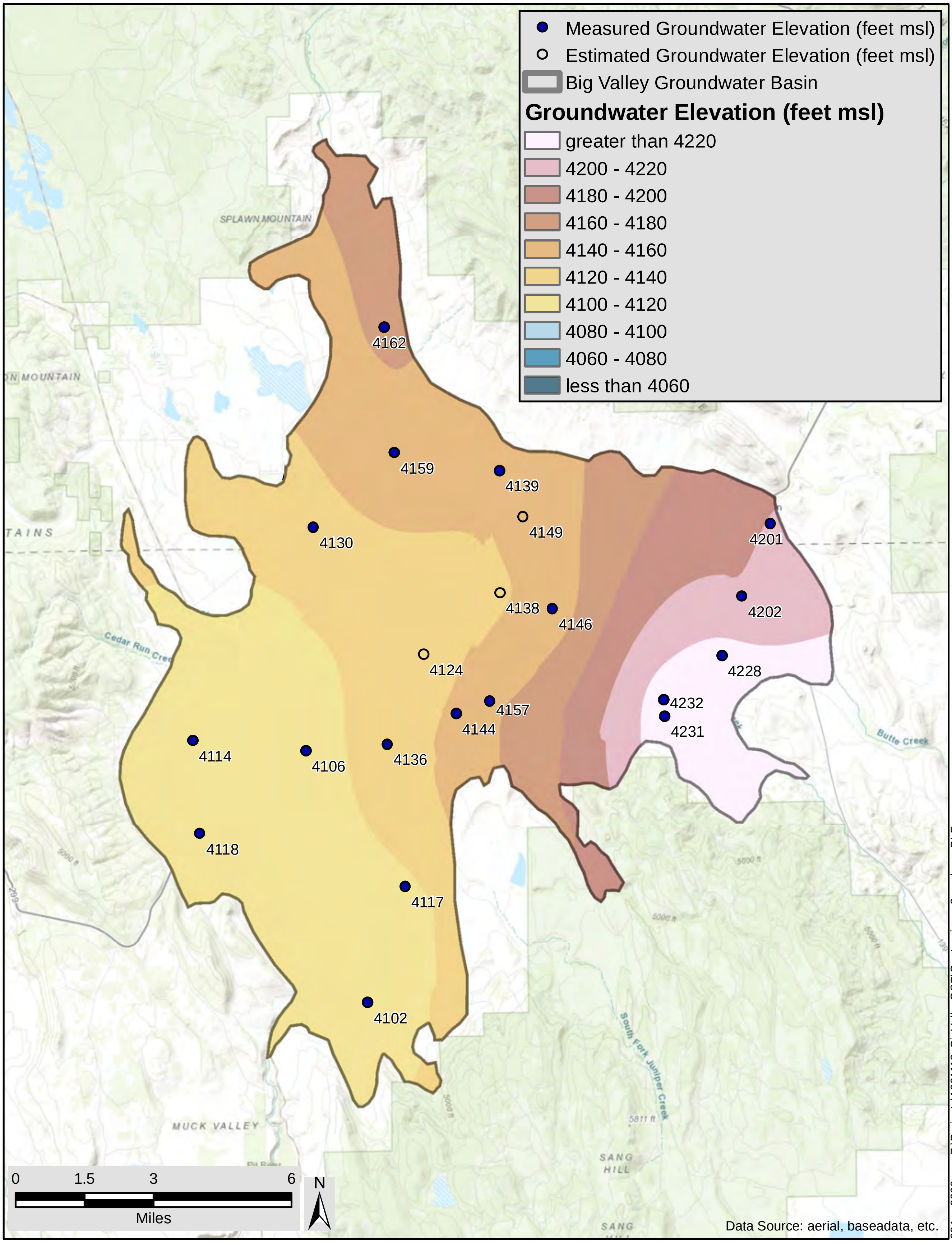

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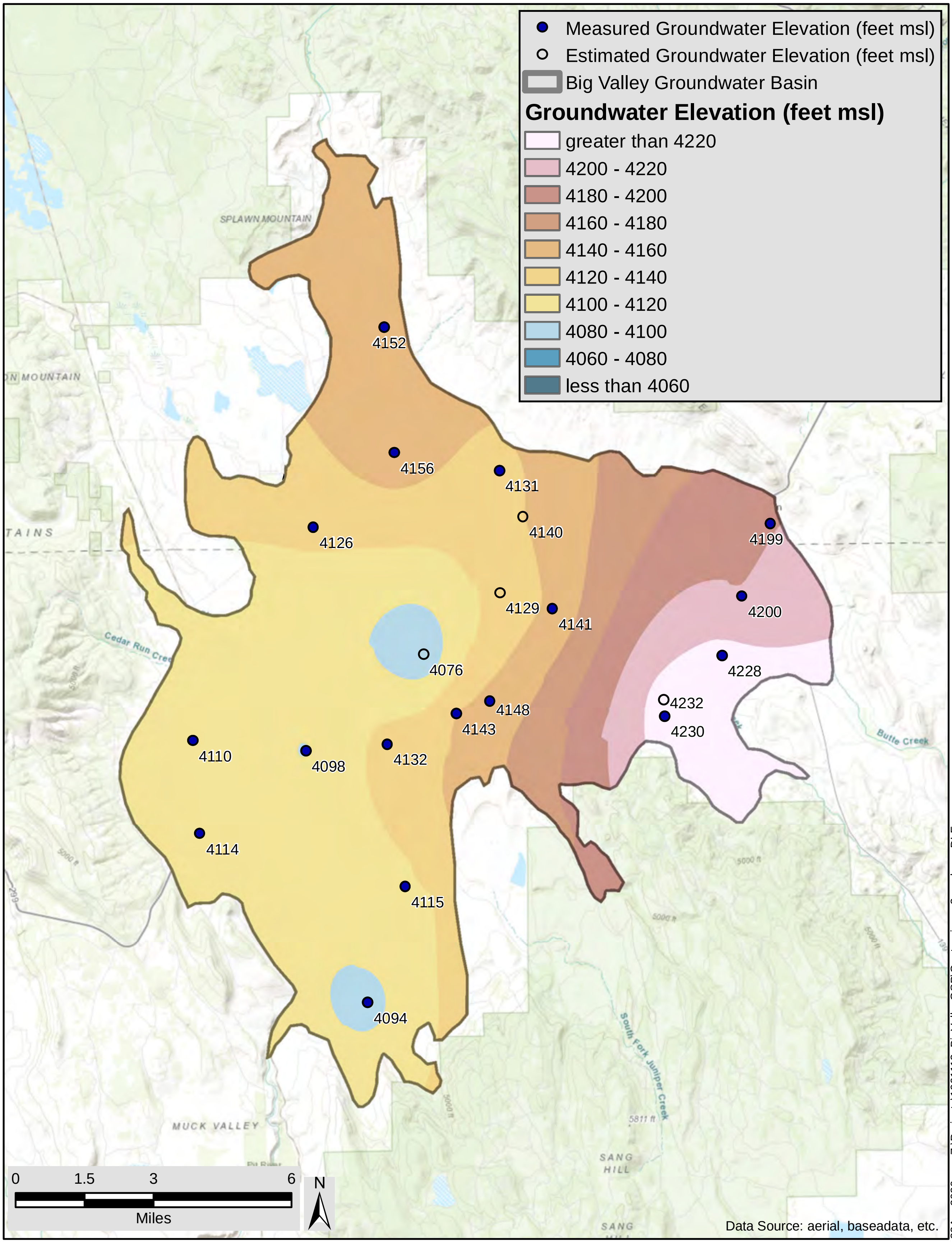
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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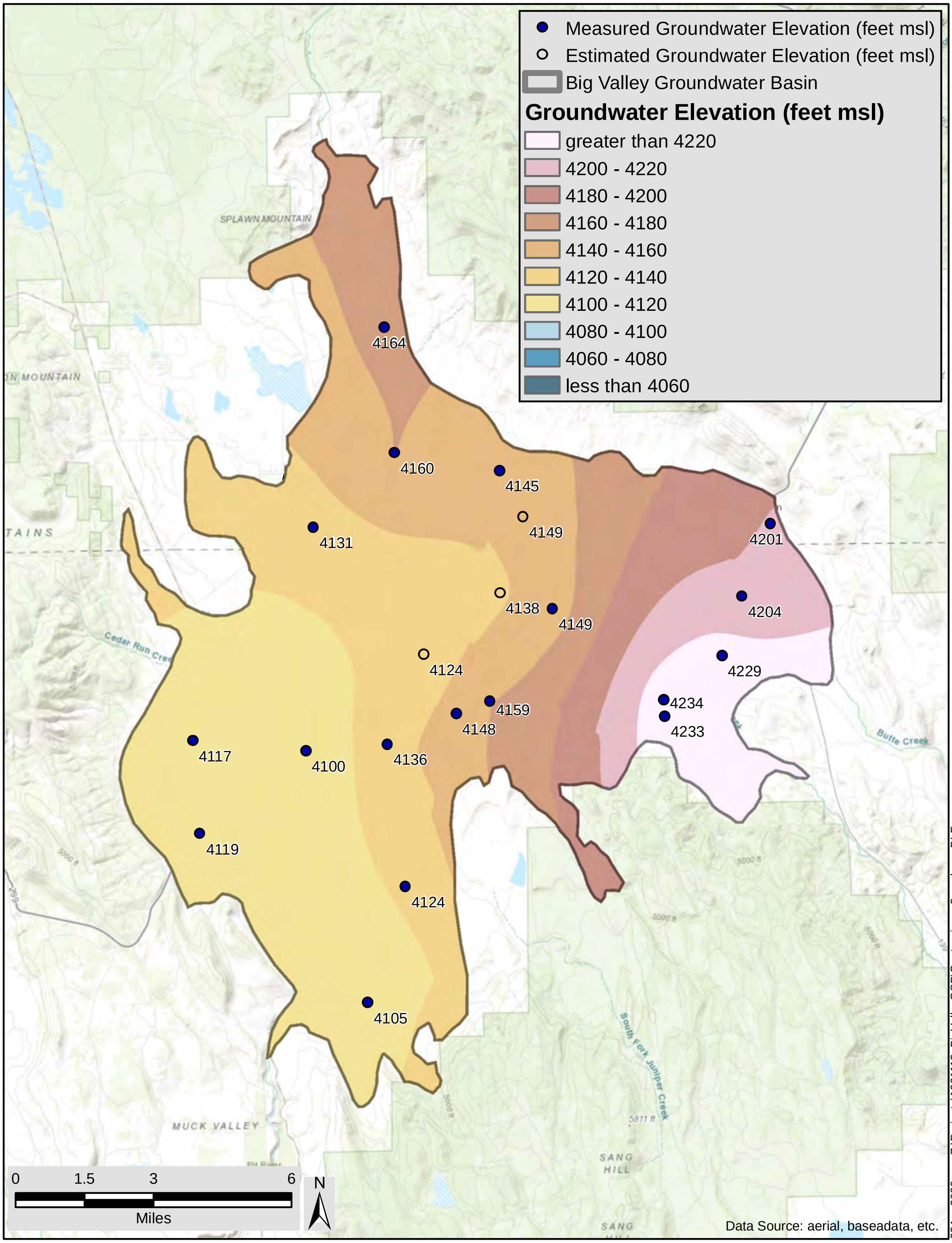

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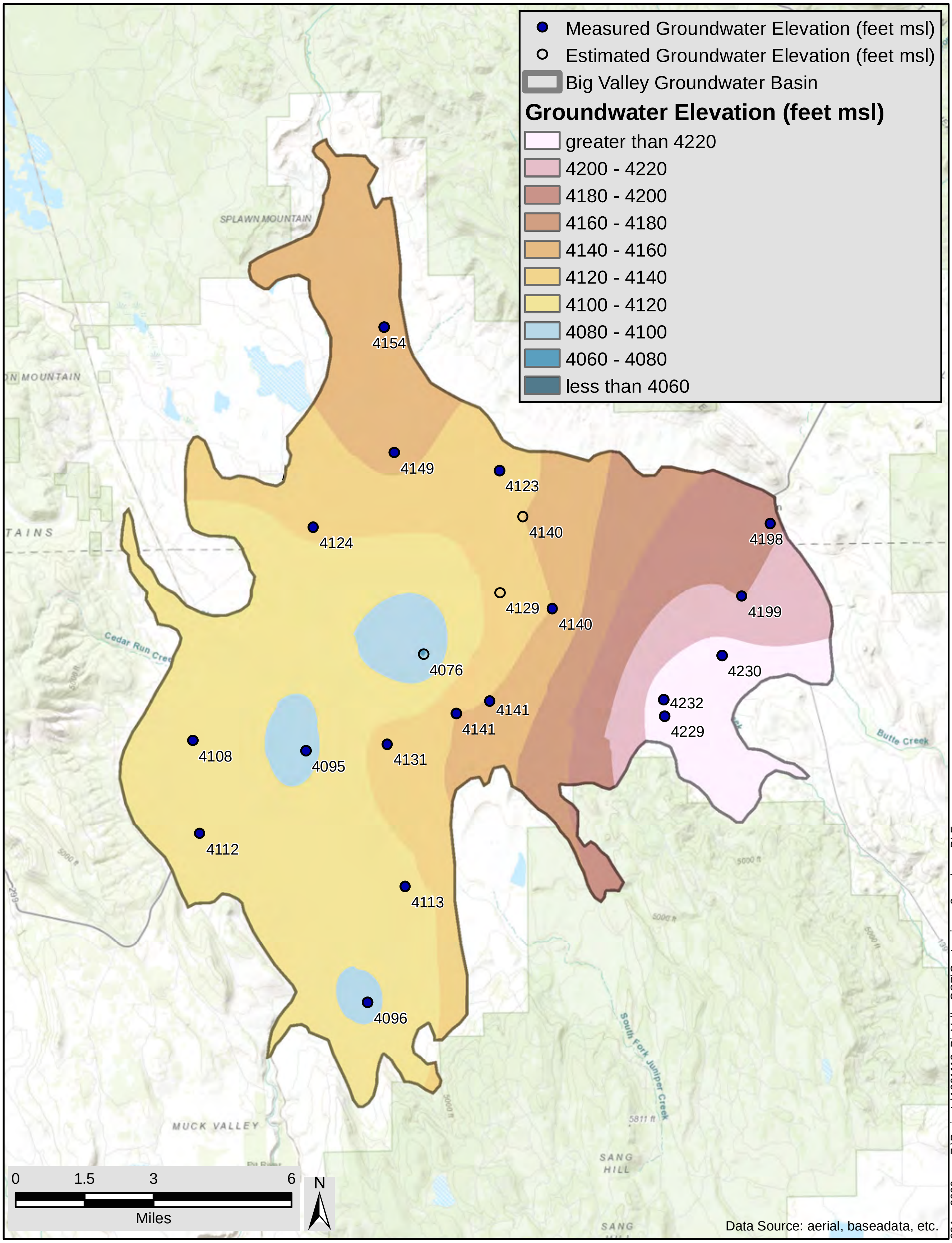
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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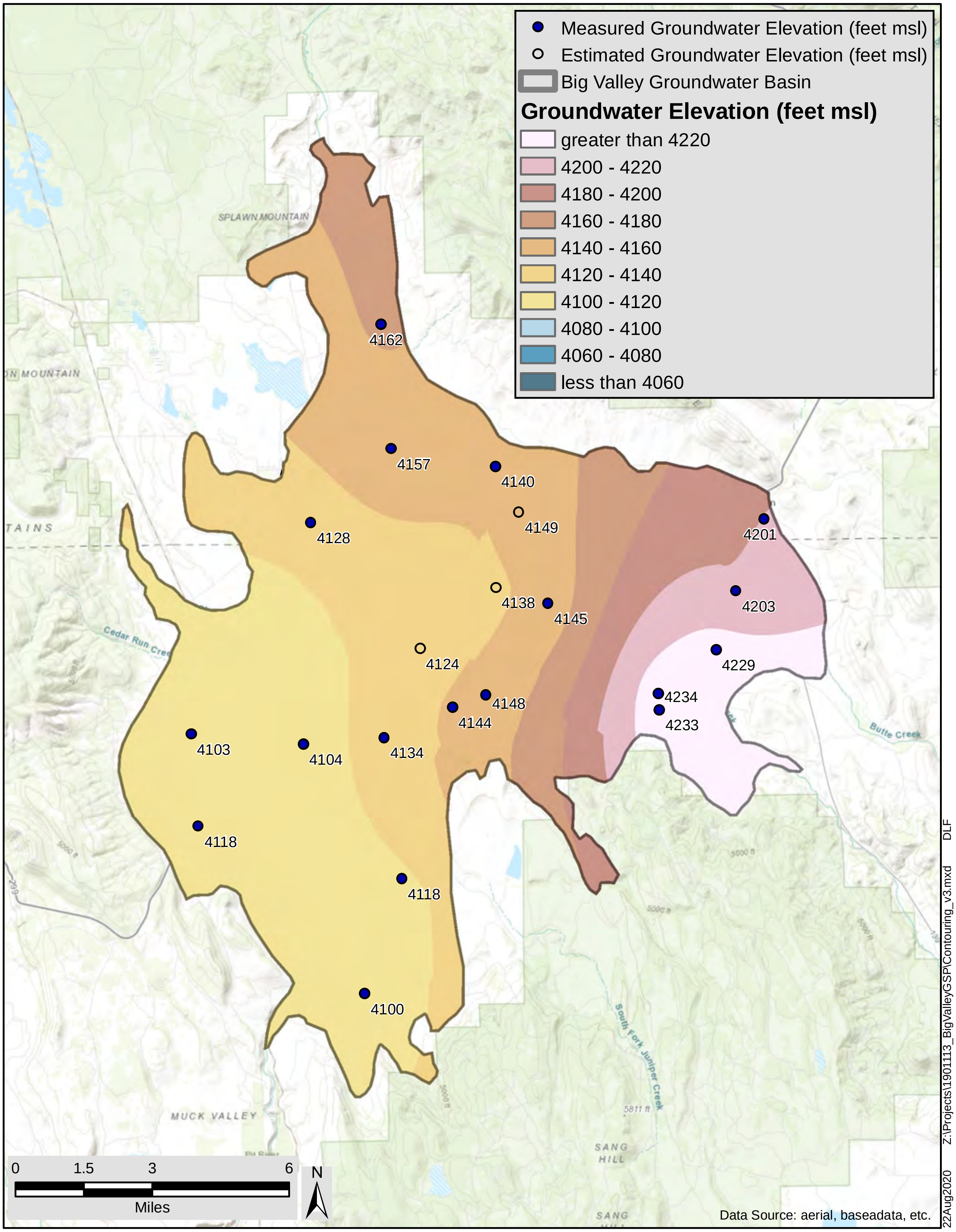

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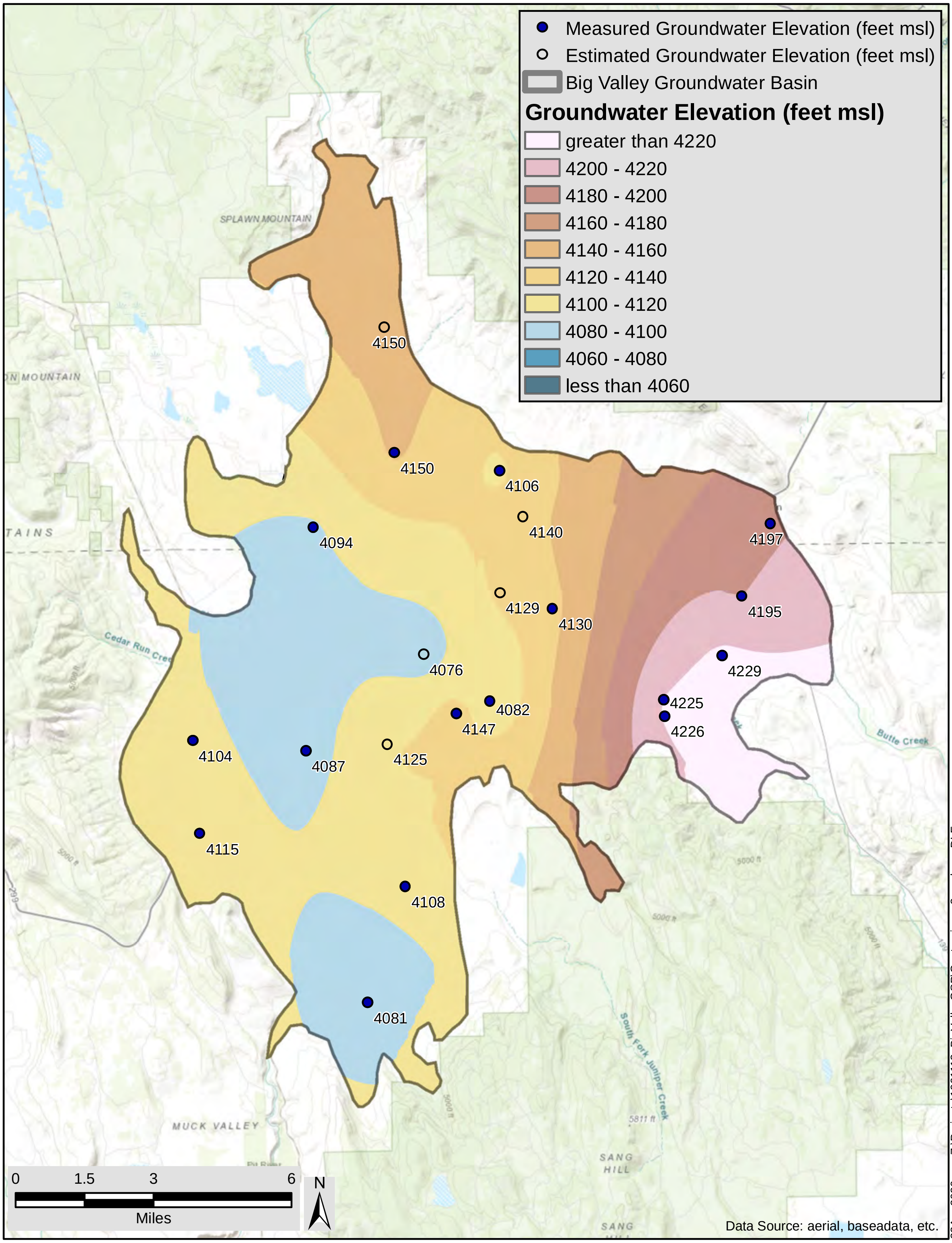

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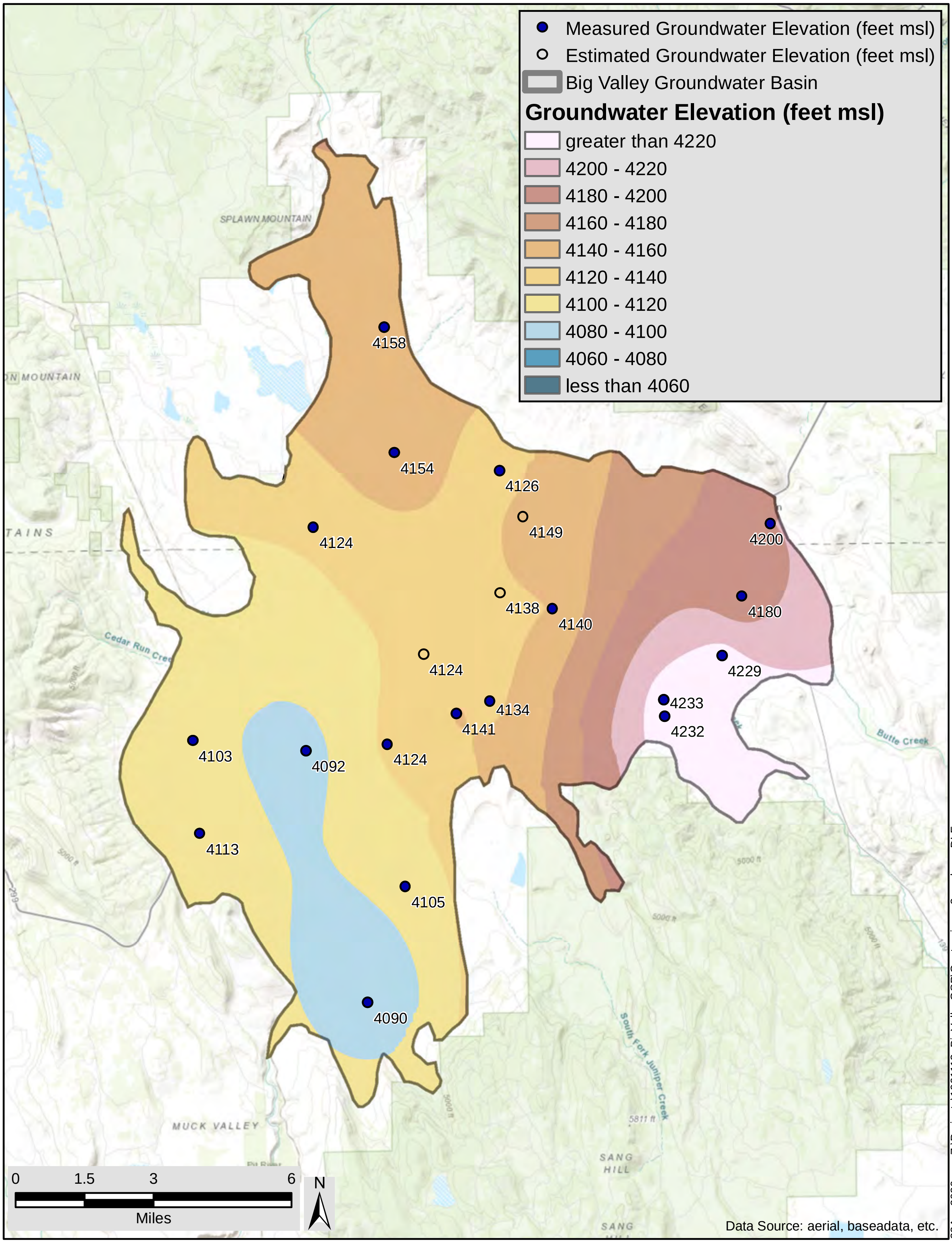
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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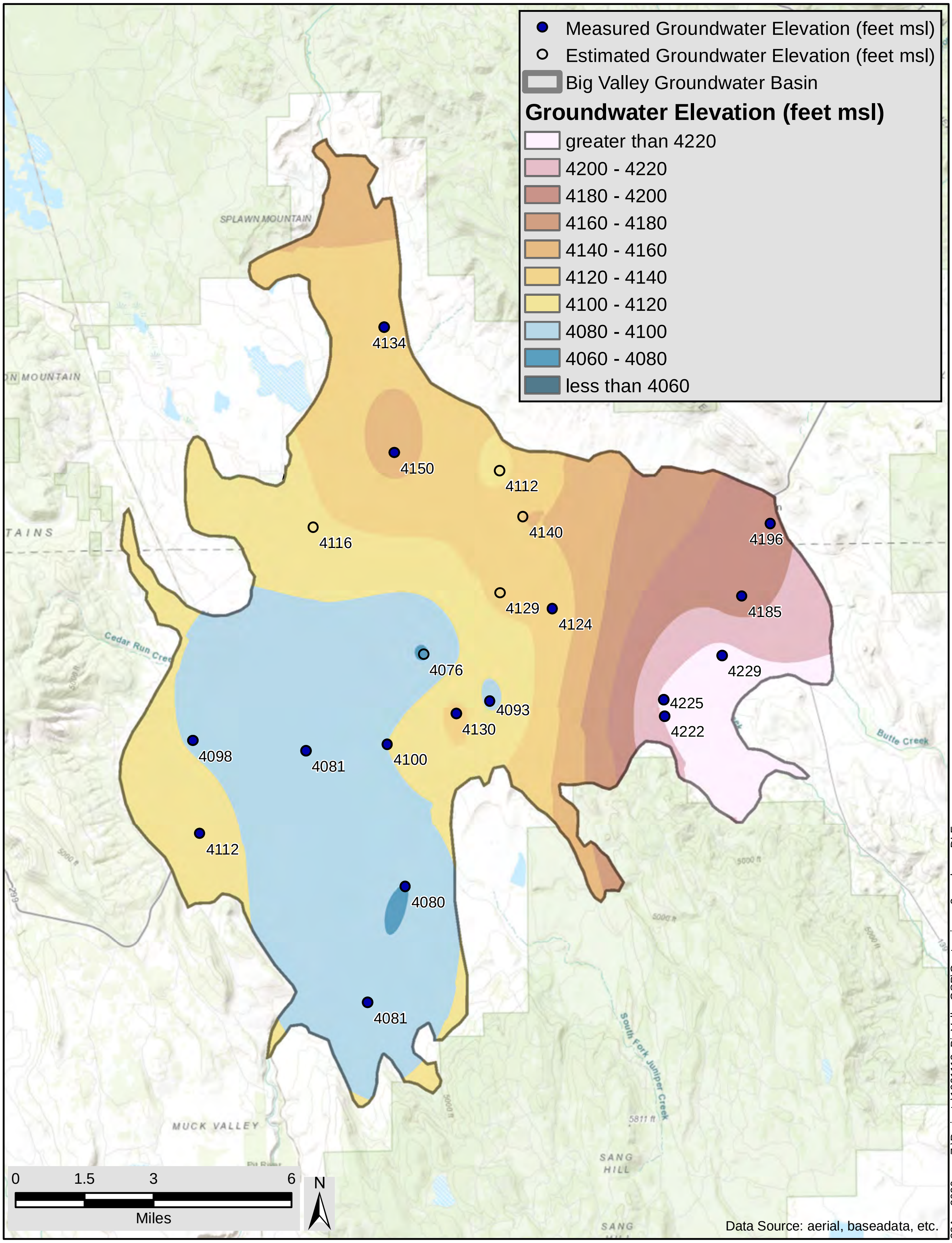
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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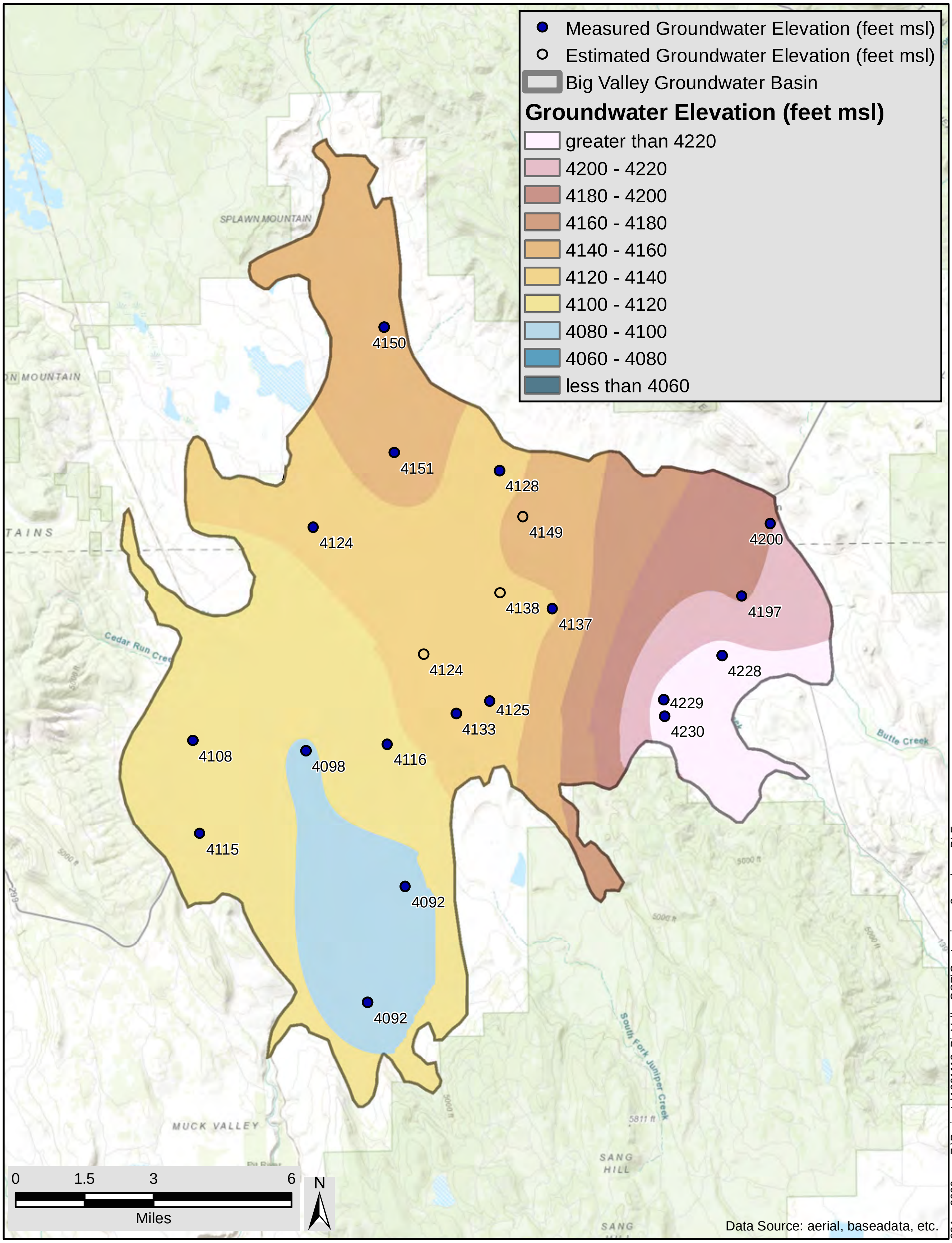
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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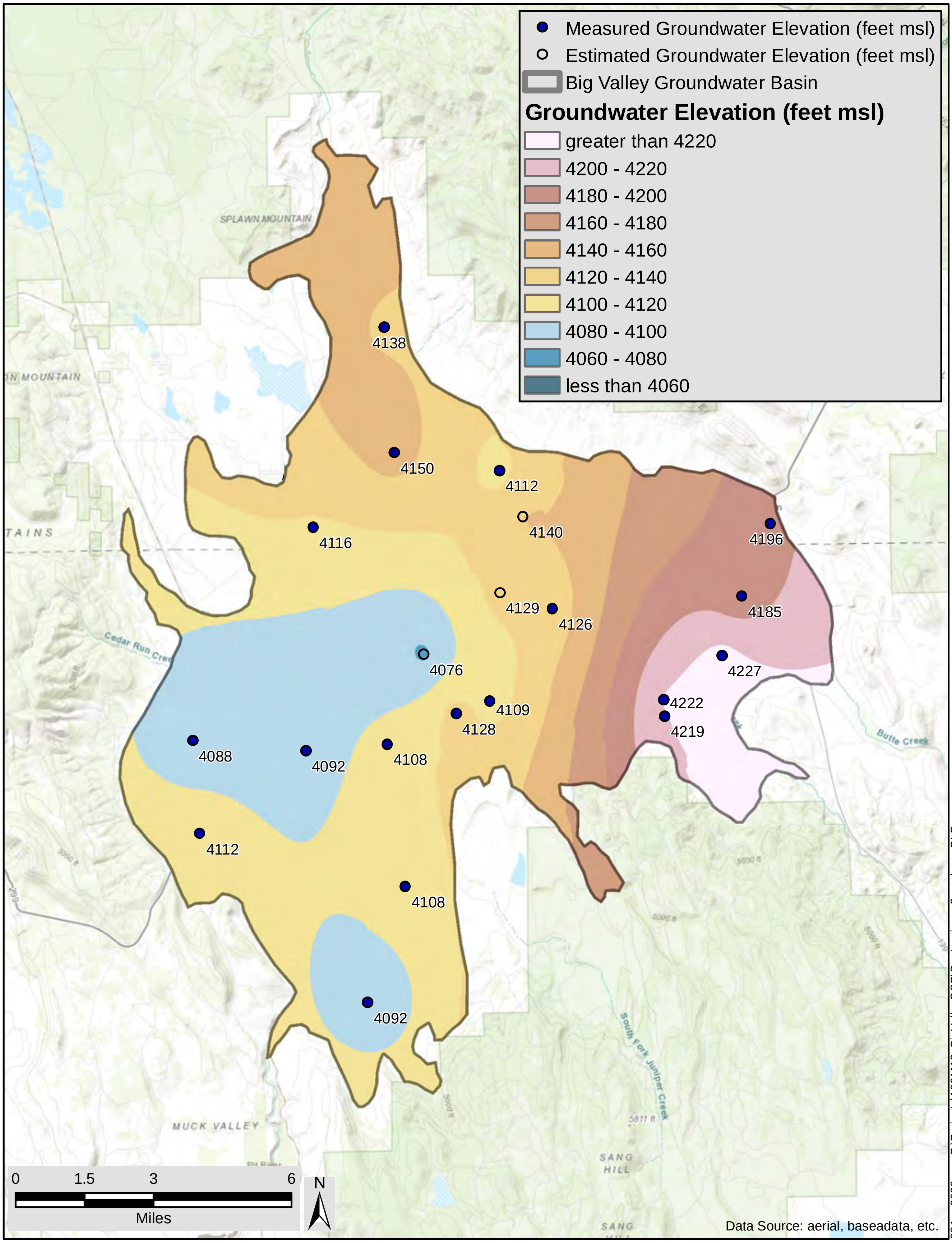

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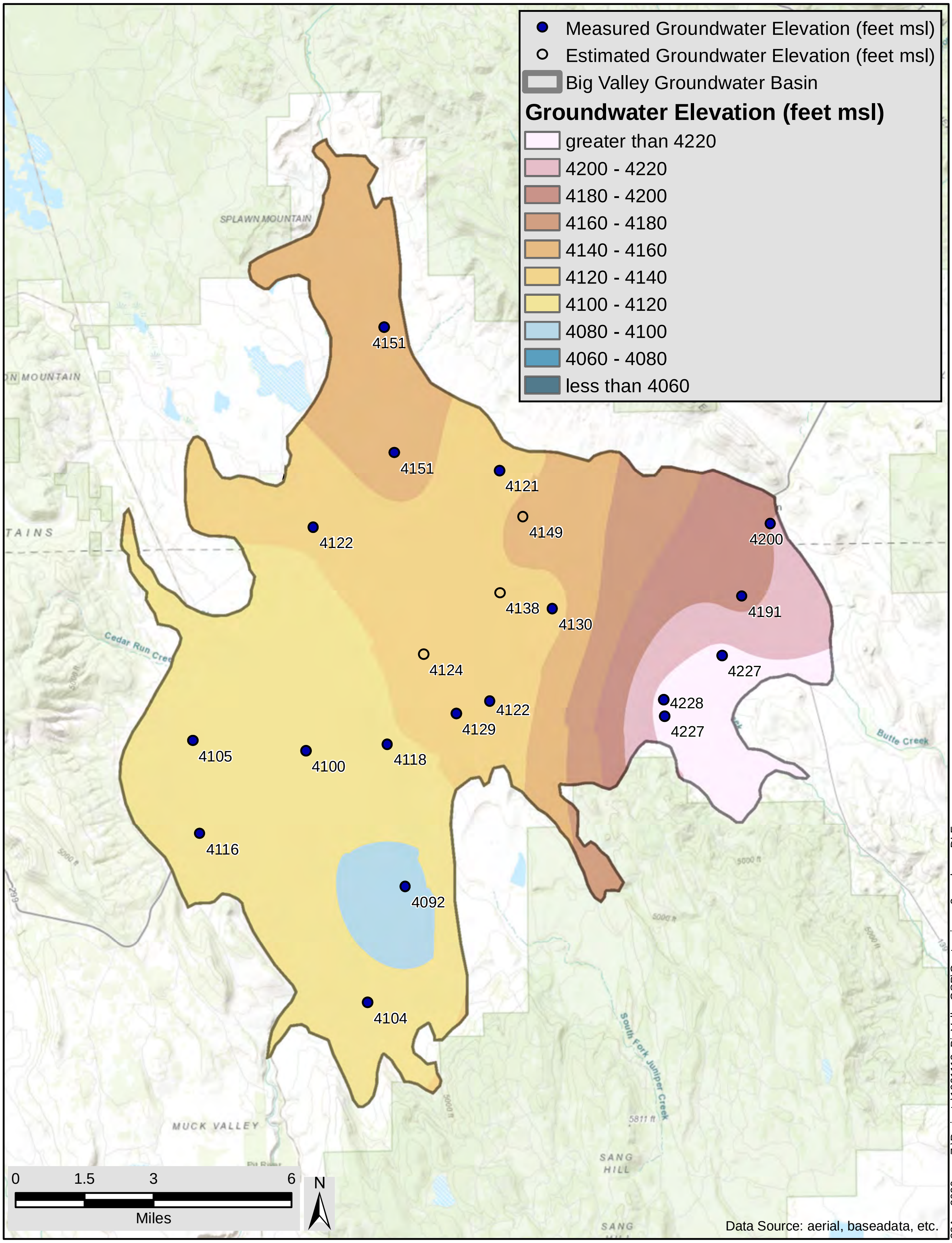
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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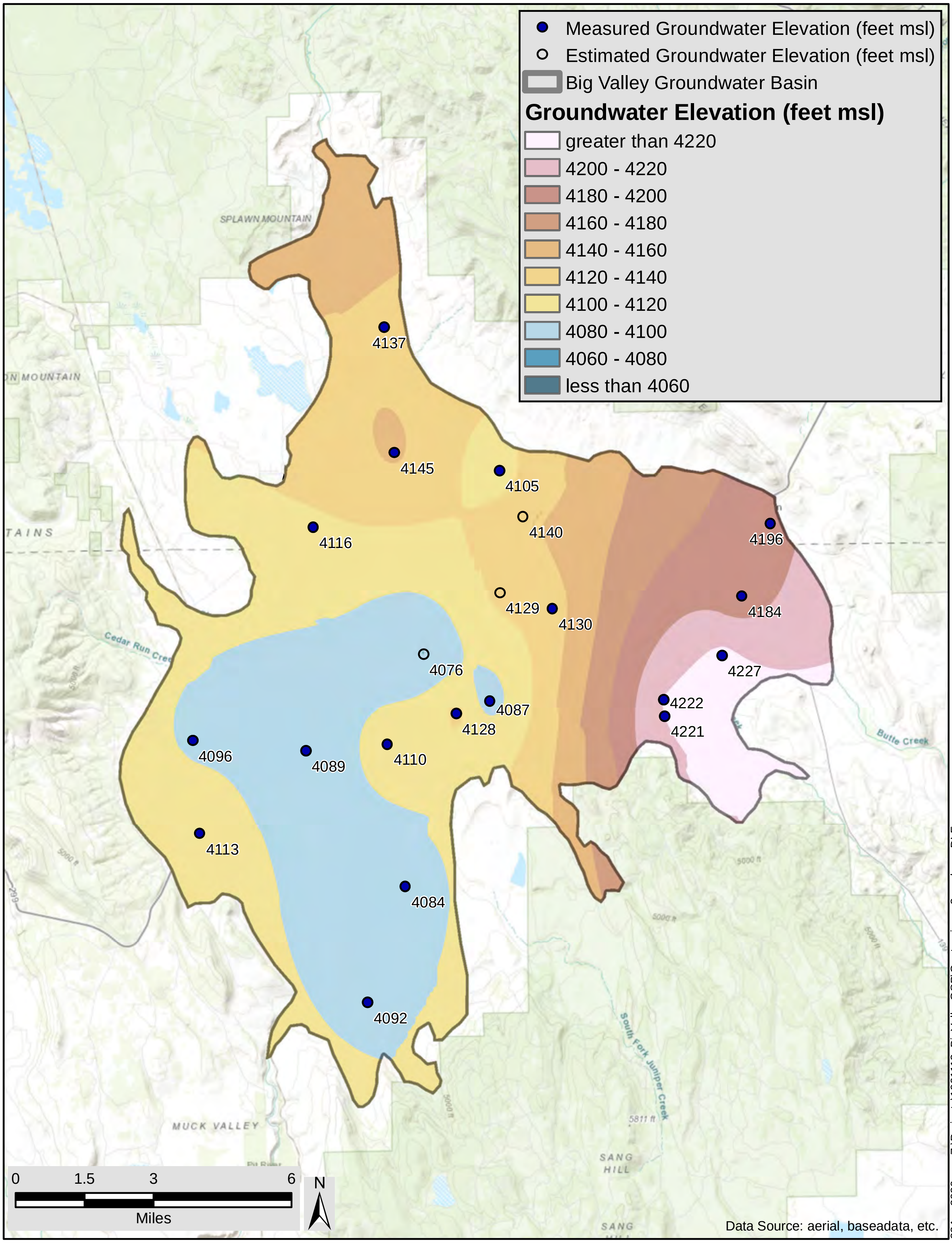
Big Valley Basin Groundwater Sustainability Plan Modoc and Lassen Counties, California	GEI Consultants	Groundwater Elevations Spring 2003		
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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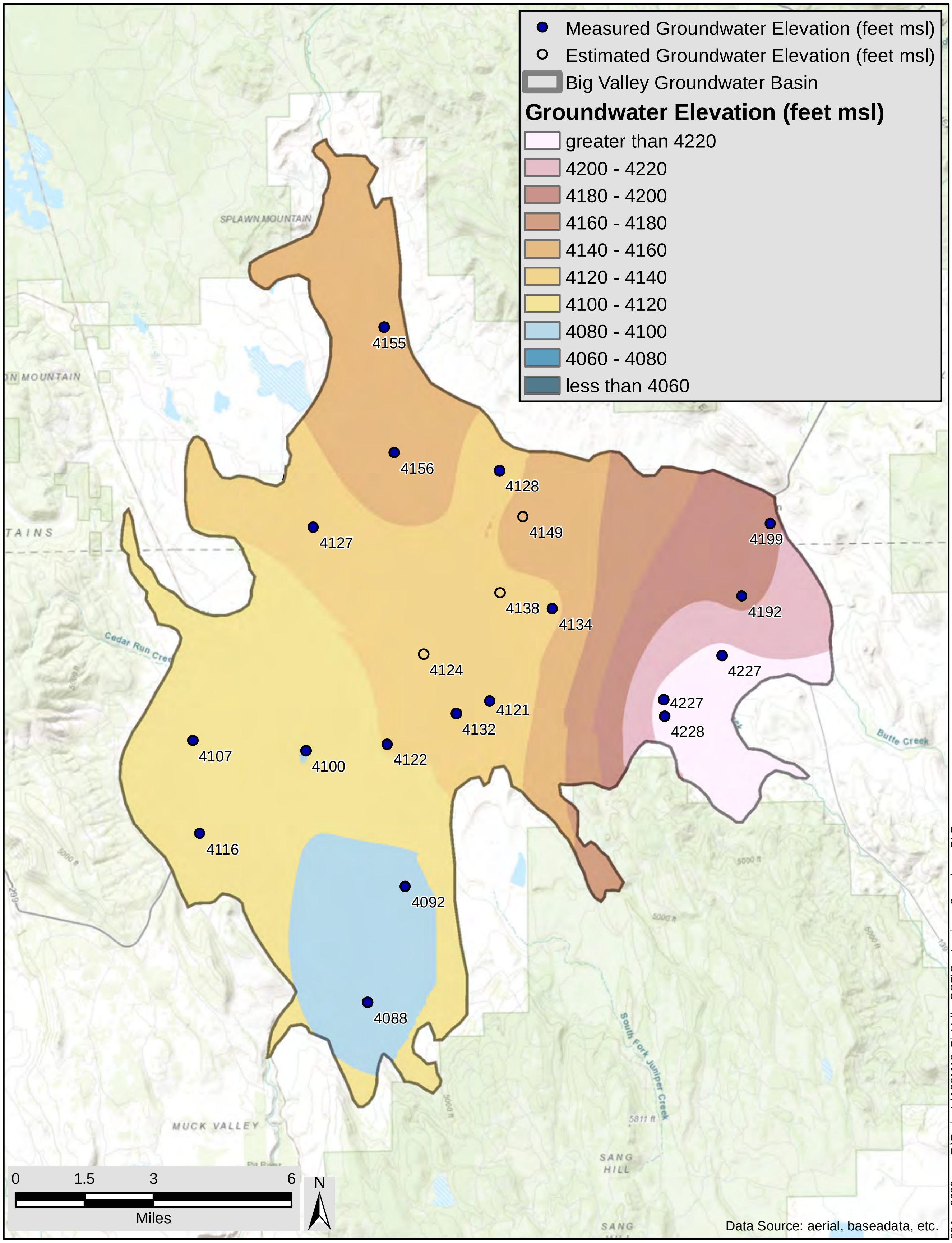
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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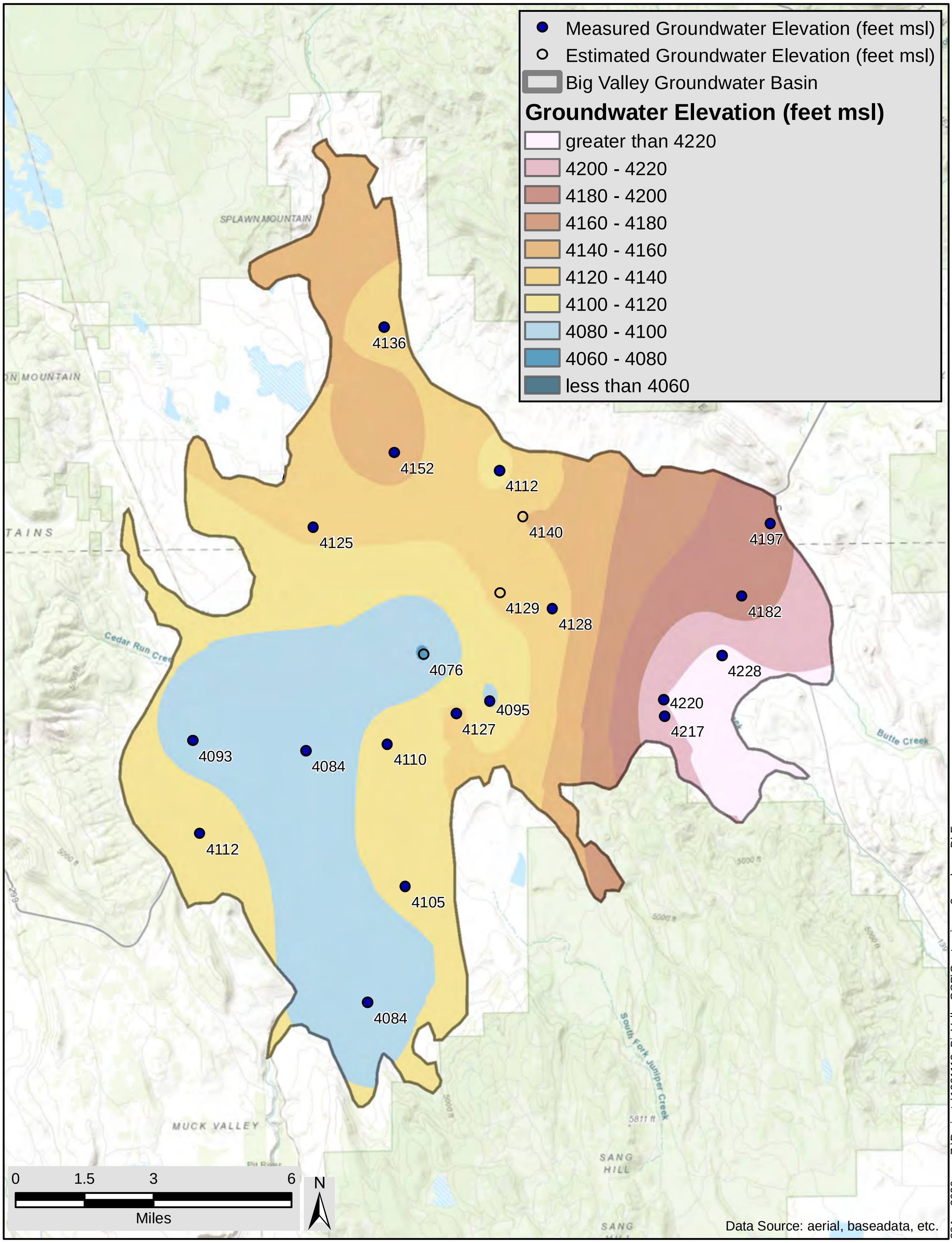
Big Valley Basin Groundwater Sustainability Plan Modoc and Lassen Counties, California	GEI Consultants	Groundwater Elevations Spring 2004		
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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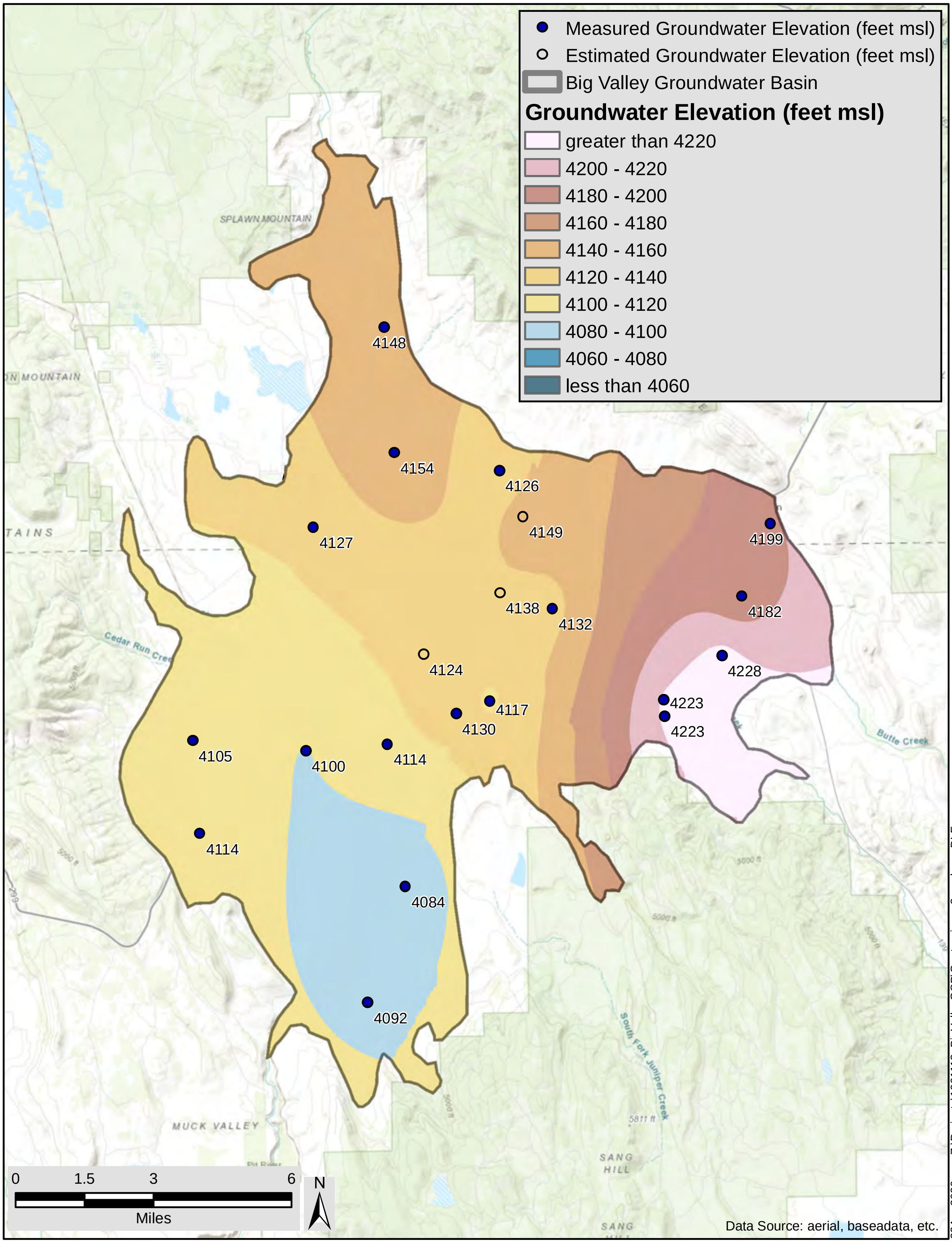
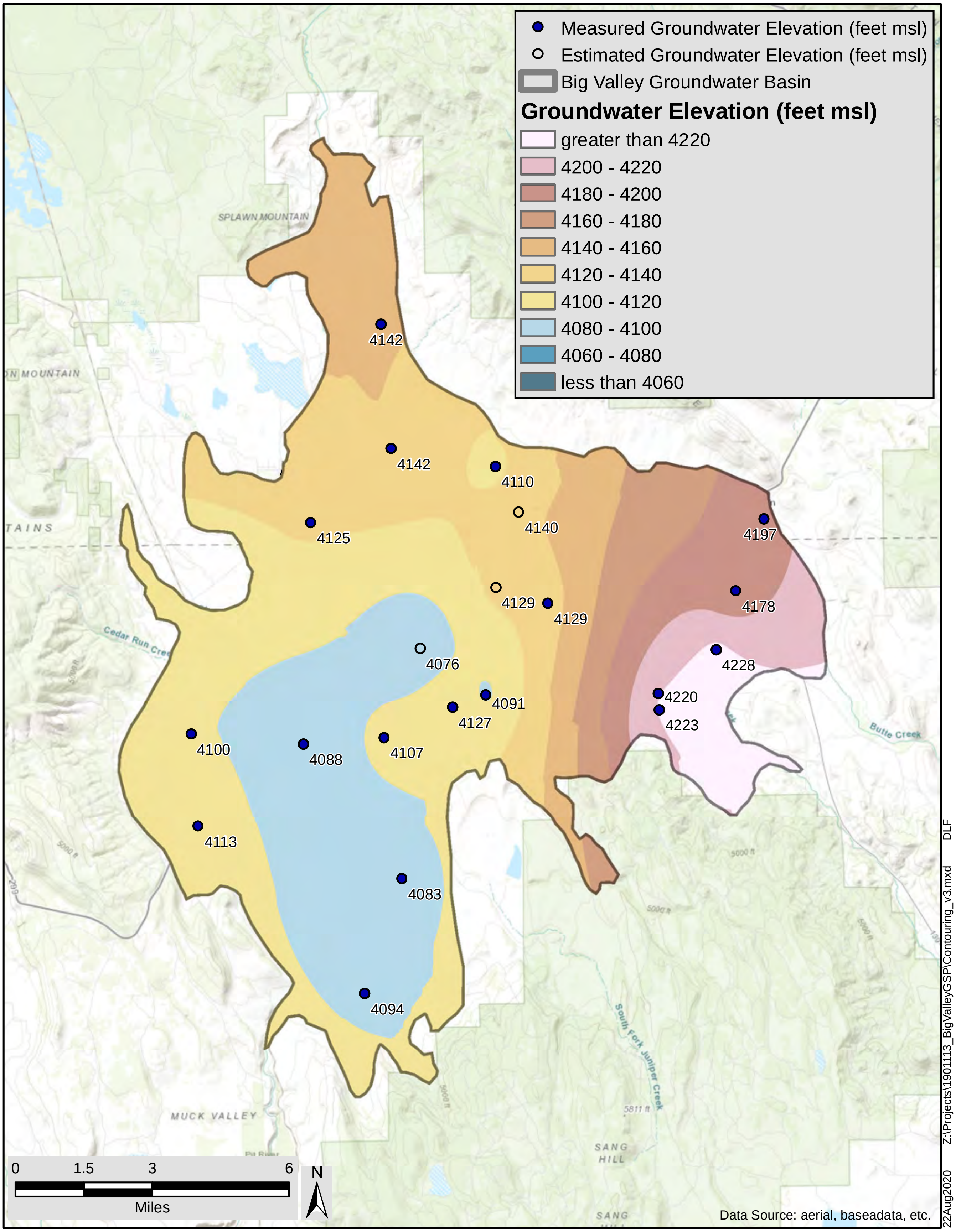
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



Big Valley Basin Groundwater Sustainability Plan Modoc and Lassen Counties, California	GEI Consultants	Groundwater Elevations Spring 2005
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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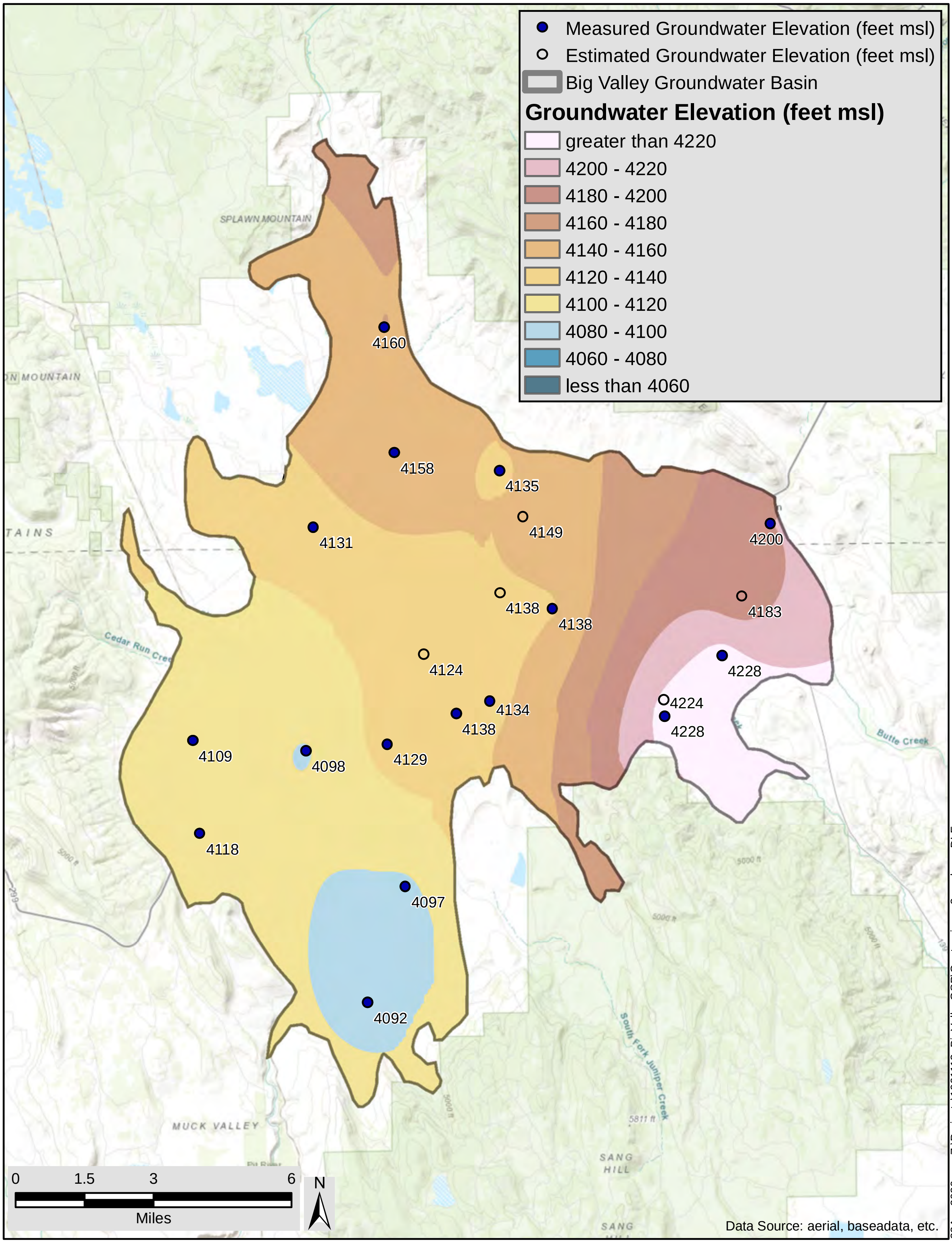

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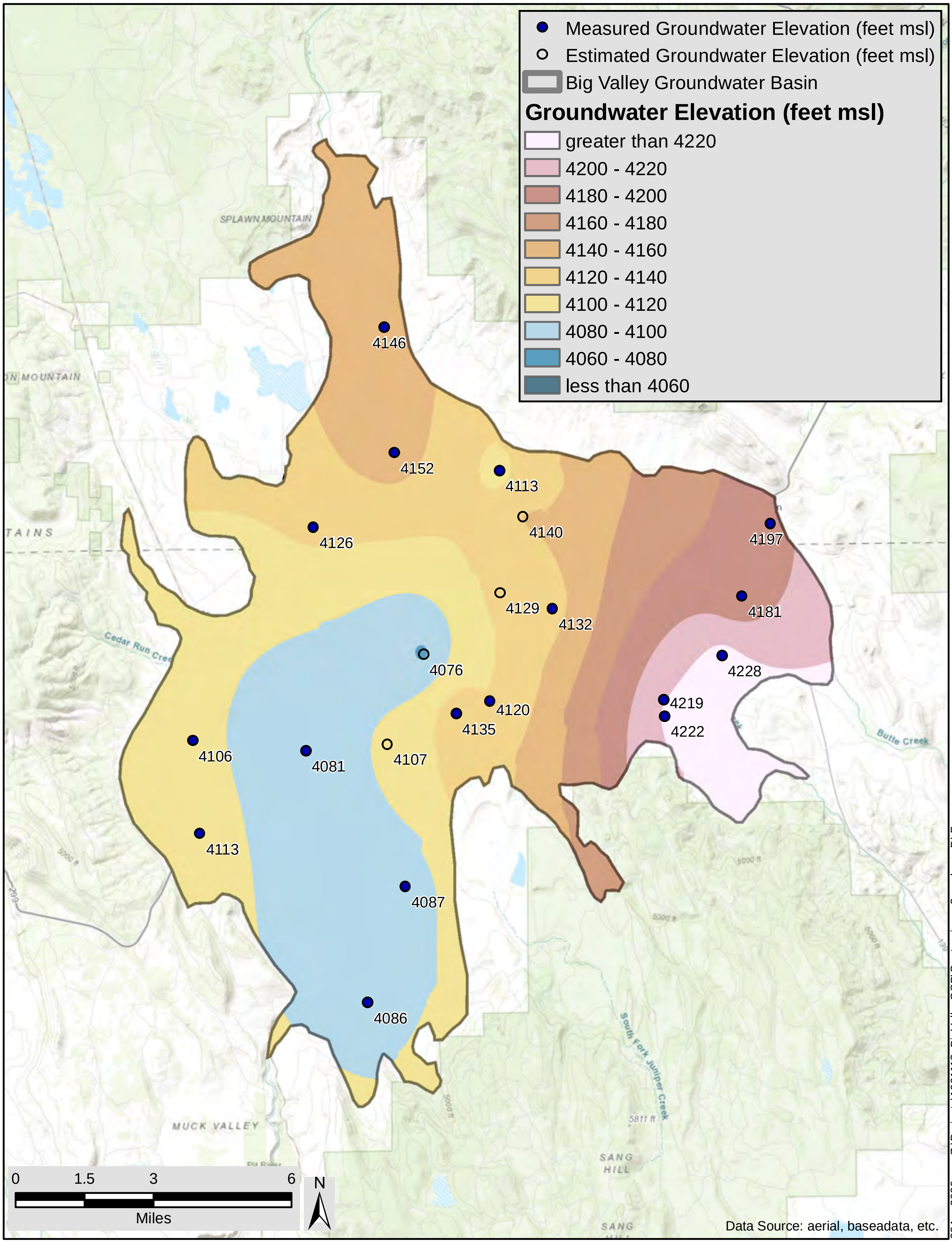
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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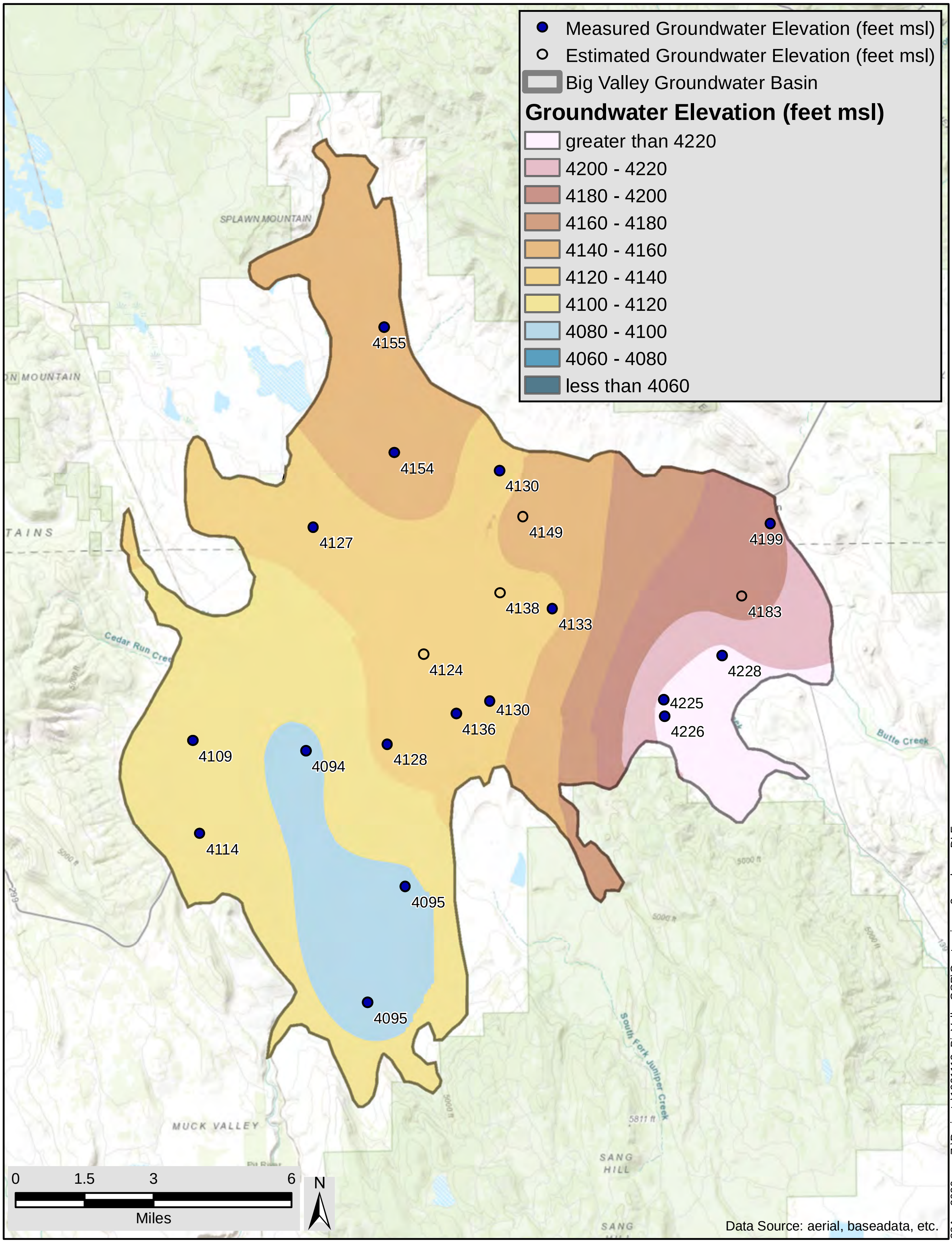

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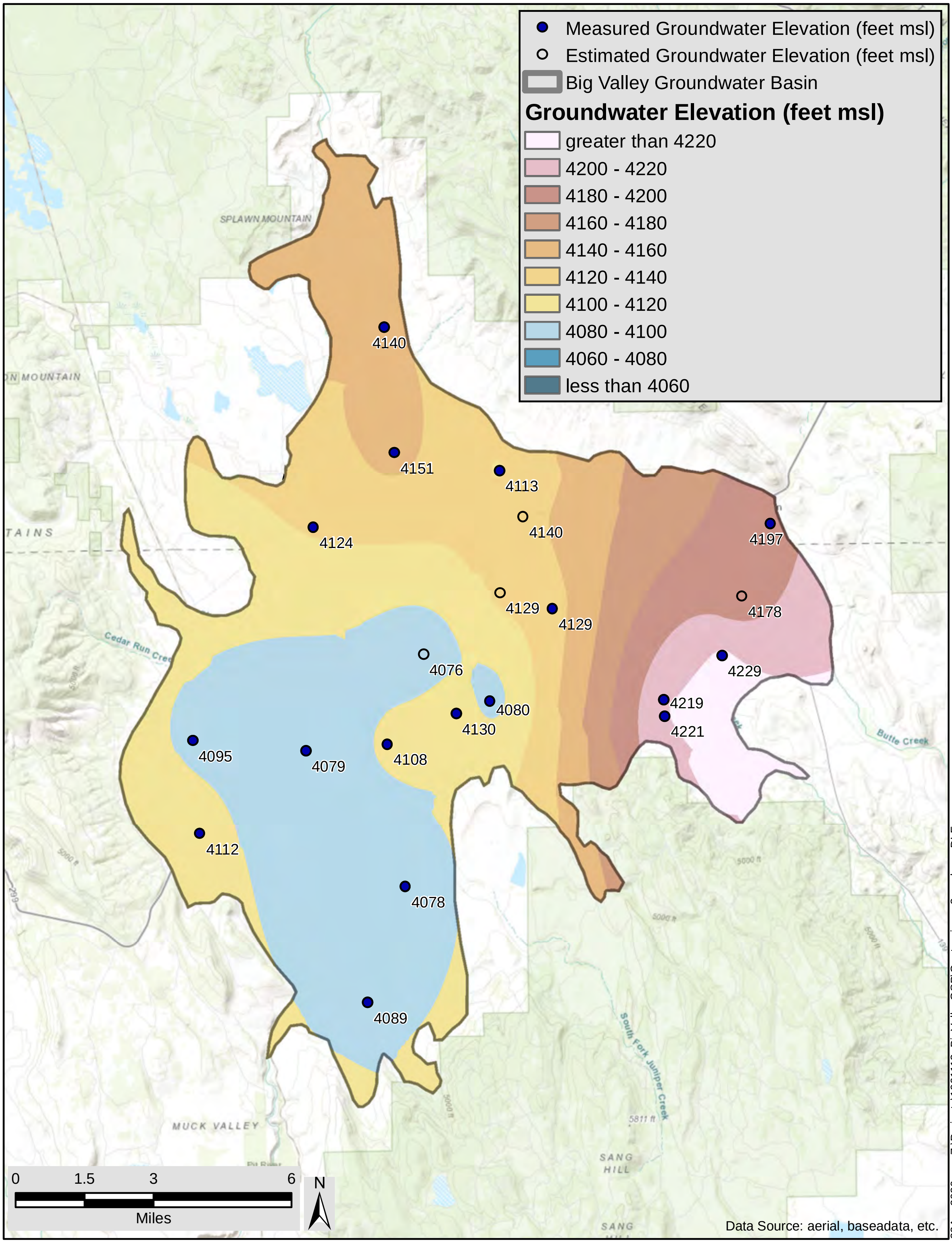
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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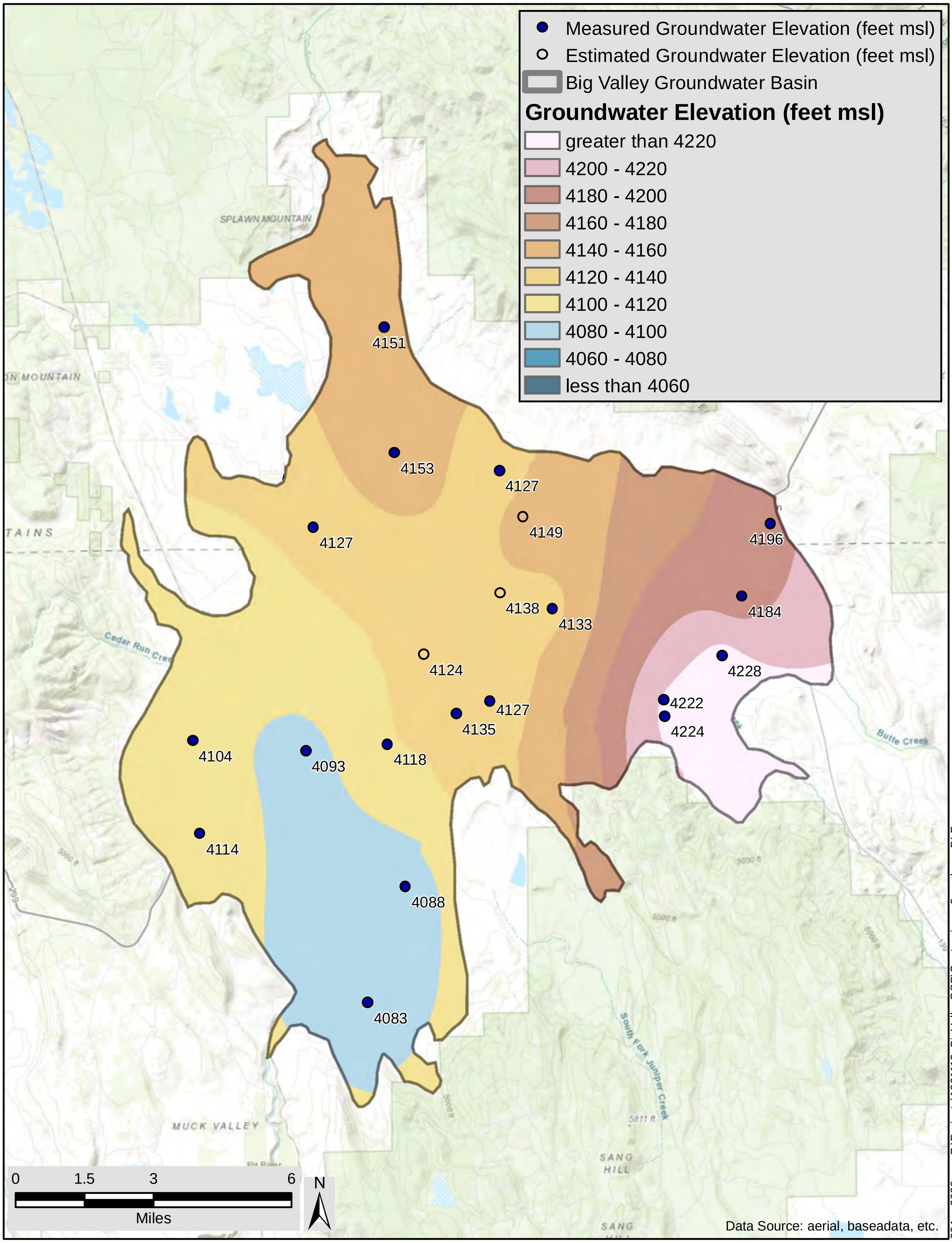
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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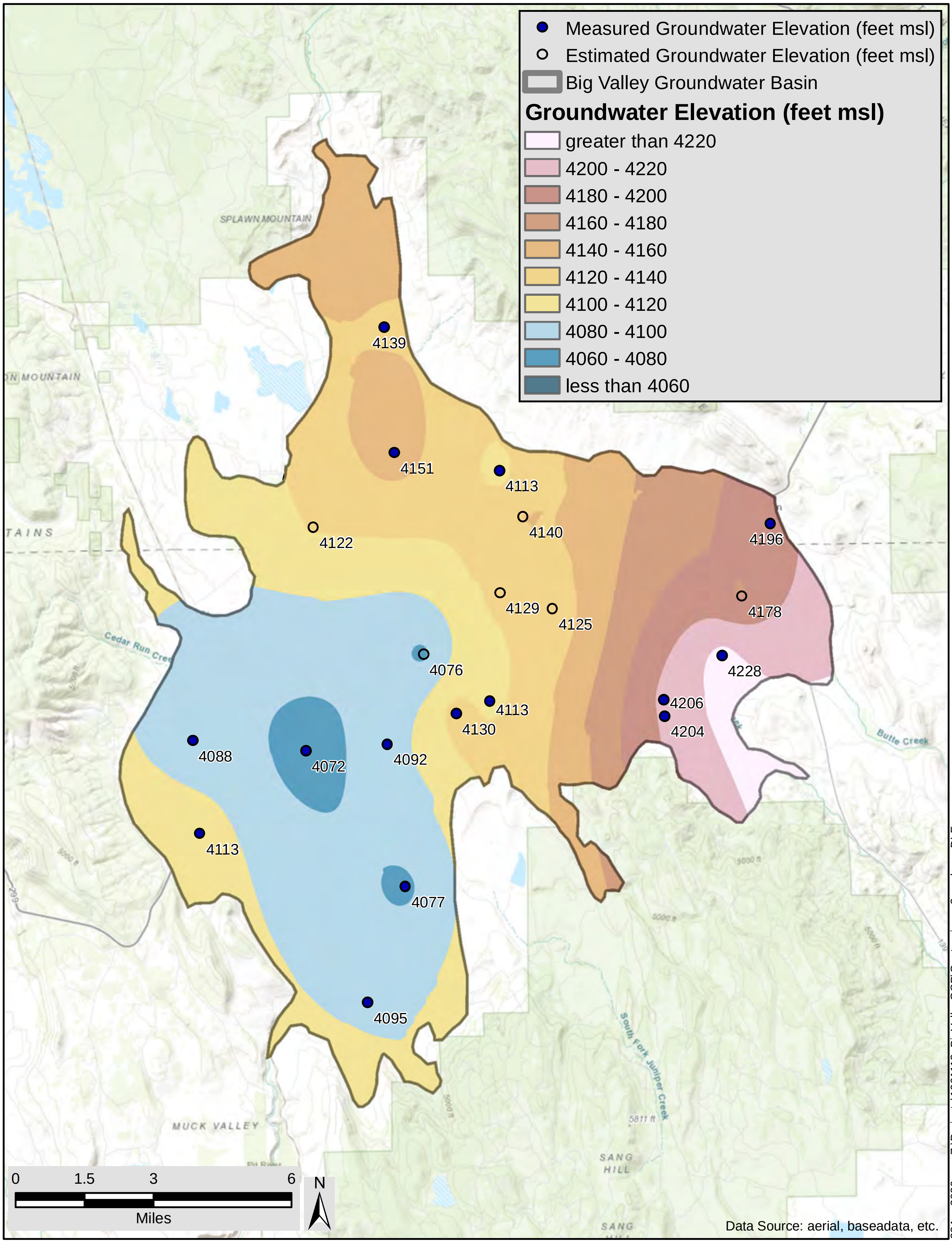
Big Valley Basin Groundwater Sustainability Plan Modoc and Lassen Counties, California	GEI Consultants	Groundwater Elevations Spring 2008
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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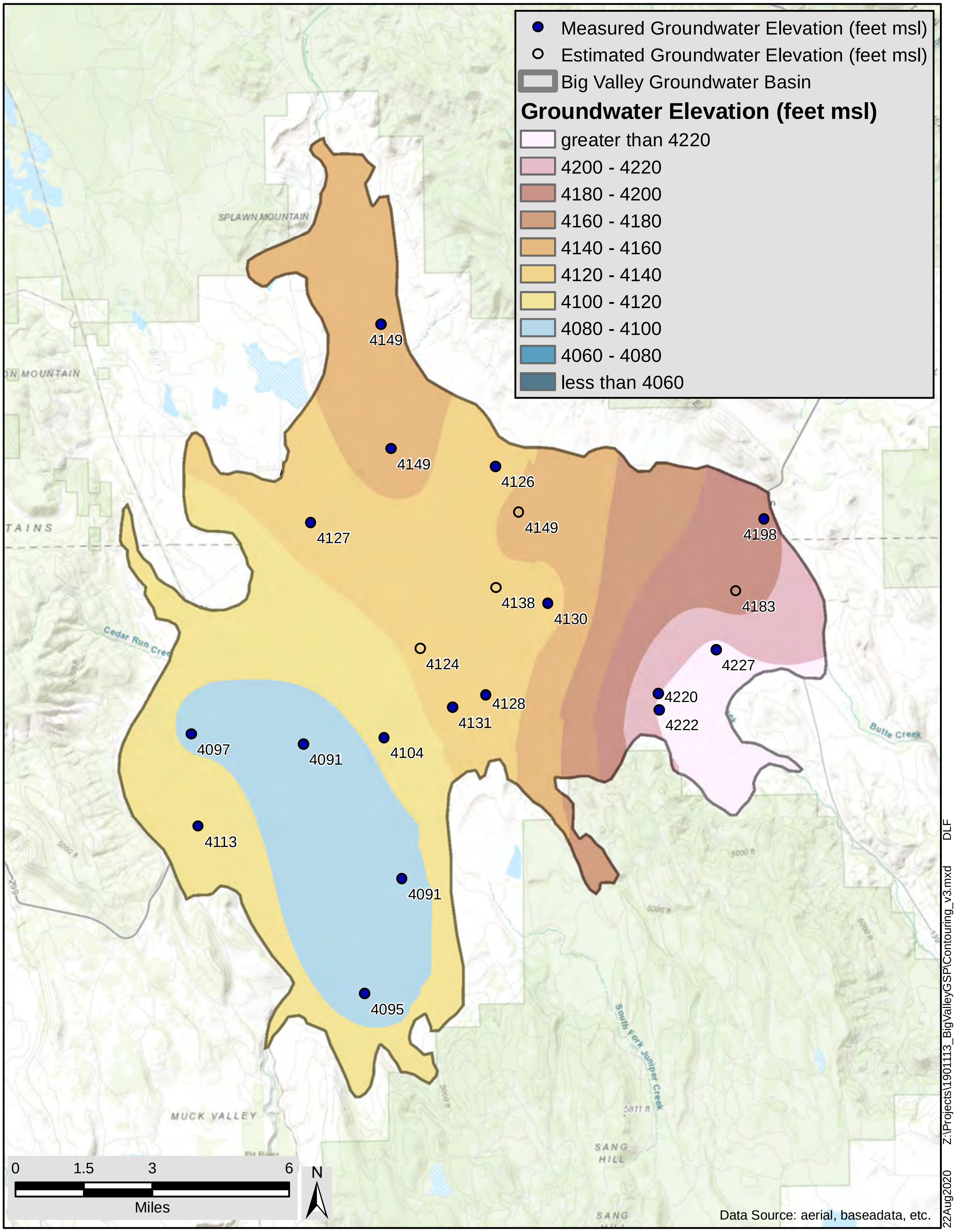
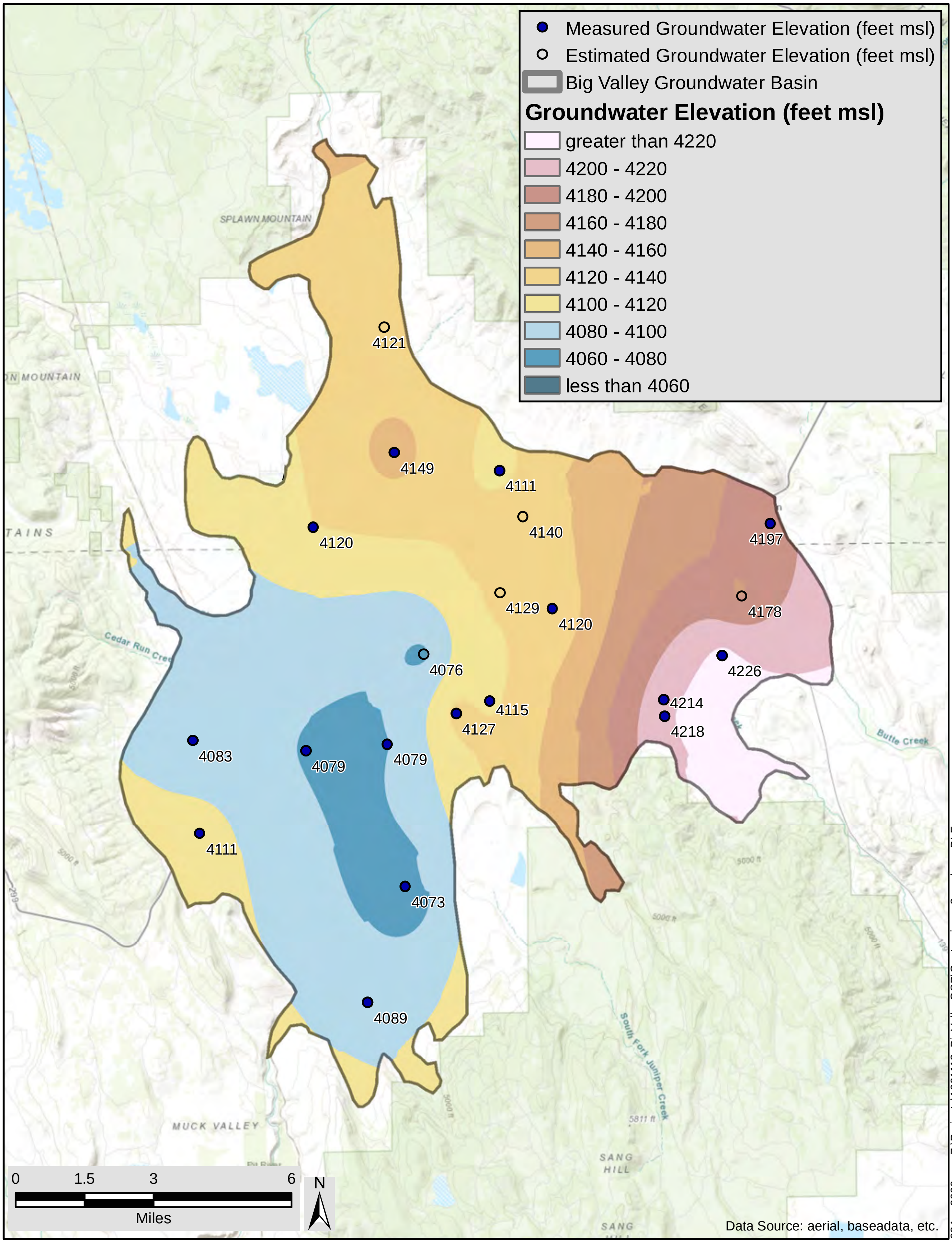
Big Valley Basin Groundwater Sustainability Plan Modoc and Lassen Counties, California	GEI Consultants	Groundwater Elevations Fall 2008		
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



Big Valley Basin Groundwater Sustainability Plan Modoc and Lassen Counties, California	GEI Consultants	Groundwater Elevations Spring 2009
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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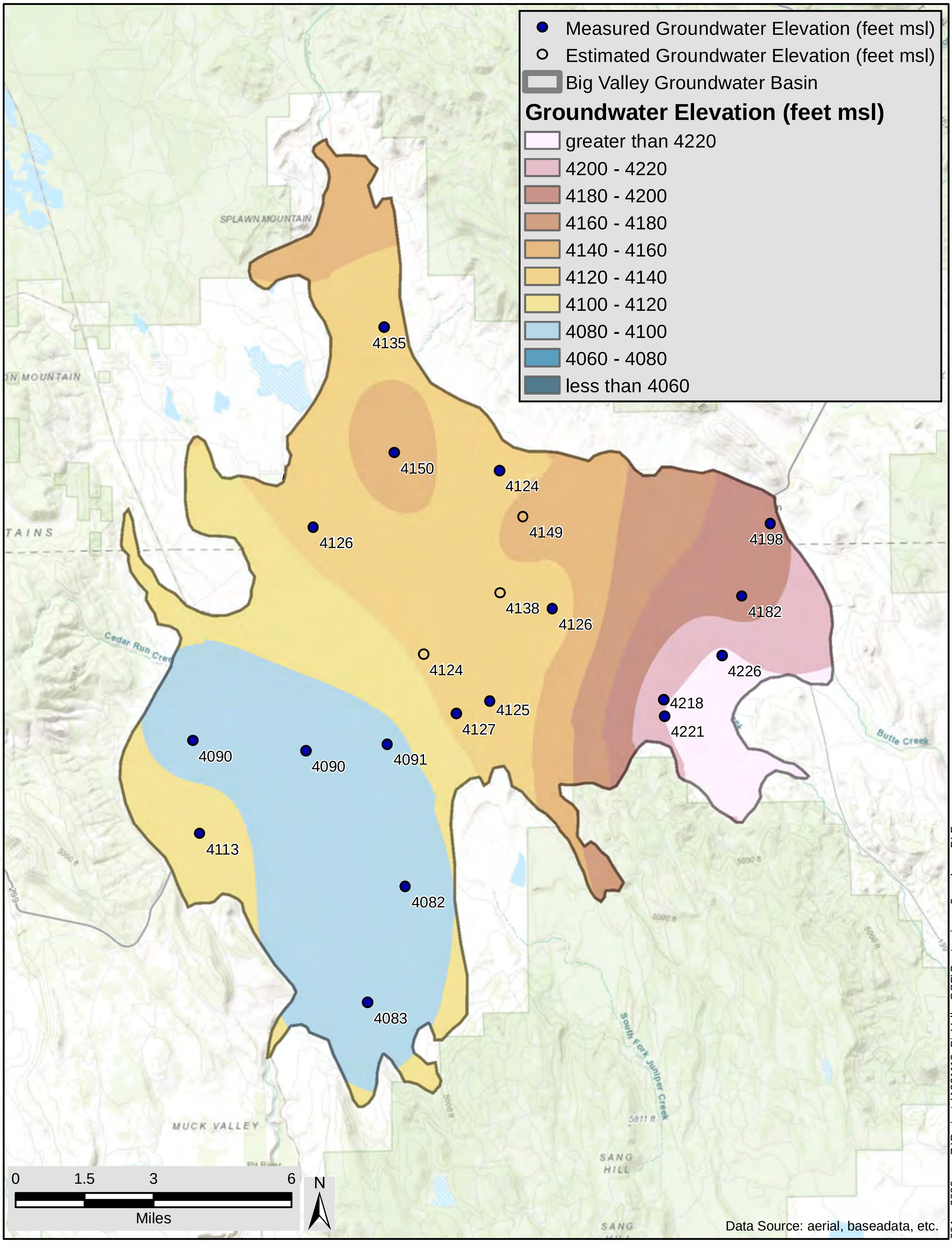
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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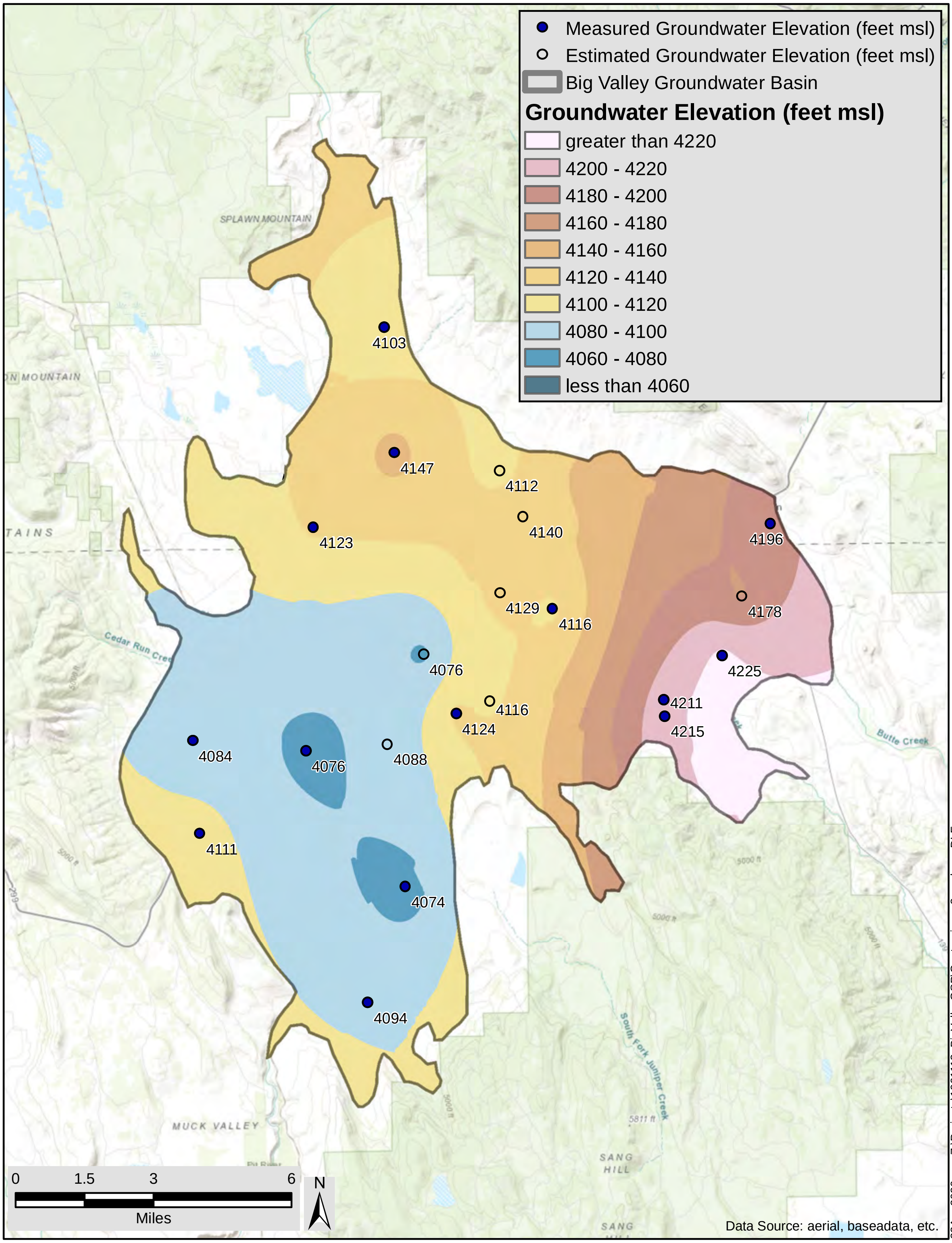
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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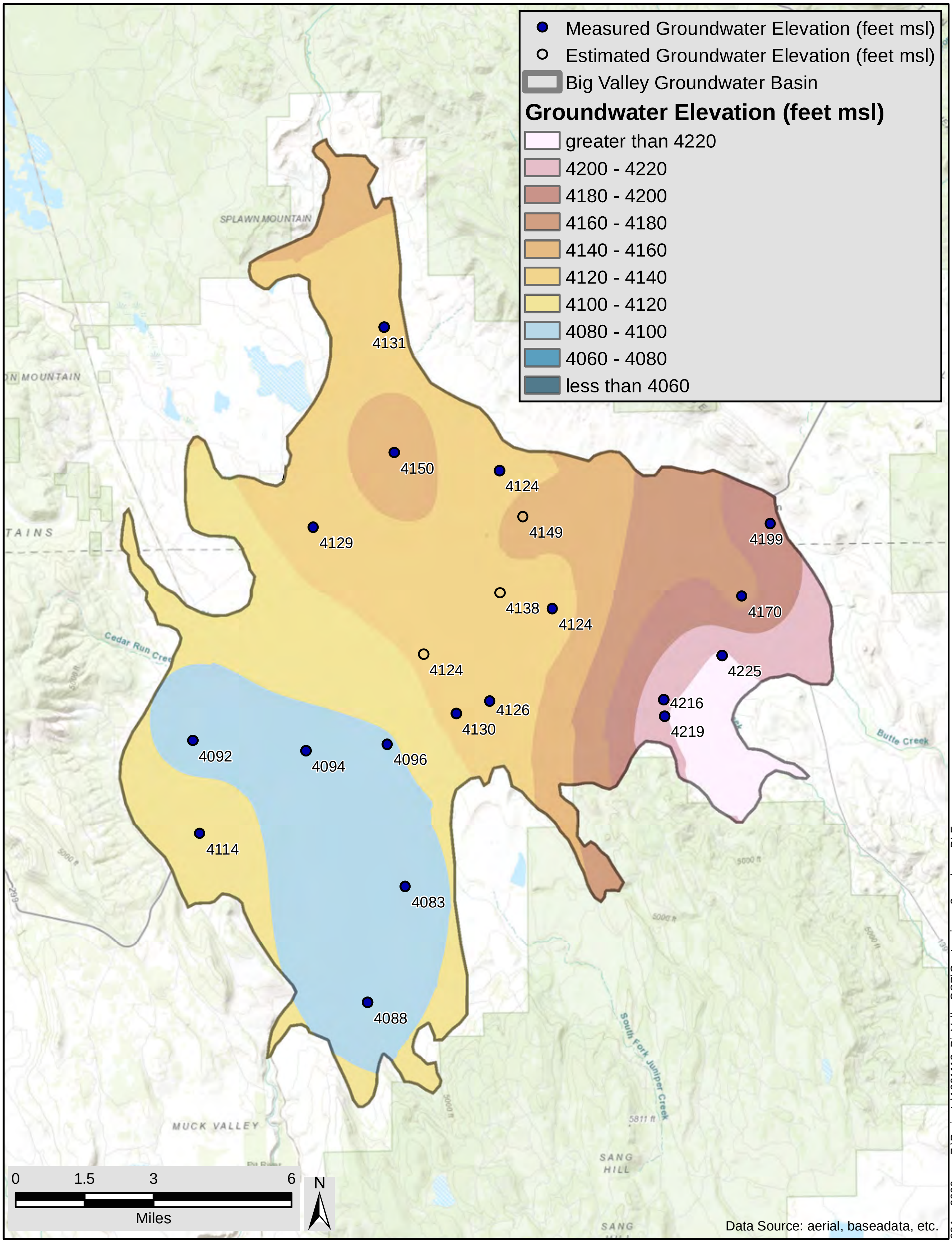
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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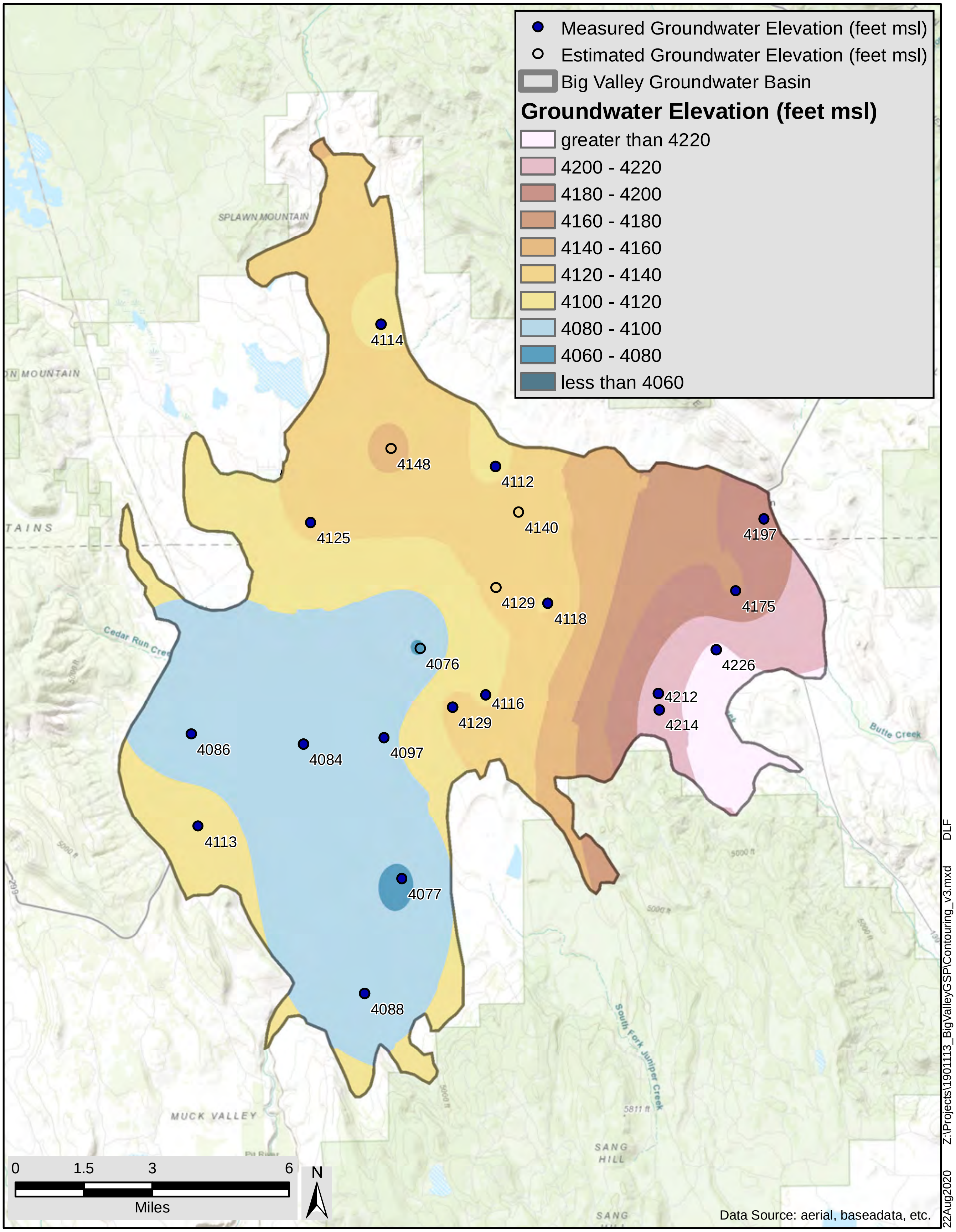
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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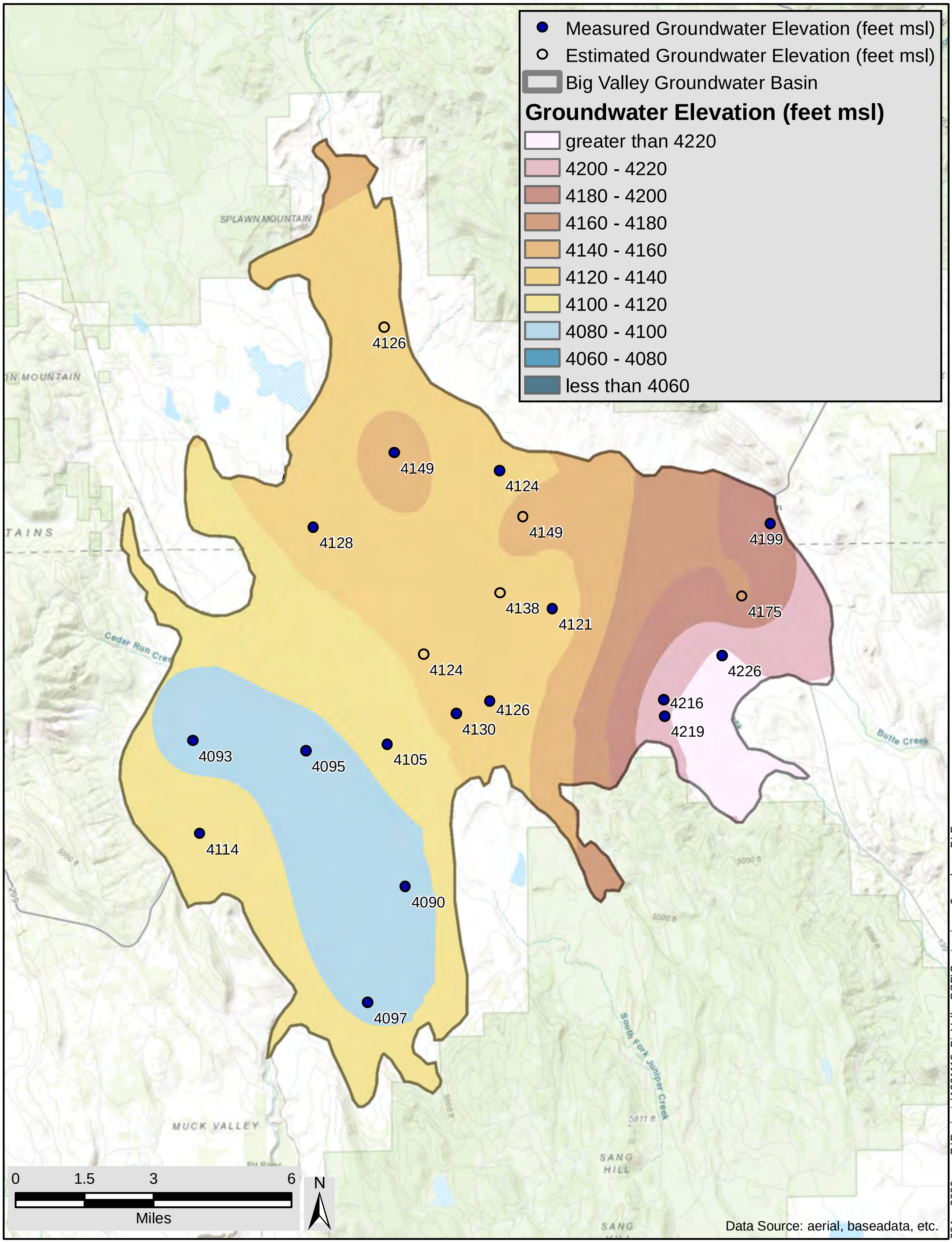
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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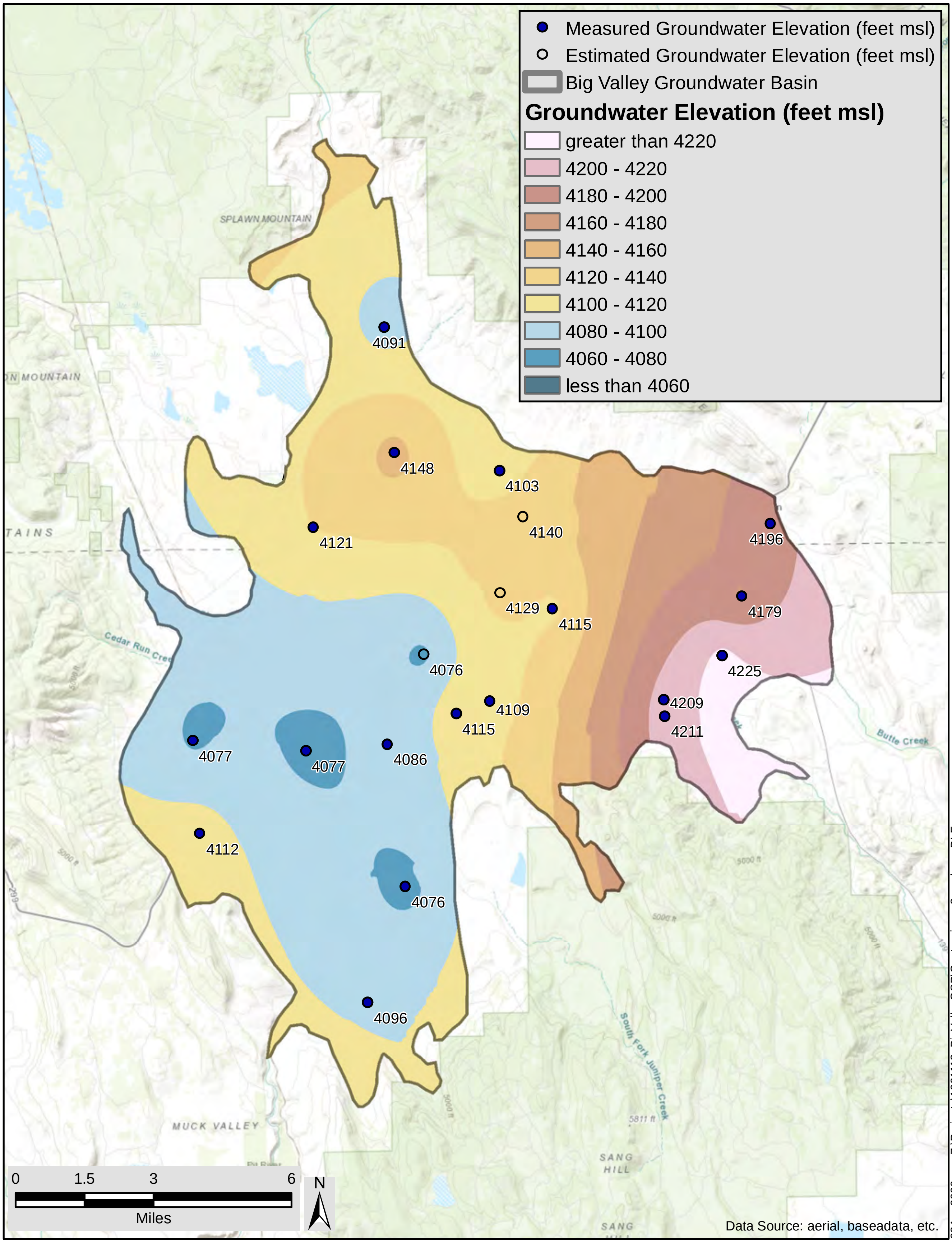
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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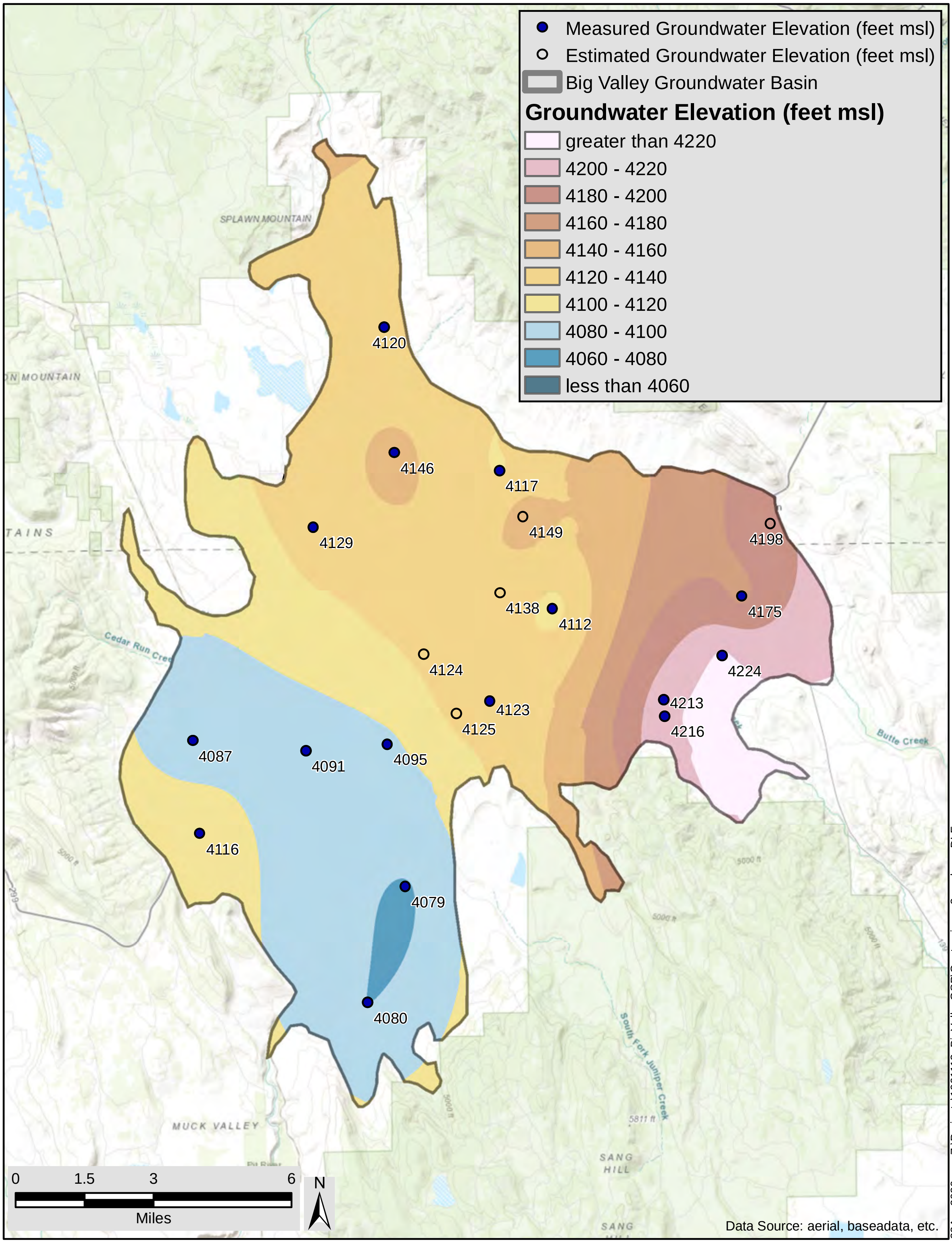
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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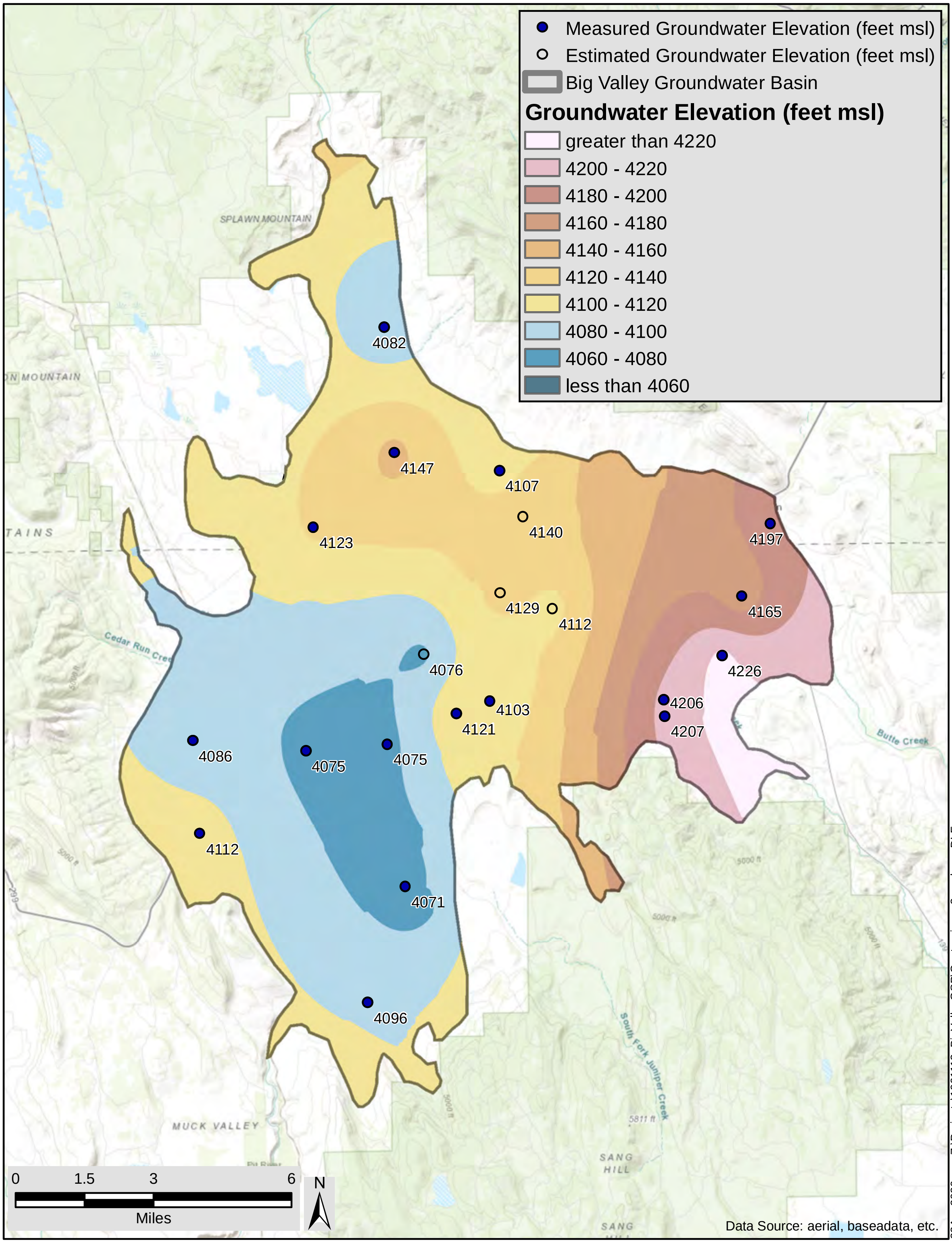
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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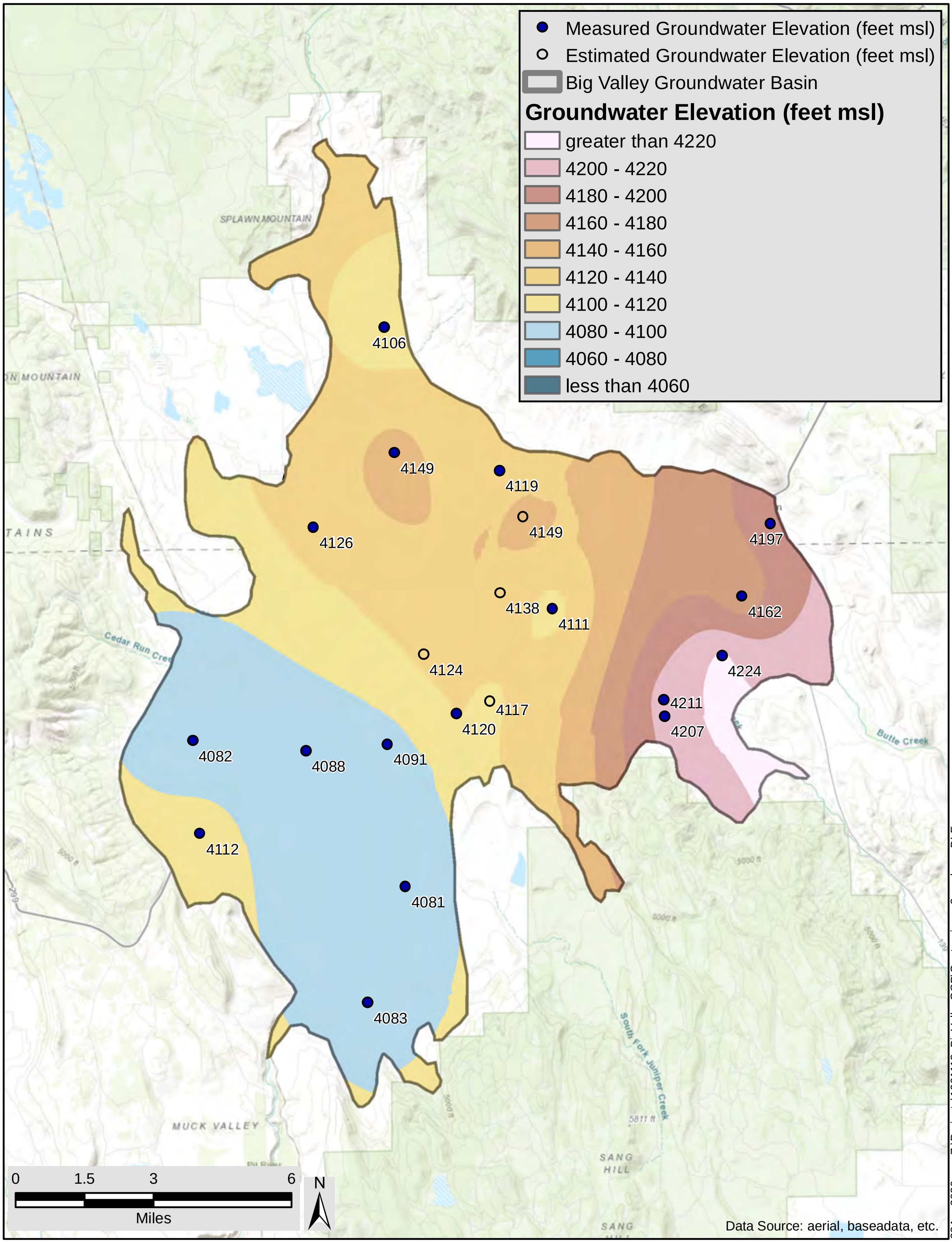
Big Valley Basin Groundwater Sustainability Plan Modoc and Lassen Counties, California	GEI Consultants	Groundwater Elevations Fall 2013
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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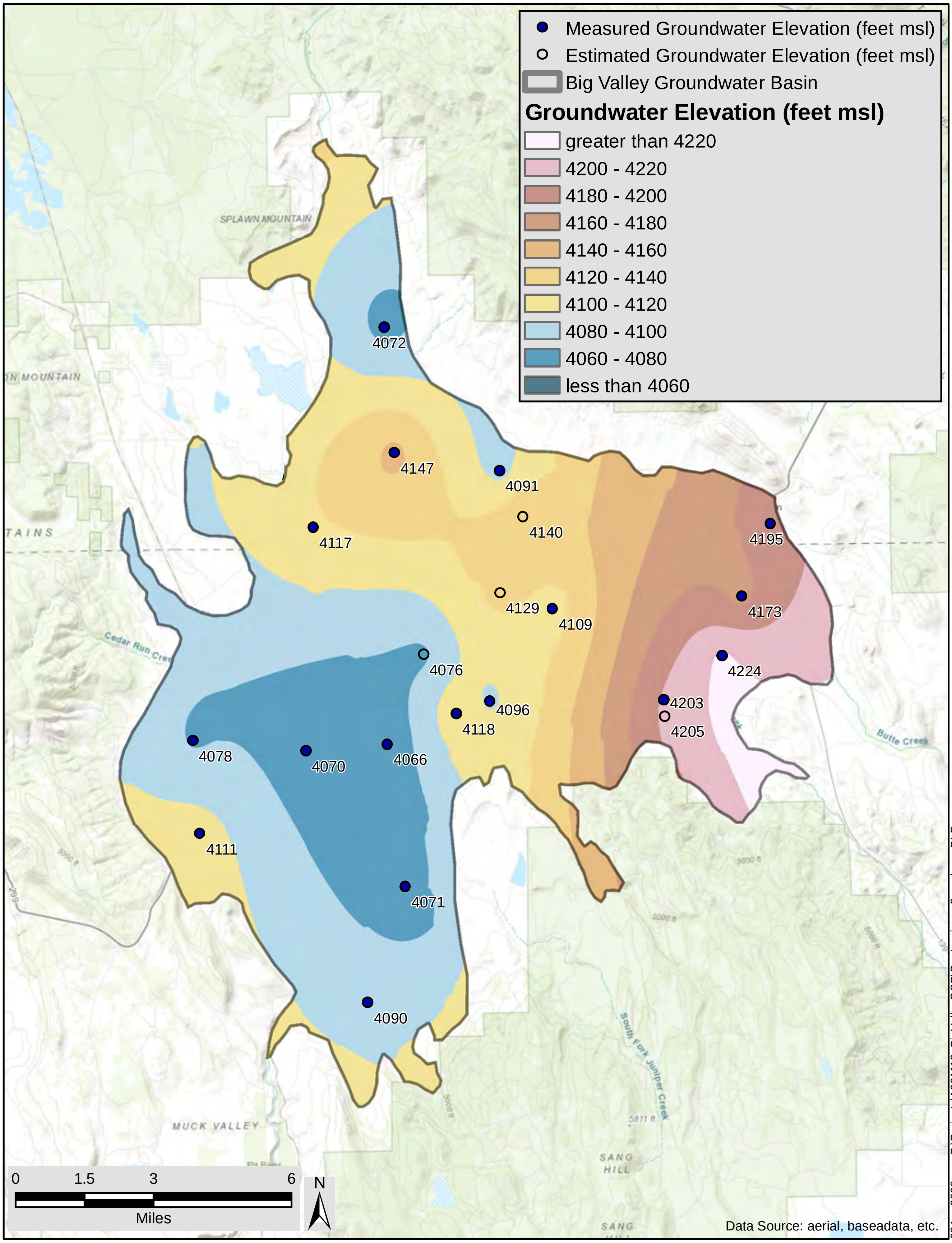
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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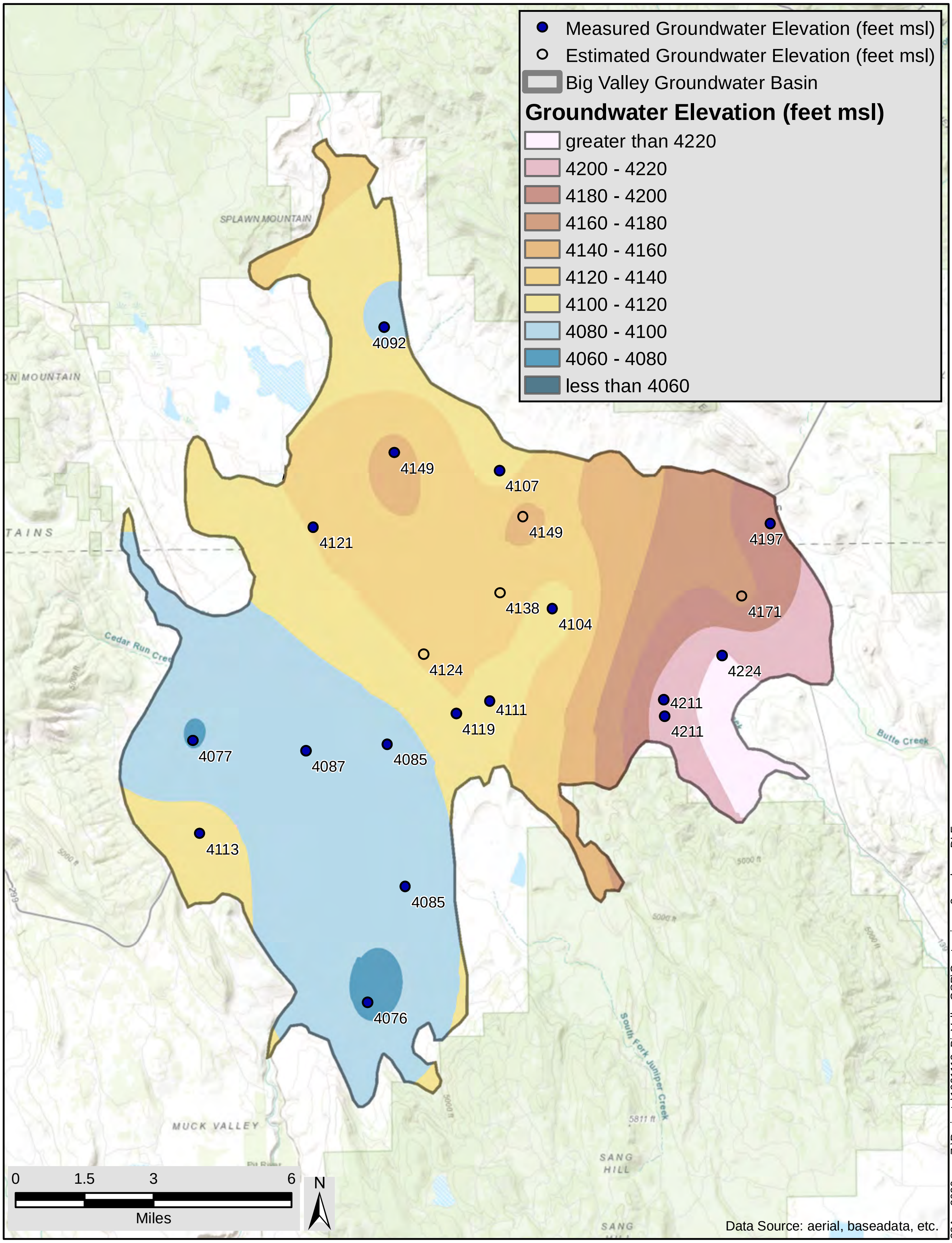
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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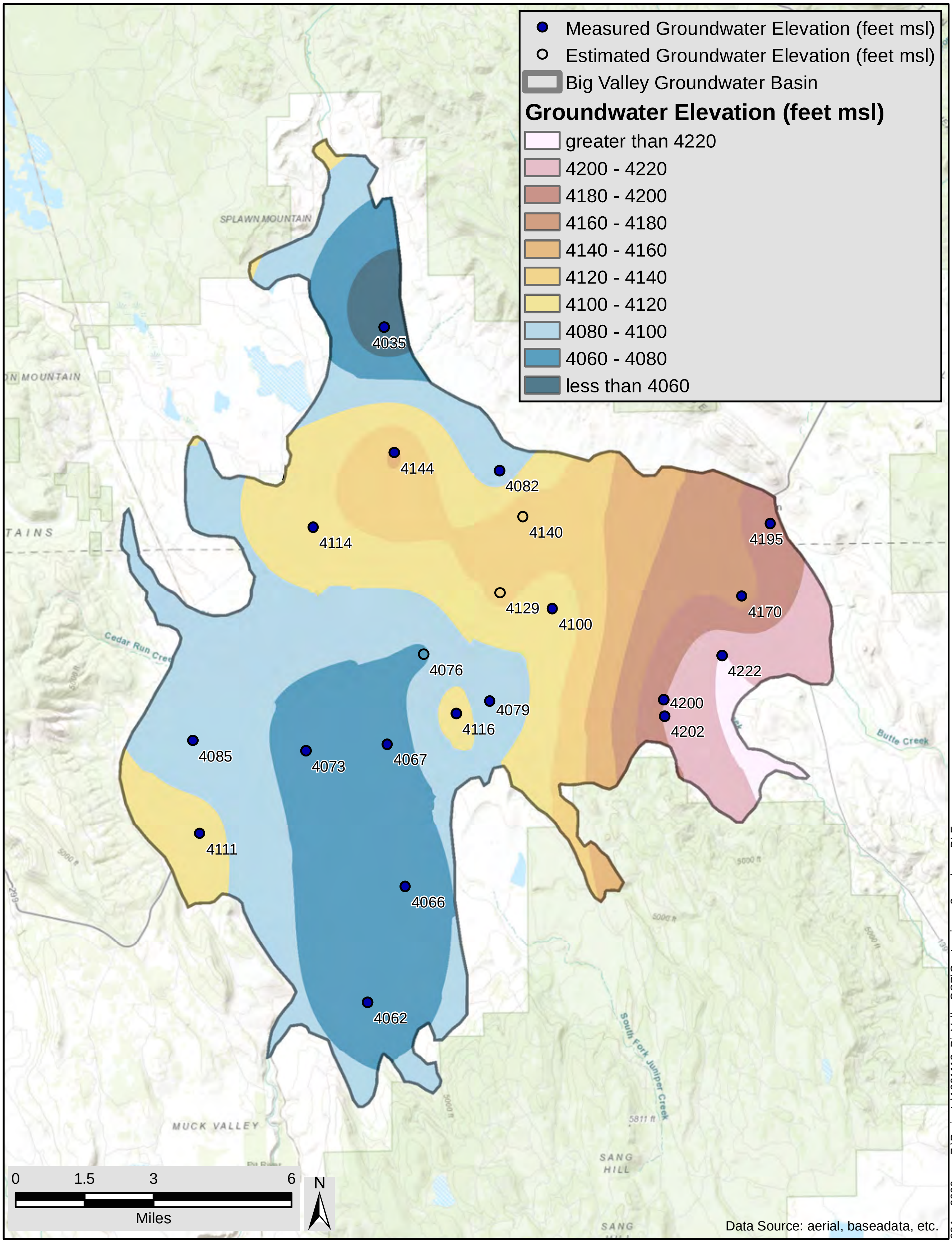
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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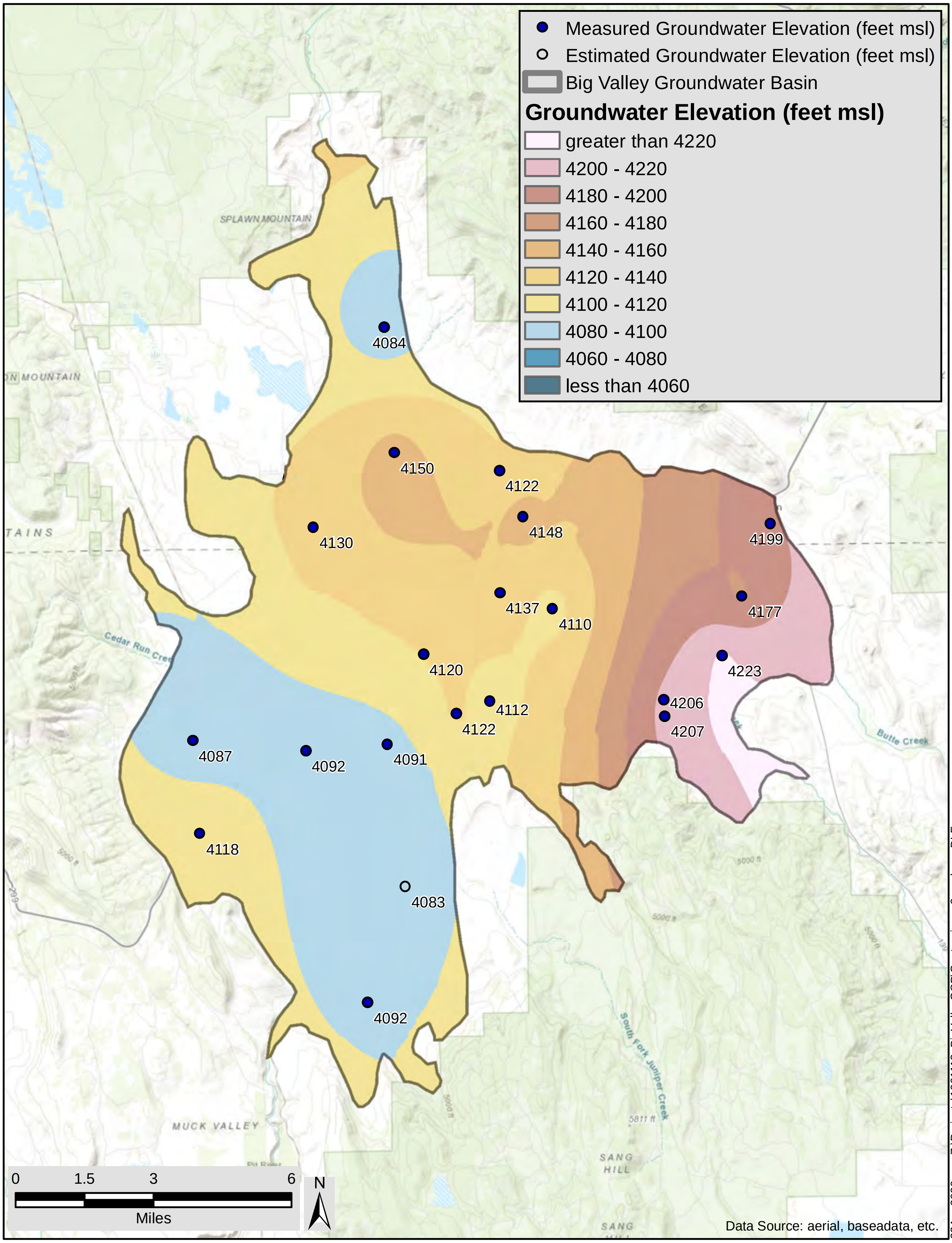

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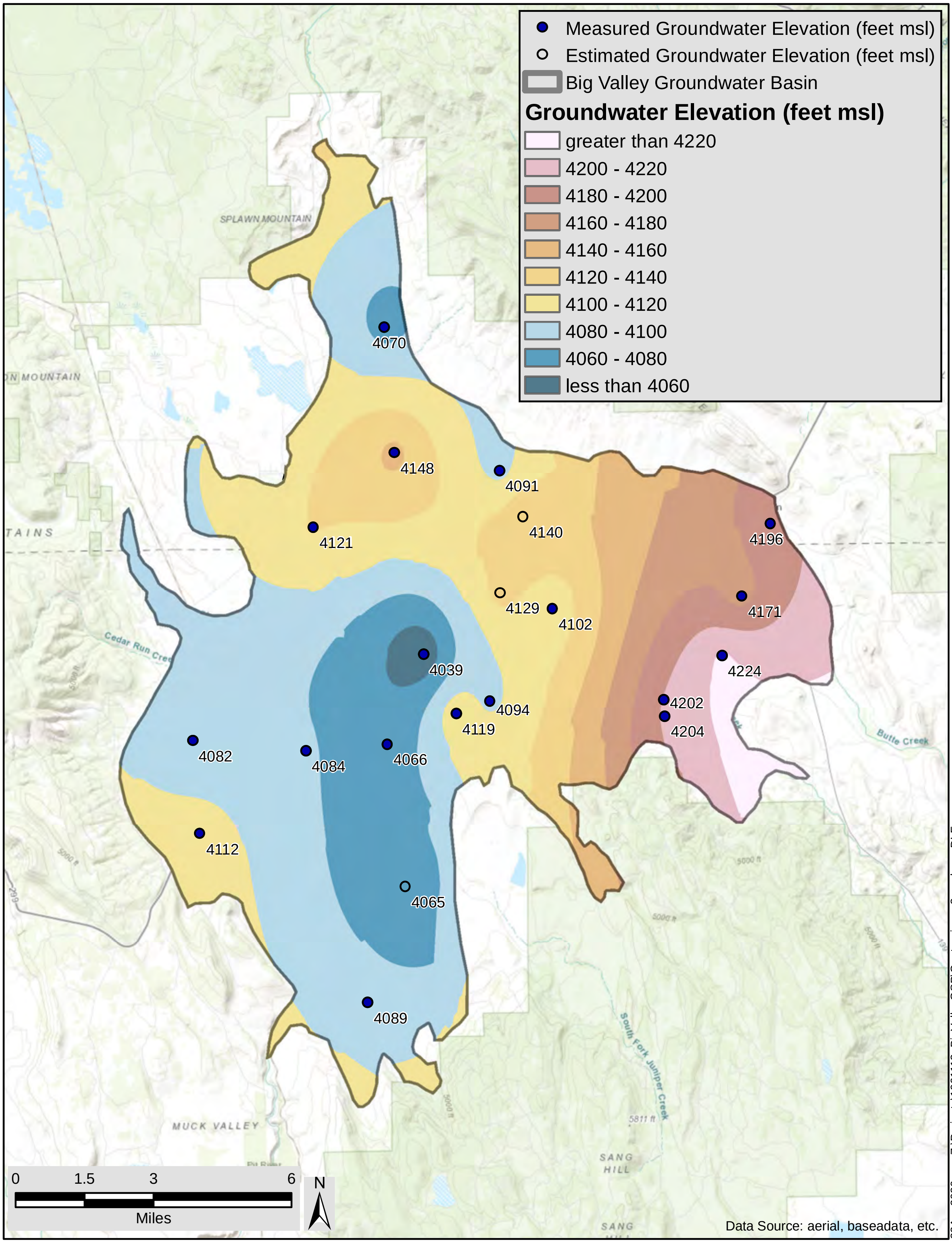

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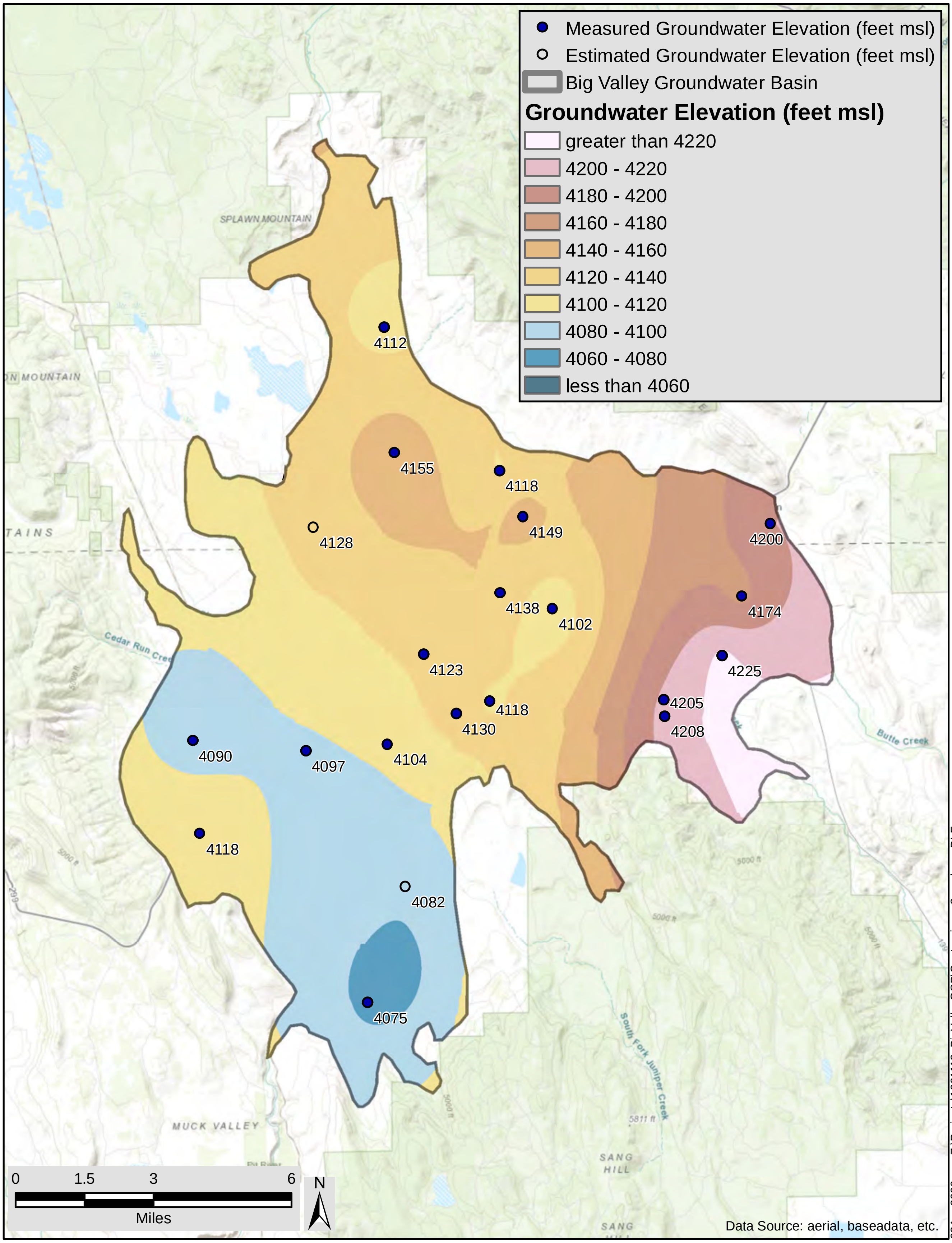
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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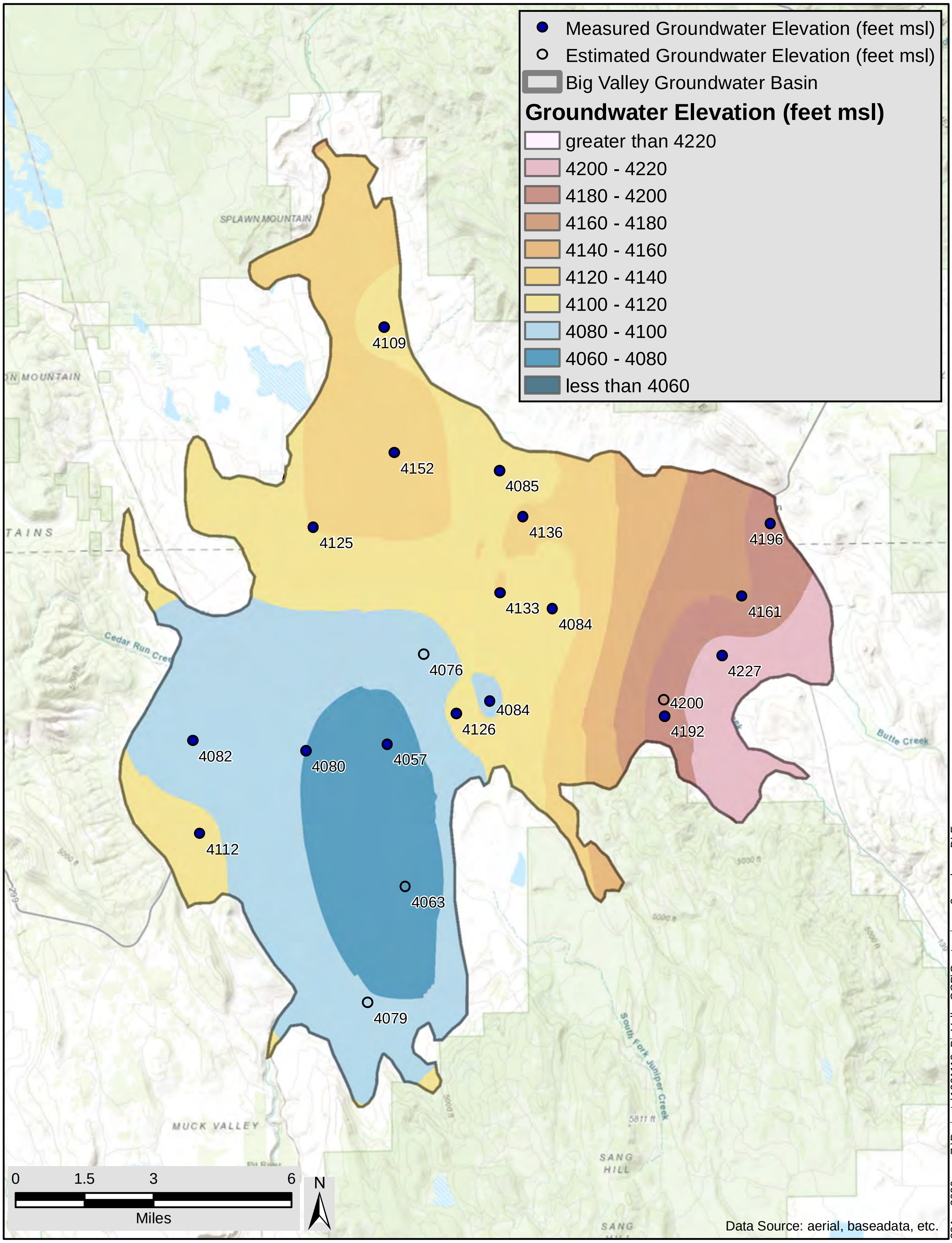
Big Valley Basin Groundwater Sustainability Plan Modoc and Lassen Counties, California	GEI Consultants	Groundwater Elevations Spring 2017
Big Valley Groundwater Basin GSAs		AUGUST 2020 DRAFT FIGURE



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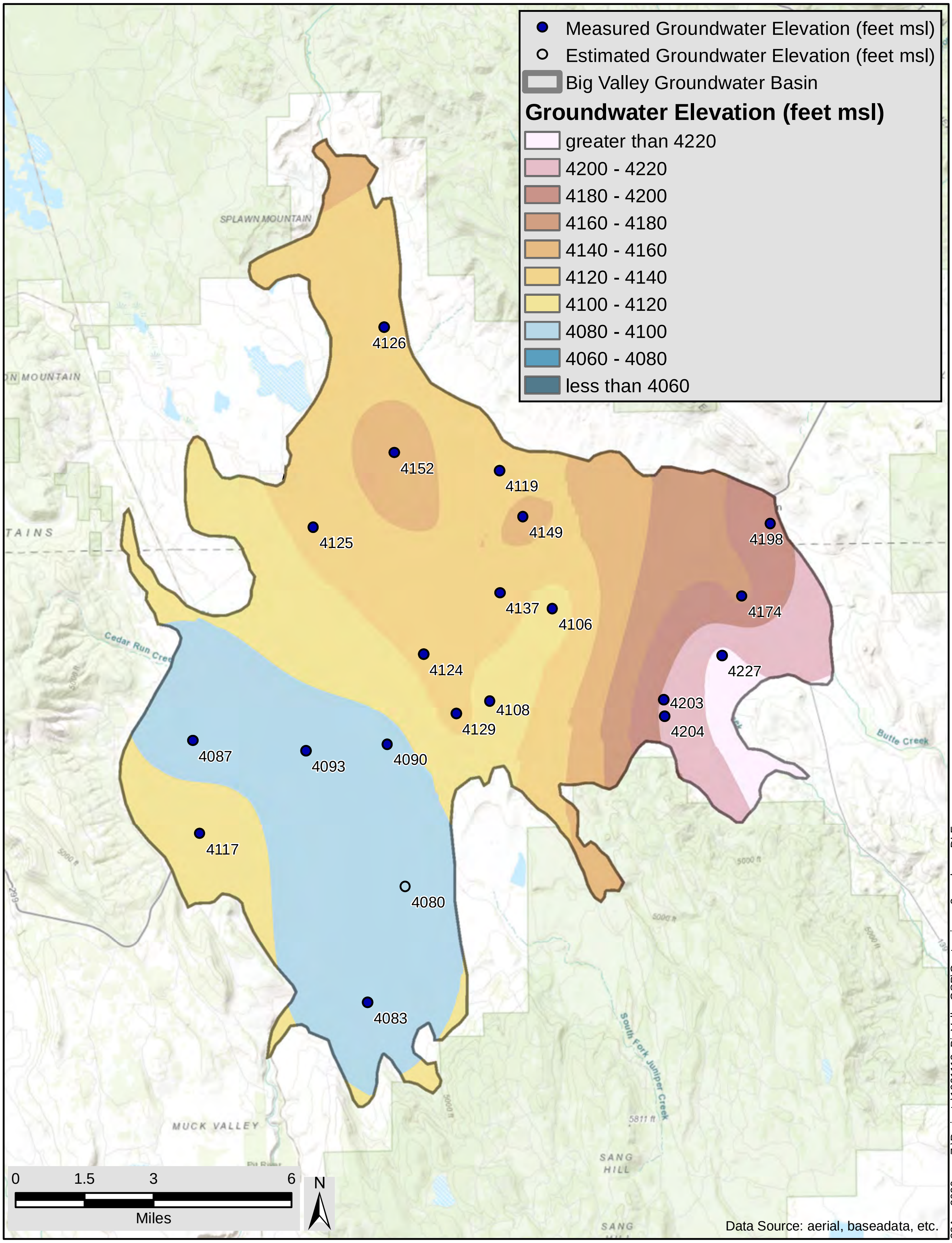
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE



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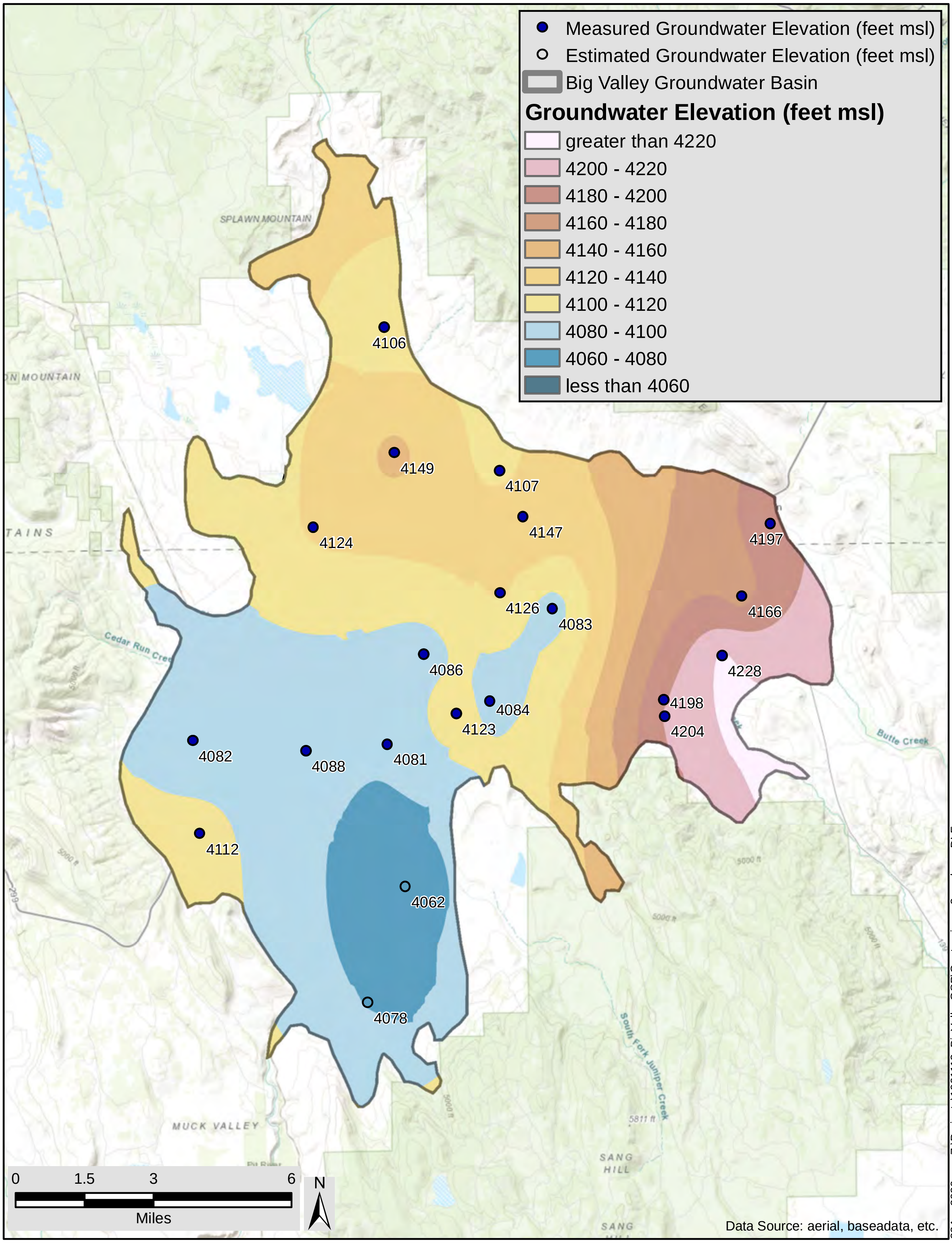

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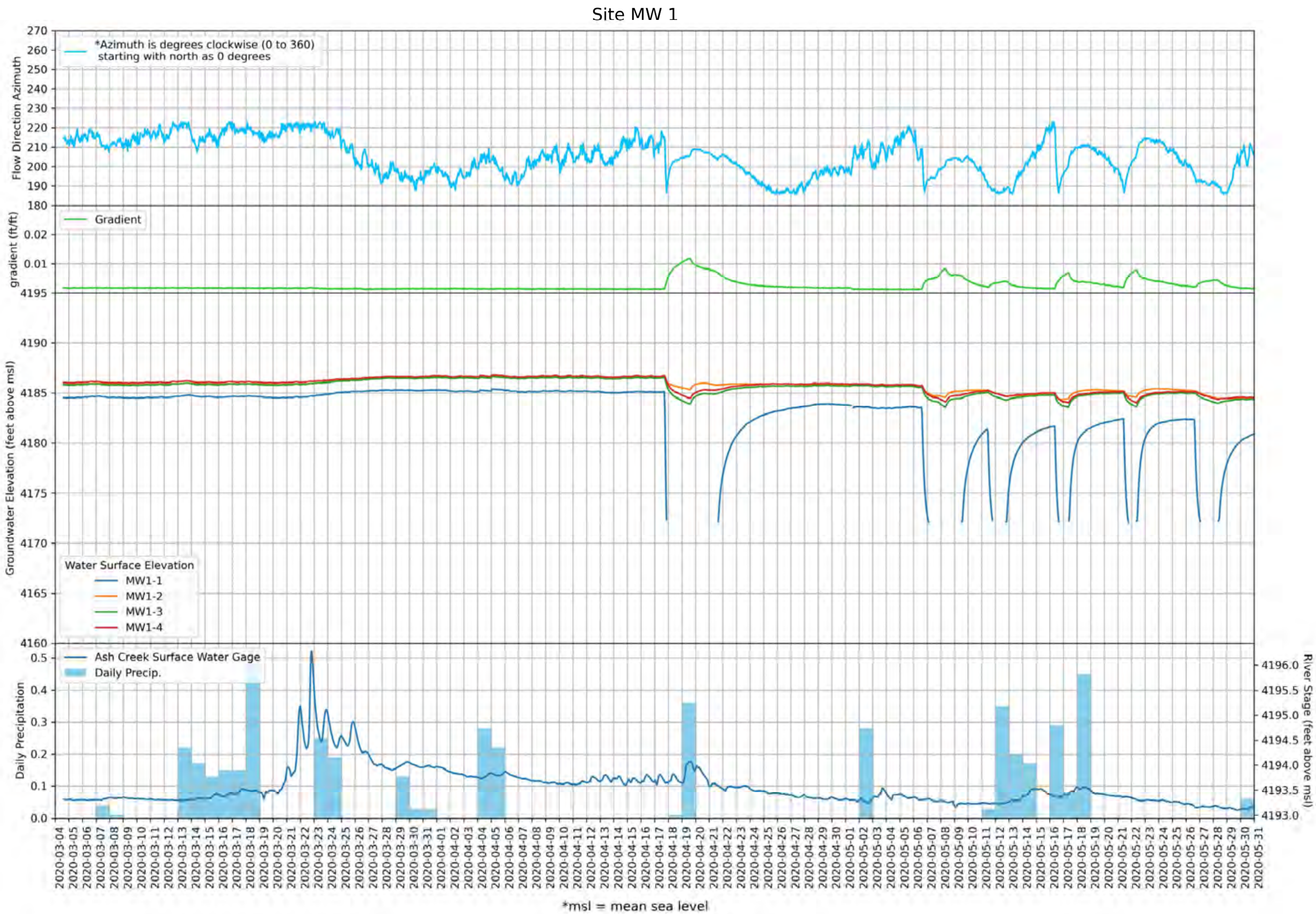
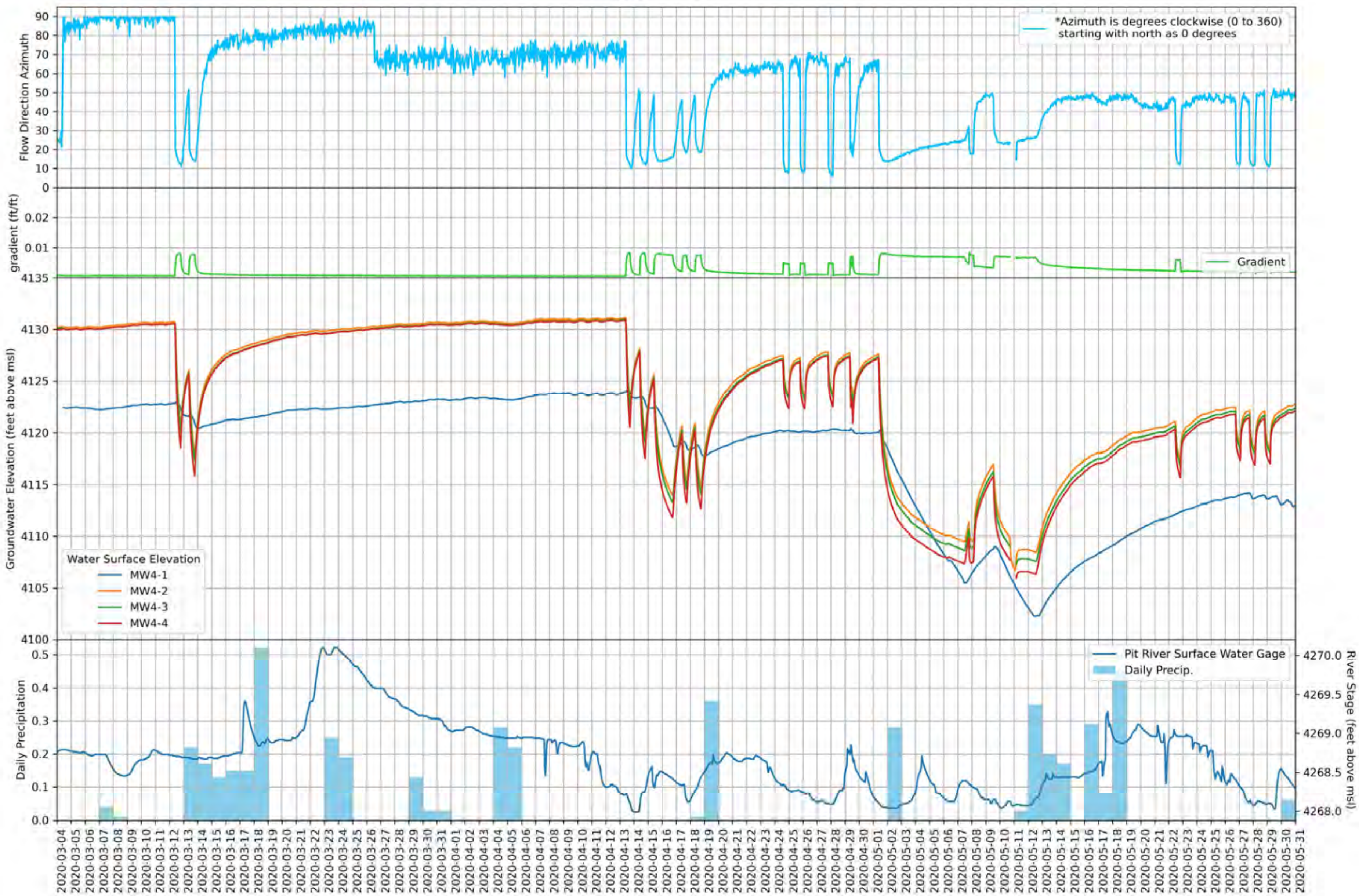
Big Valley Basin Groundwater Sustainability Plan Modoc and Lassen Counties, California	GEI Consultants	Groundwater Elevations Fall 2018		
Big Valley Groundwater Basin GSAs		AUGUST 2020	DRAFT	FIGURE

Appendix 5C

Transducer Data from Monitoring Well Clusters 1 and 4


Site MW 1
*Azimuth is degrees clockwise (0 to 360) starting with north as 0 degrees
Flow Direction Azimuth
Gradient
gradient (ft/ft)
Groundwater Elevation (feet above msl)
Water Surface Elevation
MW1-1
MW1-2
MW1-3
MW1-4
Ash Creek Surface Water Gage
Daily Precip.
Daily Precipitation
River Stage (feet above msl)
*msl = mean sea level

Site MW 4



*msl = mean sea level

Big Valley GSP Comment Matrix (Chapter 5)

Document	Page & Line Number	Comment	Date	Notes and Responses
Public Draft Chapter 5	Subsidence, Section 5.5, pages 5-22 to 5-24	**How do the measurements account for agricultural practices that affect ground level? That should be discussed. Subsidence may not be due to changes in groundwater levels. It could be compaction, grazing land converted to row crops - with soils used to enhance levees. Or earthwork done at Caltrans. Or erosion. There may be other actions affecting ground levels, such as new ground disturbance.** **• Consider a footnote on land use, saying that additional on-ground monitoring is needed. Explain that these measurements show where ground is lower or higher.**	9/24/2020	Subsidence associated with groundwater dynamics and pumping generally result in "bulls-eye" patterns of subsidence. Some of the subsidence in Big Valley is likely due to oxidation of organic materials. There are other options for monitoring subsidence, including the survey markers embedded in the new well monitoring foundations. A key consideration is where groundlevel changes are due to groundwater pumping are undesirable. Added text expanding on different causes of subsidence and clarification that subsidence observed via InSAR may not be induced by groundwater extraction.
Public Draft Chapter 5	Water Quality Section 5.4, pages 5-9 to 5-22.	There are concerns that providing quantifative measurements on water quality will encourage micro-analysis by the state.	9/24/2020	Elevated constituents are naturally occurring (iron, manganese, arsenic). Also good to watch specific conductants. The GSP is required to report on contamination sites (such as gas stations and landfills). The graphs do show that there is better water quality (graphs 5-8, 5-9 and 5-10). It can support a baseline groundwater quality monitoring in the GSP. Additional data on water quality can show that conditions are even better than what was seen with Bieber samples.
Public Draft Chapter 5	Groundwater Levels (and surface water interactions)	Don't groundwater levels necessarily need to be the same across the basin? Explain how it's determined that a stream is gaining or losing. It is not understandable.	9/24/2020	Two reaons way surface water depletions are a critical element: surface water rights and groundwater dependent ecosystems. (Response: as long as the wells are in the same geologic formation, the levels should be very close. If a pump is located in a different formation, the response times may be different - and affect the levels) (Response: Pit River and Ash Creek have different water signatures. Additional monitoring and samples will better inform the patterns of gaining and losing.
Public Draft Chapter 5	GDEs, Sec. 5.7, pages 5-26 to 5-31	• The acreage for amount of willows in the basin is overstated. There is not 4,700 acres of willows in the basin. • Ash Creek Refuge uses surface water supplies. There was discussion about groundwater levels in that specific area, which are closer to the surface and contribute to surface water supplies. <u>Table 5.5, page</u> **• Alfalfa is listed as a native species – change this** • Is aspen found in the basin? • Is elderberry found in the basin? **• Change "salix" to "willow"**	9/24/2020	Ash Creek Refuge does also use groundwater pumping to irrigate at Ash Creek. This area is known as an ecological preserve and land uses are not likely to change. The consultants were careful to clearly delineate what truly qualifies as a GDE. This current text is about describing likely or potential GDE. The big question is about managing for GDEs, w.hich comes later Species listings are obtained from the Native CalFlora website. The Nature Conservancy website was also reviewed and many of the species listed were deleted for the Big Valley GSP. Changes made to text to address alfalfa as a non-native species and changing salix to willow

Big Valley GSP Comment Matrix (Chapter 5)

Document	Page & Line Number	Comment	Date	Notes and Responses
Public Draft Chapter 5	GDEs	Do not say that Ash Crrek is "managed" Descriptions of GDEs should be verified by those who are working on the land	9/24/2020	Chapter 5 does not contain the word "managed" or "managed wetlands" - the area is referred to as Ash Creek Wildlife Area
Public Draft Chapter 5	River reaches: Page 5-25 b and c	**• Reaches 6 and 9 are both labled Upper Pit River** • Reach 3 is Willow Creek: water rights and diversions mean that Willow Creek does not exist after a certain point during the summer	9/24/2020	Change made to reach 9 labeling it Lower Pit River Text added to description of Reach 3 that clarifies that most of the water is diverted to reservoirs and lands adjacent to the creek.
Public Draft Chapter 5		Referring to the Elements checklist guide, there was a question about which items are required.	9/24/2020	Clarification was provided during the presentation.