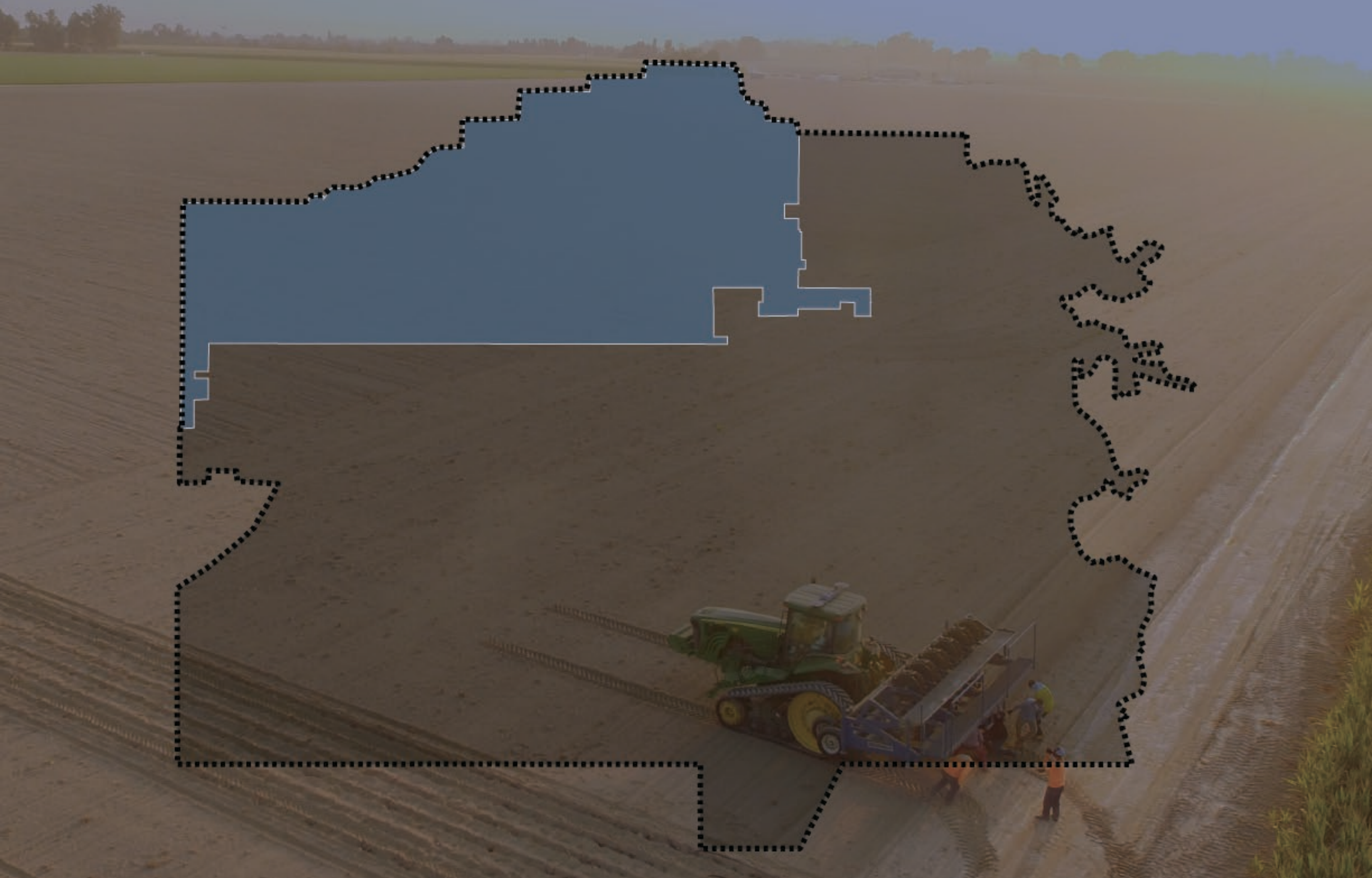
Sustainable Groundwater Management Act
Annual Report

October 2018 - September 2019



Lower Tule River Irrigation District Groundwater Sustainability Agency

Tule Subbasin

April 2020

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ATTACHMENTS

ABBREVIATIONS & ACRONYMS

amsl	above mean sea level
CASGEM	California State Groundwater Elevation Monitoring
CDWR	California Department of Water Resources
CEOP	Communication, Engagement and Outreach Plan
CEQA	California Environmental Quality Act
CGQMP	Comprehensive Groundwater Management Plan
CSD	Community Services District
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
DCTRA	Deer Creek Tule River Authority
DDW	Division of Drinking Water
DMS	Data Management System
DWR	Department of Water Resources
EC	Electrical Conductivity
ET	Evapotranspiration
EIR	Environmental Impact Report
FKC	Friant-Kern Canal
GAMA	Groundwater Ambient Monitoring and Assessment
GAR	Groundwater Assessment Report
GDEs	Groundwater Dependent Ecosystems
GFM	Groundwater Flow Model
GP	General Plan
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
GQTMP	Groundwater Quality Trend Monitoring Program
GQTMW	Groundwater Quality Trend Monitoring Workflow
ILRP	Irrigated Lands Regulatory Program
InSAR	Interferometric Synthetic Aperture Radar
IRWM	Integrated Regional Water Management
IRWMGs	Integrated Regional Water Management Groups
IRWMP	Integrated Regional Water Management Plan
ITRC	Irrigation Training and Research Center
JPL	Jet Propulsion Laboratory

LTRID	Lower Tule River Irrigation District
LUSTs	leaking underground storage tanks
MOU	Memorandum of Understanding
NASA	National Aeronautics and Space Administration
NC	Natural Communities
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priority List
NTFGW	net to and from groundwater
PCSD	Poplar Community Service District
PUD	Public Utility District
RMS	representative monitoring sites
RWQCB	Regional Water Quality Control Board
SAGBI	Soil Agricultural Groundwater Banking Index
SB	Senate Bill
SCADA	Supervisory Control and Data Acquisition
SGMA	Sustainable Groundwater Management Act
SMC	Sustainable Management Criteria
SREP	Success Reservoir Enlargement Project
SWRCB	State Water Resources Control Board
TBWQC	Tule Basin Water Quality Coalition
TCSD	Tipton Community Service District
Tipton CP	Tipton Community Plan
TRA	Tule River Association
TSMP	Tule Subbasin Monitoring Plan
UABs	Urban Area Boundaries
UDBs	Urban Development Boundaries
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WDL	Water Data Library
WPUD	Woodville Public Utility District

EXECUTIVE SUMMARY [§356.2(a)]

23 Cal. Code Regs. § 356.2 Annual Reports. *Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:*

(a) *General information, including an executive summary and a location map depicting the basin covered by the report.*

The Tule Subbasins hydrogeologist, Thomas Harder and Company, has prepared an Annual Report summarizing the 2018/2019 groundwater conditions for the entirety of the subbasin (see Attachment 1). Appendices A through F of the subbasin-wide annual report describes groundwater conditions as it relates to each of the six (6) adopted Groundwater Sustainability Plans (GSPs) that collectively cover the subbasin. The data for describing the groundwater conditions within the LTRID GSA Plan area is provided as Appendix A of the subbasin-wide annual report and will be referenced throughout this report (see Attachment 1).

This is the first annual report of the Lower Tule River Irrigation District Groundwater Sustainability Agency (LTRID GSA, GSA), as part of the Tule Subbasin identified by the California Department of Water Resources (CDWR) as No. 5-22-13 of the Tulare Lake Hydrologic Region (see Attachment 1, Figure 1). This report is being submitted in compliance with Title 23 of the California Code of Regulations, Division 2, Chapter 1.5, Subchapter 2, Article 7, Section 356.2, as required under the Sustainable Groundwater Management Act (SGMA). As per Section 356.2, this report addresses data collected for the preceding water year, which covers October 1, 2018 through September 30, 2019.

Sections of the LTRID GSA Annual Report Include the following:

SECTION 1. INTRODUCTION. A brief background on the GSA and coordination within the Tule Subbasin, a summary of the GSA Hydrogeologic Setting and Monitoring Networks.

SECTION 2. GROUNDWATER ELEVATION DATA [§356.2(b)(1)(A)]. A description of 2018/2019 groundwater elevation monitoring data with contours for spring and fall monitoring events and representative hydrographs.

SECTION 3. GROUNDWATER EXTRACTION [§356.2(b)(2)]. A description of 2018/2019 groundwater extractions by water use sector.

SECTION 4. SURFACE WATER USE [§356.2(b)(3)]. A description of 2018/2019 surface water use by source.

SECTION 5. TOTAL WATER USE [§356.2(b)(4)]. A description of 2018/2019 total groundwater extractions and surface water use.

SECTION 6. CHANGE IN GROUNDWATER STORAGE [§356.2(b)(4)]. A description of 2017/2019 change in groundwater storage through maps and graphs depicting water year type, groundwater use, the annual change in groundwater storage, and the cumulative change in groundwater in storage.

SECTION 7. PROGRESS TOWARDS PLAN IMPLEMENTATION [§356.2(c)]. A description of the 2018/2019 groundwater conditions compared to SMC established in the GSA's GSP and the GSA's progress towards implementing projects and management action identified in the GSP.

Groundwater Elevations

The GSA has identified ten (10) wells to use as Representative Monitoring Sites (RMS), six (6) of which are perforated in the upper aquifer, three (3) are perforated in the lower aquifer, and one (1) well is perforated across both aquifers. Being the GSP was not adopted and the monitoring network was implemented during the 2018/2019 water year, data was only available for four (4) of the RMS wells and is provided in **Table ES-1.**

Table ES-1: Groundwater Levels at Representative Monitoring Site Wells

Well	Groundwater Elevation (ft amsl)	
	Spring 2019	Fall 2019
Upper Aquifer		
21S/23E-32K01	124.80	111.60
21S/24E-35A01	112.80	115.00
21S/25E-03R01	N/A	N/A
21S/26E-32A01	N/A	N/A
22S/23E-30J01	N/A	N/A
21S/26E-34	N/A	N/A
Lower Aquifer		
22S/24E-01Q01	-13.60	-36.60
21S/25E-36	-23.18	N/A
22S/23E-07	N/A	N/A
Composite Aquifer		
20S/26E-32	167.00	154.10

Seasonal trends show that for the four (4) RMS wells spring elevations were higher than fall as would be expected, with the average change in elevation between seasons was 5.5 feet, 23.0 feet, and 12.9 feet for the upper aquifer, lower aquifer and composite well, respectively.

Groundwater Extractions

The primary extractor of groundwater within the GSA was identified agricultural as it makes up the majority of the area covered by the GSP. Other sources of groundwater extractions included the communities of Tipton, Poplar, and Woodville, as well as groundwater pumped for exportation. Volumes of groundwater extraction by sector for the 2018/2019 water year is provided in **Table ES-2**.

Table ES-2: Total Groundwater Extractions

Agricultural (AF)	Municipal (AF)	Export (AF)	Total (AF)
137,000	1,900	9,234	148,134

Surface Water Use

Surface water supplies are available to the GSA as Tule River streamflow diversions, Central Valley Project (CVP) Friant Division imports, and native precipitation. Volumes of surface water supplies used with the GSA during the 2018/2019 water year is provided in **Table ES-3.**

Table ES-3: Total Surface Water Supply

Stream Diversions (AF)	Imported Water (AF)	Precipitation (AF)	Total (AF)
143,735	216,118	106,100	465,963

Total Water Use

Total water use is the combination of groundwater extractions and surface water supplies. While surface water is used to meet agricultural crop demands and when available at times in excess of demands recharged for conjunctive management, groundwater meets agricultural demands in excess of available surface water supplies, as well as municipal demands and is exported. Precipitation makes up a portion of the agricultural demand met by surface water. **Table ES-4** breaks down total water use by sector and supply.

Table ES-4:Total Water Use by Water Use Sector

Water Year	Groundwater (AF)			Surface Water (AF)		Total (AF)
Source:	Ag.	Municipal	Exported	Ag[1].	Recharged[2]	
2018/2019	137,000	1,900	9,234	256,204	209,759	**614,097**

Notes:
1) Includes precipitation
2) Recharge volumes include channel losses

Groundwater Storage

Change in groundwater storage is calculated using several methodologies in this annual report, one to represent the conditions directly underlying the GSAs plan area using groundwater elevations and aquifer specific yield characteristics and the other based a net water balance accounting determined from surface water supplies less total water consumption. The first method is utilized for comparing change in groundwater storage to established SMCs but is influenced by groundwater flowing away from areas of natural and artificial recharge towards pumping depressions which is not indictive of a GSA's actions. The second method allows the GSA to account for storage strictly based on total consumptive water use, using remotely sensed ETc data and metered municipal use, compared to total surface water supplies to derive a net water balance accounting of change in groundwater storage.

Using the first methodology change in groundwater storage in the GSA plan area amounted to 184,000 acre-feet decrease in storage during the 2017/2019 water years. While this methodology is useful for understanding total groundwater storage in the Subbasin, it is not intended to account for ownership of water in storage. The volume of groundwater each GSA has access to will differ due to the accumulation of Net Water Balance contributions and extractions by the individual GSA over time. This apparent discrepancy is noted and will be investigated further as more data become available. The second methodology, calculating net water balance yields 98,826 acre-feet increase in groundwater storage during the 2017/2019 water years and is accounted for in **Table ES-5**.

TABLE ES-5: GSA ACCOUNTING OF GROUNDWATER STORAGE (OCTOBER 2017 THROUGH SEPTEMBER 2019)

October 2017 through September 2019	Volume (AF)
Total Non-Groundwater Supply	**666,369**
Surface Water (streamflow, imported)	*513,492*
Applied Irrigation	*229,566*
Recharged	*283,926*
Precipitation	*152,877*
Total Consumptive Use	**(536,593)**
ETc (agricultural)	*(536,593)*
Metered (municipal, exported)	*(30,950)*
Water Balance (Δ GW Storage)	**98,826**

PROGRESS TOWARDS PLAN IMPLEMENTATION

Groundwater conditions experienced in the 2018/2019 water year were compared to 2025 interim milestone and minimum thresholds established at RMS locations for the four (4) applicable sustainability indictors within the Tule Subbasin. Although conditions experienced during the previous water year were not within the implementation period for the GSP, the comparison provides insightful information for understanding how the aquifer(s) react to conditions as presented in this report. Based on the available data representing from RMS locations used to track groundwater conditions for the sustainability indicators, all RMS were within the 2025 interim milestones and minimum thresholds corresponding to the RMS.

Progress towards plan implementation was also evaluated in terms of progress of implementing projects and management actions proposed in the GSP. Several of the projects and management actions have been or are in the process of being implemented in the GSA in order to meet the sustainable groundwater management by the year 2040. Many of these projects and management action include policies providing for a structured reduction in groundwater use above sustainable supplies and incentives to promotes conjunctive management of water resources, along with other capital projects. Some of the completed and ongoing efforts include:

- Groundwater Accounting
- Water Supply Optimization
- Surface Water Development
- Managed Aquifer Recharge and Banking
- Municipal Management Actions

1 INTRODUCTION

1.1 DESCRIPTION OF THE TULE SUBBASIN

The Tule Subbasin is identified by the California Department of Water Resources (CDWR) as No. 5-22-13 of the Tulare Lake Hydrologic Region (see Attachment 1 – Tule Subbasin 2018/2019 Annual Report, Figure 1) is completely located within Tulare County. The following seven (7) GSAs are located within Tule Subbasin (see **FIGURE 1-1**):

1. Eastern Tule Groundwater Sustainability Agency (ETGSA),
2. Tri-County Water Authority Groundwater Sustainability Agency (TCWA GSA),
3. Pixley Irrigation District Groundwater Sustainability Agency (Pixley GSA),
4. Lower Tule River Irrigation District Groundwater Sustainability Agency (LTRID GSA),
5. Delano-Earlimart Irrigation District Groundwater Sustainability Agency (DEID GSA)
6. Alpaugh Groundwater Sustainability Agency (Alpaugh GSA), and
7. Tulare County Groundwater Sustainability Agency (Tulare County GSA)

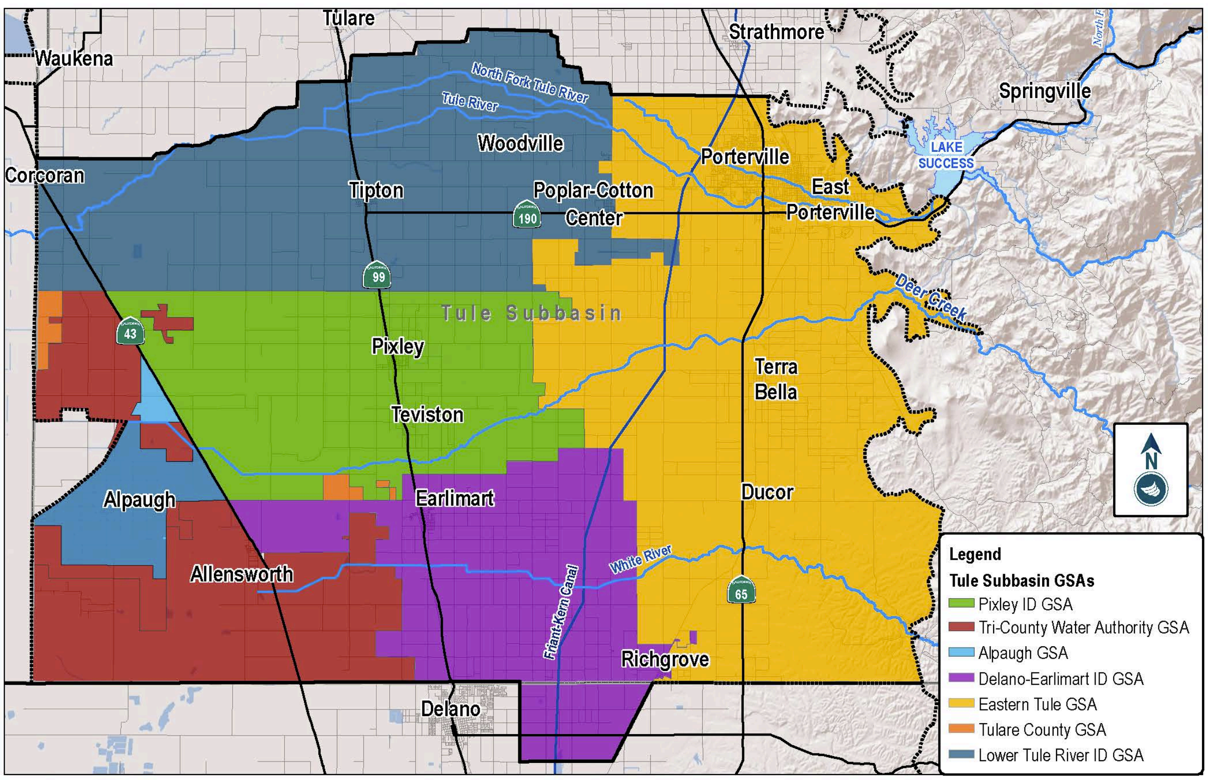

FIGURE 1-1: TULE SUBBASIN LOCATION MAP

Six (6) of the seven (7) GSAs within the Tule Subbasin have developed and submitted to the CDWR independent Groundwater Sustainability Plans (GSPs) pursuant to 23 CCR §353.6. Tulare County GSA has entered into Memoranda of Understanding (MOUs) concerning coverage of territories under adjacent GSPs. As such, their jurisdictional areas are included in the other six GSPs.

Pursuant to 23 Cal. Code Regs. §357.4(a), the six (6) GSPs for the Tule Subbasin have been developed and submitted under a Coordination Agreement to fulfill all statutory and regulatory requirements related to intra-basin coordination agreements pursuant to SGMA. The Coordination Agreement includes two attachments: Attachment 1 describes the subbasin-wide monitoring network that all Tule Subbasin GSAs shall utilize for the collection of data to be used in annual reports. Attachment 2 describes the subbasin setting, which represents the coordinated understanding of the physical characteristics of the subbasin.

1.2 Description of the LTRID GSA

The LTRID GSA is located in the north-central portion of the Tule Subbasin and encompasses 105,338 acres within Tulare County. The GSA Plan area includes lands within the jurisdictional boundaries of Lower Tule River Irrigation District (LTRID), a portion of the Tulare County GSA area, and the municipalities adjacent to the District, each of which the Agency has entered into agreements providing for the management of groundwater under the LTRID GSA GSP (see **Figure 1-2**).

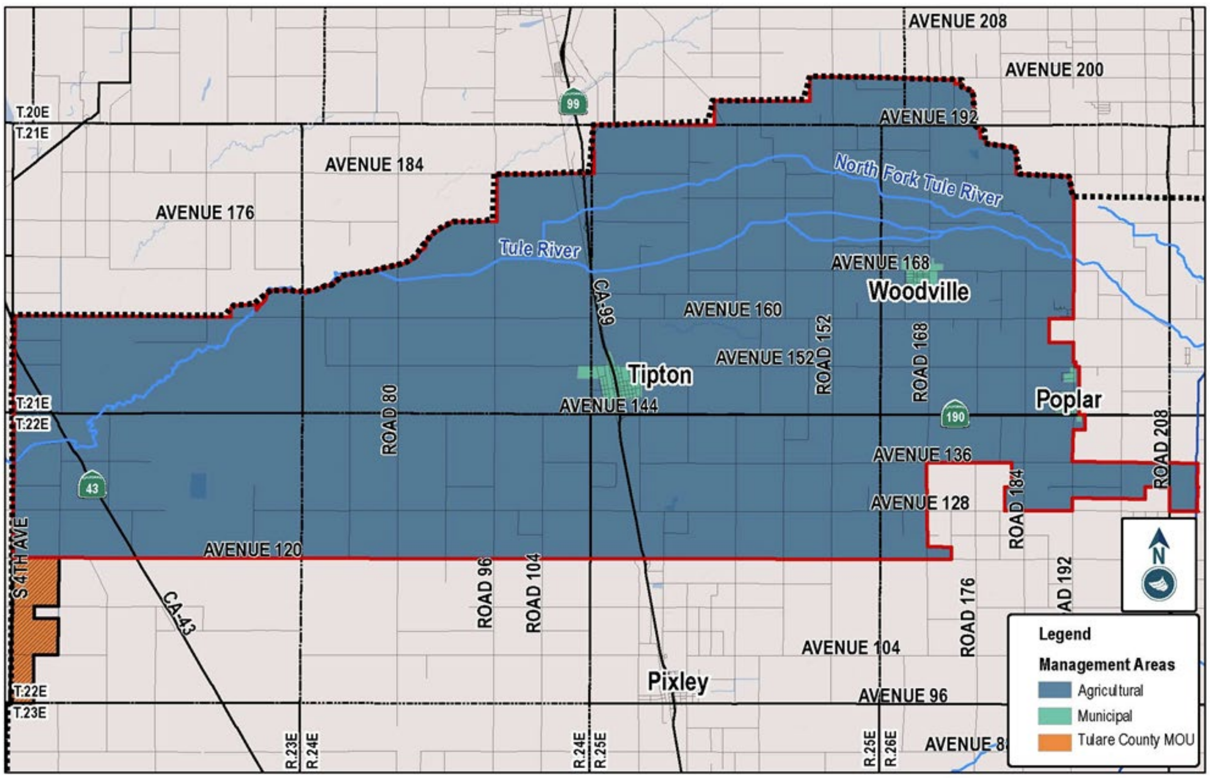

Figure 1-2: LTRID GSA Plan Area

Management Areas have been established to corresponded to the jurisdictional status and principle land use of their respective areas for defining different minimum thresholds and operate to different measurable objectives, understanding each management area presents unique circumstances and objectives for managing sustainably. Management areas are described by following three (3) categories and displayed on **Figure 1-2**:

1. LTRID/ Agricultural Management Area
2. Municipal Management Area
   - Tipton CSD, Woodville PUD, Poplar CSD
3. Tulare County MOU Management Area

1.3 Hydrogeological Setting

The hydrogeological of the Tule subbasin is described in Section 1.2 of the Tule Subbasin 2018/2019 Annual Report (see Attachment 1), and a description relating to the LTRID GSA Plan area is provided below.

The GSA Plan area is located on a series of coalescing alluvial fans that extend toward the center of the San Joaquin Valley from the Sierra Nevada Mountains (see Attachment 1, Figure 3). The alluvial fans merge with lacustrine deposits of the Tulare Lakebed in the western portion of the GSA Plan area. Land surface elevations within the GSA range from approximately 400 ft above mean sea level (amsl) along the eastern boundary of the GSA to approximately 180 ft amsl at the western boundary (see Attachment 1, Figure 3).

Where saturated in the subsurface, the permeable sand and gravel layers form the principal aquifers in the Plan Area and adjacent areas to the north, south and west. Individual aquifer layers consist of lenticular sand and gravel deposits of varying thickness and lateral extent. The aquifer layers are interbedded with low permeability silt and clay confining layers. There are four (4) aquifer/aquitard units in the subsurface beneath the Plan Area (see Attachment 1, Figure 4):

1. Upper Aquifer
2. The Corcoran Clay Confining Unit
3. Lower Aquifer
4. Pliocene Marine Deposits (generally considered an aquitard)

Two primary aquifers have been identified within the Plan Area: an upper unconfined to semi-confined aquifer and a lower semi-confined to confined aquifer. The upper and lower aquifers are separated by the Corcoran Clay confining unit in the western portion of the GSA.

In general, groundwater in the GSA Plan area flows from areas of natural recharge along Tule River in the towards a pumping depression located south of the GSA Plan area in the adjacent Pixley GSA (see **Attachment 1**, Figures 6 & 7).

1.4 Monitoring Features within the Plan Area

The Tule Subbasin Technical Advisory Committee has developed a subbasin-wide monitoring plan, which describes the monitoring network and monitoring methodologies to be used to collect the data to be included in Tule Subbasin GSPs and annual reports. The subbasin-wide monitoring plan is included as **Attachment 1** to the Coordination Agreement. The groundwater level monitoring network for the Tule Subbasin includes monitoring features to enable collection of data from the Upper Aquifer, Lower Aquifer and Santa Margarita Formation aquifer (see **Attachment 1**, Figure 5). Groundwater levels are collected in the late winter/early spring (February to March) and in the fall (August to November) to account for seasonal high and low groundwater conditions.

A subset of groundwater level monitoring features in the monitoring plan have been identified as representative monitoring sites to be relied on for the purpose of assessing progress with respect to groundwater level sustainability in the GSA Plan area. The representative groundwater level monitoring sites for the are shown on **Figure 1-3**.

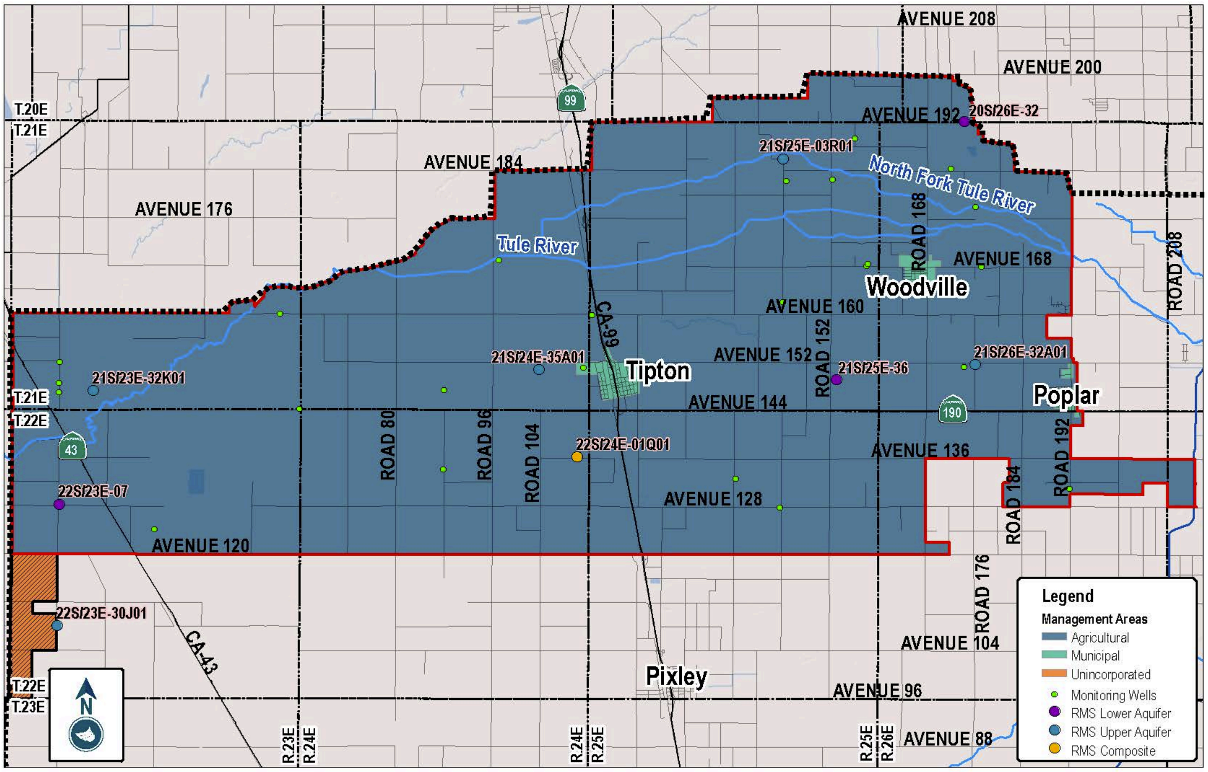

FIGURE 1-3: RMS GROUNDWATER ELEVATION WELLS

2 GROUNDWATER ELEVATIONS [§356.2(B)(1)]

23 Cal. Code Regs. § 356.2 Annual Reports. *Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:*

(b) *A detailed description and graphical representation of the following conditions of the basin managed in the Plan:*

(1) *Groundwater elevation data from monitoring wells identified in the monitoring network shall be analyzed and displayed as follows:*

2.1 GROUNDWATER ELEVATION CONTOUR MAPS [§356.2 (b)(1)(A)]

2.1.1 UPPER AQUIFER

Figures 6 and 7 of Appendix A in the Tule Subbasin 2018/2019 Annual Report displays groundwater contours for the upper aquifer in the LTRID GSA Plan area for the spring and fall of 2019, respectively (see **ATTACHMENT 1**).

From visual examination of the groundwater contour maps, groundwater in the upper aquifer of the GSA Plan area flows from areas of natural recharge along Tule River towards a pumping depression located south of the GSA Plan area in the adjacent Pixley GSA. The pumping depression has reversed the natural groundwater flow direction in the western portion of the subbasin. The pumping depression is most pronounced between the Tule River and Deer Creek near Highway 99. The groundwater level depression was observed from data collected in both the spring and fall of 2019. Groundwater flow patterns in the upper aquifer did not change significantly between the spring and fall of 2019.

2.1.2 LOWER AQUIFER

Figures 8 and 9 of Appendix A in the Tule Subbasin 2018/2019 Annual Report displays groundwater contours maps for the lower aquifer in the LTRID GSA Plan area for the spring and fall of 2019, respectively (see **ATTACHMENT 1**).

From visual examination of the groundwater contour maps, groundwater in the lower aquifer generally follows the same flow pattern as flows in the upper aquifer, with the pumping depression being observed moving slightly north along the LTRID GSA Plan area south boundary and in Tri-County GSA and Alpaugh GSA.

2.2 GROUNDWATER HYDROGRAPHS [§356.2 (b)(1)(B)]

Groundwater level hydrographs for Representative Monitoring Site (RMS) wells in the LTRID GSA Plan area are provided in Figures 1 through 5 of Appendix A in the Tule Subbasin 2018/2019 Annual Report (see **ATTACHMENT 1**).

Spring and fall 2019 groundwater levels for the RMS wells are summarized in **TABLE 2-1**. It is noted that the Tule Subbasin Monitoring Plan had not been implemented as of fall 2019 so many of the RMS wells have not been monitored. However, with the implementation of the monitoring plan in February 2020, a more complete dataset will be available for subsequent annual reports.

TABLE 2-1: GROUNDWATER LEVELS AT REPRESENTATIVE MONITORING SITE WELLS

Well	Groundwater Elevation (ft amsl)	
	Spring 2019	Fall 2019
Upper Aquifer		
21S/23E-32K01	124.80	111.60
21S/24E-35A01	112.80	115.00
21S/25E-03R01	N/A	N/A
21S/26E-32A01	N/A	N/A
22S/23E-30J01	N/A	N/A
21S/26E-34	N/A	N/A
Lower Aquifer		
22S/24E-01Q01	-13.60	-36.60
21S/25E-36	-23.18	N/A
22S/23E-07	N/A	N/A
Composite Aquifer		
20S/26E-32	167.00	154.10

3 GROUNDWATER EXTRACTIONS [§356.2(b)(2)]

23 Cal. Code Regs. § 356.2 Annual Reports. *Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:*

(b) *A detailed description and graphical representation of the following conditions of the basin managed in the Plan:*

(2) *Groundwater extraction for the preceding water year. Data shall be collected using the best available measurement methods and shall be presented in a table that summarizes groundwater extractions by water use sector, and identifies the method of measurement (direct or estimate) and accuracy of measurements, and a map that illustrates the general location and volume of groundwater extractions.*

Groundwater extractions are categorized by agricultural, municipal and exported. Being that the land use within the LTRID GSA Plan area is predominantly associated with agriculture, the majority of the groundwater extractions within the GSA Plan area are attributed to meeting crop demands that are not met through native precipitation, diverted surface and imported water supplies.

3.1 AGRICULTURAL

The process for determining agricultural groundwater pumping within the Tule Subbasin is described in Section 3.1 of the Tule Subbasin 2018/2019 Annual Report (see **ATTACHMENT 1**).

In summary, total agricultural groundwater pumping is estimated as a function total agricultural water demand derived from remotely sensed ET data using Landsat satellites and applying irrigation efficiencies based CDFW land use map and crop surveys, less surface water deliveries and effective precipitation.

Within the LTRID GSA Plan area estimated volume of groundwater pumped for agricultural purposes in 2018/2019 water year amounted to approximately 137,000 acre-feet.

3.2 MUNICIPAL

Municipal groundwater pumping by the small communities of Tipton, Woodville, and Poplar within the LTRID GSA Plan area is estimated based on population density and per capita water use as reported in Urban Water Master Plans. It is noted in 2018/2019 water year municipalities in the LTRID GSA Plan area were not required to report groundwater extractions to the GSA. However, with the adoption of the LTRID GSA GSP in January 2020, actual pumped quantities by municipality will be available for subsequent annual reports.

Within the LTRID GSA Plan area estimated volume of groundwater pumped for municipal purposes in 2018/2019 water year was based on 2017/2018 water year data and amounted to approximately 1,900 acre-feet.

3.3 EXPORTED

Some of the groundwater pumping that occurs in the LTRID GSA Plan area is exported out of the Boswell/Creighton Ranch for use out of the Tule Subbasin. Total groundwater exports out of the GSA Plan area for the 2018/19 water year was 9,234 acre-ft, obtained through meter data from wells that extract the groundwater for exportation. This water is accounted for separately because the water is not applied within the subbasin and there is no associated return flow.

3.4 SUMMARY OF TOTAL GROUNDWATER EXTRACTIONS

Total groundwater extraction from the LTRID GSA Plan area for the 2018/19 water year was 148,134 acre-ft (see **TABLE 3-1**).

TABLE 3-1: TOTAL GROUNDWATER EXTRACTIONS

Agricultural (AF)	Municipal (AF)	Export (AF)	Total (AF)
137,000	1,900	9,234	148,134

The distribution of groundwater production across the subbasin is shown on Figure 10 of the Tule Subbasin 2018/2019 Annual Report (see **ATTACHMENT 1**).

The GSA also performs an analysis of net to and from groundwater (NTFGW) for determining the net of groundwater contributions to extractions at a parcel level, by comparing surface water deliveries and precipitation to remotely sensed ETc data. The analysis allows the GSA to evaluate the spatial distribution of groundwater extracted in excess of conjunctively managed supplies. During the 2018/2019 water year, groundwater contributions exceeded extractions by 94,869 ace-feet. A net to and from groundwater heat map, prepared for the 2018/2019 water year, displays the distribution of net balance of groundwater extractions to contributions as **FIGURE 3-1**.

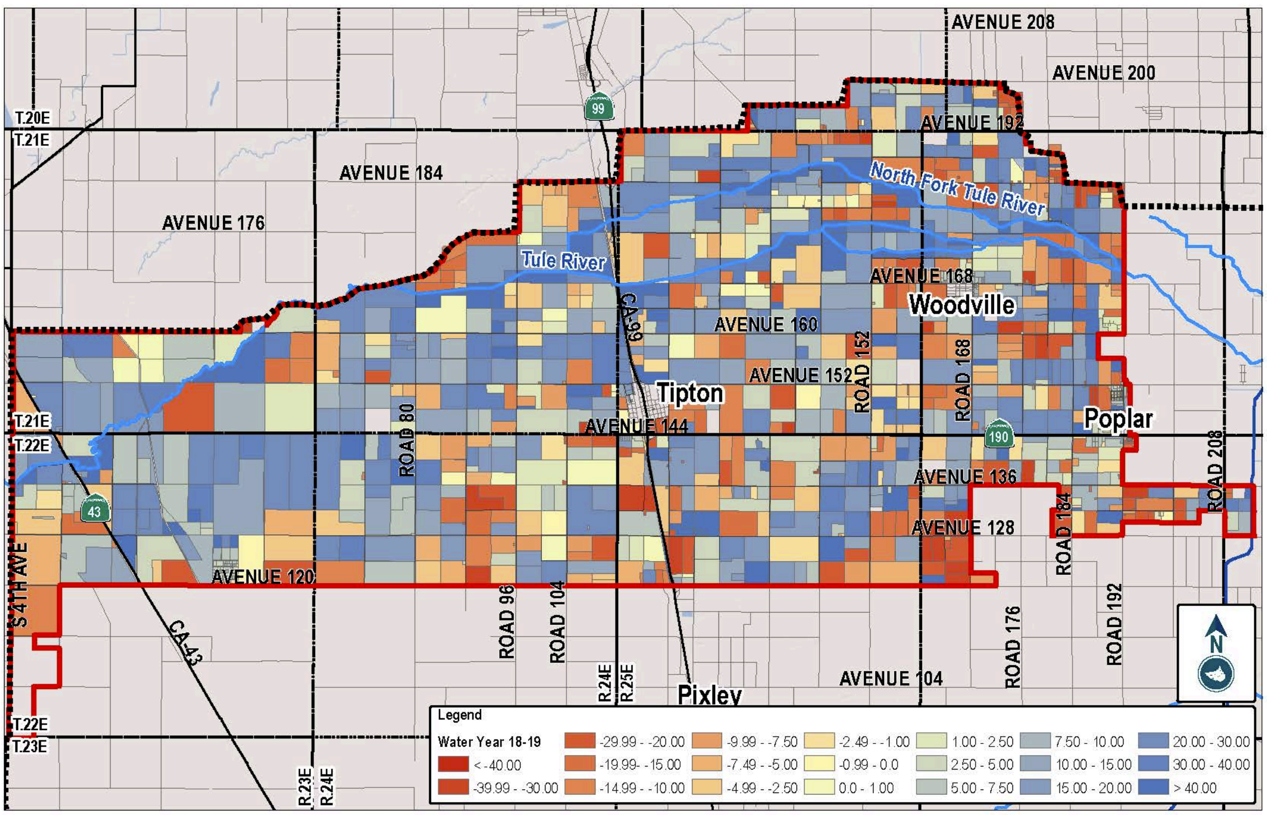

FIGURE 3-1: 2018/2019 NET TO AND FROM GROUNDWATER

4 SURFACE WATER SUPPLY [§356.2(b)(3)]

23 Cal. Code Regs. § 356.2 Annual Reports. *Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:*

(b) *A detailed description and graphical representation of the following conditions of the basin managed in the Plan:*

(3) *Surface water supply used or available for use, for groundwater recharge or in-lieu use shall be reported based on quantitative data that describes the annual volume and sources for the preceding water year.*

Surface water is supplied to lands within the LTRID GSA Plan area through the Lower Tule River Irrigation District (LTRID, District) as diverted stream flow from native Tule River downstream as a downstream rights holder and imported Central Valley Project (CVP) Friant and Shasta Division contracts.

The District delivers the surface and imported water available to them to meet crop demands for landowners within the District as a first priority of use. During time surface water supplies are available in excess of crop demands, the supplies can be diverted to 4,516 acres of recharge basins owned by the District for future landowner in-lieu pumping of groundwater. The GSA and District also promote their landowners to develop on-farm recharge basins to maximize surface water supplies when available in large volumes during short periods of time.

4.1 DIVERTED TULE RIVER STREAMFLOW

Flow in the Tule River is controlled through releases from Lake Success. Stream flow entering Lake Success is measured and distributed to various water rights holders as allocated at Success Dam in accordance with the Tule River Water Diversion Schedule and Storage Agreement.[1] Releases of water from Lake Success and downstream diversions are documented in Tule River Association (TRA) annual reports.

For water year 2018/19, 143,735 acre-ft of water was released to the Tule River from Success Reservoir and delivered within the LTRID service area to meet crop demands or as in-lieu pumping of groundwater to recharge basin owned by the District or landowners.

4.2 IMPORTED WATER

All of the water imported into the LTRID GSA Plan area is from the Central Valley Project (CVP) and delivered via the Friant-Kern Canal and later diverted into the LTRID's distribution system consisting of unlined canals for delivery to landowners and recharge basins within the District.

Imported water delivery data for 2018/19 was obtained from United States Bureau of Reclamation (USBR) Central Valley Operation Annual Reports[2] and totaled 216,118 acre-ft.

4.3 EFFECTIVE PRECIPITATION

Section 4.5 of the Tule Subbasin 2018/2019 Annual Report describes the methodology used to estimate the effective for the Tule Subbasin (see **ATTACHMENT 1**).

[1] TRA, 1966
[2] USBR, 2019

The total volume of precipitation available for crops in 2018/19 was based on California Irrigation Management Information Systems (CIMIS)[3] estimated to be 106,100 acre-ft.

4.4 Summary of Total Surface Water Supplies

Total surface water supplied to the LTRID GSA Plan Area for the 2018/2019 water year was estimated to be 465,963 acre-feet (**Table 4-1**).

Table 4-1: Total Surface Water Supply

Stream Diversions (AF)	Imported Water (AF)	Precipitation (AF)	Total (AF)
143,735	216,118	106,100	465,963

[3] CIMIS, 2019 (Irrigation Technology Research Ceneter 2019)

5 TOTAL WATER USE [§356.2(b)(4)]

23 Cal. Code Regs. § 356.2 Annual Reports. *Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:*

(b) *A detailed description and graphical representation of the following conditions of the basin managed in the Plan:*

(4) *Total water use shall be collected using the best available measurement methods and shall be reported in a table that summarizes total water use by water use sector, water source type, and identifies the method of measurement (direct or estimate) and accuracy of measurements. Existing water use data from the most recent Urban Water Management Plans or Agricultural Water Management Plans within the basin may be used, as long as the data are reported by water year.*

Total water use within the LTRID GSA Plan area during the water year 2018/19 consisted of water for meetings agricultural and municipal demand, along with groundwater exports. Agricultural demands were met through a combination of groundwater extractions and surface water deliveries, while municipal and exported water was entirely from groundwater extractions. The total water use within the GSA Plan area was 614,097 acre-ft. **TABLE 5-1** describes the volumes of water use by use sector, source, method of measurement, and level of accuracy for the measurement method.

TABLE 5-1:TOTAL WATER USE BY WATER USE SECTOR

Water Year	Groundwater (AF)			Surface Water (AF)		Total (AF)
Source:	Ag.	Municipal	Exported	Ag[1].	Recharged[2]	
2018/2019	137,000	1,900	9,234	256,204	209,759	**614,097**
Method of Measurement:	Satellite ET/ GFM[3]	2017/2018 UWMP[4]	Metered	Metered	Metered	
Level of Accuracy:	Medium	Medium	High	High	High	

Notes:

1) Includes precipitation
2) Recharge volumes include channel losses
3) GFM: Tule Subbasin Groundwater Flow Model
4) UWMP: Urban Water Management Plan

6 GROUNDWATER STORAGE [§356.2(b)(5)]

23 Cal. Code Regs. § 356.2 Annual Reports. *Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:*

(b) *A detailed description and graphical representation of the following conditions of the basin managed in the Plan:*

(4) *Change in groundwater in storage shall include the following:*

(A) *Change in groundwater in storage maps for each principal aquifer in the basin.*

(B) *A graph depicting water year type, groundwater use, the annual change in groundwater in storage, and the cumulative change in groundwater in storage for the basin based on historical data to the greatest extent available, including from January 1, 2015, to the current reporting year.*

In the Tule Subbasin Coordination Agreement two methodologies are identified as acceptable for determining the volume if groundwater storage within the Tule Subbasin. Each of the methods are described are further described below.

The first methodology uses Geographic Information System (GIS) mapping to spatially quantify gross groundwater storage volume as a function of specific yield and groundwater elevation data. While this methodology is useful for understanding total groundwater storage in the Subbasin, it is not intended to account for ownership of water in storage.

The second methodology uses the calibrated groundwater flow model of the Tule Subbasin to take the exported calibrated groundwater surface from one year and subtract it from the exported calibrated groundwater surface from a subsequent year. The difference in groundwater levels is multiplied by the specific yield distribution of the shallow aquifer in the model to obtain an estimate of the change in groundwater storage across the subbasin. For this methodology the model will be updated regularly, and include groundwater extractions, recharge values, and groundwater levels.

For this first annual report, the change in groundwater storage for the GSA Plan area was estimated for the time period between fall 2017 and fall 2019 using the GIS methodology and a description of the equation and methodology used for determining the change in groundwater storage throughout the Tule Subbasin is provided in Section 6 of the Tule Subbasin 2018/2019 Annual Report (see **ATTACHMENT 1**).

Results of the change in groundwater in storage analysis showed that between fall 2017 and fall 2019, groundwater in storage decreased by approximately 184,000 acre-ft.

A change in groundwater storage map within the GSA Plan area is displayed as Figure 10 in Appendix A of the Tule Subbasin 2018/2019 Annual Report (see **ATTACHMENT 1**). Figure 10 shows the change in groundwater elevations throughout the GSA being the groundwater elevations were the basis for estimating groundwater change in storage.

Figure 13 of the Tule Subbasin 2018/2019 Annual Report utilizes a column chart depicting water year type, groundwater pumping, the annual change in groundwater in storage, and the cumulative change in groundwater in storage for the Tule Subbasin between 1986/1987 water year and 2018/2019 water year (see **ATTACHMENT 1**).

Several of the GSAs and irrigation districts also maintain a separate water accounting systems to track the amount of groundwater that has been banked by the Irrigation Districts and/or individual landowners, which will be internally calculated from the gross groundwater storage volume for the GSA. This is necessary as surface or imported water banked by irrigation districts or landowners is not to be considered groundwater storage that is available to or be a part of other agencies or the subbasin as a whole quantification of sustainability but remain in ownership with the banker. This methodology uses **EQUATION 6-1** to determine change in groundwater storage based on total water use (ETc, metered) and total non-groundwater supply **TABLE 6-1**provides a summary of this accounting for the GSA.

$$\Delta\, \boldsymbol{GW\ Storage} = \boldsymbol{Total\ Non\ Groundwater\ Supply} - \boldsymbol{Total\ Water\ Use} \qquad \textbf{Eq.}\ 6\text{-}1$$

TABLE 6-1: GSA ACCOUNTING OF GROUNDWATER STORAGE (OCTOBER 2017 THROUGH SEPTEMBER 2019**)**

October 2017 through September 2019	Volume (AF)
Total Non-Groundwater Supply	**666,369**
Surface Water (streamflow, imported)	*513,492*
Applied Irrigation	*229,566*
Recharged	*283,926*
Precipitation	*152,877*
Total Consumptive Use	**(536,593)**
ETc (agricultural)	*(536,593)*
Metered (municipal, exported)	*(30,950)*
Water Balance (Δ GW Storage)	**98,826**

Based on the GSA's accounting of change in groundwater storage from the fall of 2017 to fall of 2019, groundwater increased by 98,826 acre-feet.

The difference in the change in groundwater storage volumes between the GIS methodology and the GSA's accounting is approximately 282,826 acre-feet. This apparent discrepancy is noted and will be investigated further as more data become available. While the GIS methodology is representative of the physical groundwater storage conditions, the GSA relies on their accounting of groundwater storage for determining the volume of groundwater in storage as a result of their actions and available to their benefit for future extraction.

7 PROGRESS TOWARDS PLAN IMPLEMENTATION [§356.2(C)]

23 Cal. Code Regs. § 356.2 Annual Reports. *Each Agency shall submit an annual report to the Department by April 1 of each year following the adoption of the Plan. The annual report shall include the following components for the preceding water year:*

(c) *A description of progress towards implementing the Plan, including achieving interim milestones, and implementation of projects or management actions since the previous annual report.*

Progress of plan implementation will be evaluated through comparing monitoring data to sustainable management criteria (SMC) established in Section 3 of the GSP and the GSAs progress towards implementing projects and management actions compared to the schedules outlined in Section 5 of the GSP.

Since 2018/2019 water year is prior to the GSP implementation period, many of the monitoring networks identified in the GSP and the Tule Subbasin Monitoring network were not fully established to evaluate the GSAs progress towards implementing. For this report, if data was available for the 2018/2019 water year, it was included in the evaluation. Subsequent reports will include a more comprehensive evaluation as monitoring networks are finalized.

7.1 INTERIM MILESTONES, MEASURABLE OBJECTIVES, AND MINIMUM THRESHOLDS

Throughout this section measured data for the 2018/2019 water year within the LTRID GSA Plan relating to the four (4) sustainability indicators identified as occurring within Tule Subbasin will be compared to the 2025-interim milestone, measurable objective, and minimum threshold established for each RMS feature in Section 3 of the LTRID GSA GSP to determine the GSAs progress toward successfully implementing its GSP.

With the exception of groundwater quality, the other three sustainability indicators relied on the Tule Subbasin Groundwater Flow Model (GFM) projections for establishing SMC's. By incorporating historical data, climate change, and GSAs proposed projects and management actions, the GFM predicted conditions relative to each sustainability indicators and is the basis for the established quantifiable interim milestones and measurable objectives. As the GSPs are implemented resulting in refined monitoring and data collection, the GFM will provide more accurate predictions of groundwater conditions and adjustments will be made to SMCs to reflect the best available data. The adjustments will be made during the first periodic evaluation of the GSP in 2025.

7.1.1 GROUNDWATER ELEVATIONS

There are ten (10) RMS wells in the LTRID GSA (see **FIGURE 1-3**). Of these wells, six are perforated in the Upper Aquifer, three are perforated in the Lower Aquifer, and one is a composite well perforated in two aquifers. Hydrographs for each of the wells are provided in Appendix A of the Tule Subbasin 2018/2019 Annual Report as Figures 1 through 5 (see **ATTACHMENT 1**). Available groundwater level data for RMS wells from spring 2019 are summarized in **TABLE 7-1** and is the basis for comparing the measured data in RMS well to sustainable management criteria in Section 3 of the LTRID GSA GSP.

TABLE 7-1: RMS WELL GROUNDWATER ELEVATION DATA

RMS Well	Groundwater Elevation (ft amsl)			
	Spring 2019	2025 Interim Milestone	Measurable Objective	Minimum Threshold
Upper Aquifer				
21S/23E-32K01	**124.80**	111	71	56
21S/24E-35A01	**112.80**	94	57	44
21S/25E-03R01	**N/A**	136	92	58
21S/26E-32A01	**N/A**	170	131	83
22S/23E-30J01	**N/A**	170	48	31
21S/26E-34	**N/A**	108	110	73
Lower Aquifer				
22S/24E-01Q01	**-13.60**	-21	-39	-154
21S/25E-36	**-23.18**	19	1	-52
22S/23E-07	**N/A**	-126	-139	-174
Composite Aquifer				
20S/26E-32	**167.00**	85	53	-6

For Upper Aquifer monitoring wells, during the spring 2019 monitoring activities groundwater levels in Well 21S/23E-32K01 was measured at 125 feet above mean sea level (ft amsl) and groundwater levels in Well 21S/24E-35A01 was measured at 113 ft amsl. Groundwater levels in both wells remain above their respective 2025 interim milestones, measurable objectives and are more than 50 feet above their respective minimum thresholds.

Of the Lower Aquifer monitoring wells, spring 2019 groundwater levels was available for Well 22S/24E-01Q01 and Well 21S/25-36. Groundwater levels in Well 22S/24E-01Q01 was measured at -13.6 ft amsl in the spring 2019 and groundwater levels in Well 21S/25-36 was measured at -23.18 ft amsl. Groundwater levels in both wells remain above their respective 2025-interim milestones, measurable objectives and minimum thresholds.

7.1.2 GROUNDWATER STORAGE

Groundwater storage in 2017 was estimated according to the equation and methodology described in Section 6 of the Tule Subbasin 2018/2019 Annual Report using available groundwater elevation data (see **ATTACHMENT 1**). Based on this estimation, approximately 62.5 million acre-feet of groundwater was stored within the aquifers beneath the LTRID GSA Plan area. Applying the loss of groundwater storage volume previously mentioned in **SECTION 6: GROUNDWATER STORAGE** of 184,000 acre-feet occurring between 2017 and 2019, the volume of groundwater storage beneath the LTRID GSA Plan area amounts to approximately 62.342 million acre-feet. While this methodology is useful for understanding total groundwater storage in the Subbasin, it is not intended to account for ownership of water in storage. The volume of groundwater each GSA has access to will differ due to the accumulation of Net Water Balance contributions and extractions by the individual GSA over time.

The interim milestones/measurable objective and minimum threshold for volume of groundwater storage in the aquifers beneath the LTRID GSA Plan area were identified in Tables 3-3 and 3-8, respectively, in Section 3 of the LTRID GSA GSP. **TABLE 2-1** provides a comparison of the 2019 groundwater storage conditions to the 2025 interim milestone, measurable objective and minimum threshold.

TABLE 7-2: GROUNDWATER STORAGE DATA

Groundwater Storage (million AF)				
Spring 2017	**Spring 2019**	**2025 Interim Milestone**	**Measurable Objective**	**Minimum Threshold**
62.500	**62.342**	60.590	59.000	58.100
Annual Change in Storage:	**0.079**[1]	*0.292*[2]	*0.207*[3]	*0.202*[4]

Notes:

1) [62.500 million AF – 62.342 million AF] ÷ 2 year
2) [62.342 million AF –60.590 million AF] ÷ 6 years
3) [63.342 million AF – 59.000 million AF] ÷ 21 years
4) [63.342 million AF – 58.100 million AF] ÷ 21 years

The volume of groundwater storage in 2019 remains greater than the established 2025 interim milestone, measurable objective and minimum threshold volumes for the LTRID GSA Plan area. The average annual rate of decline in groundwater storage for LTRID GSA Plan area between 2017 to 2019 amounts to 79,000 acre-feet per year. Whereas the average annual rate of decline for groundwater storage between 2017 and the established 2025-interim milestone is 292,000 acre-feet per year, putting the experienced change in groundwater storage annual average rate of decline well within an acceptable range for achieving the 2025 interim milestone.

7.1.3 GROUNDWATER QUALITY

The GSA utilizes the Irrigated Lands Regulatory Program and community Consumer Confidence Reports as the existing regulatory water quality programs for monitoring water quality and setting baseline standards that are applicable to the overlying land uses and users of the groundwater.

There are three (3) water quality RMS wells within the LTRID GSA Plan area. Additionally, the GSA has will analyze water quality data from the communities of Tipton, Poplar, and Woodville municipal wells for monitoring water quality conditions throughout the implementation of its GSP. SMC's established for the RMS location are provided in Tables 3-5 and 3-9 of Section 3 of the LTRID GSP. The basis for setting SMC's at each RMS location as described in the LTRID GSA GSP is outlined below:

<u>Interim Milestones/ Measurable Objective</u>

Establish interim milestones and the measurable objective at each RMS well with calculating a change above the baseline groundwater quality to not exceed 10% of long term 10 year running average.

<u>Minimum Threshold</u>

Establish minimum threshold for COCs associated at each RMS well with calculating a change above the baseline groundwater quality to not exceed 15% of long term 10 year running average.

The GSP further states that the 10-year running average will be re-calculated each year based on monitoring data and the change in groundwater quality will be evaluated in comparison to lowering of groundwater elevations and groundwater recharge efforts. For RMS wells with that a change in the10-year running average by 10-percent and 15-percent does not result in an MCL exceedance, the MCL is used for determining the SMCs.

Since most community's water systems are supplied groundwater through multiple production wells, the average concentration for COCs for a given year across all wells is used for determining the 10-year average and monitoring results relative the water year being reported.

The GSA 2018/2019 water year water quality data at RMS wells is provided in **TABLE 7 3** compared the 10-year running average and re-established interim milestones, measurable objectives and minimum thresholds.

TABLE 7-3: RMS WATER QUALITY DATA

Constituent	Period of Record	Results			
		2019	10-Year Average	Interim Milestone/ Measurable Objective	Minimum Threshold
RMS Well: **E0090245**					
Conductivity (*µm/cm*)	2018-2019	**278**	*486*	<700	<700
pH	2018-2019	**7.93**	*7.71*	>6.5, <8.3	>6.5, <8.3
Nitrate as N (*mg/L*)	2018-2019	**1.2**	*1.2*	<10	<10
RMS Well: **E049930**					
Conductivity (*µm/cm*)	2018-2019	**443**	*446*	<700	<700
pH	2018-2019	**7.64**	*7.59*	>6.5, <8.3	>6.5, <8.3
Nitrate as N (*mg/L*)	2018-2019	**5.4**	*5.1*	<10	<10
RMS Well: **E0047650**					
Conductivity (*µm/cm*)	2019	**1,000**	*1,000*	1,100	1,150
pH	2019	**7.93**	*7.93*	>6.5, <8.3	>6.5, <8.3
Nitrate as N (*mg/L*)	2019	**ND**	*ND*	<10	<10
RMS Well: **Tipton CSD CCR**[4]					
Nitrate as N (*mg/L*)	2016-2019	**8.1**	*6.6*	<10	<10
Arsenic (*ppb*)	2010-2019	**9.1**	*7.9*	<10	<10
Chromium (*µg/L*)	2010-2019	**0**	*0*	<10	<10
RMS Well: **Poplar CSD CCR**[5]					
Nitrate as N (*mg/L*)	2015-2019	**5.8**	*6.12*	<10	<10
Arsenic (*ppb*)	2010-2019	**0**	*0*	<10	<10
Chromium (*µg/L*)	2010-2019	**0**	*0*	<10	<10
RMS Well: **Woodville PUD CCR**[6]					
Nitrate as N (*mg/L*)	2015-2019	**9.5**	*9.2*	10.1	10.6
Arsenic (*ppb*)	2010-2019	**0**	*0*	<10	<10
Chromium (*µg/L*)	2010-2019	**0**	*0*	<10	<10

From a review of the 2019 water quality data available at the RMS locations all are within the established SMCs. Data obtained from ILRP wells E0090245, E049930, and E0047650 ranges from 2018 through 2019 due to the program that monitors groundwater quality was first established in 2018. Of the three (3) ILRP wells only Well E0047650 is approaching its established interim milestone, with conductivity being measured at 1,000 µm/cm in 2019 and the interim milestone of 1,100 µm/cm. This is due to SMCs being established based on a single monitoring event in 2019 for Well E0047650, resulting in measured

[4] https://sdwis.waterboards.ca.gov/PDWW/JSP/MonitoringResults.jsp?tinwsys_is_number=5944&tinwsys_st_code=CA&counter=0
[5] https://sdwis.waterboards.ca.gov/PDWW/JSP/MonitoringResults.jsp?tinwsys_is_number=5955&tinwsys_st_code=CA&counter=0
[6] https://sdwis.waterboards.ca.gov/PDWW/JSP/MonitoringResults.jsp?tinwsys_is_number=5954&tinwsys_st_code=CA&counter=0

conductivity to be within 10% of the established interim milestone due to the process for establishing SMCs.

Community wells have a longer history of being monitored under State regulations allowing the 10-year running average to be used for establishing SMCs for arsenic and chromium. Results for nitrogen concentration in groundwater using nitrate as N started in 2015/2016, which resulted in a shorted period of record to determine running average to calculate SMCs. Of the three (3) communities, Tipton and Woodville show increases in nitrogen concentrations from the running average and are approaching the established interim milestones. The community of Tipton 10-year running average for arsenic levels is 7.9 ppb, and in 2019 arsenic levels were measured at 9.1 ppb.

7.1.4 Land Subsidence

There are five (5) subsidence RMS locations proposed within the LTRID GSA Plan area. The proposed locations were not constructed and or monitored during the 2018/2019 water year. Alternatively, fall 2019 National Aeronautics and Space Administration (NASA) Interferometric Synthetic Aperture Radar (InSAR) Jet Propulsion laboratory data was used for comparing subsidence at the RMS sites within the GSA to the established 2025-interim milestones, measurable objectives, and minimum thresholds (see **Table 7-4**). Data from GPS surveyed subsidence RMS benchmarks in conjunction with InSAR data will be provided in subsequent annual reports.

Table 7-4: RMS Subsidence Data

RMS Well	Ground Surface Elevation (ft amsl)			
	Fall 2019	2025 Interim Milestone	Measurable Objective	Minimum Threshold
U	**202.48**	200.80	194.91	194.91
W	**350.25**	349.71	348.28	347.70
X	**260.01**	257.98	253.24	250.73
Y	**255.76**	254.39	251.18	249.64
Z	**229.18**	227.34	223.60	220.25

Fall of 2019 InSAR data shows ground surface elevations at subsidence RMS locations to be above the established SMCs.

7.2 Implementation of Projects or Management Actions

This section describes the projects and management actions that are being implemented by the GSA in order to achieve the groundwater sustainability in the GSA. The projects and management actions primarily consist of adaptive policies to define rules for extraction and management of groundwater to reduce the over drafting of the resource in the GSA and subbasin by 2040. These sorts of projects allow for the greatest benefit experienced in a shorter period of time with the least amount of capital being invested. The policies adopted by the governing board of the GSA are included as **Attachment 2 – LTRID GSA Rules and Operating Policies** to this report.

The following projects and management actions were proposed by the GSA in the GSP:

1. Agency Groundwater Accounting Action
2. Existing Water Supply Optimization Projects
3. Surface Water Development Projects

4. Managed Aquifer Recharge and Banking Projects
5. Agricultural Land Retirement Projects
6. Municipal Management Area Projects

In parts or collectively the above-mentioned projects and management actions will help the GSA avoid undesirable results. Throughout implementation of the GSP the GSA will monitor the effectiveness of projects and management actions at maintaining a path toward sustainability, and when necessary adjust accordingly. The following sections briefly summarize and catalog progress towards implementing projects and management actions.

7.2.1 GROUNDWATER ACCOUNTING

The LTRID GSA began implementing the "Agency Groundwater Accounting Action", as described in Section 5.2.1 of the LTRID GSP, before GSP adoption. Many of the key components described under this Action were undertaken in the beginning stages of the GSP development both by the GSA and the Tule Subbasin GSAs collectively, as they were recognized as essential or required elements for defining a successful path to achieving sustainability.

The GSAs progress towards implementing the key components of this action are summarized below.

Identification of groundwater users and groundwater allocations

Status: *complete*

The Groundwater Flow Model (GFM) for the Tule Subbasin established water budgets depicting water uses and users for the past, present, and future. Based on the water budgets, Sustainable Yield allocation of groundwater consumption was determined to be 0.09 acre-feet per acre. Precipitation was all recognized as an allocation of groundwater that was available to landowners for consumption, with allocation amounts varying throughout the subbasin. Within the GSA this amounted to 0.71 acre-feet per acre based on the 27-year average.

The governing board to the GSA has also adopted the *District Allocated Groundwater Credits* policy to define rules for groundwater allocations and is attached to this report as Policy 6 in **ATTACHMENT 2**.

Accurate accounting groundwater extractions

Status: *complete*

The Tule Subbasin and GSA have hired consultants to provide groundwater extractions data in the form of remotely sensed crop evapotranspiration (ET) data using satellite imagery. This technology coupled with the Districts detailed records of surface water deliveries to landowners allows for the GSA to spatially determine the greater majority of groundwater extractions, being agriculture it the primary user of groundwater in the GSA Plan area. Meters will be used to account for groundwater users that are not associated with agriculture, such as municipalities.

The governing board to the GSA has also adopted the *Water Measurement and Metering* policy to define the accounting of groundwater consumption and is attached to this report as Policy 1 in **ATTACHMENT 2**.

Gradually reduce total groundwater consumption

Status: *complete*

The governing board to the GSA has adopted the *Transitional Groundwater Consumption* policy to define rules for groundwater use above sustainable yield and is attached to this report as Policy 4 in **ATTACHMENT 2**.

The rampdown schedule described in Policy 4 (see **TABLE 7-5**), was adopted by the GSA governing board to gradually reduce groundwater consumption to sustainable levels by 2040.

TABLE 7-5: RAMP DOWN SCHEDULE

Groundwater Consumptive Use Allowed Above Sustainable Yield (AF)			
2021-2025	**2026-2030**	**2031-2035**	**2035-2040**
2	1.5	1.0	0.5

By adopting the schedule, the GSA is allowing landowners to not feel the economic impacts of reducing groundwater use “overnight” to sustainable levels, but also enforces immediate actions for achieving sustainability, by making consumptions restrictions in effect as of February 2020.

<u>Water accounting</u>

Status: *complete, on-going refinement*

All of the previous and after-mentioned key components of the Groundwater Accounting Action rely on accurate water accounting for them to be successfully be implemented. The GSA recognized this in the early stages of GSP development and begin working with a consultant to build a system that incorporated both subbasin and GSA policies for tracking groundwater use. As of February 2020, the GSA water accounting system is operational and being utilized by the GSA to support implement its GSP.

The accounting system is designed to give landowners the ability to view and track annual allocations, monthly water landowners consumption based on remotely sensed ET data, daily surface water deliveries, and volumes of surface water recharged or banked for future in-lieu use, among other features that give the landowners the tools to successfully manage their operation in a sustainable manner.

<u>Develop policy for crediting groundwater recharge and banking activities</u>

Status: *complete, on-going refinement*

The governing board for the GSA has adopted the *Groundwater Banking at the Landowner Level* policy to define rules for developing groundwater consumption credits from landowner and District recharge and banking activities and is attached to this report as Policy 4 in **ATTACHMENT 2**. The policy incentives landowners to user groundwater for recharge and banking when it is available in excess of what’s needed for crop demands by crediting the landowners water account with a percentage of the total volume surface water recharged as a groundwater credit. As a result, many landowners have constructed and operate recharge basins on their farms.

<u>Develop policy for transferring groundwater credits</u>

Status: *complete, on-going refinement*

The governing board for the GSA has adopted the *Water Accounting and Water Transfers* and *Landowner Surface Water Imported* into the GSA policies to define rules for movement of groundwater credits from one landowner to another within the GSA Plan area and for surface water imported into the GSA by landowners and are attached to this report as Policy 4 and Policy 5, respectively, in **ATTACHMENT 2**.

These policies are intended to allow landowners all opportunities available to feasibly and economically manage groundwater resources during the implementation of the GSP.

<u>Adjustment of policies for groundwater allocations and transfers</u>

Status: *subject to future consideration*

The GSA has included this component in the Groundwater Accounting Action understanding that all options for transferring and allocating groundwater credits will be based on the best available data. Adjustment of policies for groundwater allocations or transfers are intended to continue granting landowners all opportunities available to feasibly and economically manage groundwater resources to the extent undesirable results are not experienced within the GSA Plan area or the subbasin. As a result, the GSA reserves its right to increase or reduce groundwater allocations and expand or limit transferring of groundwater credits based on the GSA progress toward reaching its sustainability goal.

<u>Create revenue for financing GSA operation, mitigation, monitoring, and projects</u>

Status: *complete, future implementation*

Although the GSA has established a fee structure for consumption of groundwater above sustainable amounts, also known as transition groundwater consumption. During the first year of implementation of the groundwater accounting action the GSA waived fees associated with first two (2) feet of transitional groundwater consumption, while landowners will still be charged for districted allocated groundwater credits. Full implementation of groundwater consumption fee's, including all amounts of consumed transitional will be collected by the GSA starting in 2021.

The fee structure for transitional groundwater consumption is included as part of the *Transitional Groundwater Consumption* policy and is attached to this report as Policy 4 in **ATTACHMENT 2**.

<u>Develop policy for enforcement to ensure compliance with rules established to achieve sustainability.</u>

Status: *complete, subject to future refinement*

The governing board to the LTRID GSA has adopted the *Implementation and Enforcement of Plan Actions* policy to clearly outlines the process the GSA will use to enforce compliance with the policies adopted in order to achieve sustainability.

The rules for GSP implementation and enforcement are included as part of the Policy 8 within **ATTACHMENT 2** of this report.

7.2.2 WATER SUPPLY OPTIMIZATION

Projects for optimization of existing surface supplies is discussed in Section 5.2.2 of the LTRID GSA GSP and has been a joint implementation between the LTRID and the landowners within the District.

<u>Modify existing key water control structures</u>

Annually the district performs maintenance on the distribution systems when the system is not in use. This includes nature water way and district owned channels routine maintenance. Additionally, the district has received grant funding to install meters at all recharge facilities to more accurately track volumes of surface water diverted for recharge activities that is expected to occur during the year 2020.

Modify existing District recharge basins

As previously mentioned, the district received a grant for purchasing and installing meters at all recharge facilities which is expected to occur during the year 2020.

Expand Supervisory Control and Data Acquisition (SCADA) system

Status: *on-going*

As part of the Groundwater Accounting Action, the LTRID has expanded its SCADA system for tracking and managing the delivery of surface within its distribution system and to landowners. Upgrades to the system allows the district to utilize real time data to remotely monitor and adjust target flow rates at key bifurcation points. The meters being installed at the recharge facilities is a component of the Districts expansion of the SCADA system.

Replace open channel canals with pipeline distribution systems

Status: *in-progress*

Since 2016, the District has successfully obtained WaterSMART grants to install the Riparian Pipeline for replacing open channel distribution system with a pipeline distribution system. The first phase of the project was completed in 2019 and the second is under construction in 2020. Prior to installation of the pipeline, approximately 5,750 acres within LTRID was served surface water though existing open the channels of the Tule River resulting in significant channel loss. The pipeline project relocated the distribution system from the Tule River channel to a pipeline distribution system and enhances in-lieu recharge for water that was previously lost to seepage. The project also expanded the District's ability to deliver surface water to lands that previously did not have direct access.

The District will continue to utilize funding made available for similar open channel replacement projects to increase efficiency of surface water delivers to members of its district.

Maintain existing pipeline distribution systems

Status: *on-going*

Maintaining existing pipeline distribution systems in an on-going project the districts perform as part of their annual maintenance activities and in real time as issues arise.

Upgrade on-farm irrigation distribution systems

Status: *on-going*

Upgrading of on-farm irrigation distribution systems are implemented at the landowner level to ensure the most efficient practices for irrigating crops is used to maximum resources available. This is an on-going project and will occur throughout the implementation of the GSP.

7.2.3 Surface Water Development

Surface water development projects are discussing in Section 5.2.3 of the LTRID GSA GSP and include additional supplies made available through the Success Reservoir Enlargement Project (SREP), surface water infrastructure development, and delivery or increased deliveries of Central Valley Project (CVP) contracts. Progress towards implementing these projects is summarized below.

<u>Success Reservoir Enlargement Project</u>

Status: *on-going*

During the water year 2019, the Success Reservoir Enlargement Project made significant progress in moving forward with design. The Army Corps of Engineers completed Phase 1 Construction documents to relocate a road and complete the initial blasting and demolition. The Phase 2 Construction documents for the new spillway design began, scheduled to complete during 2020. Additionally, the process to acquire the additional property due to the raised spillway began, the boundary survey and field topography was completed in 2019. The project will provide additional flexibility in management of the Tule River water, particularly during the Spring and Summer water runs. The project is on schedule to be completed in 2024.

<u>Surface water infrastructure development</u>

Status: *on-going*

The Riparian Pipeline Project previously described also applies to the surface water infrastructure development component of the surface water development project.

<u>Delivery of CVP Shasta Division Contract</u>

Status: *on-going*

While the District endeavors to find ways to deliver this water directly into the District, during 2018 and 2019 short term exchange agreements were put in place to exchange this water for water supplies available out of watersheds and reservoirs on the East side of the Valley.

<u>Additional deliveries of CVP Friant Division Contract</u>

Status: *on-going*

As the District and landowners continue to develop more land for groundwater recharge capability, it will allow the district to increase deliveries of CVP Friant Division Contract supplies during wet years.

7.2.4 Managed Aquifer Recharge and Banking

Managed aquifer recharge and banking projects are discussed in Section 5.2.4 of the LTRID GSA GSP and in **Section 7.2.1** of this report and consists of both expansion of the LTRID recharge operations and development of landowner recharge projects. As previously mentioned, The governing board for the GSA has adopted the *Groundwater Banking at the Landowner Level* policy and is attached to this report as Policy 4 in **Attachment 2**.

A summary of progress towards implementing these projects is provided below.

<u>Expansion of District recharge basins</u>

Status: *on-going*

The District currently owns and operates over 4,500 acres of recharge basins for conjunctively manage water resources. Since adoption of the GSP, the District has not developed additional acreage of recharge facilities but continues to assess potential opportunities for doing so in the future.

Development of landowner recharge basins

Status: *on-going*

Since adoption of the *Groundwater Banking at the Landowner Level* policy, over 400 acres of recharge basins have been developed by landowners within the LTRID. As a result, the District is able to increase its capacity for taking on surface water when available in short windows of time.

7.2.5 Agriculture Land Retirement Projects

Agriculture land retirement projects are discussed in Section 5.2.5 of the LTRID GSA GSP and consists of the LTRID purchasing land for permanent retirement, landowners taking a portion of their farm permanently out of production, and landowners taking a portion of their farm annually out of production depending on water supplies available.

To date the GSA has not implemented any agriculture retirement programs. Although, some lands within the district have been converted uses from crop production to manage recharge basins by landowners, resulting in dual benefit of reduced groundwater consumption and increased managed recharge and banking. This was previously discussed in **Section 7.2.4**.

7.2.6 Municipal Management Area Projects and Management Actions

Municipal management area projects and management actions are described under Section 5.2.6 of the LTRID GSA GSP and describes the municipalities apart of the GSA to right to participate in any of the projects and management actions described within Section of the GSP as well as rules for working cooperatively with the GSA to ensure the GSA meets its sustainability goal. These rules include reporting of community water use and measurable objective and minimum thresholds required by the communities. These rules can be found in *Policy 7 – CSD and PUD Water Use* within the GSA adopted by the GSA governing board and is included as **Attachment 2** to this report.

REFERENCES

California Department of Water Resources. n.d. "Sustainable Groundwater Management Act." *2016.*

Irrigation Technology Research Ceneter. 2019. *California Irrigation Management Information System.* California Polytechnic University.

Lower Tule River Irrigation District Groundwater Sustainability Agency. 2020. "Groundwater Sustainability Plan."

National Aeronautics and Space Administration, Jet Propulsion Laboratory. 2019. *Interferometric Synthetic Aperture Radar.*

Tomas Harder and Company. 2020. "Tule Subbasin 2018/2019 Annual Report."

Tule Baisn Water Quality Coalition (TBWQC). 2017. "Groundwater Quality Trend Monitoring Workplan Addendum."

Tule River Association. 2019. "Annual Report."

Tule River Association. 1966. "Tule RIver Diversion Schedule and Storage Agreement."

United States Enviromental Protection Agency. 2020. *Safe Drinking Water Information System - Woodville PUD.* https://sdwis.waterboards.ca.gov/PDWW/JSP/MonitoringResults.jsp?tinwsys_is_number=5954&tinwsys_st_code=CA&counter=0.

United States Environmental Protection Agency. 2020. *Safe Drinking Water Information System - Tipton CSD.* https://sdwis.waterboards.ca.gov/PDWW/JSP/MonitoringResults.jsp?tinwsys_is_number=5944&tinwsys_st_code=CA&counter=0.

United States Environmnetal Protection Agency. 2020. *Safe Drinking Water Information Center - Poplar CSD.* https://sdwis.waterboards.ca.gov/PDWW/JSP/MonitoringResults.jsp?tinwsys_is_number=5955&tinwsys_st_code=CA&counter=0.

United States of the Interior - Bureau of Reclamation. 2018 and 2019. "Central Valley Operations."

ATTACHMENT 1 – TULE SUBBASIN 2018/2019 ANNUAL REPORT

Tule Subbasin 2018/19 Annual Report

April 2020

Prepared for

Tule Subbasin Technical Advisory Committee

Prepared by

Thomas Harder, P.G., C.HG.
Principal Hydrogeologist

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Groundwater Consulting

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Executive Summary

This is the first annual report of the Tule Subbasin, identified by the California Department of Water Resources (CDWR) as No. 5-22-13 of the Tulare Lake Hydrologic Region (see Figure 1). This report is being submitted in compliance with Title 23 of the California Code of Regulations, Division 2, Chapter 1.5, Subchapter 2, Article 7, Section 356.2, as required under the Sustainable Groundwater Management Act (SGMA). As per Section 356.2, this report addresses data collected for the preceding water year, which covers October 1, 2018 through September 30, 2019.

The Tule Subbasin includes seven Groundwater Sustainability Agencies (GSAs; see Figure 2):

1. Eastern Tule Groundwater Sustainability Agency (ETGSA),
2. Tri-County Water Authority Groundwater Sustainability Agency (TCWA GSA),
3. Pixley Irrigation District Groundwater Sustainability Agency (Pixley GSA),
4. Lower Tule River Irrigation District Groundwater Sustainability Agency (LTGSA),
5. Delano-Earlimart Irrigation District Groundwater Sustainability Agency (DEID GSA)
6. Alpaugh Groundwater Sustainability Agency (Alpaugh GSA), and
7. Tulare County Groundwater Sustainability Agency (Tulare County GSA).

Six of the seven GSAs within the Tule Subbasin have developed and submitted to the CDWR independent Groundwater Sustainability Plans (GSPs) pursuant to 23 CCR §353.6. Tulare County GSA has entered into Memoranda of Understanding (MOUs) concerning coverage of territories under adjacent GSPs. As such, their jurisdictional areas are included in the other six GSPs.

Groundwater Elevation Data

Two primary aquifers have been identified within the Tule Subbasin: an upper unconfined to semi-confined aquifer (the Upper Aquifer) and a lower semi-confined to confined aquifer (the Lower Aquifer). Groundwater elevation contour maps and hydrographs have been developed for each of these two primary aquifers.

Groundwater in the Upper Aquifer of the Tule Subbasin flows from areas of natural recharge along major streams at the base of the Sierra Nevada Mountains on the eastern boundary towards a groundwater pumping depression in the central portion of the subbasin. Groundwater flow patterns did not change significantly between the spring and fall 2019. In the Lower Aquifer, groundwater generally flows from the northeast to the southwest towards groundwater level depressions in the northwestern and western portions of the subbasin. The same groundwater level conditions and flow patterns were observed from Lower Aquifer contour maps generated from both the spring and fall of 2019.

Groundwater levels in the Tule Subbasin vary seasonally. Since 2017, groundwater levels have generally risen across much of the eastern portion of the subbasin, dropped in the center of the subbasin, and risen in the western subbasin.

Groundwater Extractions

Total groundwater extraction from the Tule Subbasin for water year 2018/19 was 494,834 acre-ft, as summarized by water use sector in the following table:

Table ES-1
Tule Subbasin Groundwater Extraction for Water Year 2018/19

	Agricultural Pumping	Municipal Pumping	Pumping for Export	Total
LTRID GSA	137,000	1,900	9,234	148,134
ETGSA	82,000	13,500	0	95,500
DEID GSA	49,000	3,700	0	52,700
Pixley GSA	102,000	1,100	0	103,100
TCWA GSA	91,800	300	0	92,100
Alpaugh GSA	3,000	300	0	3,300
Totals	**464,800**	**20,800**	**9,234**	**494,834**

Note: All values are in acre-ft.

Surface Water Use

Total surface water available for use within the Tule Subbasin for water year 2018/19 was 1,264,264 acre-ft as summarized by water use sector in the following table:

Table ES-2
Tule Subbasin Surface Water Supplies for Water Year 2018/19

	Stream Diversions[1]	Imported Water	Recycled Water	Oilfield Produced Water	Precipitation	Total
LTRID GSA	143,735	216,118	0	0	106,100	465,963
ETGSA	30,505	150,657	4,601	1,078	199,600	386,441
DEID GSA	0	133,860	0	0	59,600	193,460
Pixley GSA	3,097	70,457	0	0	66,300	139,854
TCWA GSA	0	4,289	0	0	51,700	55,989
Alpaugh GSA	3,100	7,157	0	0	12,300	22,557
Totals	**180,447**	**582,538**	**4,601**	**1,078**	**495,600**	**1,264,264**

Note: All values are in acre-ft.
[1]Provisional data subject to revision.

Total Water Use

Total water use in the Tule Subbasin for water year 2018/19, including both groundwater extractions and surface water supplies, was 1,759,098 acre-ft as shown in the following table:

Table ES-3
Tule Subbasin Total Water Use for Water Year 2018/19

	Groundwater Extraction	Surface Water Supplies	Total
LTRID GSA	148,134	465,963	614,097
ETGSA	95,500	386,441	481,941
DEID GSA	52,700	193,460	246,160
Pixley GSA	103,100	139,854	242,954
TCWA GSA	92,100	55,989	148,089
Alpaugh GSA	3,300	22,557	25,857
Totals	**494,834**	**1,264,264**	**1,759,098**

Note: All values are in acre-ft.

Change in Groundwater in Storage

Since 1986/87, the volume of groundwater in storage in the Tule Subbasin has decreased by approximately 5,000,000 acre-ft. However, since 2015/16, the volume of groundwater in storage has been relatively stable. This has been due to a reduction in groundwater pumping, a relatively wet precipitation year in 2016/17, and an average precipitation year in 2018/19.

Results of the change in groundwater in storage analysis showed that between fall 2017 and fall 2019, groundwater in storage decreased by approximately 24,000 acre-ft.

1. Introduction

This is the first annual report of the Tule Subbasin, identified by the California Department of Water Resources (CDWR) as No. 5-22-13 of the Tulare Lake Hydrologic Region (see Figure 1). This report is being submitted in compliance with Title 23 of the California Code of Regulations, Division 2, Chapter 1.5, Subchapter 2, Article 7, Section 356.2, as required under the Sustainable Groundwater Management Act (SGMA). As per Section 356.2, this report addresses data collected for the preceding water year, which covers October 1, 2018 through September 30, 2019.

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Six of the seven GSAs within the Tule Subbasin have developed and submitted to the CDWR independent Groundwater Sustainability Plans (GSPs) pursuant to 23 CCR §353.6. Tulare County GSA has entered into Memoranda of Understanding (MOUs) concerning coverage of territories under adjacent GSPs. As such, their jurisdictional areas are included in the other six GSPs.

The six GSPs for the Tule Subbasin have been developed and submitted under a Coordination Agreement. The purpose of the Coordination Agreement is to fulfill all statutory and regulatory requirements related to intra-basin coordination agreements pursuant to SGMA. The Coordination Agreement includes two attachments: Attachment 1 describes the subbasin-wide monitoring network that all Tule Subbasin GSAs shall utilize for the collection of data to be used in annual reports. Attachment 2 describes the subbasin setting, which represents the coordinated understanding of the physical characteristics of the subbasin.

1.1 Tule Subbasin Description

The Tule Subbasin is in the southern portion of the San Joaquin Valley Groundwater Basin in the Central Valley of California. The area of the Tule Subbasin is defined by the latest version of CDWR Bulletin 118[1] and is approximately 744 square miles (475,895 acres). The lateral boundaries of the subbasin include both natural and political boundaries (see Figure 2). The eastern boundary of the Tule Subbasin is defined by the surface contact between crystalline rocks

California Department of Water Resources, 2016. Final 2016 Bulletin 118 Groundwater Basin Boundaries shapefile. http://www.water.ca.gov/groundwater/sgm/basin_boundaries.cfm of the Sierra Nevada and surficial alluvial sediments that make up the groundwater basin. The northern boundary is defined by the Lower Tule River Irrigation District (LTRID) and Porterville Irrigation District boundaries. The western boundary is defined by the Tulare County/Kings County boundary, except for a portion of the Tulare Lake Basin Water Storage District that extends east across the county boundary and is excluded from the subbasin. The southern boundary is defined by the Tulare County/Kern County boundary except for the portion of the Delano-Earlimart Irrigation District (DEID) that extends south of the county boundary and is included in the subbasin. Communities within the subbasin include Allensworth, Alpaugh, Porterville, Tipton, Woodville, Poplar, Teviston, Pixley, Earlimart, Richgrove, Ducor and Terra Bella. Neighboring DWR Bulletin 118 subbasins include the Kern County Subbasin to the south, the Tulare Lake Subbasin to the west, and the Kaweah Subbasin to the north.

1.2 Hydrogeologic Setting

The Tule Subbasin is located on a series of coalescing alluvial fans that extend toward the center of the San Joaquin Valley from the Sierra Nevada Mountains (see Figure 3). The alluvial fans merge with lacustrine deposits of the Tulare Lakebed in the western portion of the subbasin. Land surface elevations within the Tule Subbasin range from approximately 850 ft above mean sea level (amsl) along the eastern margins of the subbasin to approximately 180 ft amsl at the western boundary (see Figure 3).

Where saturated in the subsurface, the permeable sand and gravel layers form the principal aquifers in the Tule Subbasin and adjacent areas to the north, south and west. Individual aquifer layers consist of lenticular sand and gravel deposits of varying thickness and lateral extent. The aquifer layers are interbedded with low permeability silt and clay confining layers. In general, there are five aquifer/aquitard units in the subsurface beneath the Tule Subbasin (see Figure 4):

1. Upper Aquifer
2. The Corcoran Clay Confining Unit
3. Lower Aquifer
4. Pliocene Marine Deposits (generally considered an aquitard)
5. Santa Margarita Formation and Olcese Formation of the Southeastern Subbasin

Two primary aquifers have been identified within the Tule Subbasin: an upper unconfined to semi-confined aquifer and a lower semi-confined to confined aquifer. The upper and lower aquifers are separated by the Corcoran Clay confining unit in the western portion of the subbasin. Groundwater within the southeastern portion of the subbasin is also produced from the Santa Margarita Formation, which is located stratigraphically below the lower aquifer.

In general, groundwater in the Tule Subbasin flows from areas of natural recharge along major streams at the base of the Sierra Nevada Mountains on the eastern boundary towards the western-central portion of the subbasin.

1.3 Tule Subbasin Monitoring Network

The Tule Subbasin Technical Advisory Committee has developed a subbasin-wide monitoring plan, which describes the monitoring network and monitoring methodologies to be used to collect the data to be included in Tule Subbasin GSPs and annual reports. The subbasin-wide monitoring plan is included as Attachment 1 to the Coordination Agreement. The groundwater level monitoring network from the monitoring plan is shown on Figure 5 and includes monitoring features to enable collection of data from the Upper Aquifer, Lower Aquifer and Santa Margarita Formation aquifer. Groundwater levels are collected in the late winter/early spring (March) and in the fall to account for seasonal high and low groundwater conditions.

A subset of groundwater level monitoring features in the monitoring plan have been identified as representative monitoring sites to be relied on for the purpose of assessing progress with respect to groundwater level sustainability in the subbasin. The representative groundwater level monitoring sites are shown on Figure 5.

1.4 Purpose and Scope of this Annual Report

The purpose of this annual report is to document groundwater level conditions, groundwater extractions, surface water supply, and changes in groundwater in storage in the Tule Subbasin for the 2018/19 water year, in accordance with CCR §356.2. The annual report also provides a description of progress toward implementing the collective GSPs for the six GSAs in the subbasin.

2. Groundwater Elevation Data §356.2 (b)(1)

2.1 Groundwater Elevation Contour Maps §356.2 (b)(1)(A)

Upper Aquifer

Groundwater in the Upper Aquifer of the Tule Subbasin flows from areas of natural recharge along major streams at the base of the Sierra Nevada Mountains on the eastern boundary towards a groundwater pumping depression in the central portion of the subbasin (see Figures 6 and 7). The pumping depression has reversed the natural groundwater flow direction in the western portion of the subbasin. The pumping depression is most pronounced between the Tule River and Deer Creek near Highway 99. The groundwater level depression was observed from data collected in both the spring and fall of 2019. Groundwater flow patterns in the upper aquifer did not change significantly between the spring and fall of 2019.

The Upper Aquifer in the southeastern portion of the Tule Subbasin has been largely dewatered since the 1960s.[2]

Lower Aquifer

In the Lower Aquifer, groundwater generally flows from the northeast to the southwest towards groundwater level depressions in the northwestern and western portions of the subbasin (see Figures 8 and 9). Lower Aquifer pumping depressions are observed in the Lower Tule River Irrigation District GSA, Tri-County GSA and Alpaugh GSA. A slight groundwater high is observed in the eastern Pixley GSA area. The same groundwater level conditions and flow patterns were observed from Lower Aquifer contour maps generated from both the spring and fall of 2019.

2.2 Groundwater Level Hydrographs §356.2 (b)(1)(B)

Groundwater level hydrographs for Representative Monitoring Site (RMS) wells in each GSA are provided in Appendices A through F. Spring and fall 2019 groundwater levels for the RMS wells are summarized in Tables 1 through 6 of the following sections. It is noted that the Tule Subbasin Monitoring Plan had not been implemented as of fall 2019 so many of the RMS wells have not been monitored. However, with the implementation of the monitoring plan in February 2020, a more complete dataset will be available for subsequent annual reports.

2.2.1. Lower Tule River Irrigation District GSA

There are ten RMS wells in the LTRID GSA (see Figure 5). Of these wells, six are perforated in the Upper Aquifer, three are perforated in the Lower Aquifer, and one is a composite well

[2] Lofgren, B.E., and Klausing, R.L., 1969. Land Subsidence Due to Groundwater Withdrawal Tulare-Wasco Area California. United States Geological Survey Professional Paper 437-B.

perforated in two aquifers. Hydrographs for each of the wells are provided in Appendix A. Available groundwater level data for LTRID GSA RMS wells from the spring and fall of 2019 are summarized in the following table:

Table 1
Lower Tule River Irrigation District GSA
2018/19 Groundwater Levels at Representative Monitoring Site Wells

Well	Groundwater Elevation (ft amsl)			
	Spring 2019	Fall 2019	Measurable Objective	Minimum Threshold
Upper Aquifer				
21S/23E-32K01	124.80	111.60	71	56
21S/24E-35A01	112.80	115.00	57	44
21S/25E-03R01	N/A[1]	N/A	92	58
21S/26E-32A01	N/A	N/A	131	83
22S/23E-30J01	N/A	N/A	48	31
21S/26E-34	N/A	N/A	110	73
Lower Aquifer				
22S/24E-01Q01	-13.60	-36.60	-39	-154
21S/25E-36	-23.18	N/A	1	-52
22S/23E-07	N/A	N/A	-139	-174
Composite Aquifer				
20S/26E-32	167.00	154.10	53	-6

[1]N/A = Not Available

For Upper Aquifer monitoring wells, groundwater levels in Well 21S/23E-32K01 varied from 125 feet above mean sea level (ft amsl) to 112 ft amsl. Over the same time period, groundwater levels in Well 21S/24E-35A01 varied from 113 ft amsl to 115 ft amsl. Groundwater levels in both wells remain above their respective measurable objectives and are more than 50 feet above their respective minimum thresholds.

Of the Lower Aquifer monitoring wells, spring and fall 2019 groundwater levels were available only in Well 22S/24E-01Q01. Groundwater levels in this well varied from -13.6 ft amsl to -36.6 ft amsl (39 feet) between spring and fall 2019. The fall 2019 groundwater level remains above the measurable objective and is more than 100 feet above the minimum threshold.

For the composite aquifer monitoring Well 20S/26E-32, groundwater levels varied from 167 ft amsl to 154.1 ft amsl. The groundwater levels remain above the measurable objective of 53 ft amsl and is more than 150 feet above the minimum threshold.

2.2.2. Eastern Tule GSA

There are nine RMS wells in the ETGSA (see Figure 5). Of these wells, four are perforated in the Upper Aquifer, three are perforated in the Lower Aquifer and two are perforated across multiple aquifers (see Table 2). Hydrographs for each of the wells are provided in Appendix B. Available groundwater level data for ETGSA RMS wells from the spring and fall of 2019 are summarized in the following table:

Table 2
Eastern Tule GSA
2018/19 Groundwater Levels at Representative Monitoring Site Wells

Well	Groundwater Elevation (ft amsl)			
	Spring 2019	Fall 2019	Measurable Objective	Minimum Threshold
Upper Aquifer				
22S/27E-13A01	N/A[1]	348.00	331	259
23S/26E-09C01	N/A	N/A	110	74
R-11	N/A	N/A	376	264
C-1	361.00	364.00	377	317
Lower Aquifer				
23S/27E-27	65.30	N/A	112	-87
23S/26E-23R01	N/A	N/A	-2	-66
22S/26E-24	N/A	N/A	26	-47
Composite Aquifer				
C-16	N/A	N/A	111	2
23S/27E-03	N/A	N/A	219	181

[1]N/A = Not Available

Between spring and fall 2019, groundwater levels in Well C-1 (Porterville Area) varied approximately three feet from 361 ft amsl to 364 ft amsl. These groundwater levels are more than 25 feet above the minimum threshold but below the measurable objective of 377 ft amsl. It is noted that groundwater levels in the Porterville Area are predicted to rise with implementation of the ETGSA GSP.

2.2.3. Delano-Earlimart GSA

There are 13 RMS wells in the DEID GSA (see Figure 5). Of these wells, five are perforated in the Upper Aquifer and eight are perforated in the Lower Aquifer. Hydrographs for each of the wells are provided in Appendix C. Available groundwater level data for DEID GSA RMS wells from the spring and fall of 2019 are summarized in the following table:

Table 3
Delano-Earlimart Irrigation District GSA
2018/19 Groundwater Levels at Representative Monitoring Site Wells

Well	Groundwater Elevation (ft amsl)			
	Spring 2019	Fall 2019	Measurable Objective	Minimum Threshold
Upper Aquifer				
24S/26E-32G01	N/A[1]	N/A	85	-19
24S/26E-04P01	N/A	N/A	84	-4
24S/25E-35	66.80	67.13	152	93
24S/26E-11	N/A	N/A	84	66
M-19	N/A	N/A	143	85
Lower Aquifer				
23S/26E-29D01	77.10	74.20	45	-15
M-19	N/A	N/A	128	63
23S/25E-36	N/A	N/A	26	-95
25S/26E-8D	N/A	N/A	142	36
25S/26E-9	N/A	N/A	109	61
23S/25E-27	N/A	N/A	-6	-191
24S/24E-03A01	N/A	N/A	-25	-163
24S/27E-31	75.20	N/A	60	-7

[1]N/A = Not Available

Of the Upper Aquifer monitoring wells, spring and fall 2019 groundwater levels were available only in Well 24S/25E-35. Groundwater levels in this well varied from 66.8 ft amsl in spring 2019 to 67.13 ft amsl in fall 2019. The fall 2019 groundwater level is below the measurable objective of 152 ft amsl and is approximately 26 feet below the minimum threshold.

Of the Lower Aquifer monitoring wells, spring and fall 2019 groundwater levels were available only in Well 23S/26E-29D01. Groundwater levels in this well varied from 77.1 ft amsl to

74.2 ft amsl (2.9 feet) between spring and fall 2019. The fall 2019 groundwater level remains above the measurable objective of 45 ft amsl and is approximately 90 feet above the minimum threshold.

2.2.4. Pixley Irrigation District GSA

There are five RMS wells in the Pixley GSA (see Figure 5). Of these wells, four are perforated in the Upper Aquifer and one is perforated in the Lower Aquifer. Hydrographs for each of the wells are provided in Appendix D. Available groundwater level data for Pixley GSA RMS wells from the spring and fall of 2019 are summarized in the following table:

Table 4
Pixley Irrigation District GSA
2018/19 Groundwater Levels at Representative Monitoring Site Wells

Well	Groundwater Elevation (ft amsl)			
	Spring 2019	Fall 2019	Measurable Objective	Minimum Threshold
Upper Aquifer				
22S/24E-23J01	N/A[1]	N/A	-13	-68
22S/25E-25N01	21.10	16.00	-8	-54
23S/24E-28J02	92.60	83.90	78	54
23S/25E-16N04	N/A	N/A	62	14
Lower Aquifer				
22S/25E-32K01	N/A	N/A	-18	-46

[1]N/A = Not Available

Of the Upper Aquifer monitoring wells, spring and fall 2019 groundwater levels were available for Wells 22S/25E-25N01 and 23S/24E-28J02. Groundwater levels in Well 22S/25E-25N01 varied 5.1 feet from 21.1 ft amsl to 16.00 ft amsl between spring and fall 2019, respectively. Groundwater levels in Well 23S/24E-28J02 varied 8.7 feet from 92.6 ft amsl to 83.9 ft amsl between spring and fall 2019, respectively. Groundwater levels for both of these wells remain above their respective measurable objectives and minimum thresholds.

2.2.5. Tri-County Water Authority GSA

There are seven RMS wells in the TCWA GSA (see Figure 5). Of these wells, two are perforated in the Upper Aquifer and five are perforated in the Lower Aquifer. Hydrographs for each of the wells are provided in Appendix E. Available groundwater level data for TCWA GSA RMS wells from the spring and fall of 2019 are summarized in the following table:

Table 5
Tri-County Water Authority GSA
2018/19 Groundwater Levels at Representative Monitoring Site Wells

Well	Groundwater Elevation (ft amsl)			
	Spring 2019	Fall 2019	Measurable Objective	Minimum Threshold
Upper Aquifer				
E20	59.00	N/A[1]	45	-40
24S/24E-25J01	N/A	N/A	185	125
Lower Aquifer				
G-13	-68.00	N/A	-85	-210
24S/23E-22R02	N/A	N/A	15	-175
23S/23E-25N01	9.29	-0.81	-5	-110
24S/23E-15R01	N/A	N/A	-20	-150
24S/24E-04R01	46.16	15.36	60	-40

[1]N/A = Not Available

Of the Lower Aquifer monitoring wells, spring and fall 2019 groundwater levels were available for Wells 23S/23E-25N01 and 24S/24E-04R01. Groundwater levels in Well 23S/23E-25N01 varied from 9.29 ft amsl in spring 2019 to -0.81 ft amsl in fall 2019. Groundwater levels in Well 24S/24E-04R01 varied from 46.16 ft amsl in spring 2019 to 15.36 ft amsl in fall 2019. Groundwater levels for 24S/24E-04R01are below the measurable objective for this well. Groundwater levels for both wells are above their respective minimum thresholds.

2.2.6. Alpaugh GSA

The Alpaugh GSA has one RMS well – Well 55 (see Figure 5). This well is perforated in the Lower Aquifer. The hydrograph for Well 55 is provided in Appendix F. Available groundwater level data for Well 55 from the spring and fall of 2019 are summarized in the following table:

Table 6
Alpaugh Irrigation District GSA
2018/19 Groundwater Levels at the Representative Monitoring Site Well

Well	Groundwater Elevation (ft amsl)			
	Spring 2019	Fall 2019	Measurable Objective	Minimum Threshold
Lower Aquifer				
Well 55	-112.00	N/A	-92	-209

[1]N/A = Not Available

The groundwater level in Well 55 feet was -112.00 in spring 2019. The fall 2019 data was not available. The spring 2019 groundwater level was 20 feet lower than the measurable objective of -92 ft amsl. The groundwater level was 97 feet above the minimum threshold.

3. Groundwater Extraction for Water Year 2018/2019 §356.2 (b)(2)

3.1 Agricultural Groundwater Pumping

Agricultural groundwater pumping in the Tule Subbasin is estimated as a function of the total agricultural water demand, surface water deliveries, and precipitation. The total agricultural water demand (i.e. applied water demand) is estimated as follows:

$$W_d = \frac{A_i \ x \ ET}{I_{eff}}$$

Where:

W_d = Total Agricultural Water Demand (acre-ft)

A_i = Irrigated Area (acres)

ET = Evapotranspiration (acre-ft/acre)

I_{eff} = Irrigation Efficiency (unitless)

Crop evapotranspiration (ET) is estimated using remote sensing data from Landsat satellites. The satellite data is entered into a model, which is used to estimate the ET rate and ET spatial distribution of an area in any given time period. When appropriately calibrated to land-based ET and/or climate stations and validated with crop surveys, the satellite-based model provides an estimate of crop ET (i.e. consumptive use). For the 2018/19 water year, crop evapotranspiration was estimated using METRIC.

Irrigation efficiency (I_{eff}) is estimated for any given area based on the irrigation method for that area (e.g. drip irrigation, flood irrigation, micro sprinkler, etc.). Irrigation methods are correlated with crop types based on either CDWR land use maps or field surveys. The following irrigation efficiencies will be applied to the different irrigation methods based on California Energy Commission (2006):

- Border Strip Irrigation – 77.5 percent
- Micro Sprinkler – 87.5 percent
- Surface Drip Irrigation – 87.5 percent
- Furrow Irrigation – 67.5 percent

Agricultural groundwater extraction is estimated as the total applied water demand (W_d) minus surface water deliveries and effective precipitation. Effective precipitation is the portion of precipitation that becomes evapotranspiration.

Estimated Tule Subbasin 2018/19 agricultural groundwater production for each of the six GSAs is summarized in Table 7. Total agricultural groundwater production for the Tule Subbasin in 2018/19 was approximately 464,800 acre-ft.

Table 7
Tule Subbasin Groundwater Extraction for Water Year 2018/19

	Agricultural Pumping	Municipal Pumping	Pumping for Export	Total
LTRID GSA	137,000	1,900	9,234	148,134
ETGSA	82,000	13,500	0	95,500
DEID GSA	49,000	3,700	0	52,700
Pixley GSA	102,000	1,100	0	103,100
TCWA GSA	91,800	300	0	92,100
Alpaugh GSA	3,000	300	0	3,300
Totals	**464,800**	**20,800**	**9,234**	**494,834**

Note: All values are in acre-ft.

3.2 Municipal Groundwater Pumping

Groundwater pumping for municipal supply is conducted by the City of Porterville and small municipalities for the local communities in the Tule Subbasin. The City of Porterville groundwater pumping is metered and reported by the city. Municipal groundwater pumping by the other small communities within the Tule Subbasin is estimated based on population density and per capita water use as reported in Urban Water Master Plans. Total estimated municipal pumping in the Tule Subbasin for the 2018/19 water year was approximately 20,800 acre-ft (see Table 7).

It is noted that there are some households in the rural portions of the Tule Subbasin that rely on private wells to meet their domestic water supply needs. However, given the low population density of these areas, the volume of pumping from private domestic wells is considered negligible compared to the other pumping sources.

3.3 Groundwater Pumping for Export Out of the Tule Subbasin

Some of the groundwater pumping that occurs on the west side of the Tule Subbasin is exported out of the subbasin for use elsewhere. Angiola Water District and the Boswell/Creighton Ranch have historically exported pumped groundwater out of the Tule Subbasin. Total groundwater exports out of the Tule Subbasin for the 2018/19 water year was 9,234 acre-ft (see Table 7). This water is accounted for separately because the water is not applied within the subbasin and there is no associated return flow.

3.4 Total Groundwater Extraction

Total groundwater extraction from the Tule Subbasin for water year 2018/19 was 494,834 acre-ft (see Table 7). The distribution of groundwater production across the subbasin is shown on Figure 10.

4. Surface Water Use for Water Year 2018/2019 §356.2 (b)(3)

4.1 Diverted Streamflow

Surface water inflow to the Tule Subbasin occurs primarily via three native streams: Tule River, Deer Creek, and the White River. Flow in the Tule River is controlled through releases from Lake Success. Stream flow entering Lake Success is measured and distributed to various water rights holders as allocated at Success Dam in accordance with the Tule River Water Diversion Schedule and Storage Agreement.[3] Releases of water from Lake Success and downstream diversions are documented in Tule River Association (TRA) annual reports. For water year 2018/19, 218,238 acre-ft of water was released to the Tule River from Success Reservoir. Tule River diversions occur in the ETGSA and LTRID GSA (see Table 8). In water year 2018/19, 11,882 acre-ft of water flowed out of the Tule Subbasin via the Tule River. Channel infiltration and ET losses account for the balance of Tule River water that was not diverted or did not flow out of the subbasin. Surface water diversions from Deer Creek occur in the ETGSA, Pixley GSA, and Alpaugh GSA. No surface water diversions from the White River were reported in 2018/19. Total stream diversions in the Tule Subbasin for 2018/19 totaled 180,447 acre-ft as summarized in Table 8.

Table 8
Tule Subbasin Surface Water Supplies for Water Year 2018/19

	Stream Diversions[1]	Imported Water	Recycled Water	Oilfield Produced Water	Precipitation	Total
LTRID GSA	143,735	216,118	0	0	106,100	465,963
ETGSA	30,505	150,657	4,601	1,078	199,600	386,441
DEID GSA	0	133,860	0	0	59,600	193,460
Pixley GSA	3,097	70,457	0	0	66,300	139,854
TCWA GSA	0	4,289	0	0	51,700	55,989
Alpaugh GSA	3,100	7,157	0	0	12,300	22,557
Totals	**180,447**	**582,538**	**4,601**	**1,078**	**495,600**	**1,264,264**

Note: All values are in acre-ft.
[1]Provisional data subject to revision.

[3] TRA, 1966. Tule River Diversion Schedule and Storage Agreement. Dated February 1, 1966; revised June 16, 1966.

4.2 Imported Water Deliveries

Most of the water imported into the Tule Subbasin is from the Central Valley Project (CVP) and delivered via the Friant-Kern Canal. Angiola Water District also imports water from other various sources including the King's River and State Water Project. The water is delivered to farmers and recharge basins via the Tule River and Deer Creek channels, unlined canals, and pipeline distribution systems of Porterville Irrigation District, LTRID, Pixley Irrigation District, Terra Bella Irrigation District, Teapot Dome Water District, DEID, and Saucelito Irrigation District.

Imported water is delivered to eleven water agencies within the Tule Subbasin from the Friant-Kern Canal. Imported water delivery data for 2018/19 was obtained from United States Bureau of Reclamation (USBR) Central Valley Operation Annual Reports. Imported water deliveries to TCWA GSA were obtained from the Angiola Water District. Imported water deliveries for 2018/19 totaled 582,538 acre-ft as summarized in Table 8.

4.3 Recycled Water Deliveries

A portion of the treated effluent from the City of Porterville's wastewater treatment plant is delivered to farmers for agricultural irrigation. Recycled water deliveries for agricultural irrigation are reported by the City. Recycled water deliveries for 2018/19 totaled 4,601 acre-ft, as summarized in Table 8.

4.4 Oilfield Produced Water

The Kern-Tulare Water District receives water generated as a byproduct of oil production but suitable for agricultural irrigation. The total volume of oilfield produced water received for agricultural irrigation in the portion of the Kern-Tulare Water District that is within the Tule Subbasin in 2018/19 was 1,078 acre-ft.

4.5 Precipitation

The volume of water available to crops from precipitation was estimated as the total precipitation falling on the land surface in the Tule Subbasin. An isohyetal map showing the precipitation distribution across the subbasin, as determined from long-term averages, is shown on Figure 11. Total precipitation at the Porterville precipitation station for water year 2018/19 was 10.2 inches, which is near average precipitation for the area (see Figure 12). The distribution of precipitation for the 2018/19 water year across the subbasin, for purposes of agricultural water supply, was based on California Irrigation Management Information System (CIMIS) data provided by California Polytechnic State University, San Luis Obispo. The total volume of precipitation available for crops in 2018/19 was estimated to be 495,600 acre-ft.

4.6 Total Surface Water Use

Total surface water available for use within the Tule Subbasin for water year 2018/19 was 1,264,264 acre-ft (see Table 8).

5. Total Water Use for Water Year 2018/2019 §356.2 (b)(4)

Total water use in the Tule Subbasin for water year 2018/19, including both groundwater extractions and surface water supplies, was 1,759,098 acre-ft (see Table 9).

Table 9
Tule Subbasin Total Water Use for Water Year 2018/19

	Groundwater Extraction	Surface Water Supplies	Total
LTRID GSA	148,134	465,963	614,097
ETGSA	95,500	386,441	481,941
DEID GSA	52,700	193,460	246,160
Pixley GSA	103,100	139,854	242,954
TCWA GSA	92,100	55,989	148,089
Alpaugh GSA	3,300	22,557	25,857
Totals	**494,834**	**1,264,264**	**1,759,098**

Note: All values are in acre-ft.

6. Change in Groundwater in Storage §354.16 (b)

For this annual report, the change in groundwater in storage for the Tule Subbasin was estimated for the time period between fall 2017 and fall 2019. The change in storage was estimated based on the following equation:

$$V_w = S_y A \, \Delta h$$

Where:

V_w	=	the volume of groundwater storage change (acre-ft).
S_y	=	specific yield of aquifer sediments (unitless).
A	=	the surface area of the aquifer within the Tule Subbasin/GSA (acres).
Δh	=	the change in hydraulic head (i.e. groundwater level) (feet).

The change in storage estimate is specific to the shallow aquifer as the groundwater level in the deep aquifer does not drop below the top of the aquifer. The calculations were made using a Geographic Information System (GIS) map of the Tule Subbasin discretized into 300-foot by 300-foot grids to allow for spatial representation of aquifer specific yield and groundwater level change.

The areal and vertical distribution of specific yield for the shallow aquifer is based on the values obtained from the calibrated groundwater flow model of the Tule Subbasin.[4] For the areal distribution of change in hydraulic head within the Tule Subbasin, groundwater contours for fall 2017 were digitized and overlain on the grid map of the Tule Subbasin in GIS. Groundwater levels were then be assigned to each grid. A contour map with groundwater elevation contours from fall 2019 were also digitized and overlain on the grid map. Change in hydraulic head (groundwater level) at each grid was calculated as the difference in groundwater level between the two years. The change in groundwater storage was estimated for each grid cell by multiplying the change in groundwater level by the specific yield and then by the area of the cell.

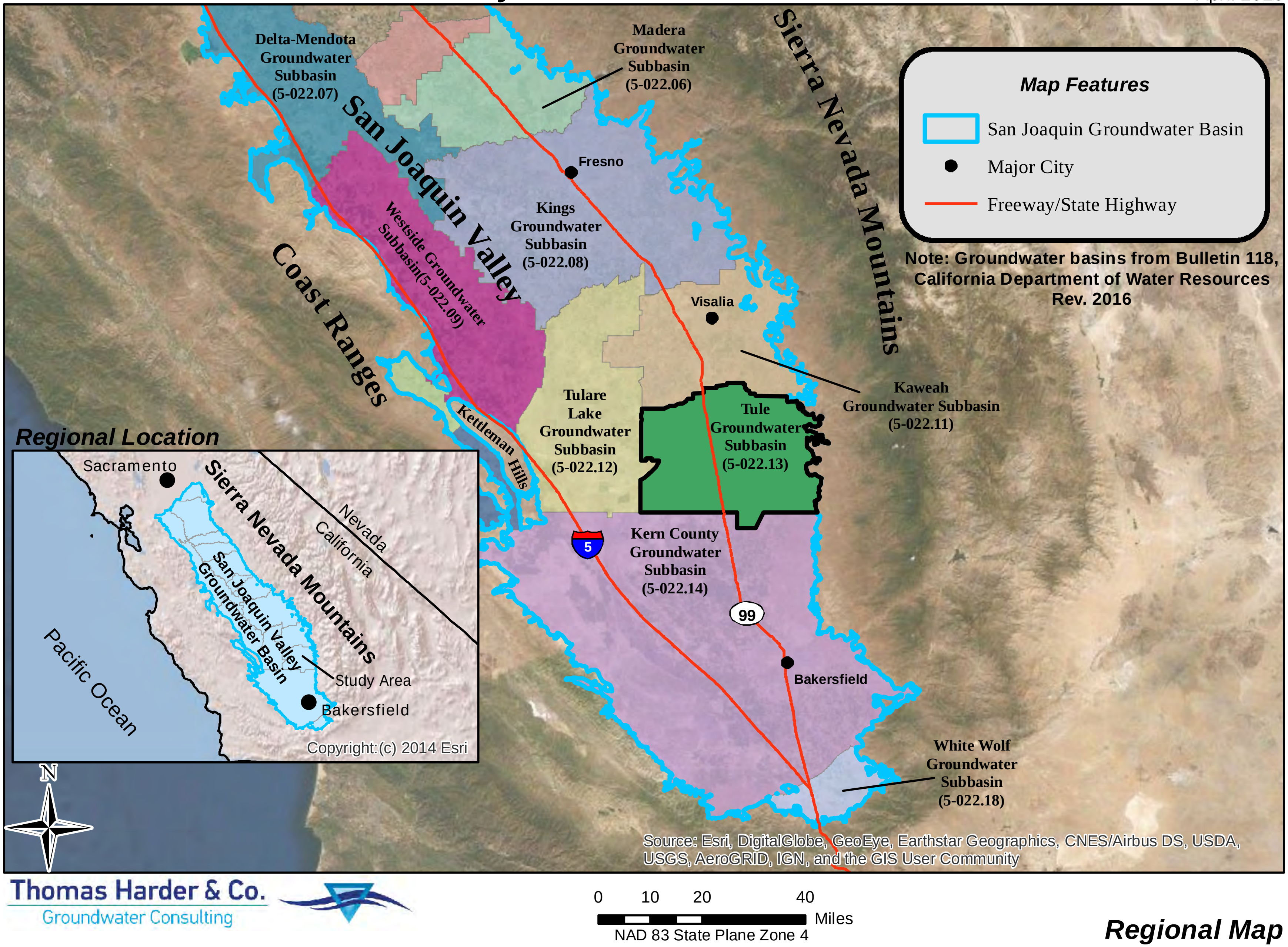
Results of the change in groundwater in storage analysis showed that between fall 2017 and fall 2019, groundwater in storage decreased by approximately 24,000 acre-ft (see Figure 13). It is noted that the change in groundwater in storage in some GSAs (e.g. LTRID GSA) show a decrease, based on analysis of groundwater levels, despite the fact that water supplies exceeded demand in those areas and the data suggest a net addition of water to the groundwater system. This apparent discrepancy is noted and will be investigated further as more data become available.

[4] Thomas Harder & Co., 2020. Groundwater Flow Model of the Tule Subbasin. Prepared for the Tule Subbasin MOU Group. January 2020.

Since 1986/87, the volume of groundwater in storage in the Tule Subbasin has decreased by approximately 5,000,000 acre-ft (see Figure 14). However, since 2015/16, the volume of groundwater in storage has been relatively stable. This has been due to a reduction in groundwater pumping, a relatively wet precipitation year in 2016/17, and an average precipitation year in 2018/19.

Figures

Tule Subbasin Technical Advisory Committee



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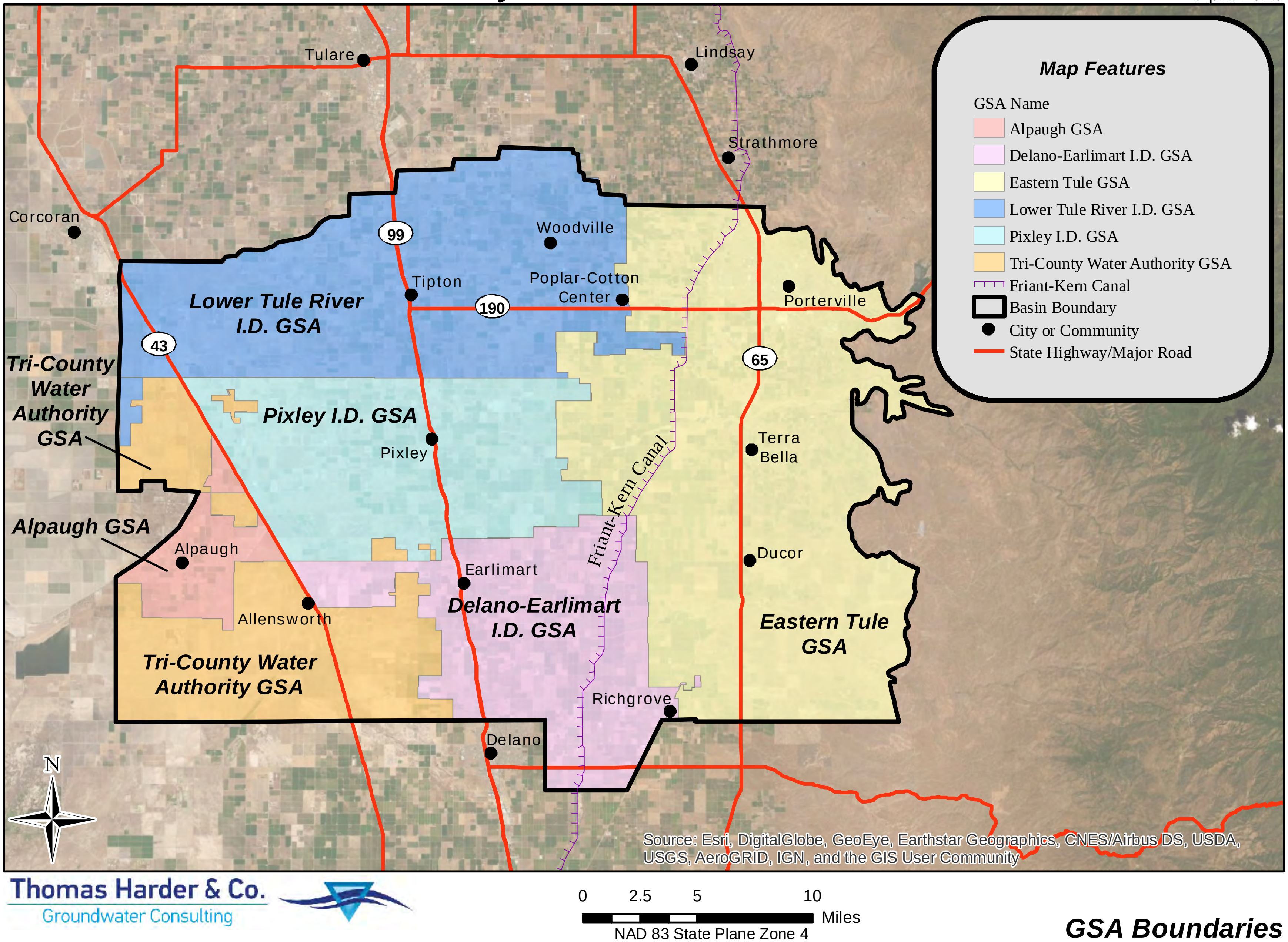
Regional Map
Figure 1

Tule Subbasin Technical Advisory Committee

2018/2019 Annual Report

April 2020



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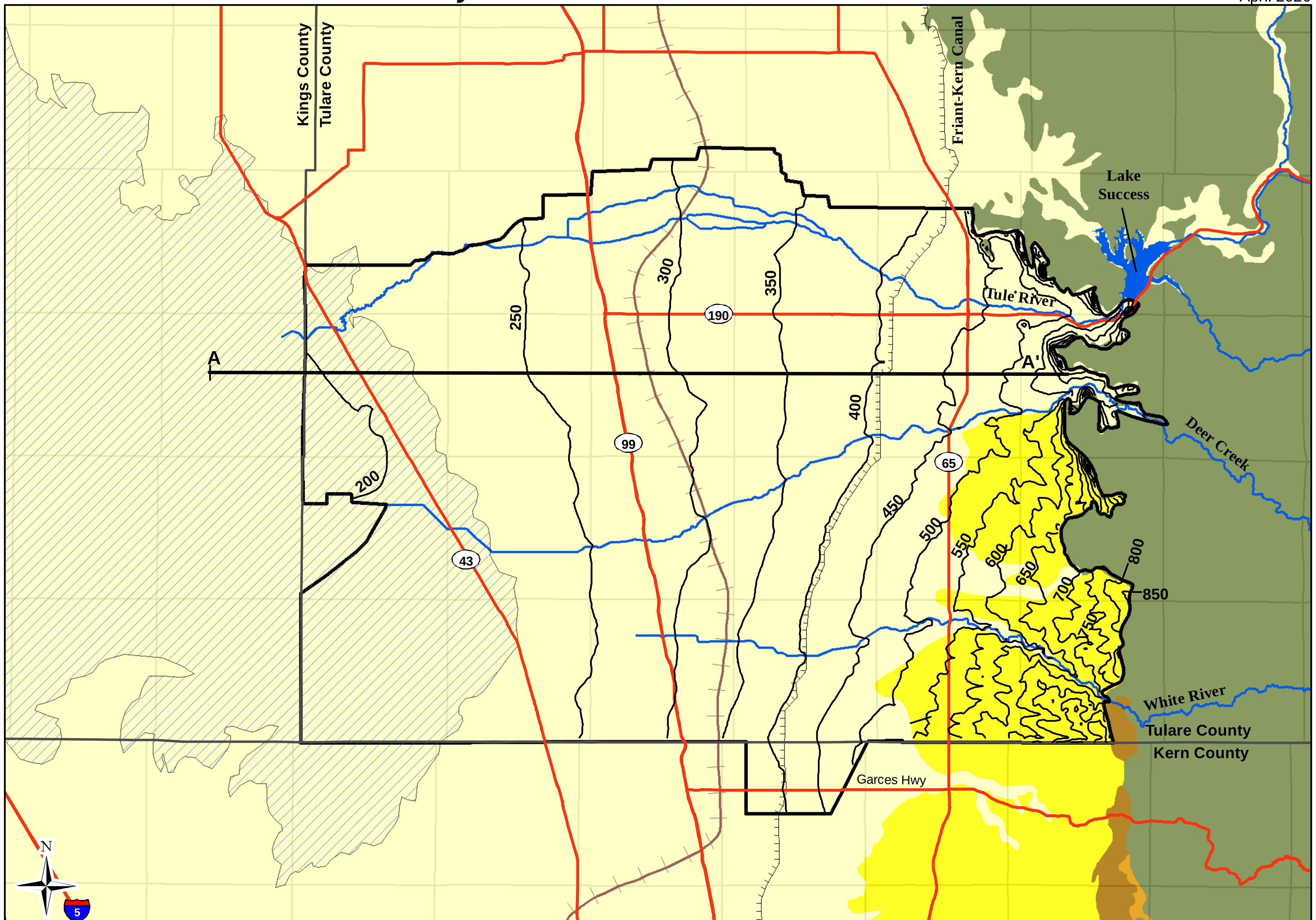
GSA Boundaries

Figure 2

Tule Subbasin Technical Advisory Committee

April 2020

2018/2019 Annual Report



Map Features

- Land Surface Elevation Contour (ft amsl)
- Cross Sections
- County Boundary
- Surficial Deposits
- Tertiary Loosely Consolidated Deposits
- Non-Marine Sedimentary Rocks
- Marine Sedimentary Rocks
- Crystalline Basement
- Approximate Eastern Extent of the Corcoran Clay
- Tulare Lake Surface Deposits
- Friant-Kern Canal
- Basin Boundary
- Major Hydrologic Feature
- State Highway/Major Road

Corcoran Clay from USGS Professional Paper 1766,
http://water.usgs.gov/GIS/dsdl/pp1766_CorcoranClay.zip

Geologic units modified from USGS Open-File Report 2005-1305

Lake Deposits from California Geological Survey Geologic Atlas of California Map No. 002 1:250,000 scale, Compiled by A.R. Smith, 1964 and Geologic Atlas of California Map No. 005, 1:250,000 scale, Compiled by: R.A. Matthews and J.L. Burnett

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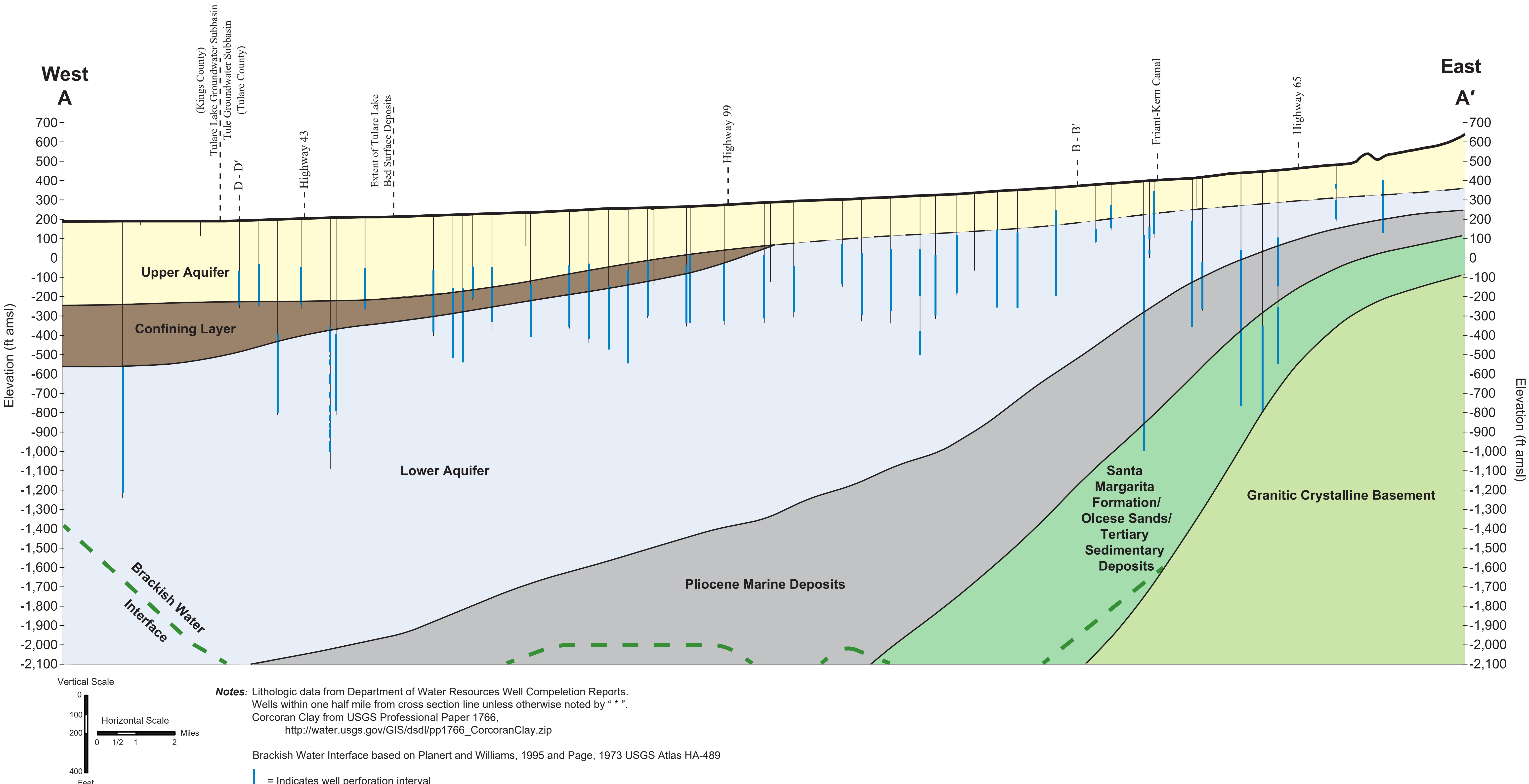
0 3 6 12 Miles
NAD 83 State Plane Zone 4

Geology and Cross Section Locations

Figure 3



Notes: Lithologic data from Department of Water Resources Well Compeletion Reports.
Wells within one half mile from cross section line unless otherwise noted by " * ".
Corcoran Clay from USGS Professional Paper 1766,
http://water.usgs.gov/GIS/dsdl/pp1766_CorcoranClay.zip

Brackish Water Interface based on Planert and Williams, 1995 and Page, 1973 USGS Atlas HA-489

| = Indicates well perforation interval

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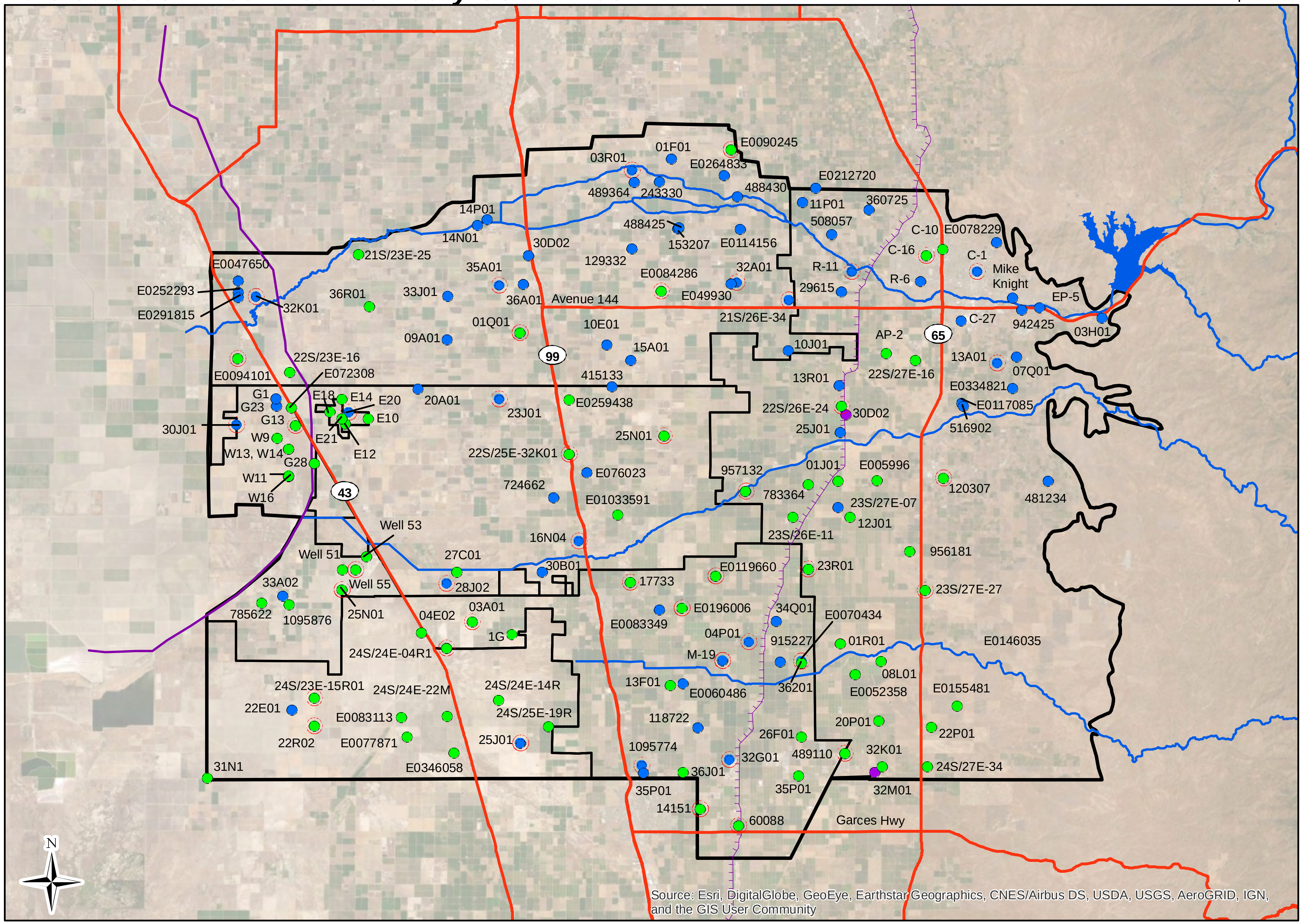
Hydrogeologic Cross Section A-A'
Tule Groundwater Subbasin
Figure 4
April 2020

Tule Subbasin Technical Advisory Committee

April 2020



T.20S.
T.21S.
T.22S.
T.23S.
T.24S.
T.25S.

R.22E. R.23E. R.24E. R.25E. R.26E. R.27E. R.28E. R.29E.

0 2.5 5 10 Miles

NAD 83 State Plane Zone 4

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Map Features

- Upper Aquifer Well
- Upper Aquifer RMS Well
- Lower Aquifer Well
- Lower Aquifer RMS Well
- Santa Margarita Well
- Canal
- Friant-Kern Canal and California Aqueduct
- Basin Boundary
- GSA Boundaries
- State Highway/Major Road

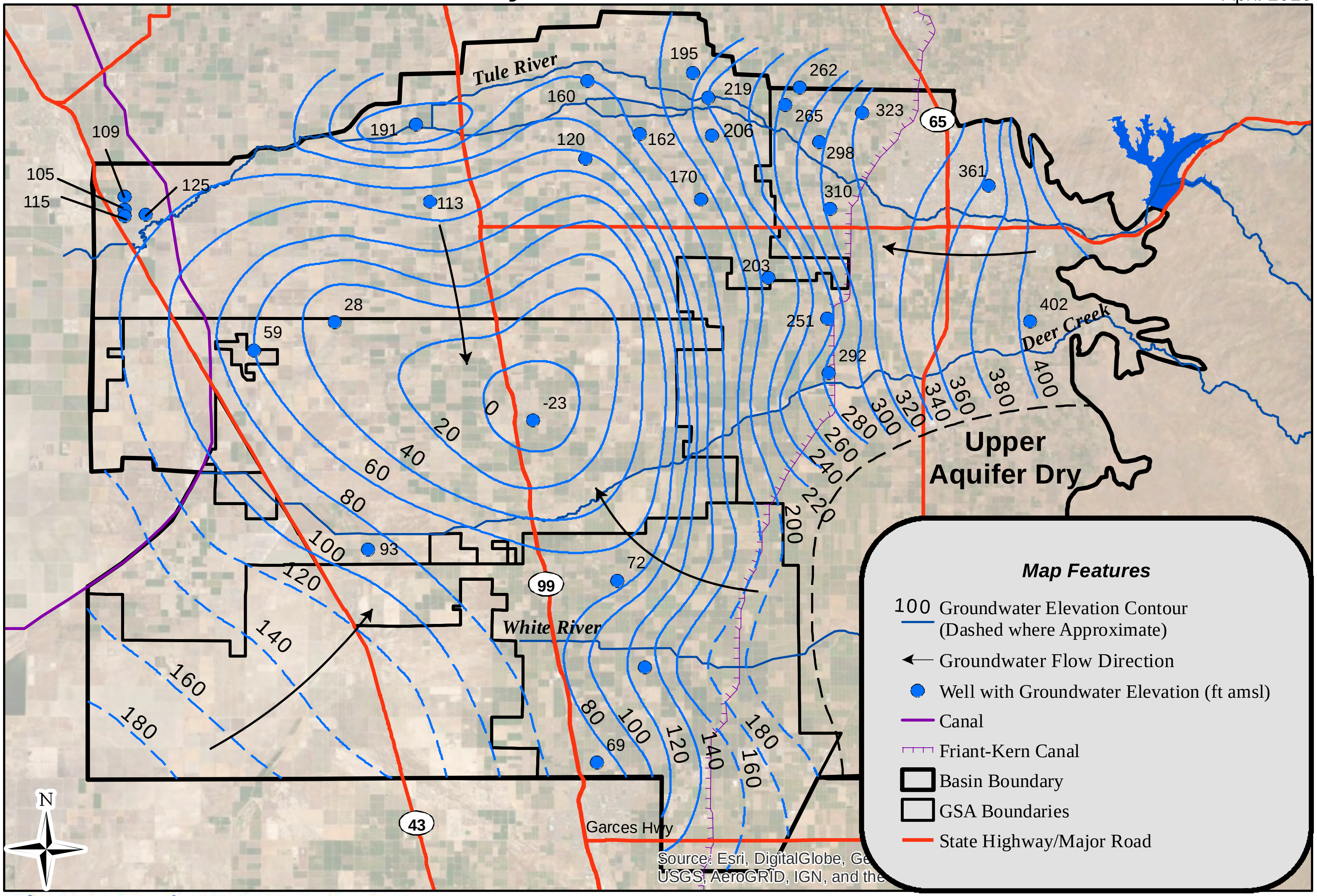
Groundwater Level Monitoring Network

Figure 5

Tule Subbasin Technical Advisory Committee

2018/2019 Annual Report

April 2020



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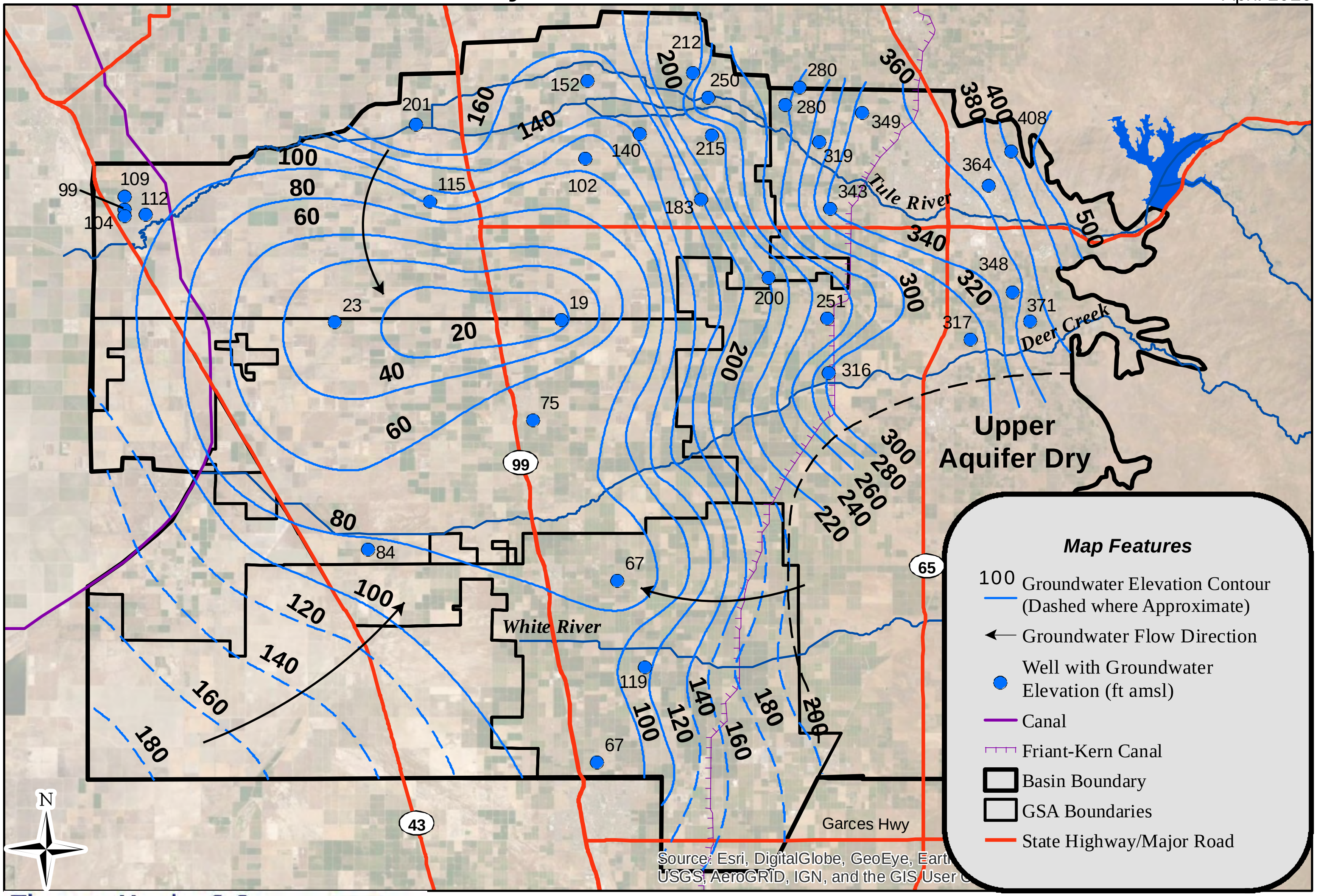
0 2 4 8 Miles

NAD 83 State Plane Zone 4

Spring 2019 Upper Aquifer Groundwater Elevation Contours

Figure 6

Tule Subbasin Technical Advisory Committee



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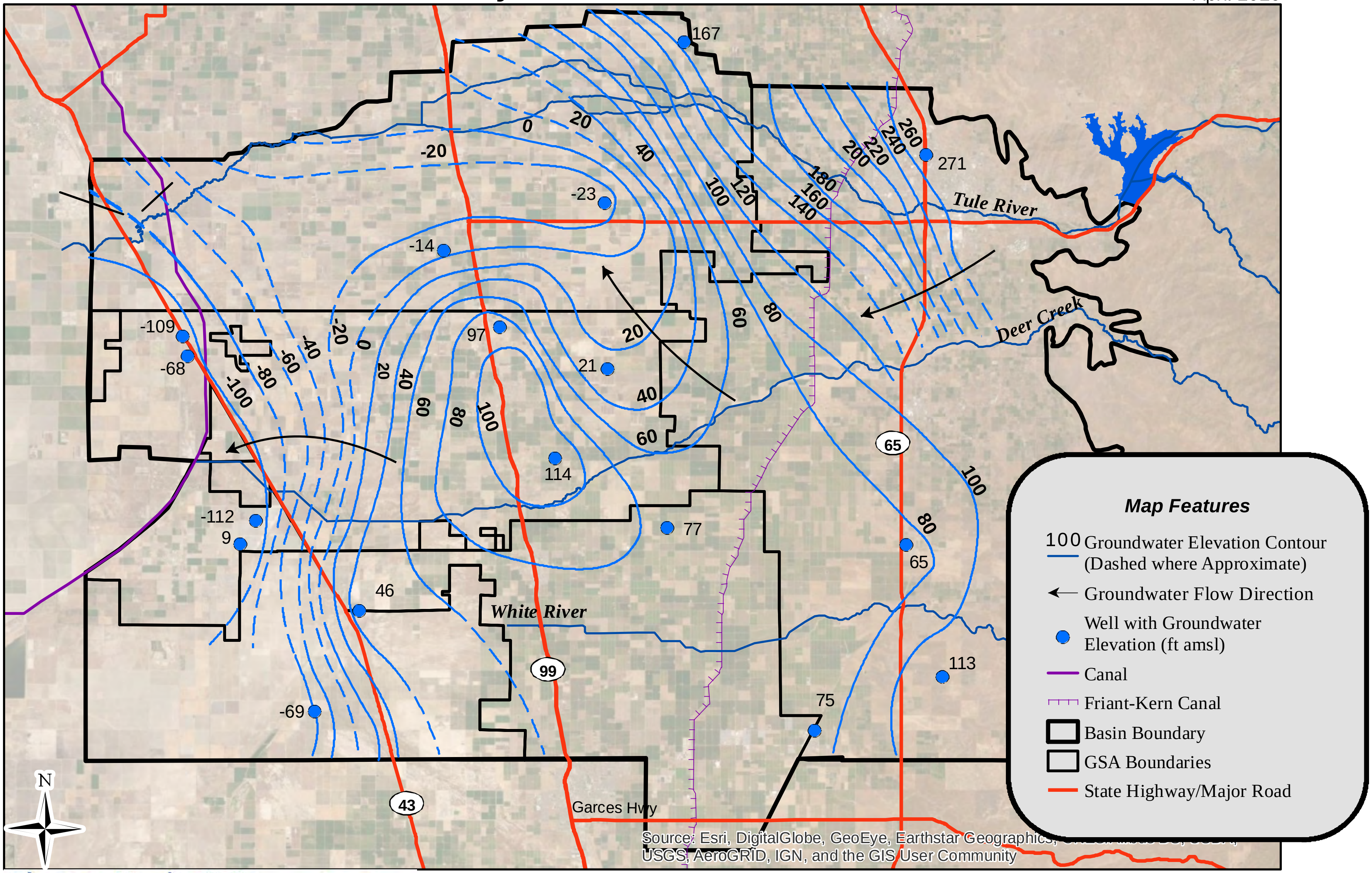
0 2 4 8 Miles
NAD 83 State Plane Zone 4

Fall 2019 Upper Aquifer Groundwater Elevation Contours

Figure 7

2018/2019 Annual Report
April 2020

Tule Subbasin Technical Advisory Committee



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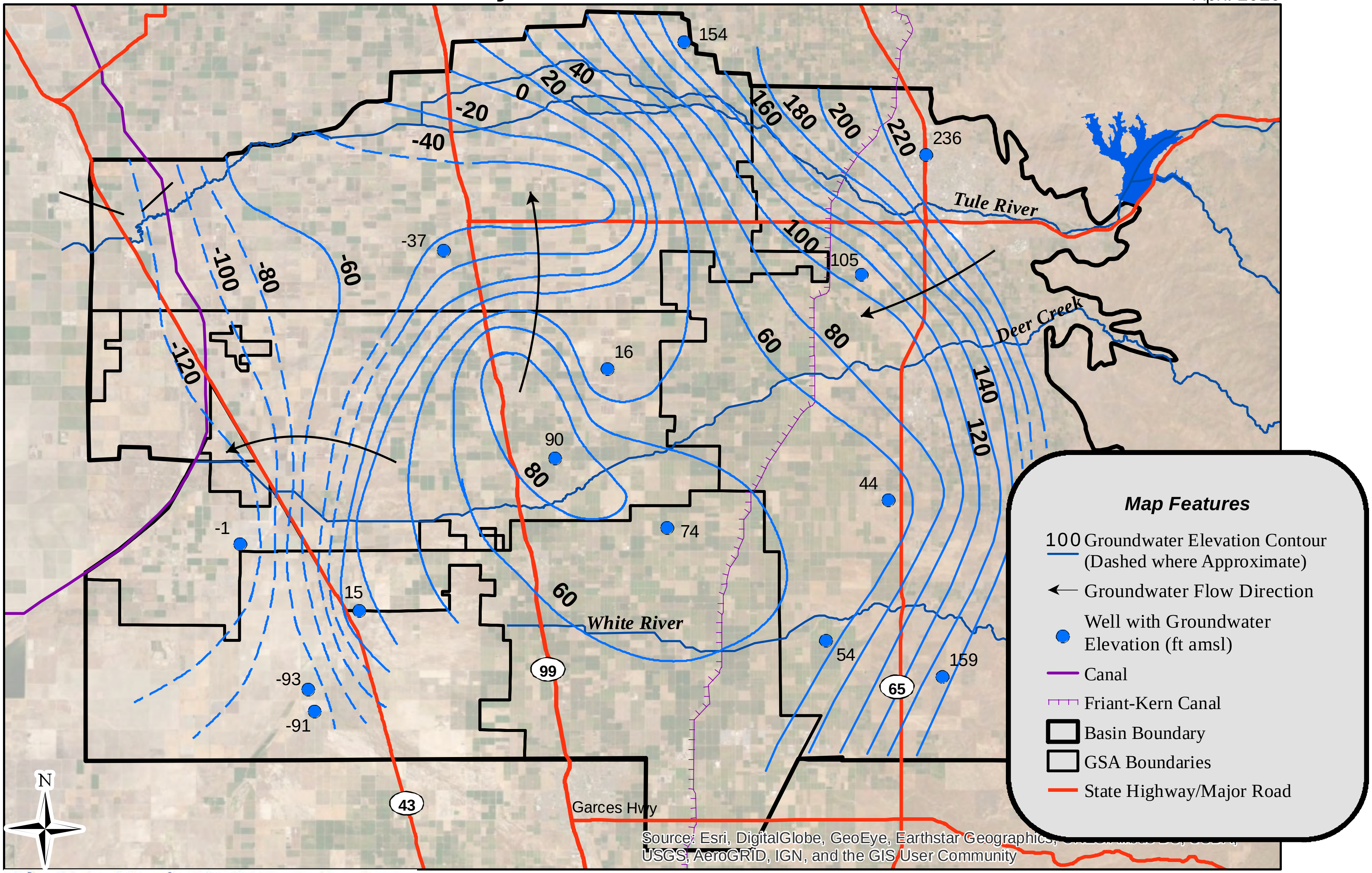
Spring 2019 Lower Aquifer Groundwater Elevation Contours

Figure 8

Tule Subbasin Technical Advisory Committee



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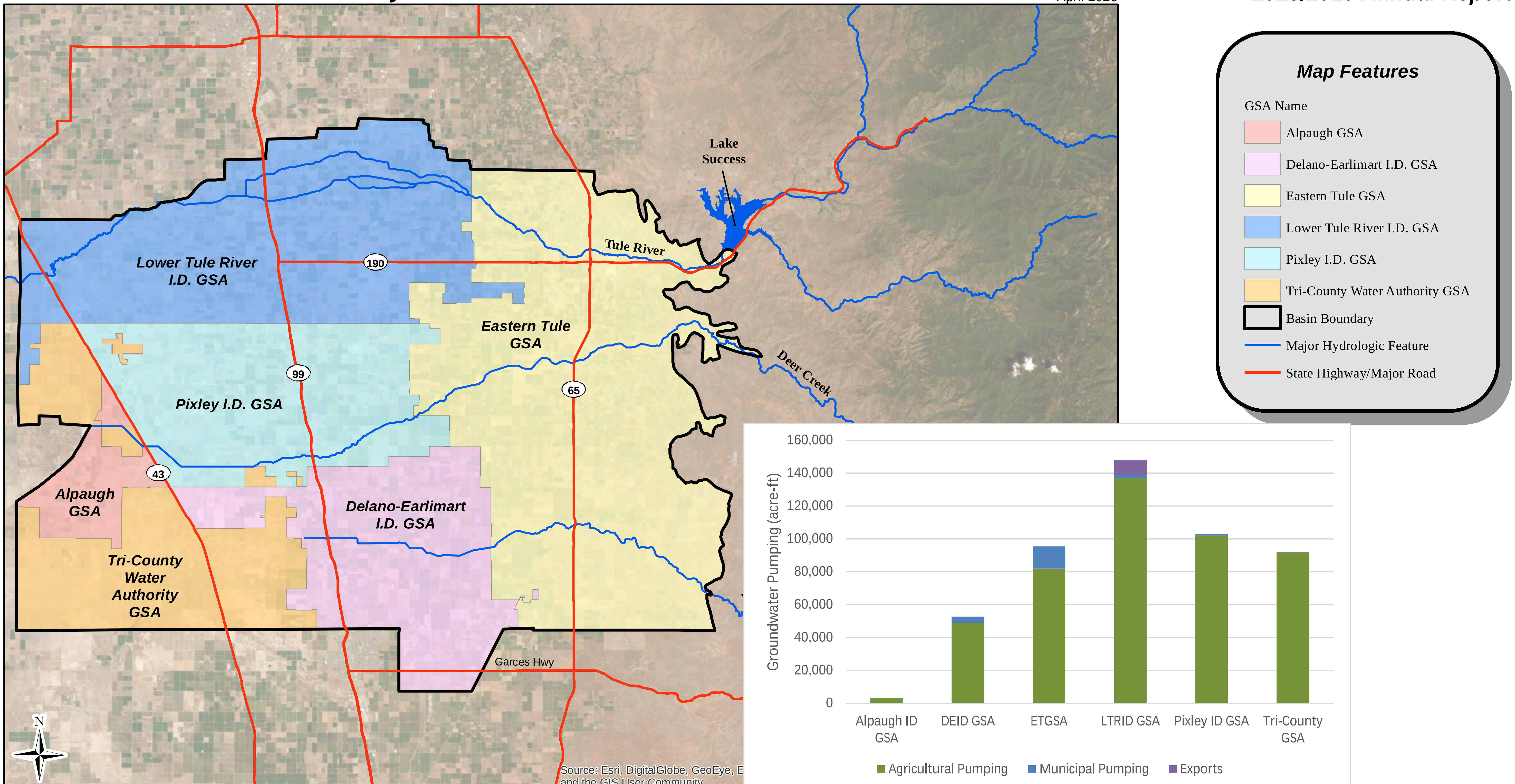
Fall 2019 Lower Aquifer Groundwater Elevation Contours

Figure 9



Groundwater Pumping

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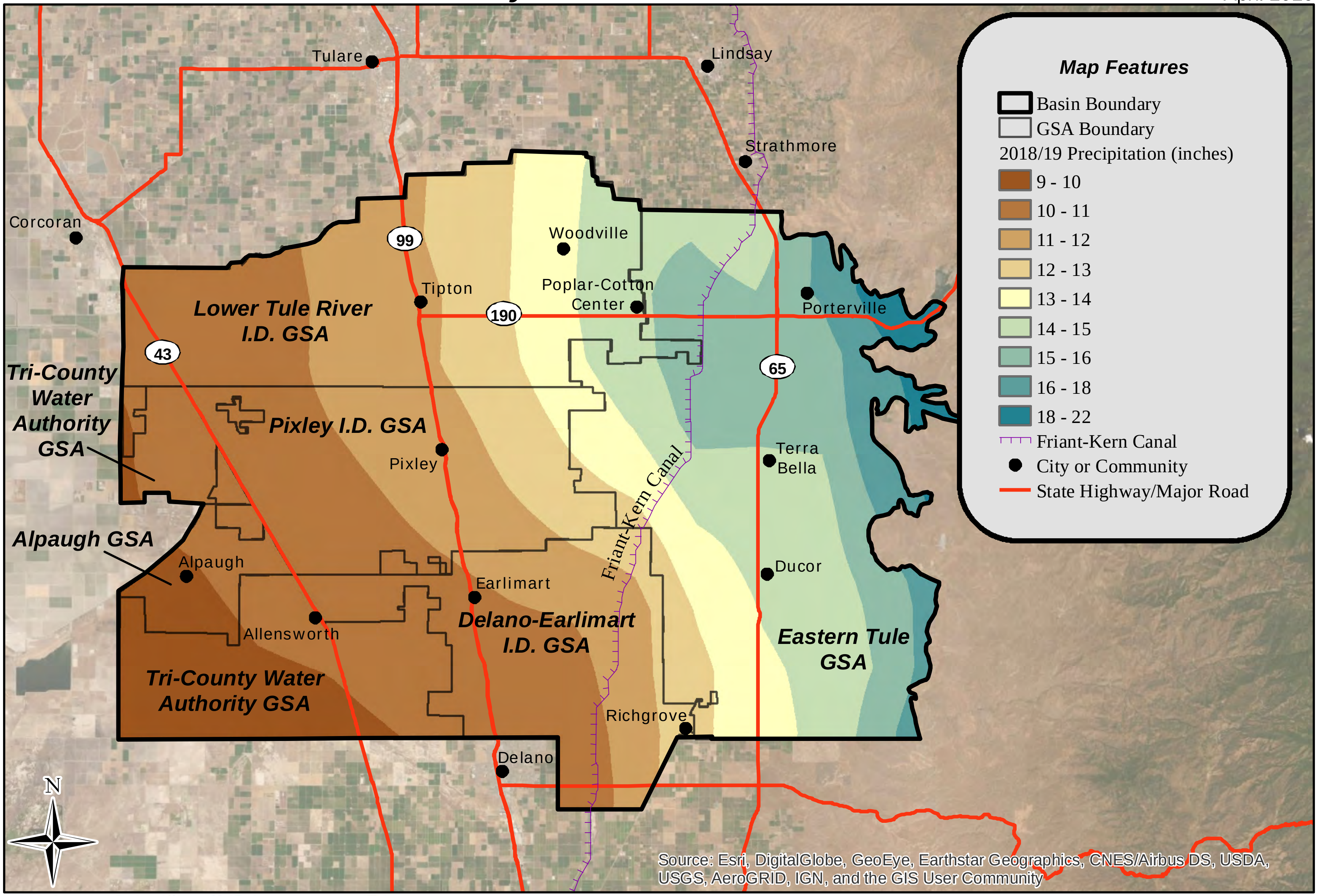
Figure 10

Tule Subbasin Technical Advisory Committee



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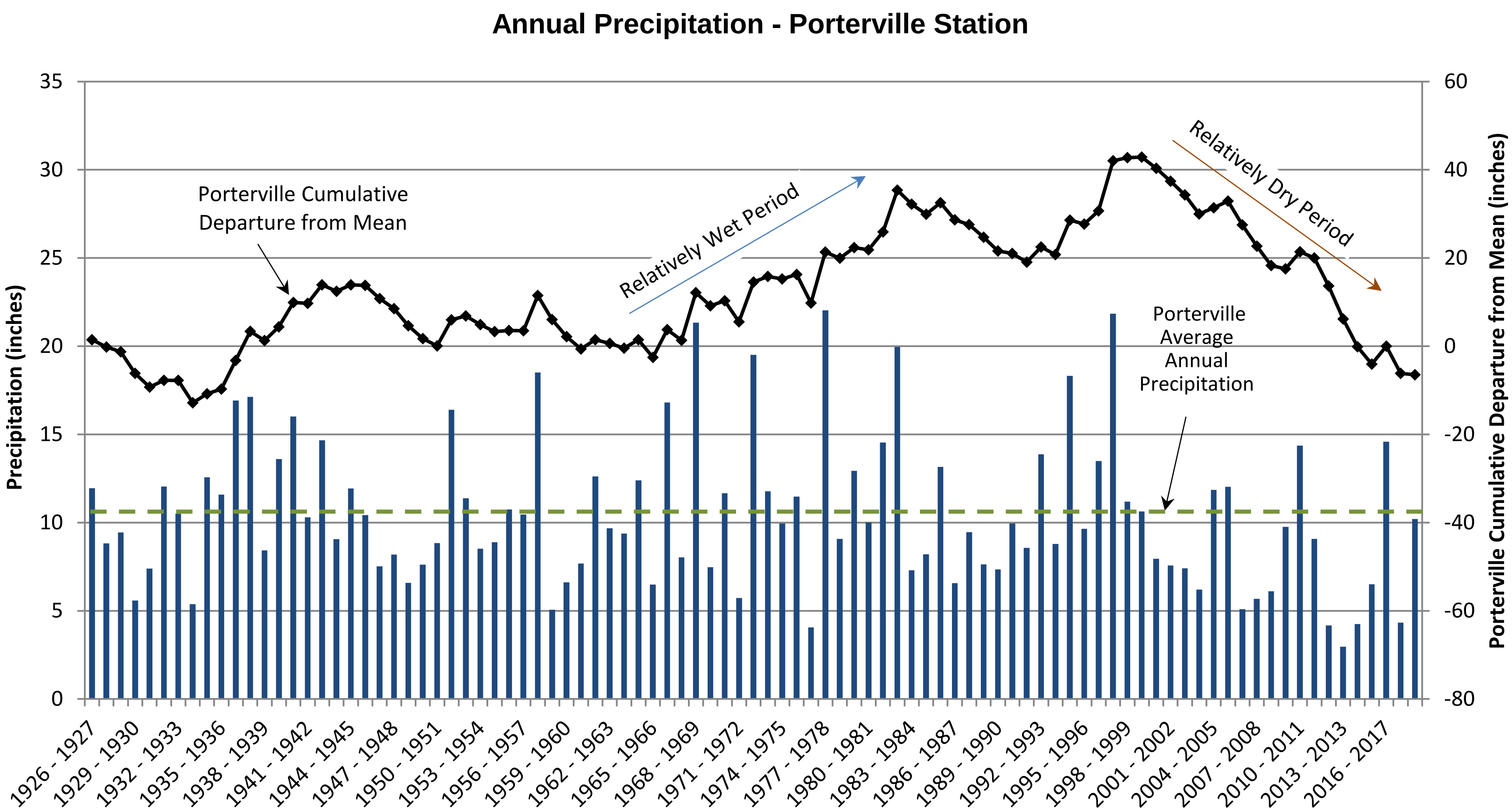
Isohyetal Map
Figure 11

Figure 12

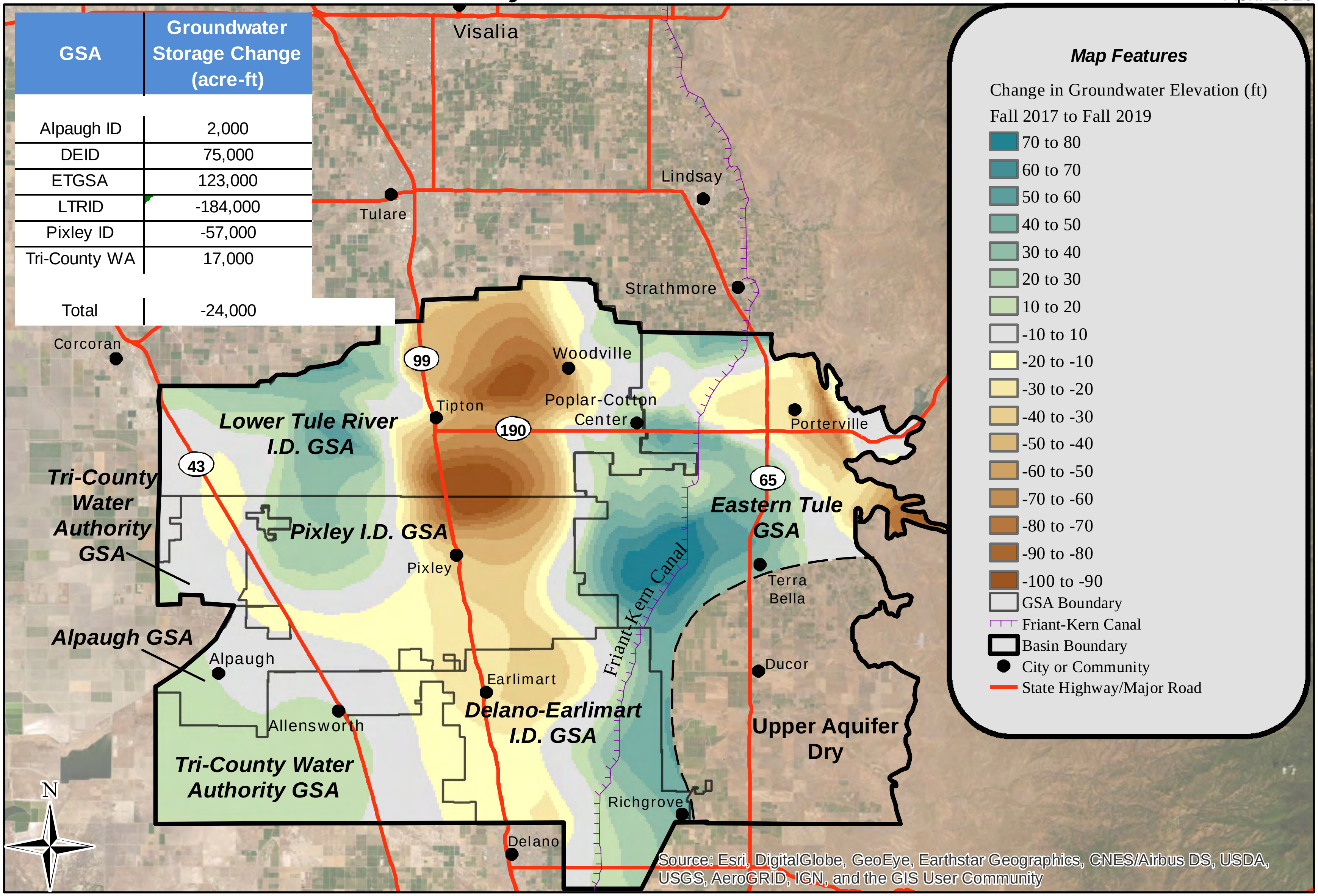


Notes:

Data in water years (October 1 to September 30).
Data from Western Regional Climate Center (1926-2001), California Irrigation Management Information System (2002-2019).

Tule Subbasin Technical Advisory Committee

GSA	Groundwater Storage Change (acre-ft)
Alpaugh ID	2,000
DEID	75,000
ETGSA	123,000
LTRID	-184,000
Pixley ID	-57,000
Tri-County WA	17,000
Total	-24,000



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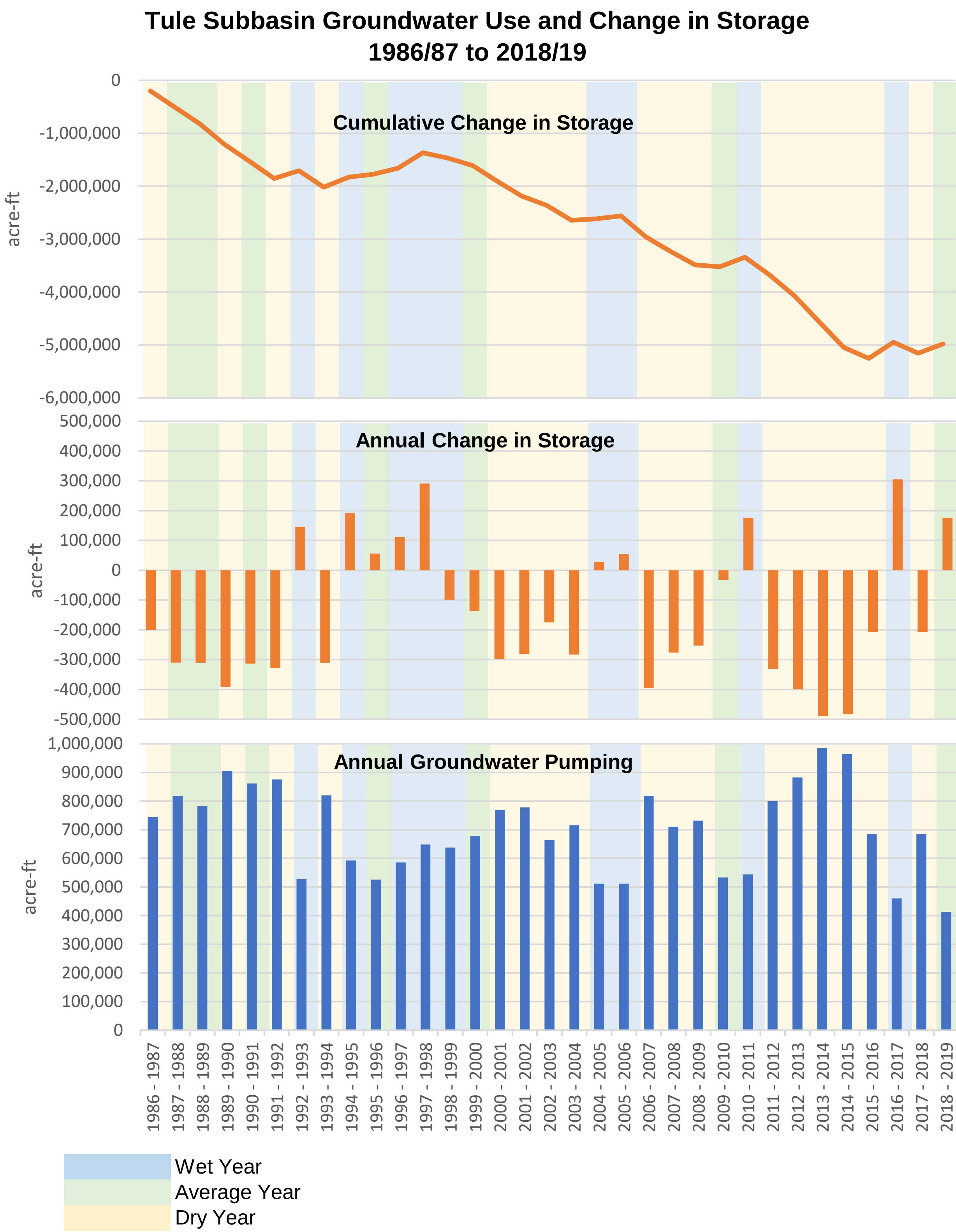
0 3 6 12 Miles
NAD 83 State Plane Zone 4

Change in Groundwater Elevation
Fall 2017 to Fall 2019
Figure 13


Tule Subbasin Groundwater Use and Change in Storage
1986/87 to 2018/19
Cumulative Change in Storage
Annual Change in Storage
Annual Groundwater Pumping
acre-ft
Wet Year
Average Year
Dry Year

Appendix A

Lower Tule River Irrigation District GSA 2018/19 Annual Data

Lower Tule River Irrigation District GSA
Groundwater Extraction for Water Year 2018/2019

	Agricultural Pumping (acre-ft)	Municipal Pumping (acre-ft)[1]	Exports (acre-ft)	Total
LTRID GSA	137,000	1,900	9,234	148,134

Note:

[1] Municipal pumping data are for water year 2016/2017.

Lower Tule River Irrigation District GSA
Surface Water Supplies for Water Year 2018/2019

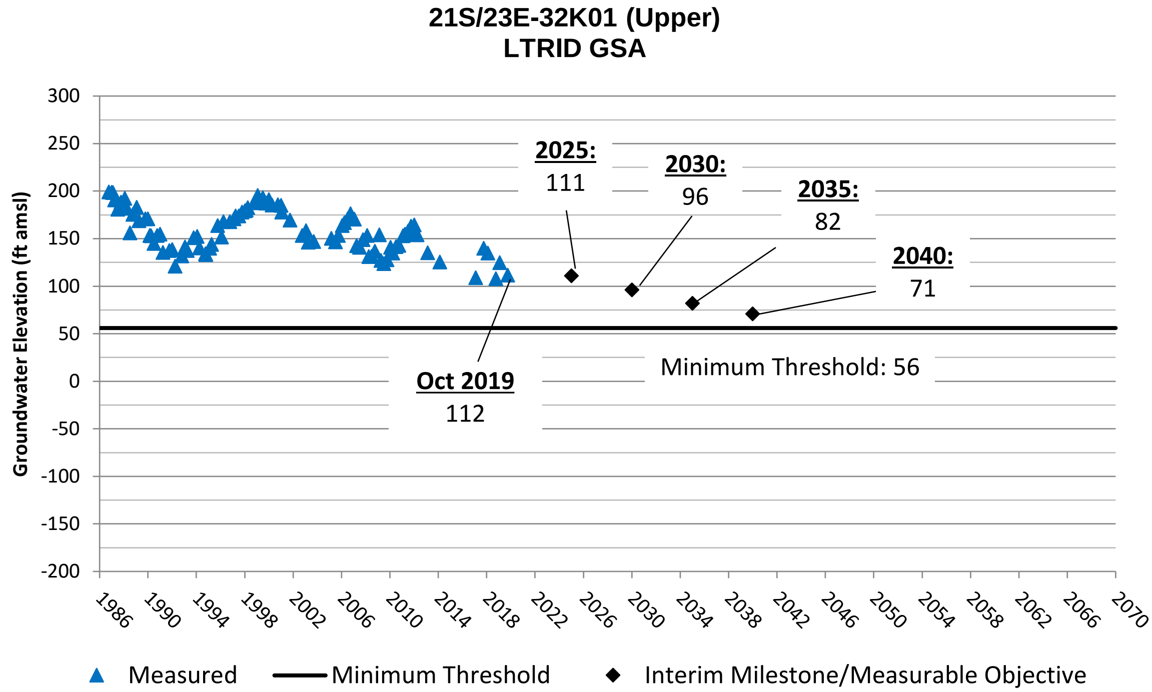
	Stream Diversions[1] (acre-ft)	Imported Water[1] (acre-ft)	Recycled Water (acre-ft)	Oilfield Produced Water (acre-ft)	Total Precipitation (acre-ft)	Total (acre-ft)
LTRID GSA	143,745	216,118	0	0	106,100	465,963

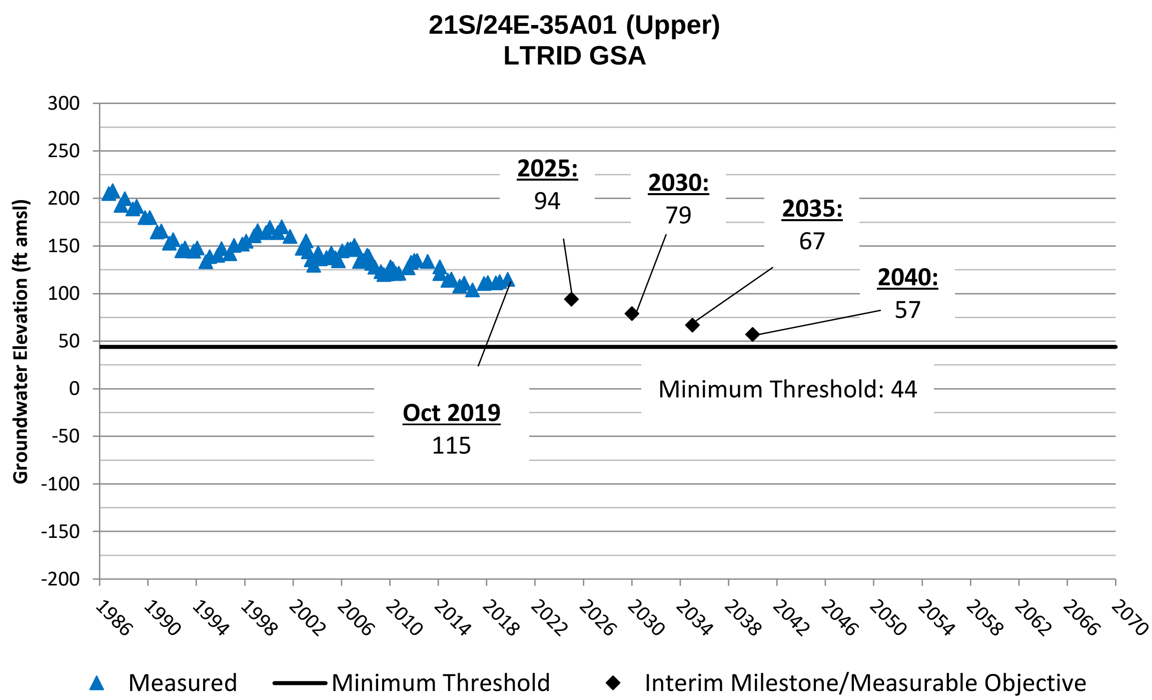
Note:
[1] Provisional subject to revision

Lower Tule River Irrigation District GSA
Total Water Use for Water Year 2018/2019

	Groundwater Extraction (acre-ft)	Surface Water Supplies (acre-ft)	Total
LTRID GSA	148,134	465,963	614,097

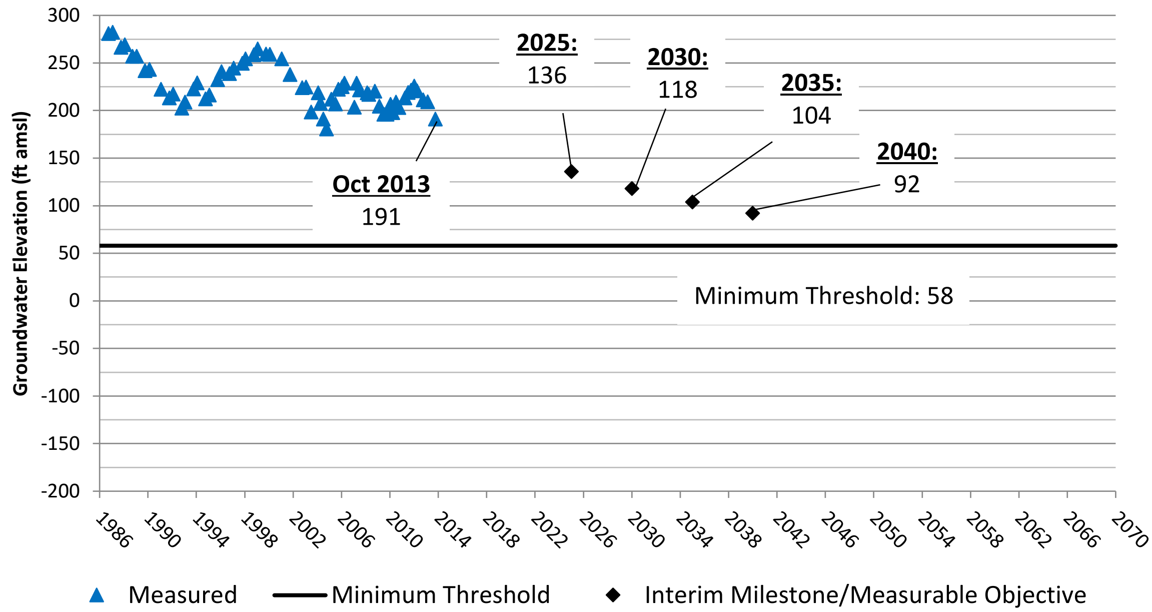
Lower Tule River Irrigation District GSA
RMS Groundwater Elevation Hydrographs



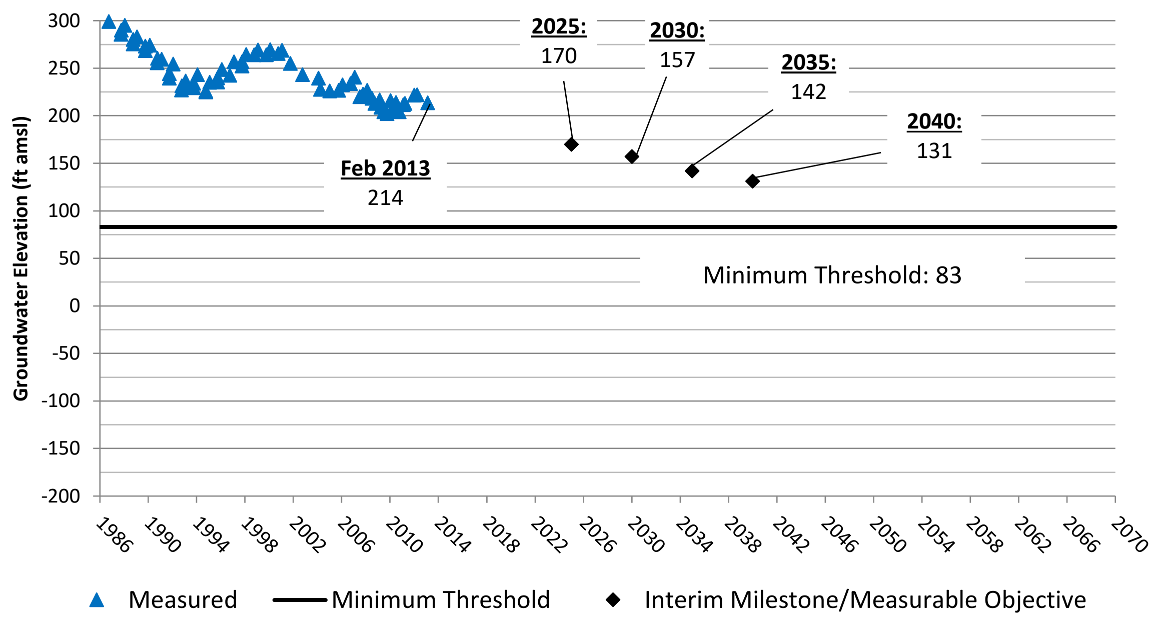


Lower Tule River Irrigation District GSA
RMS Groundwater Elevation Hydrographs

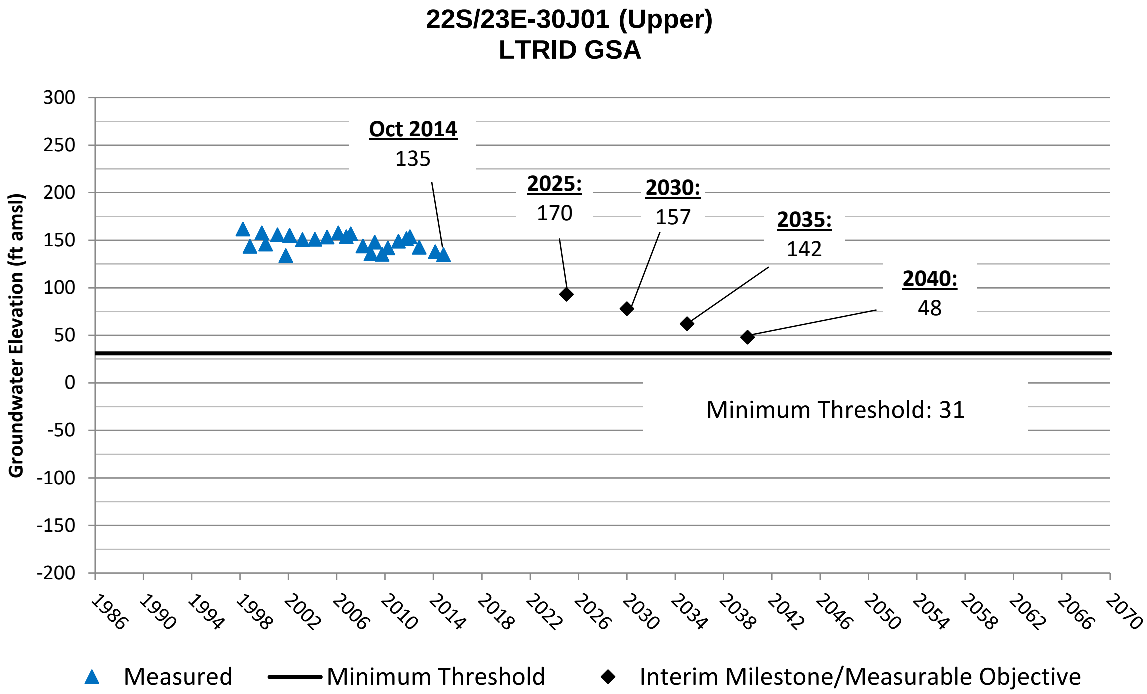
21S/25E-03R01 (Upper)
LTRID GSA

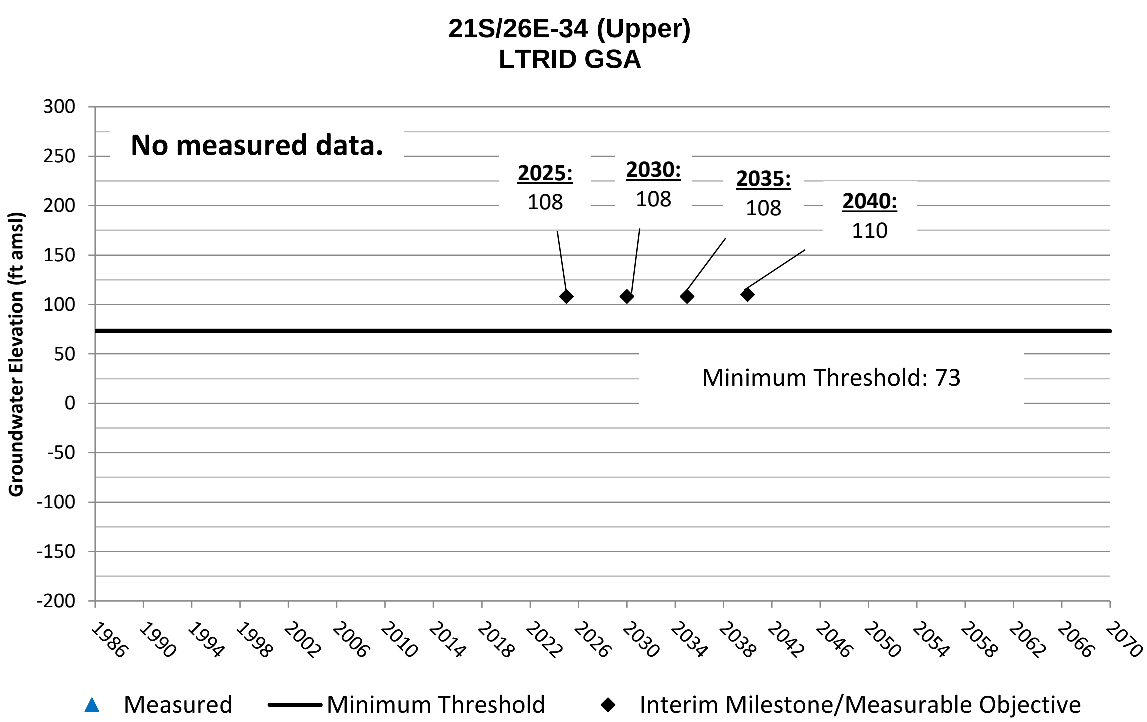


21S/26E-32A01 (Upper)
LTRID GSA

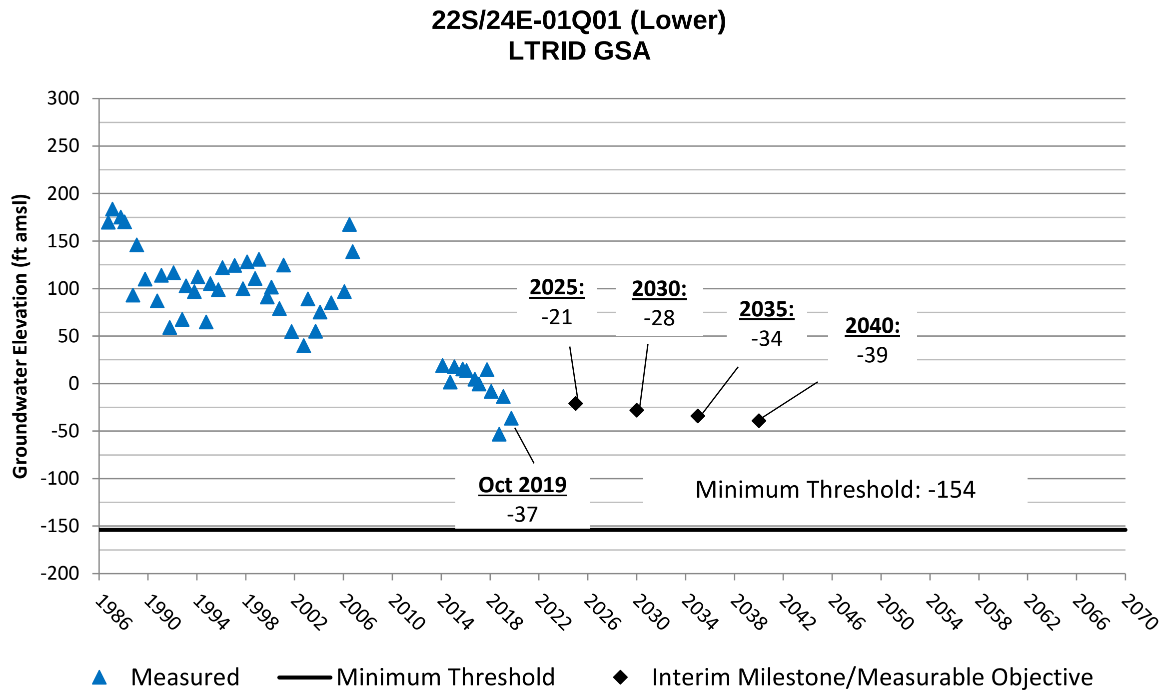


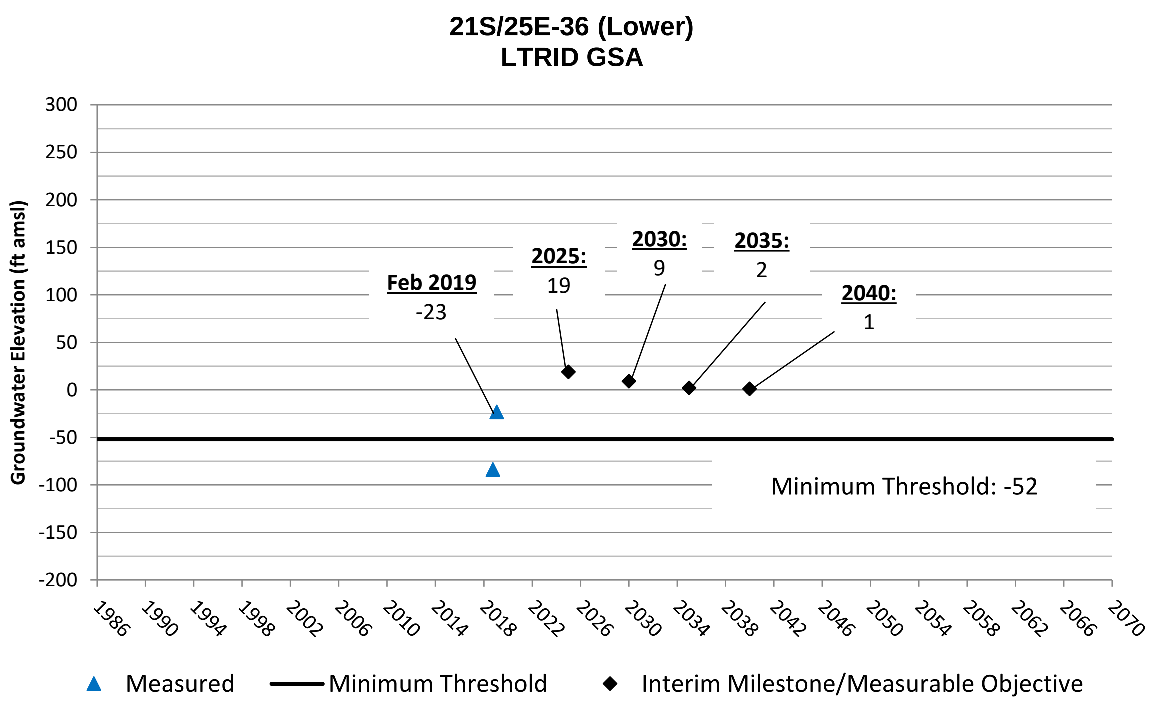
Lower Tule River Irrigation District GSA
RMS Groundwater Elevation Hydrographs



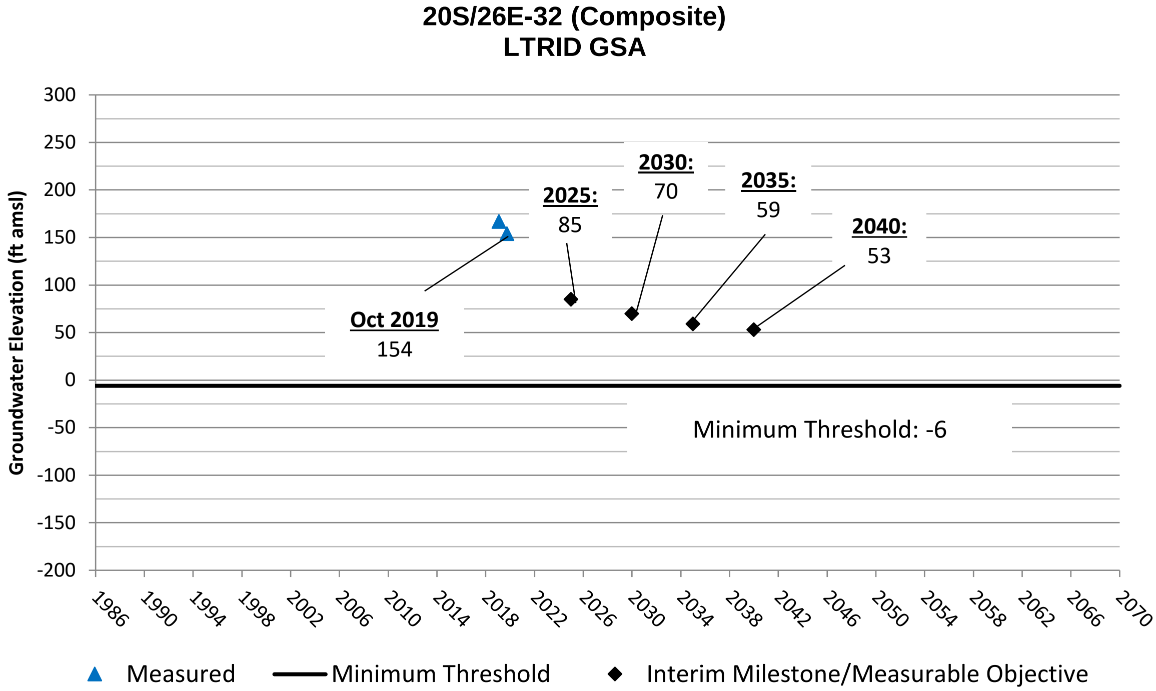


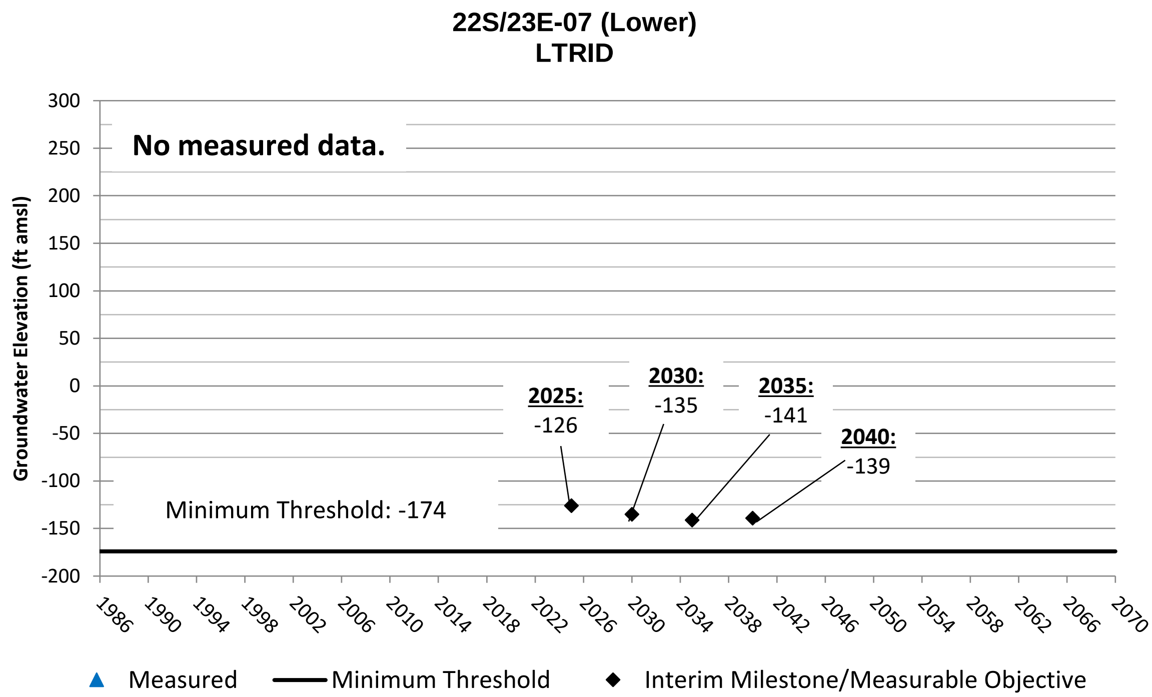
Lower Tule River Irrigation District GSA
RMS Groundwater Elevation Hydrographs

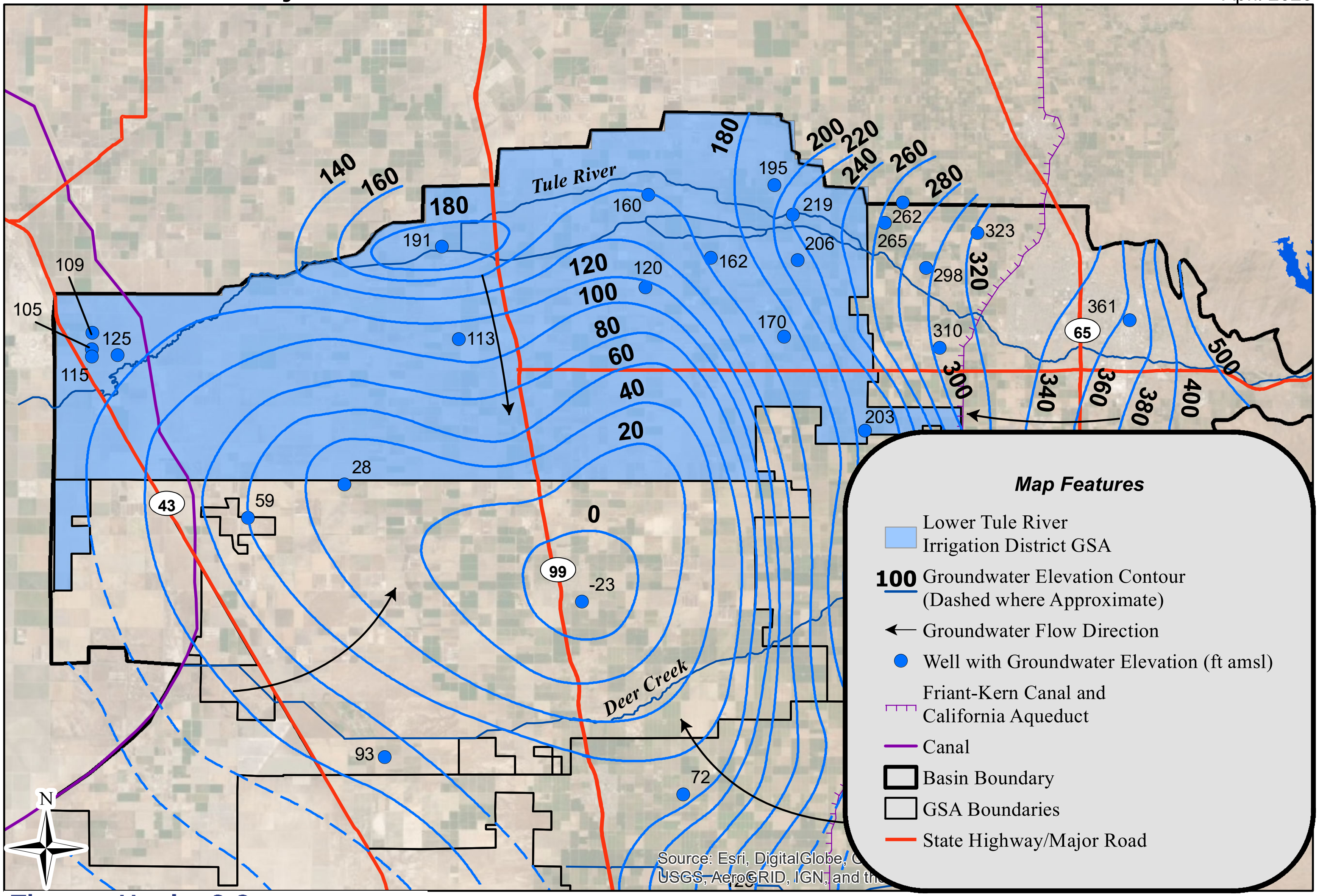




Lower Tule River Irrigation District GSA
RMS Groundwater Elevation Hydrographs







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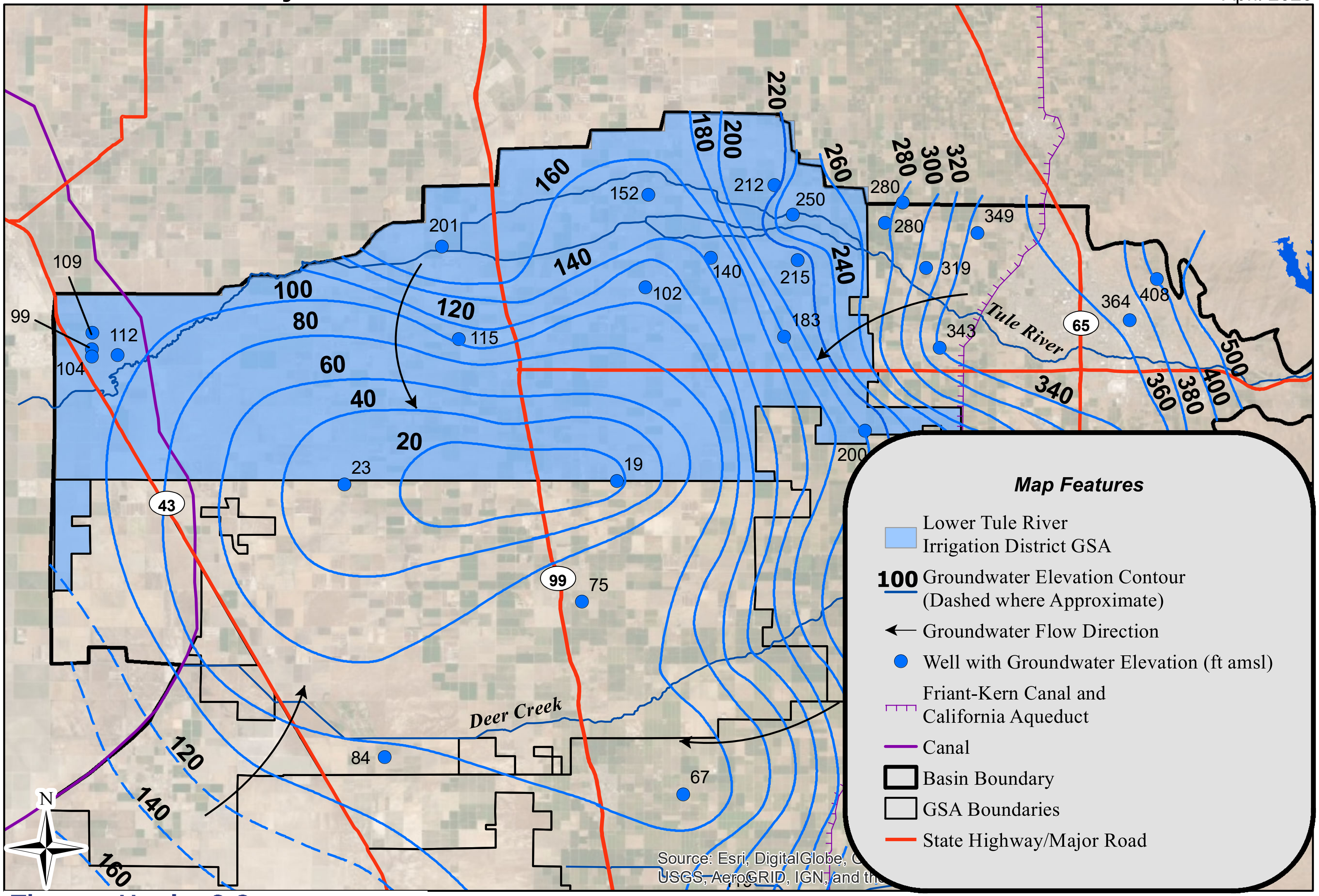
0 2 4 8 Miles
NAD 83 State Plane Zone 4

Spring 2019 Upper Aquifer
Lower Tule River I.D. GSA
Appendix A
Figure 6

Tule Subbasin
Technical Advisory Committee

2018/2019 Annual Report
April 2020



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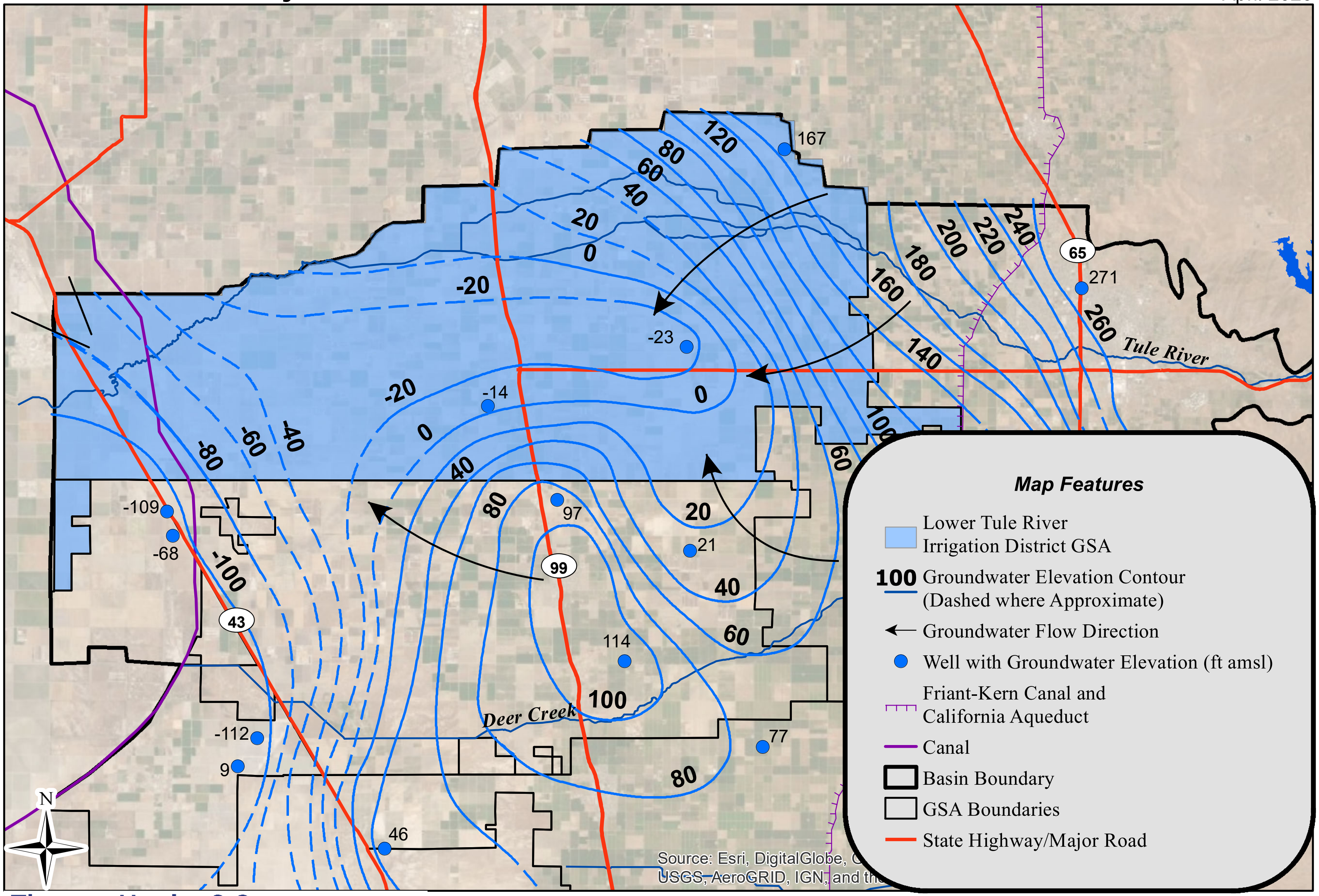
Fall 2019 Upper Aquifer
Lower Tule River I.D. GSA
Appendix A
Figure 7



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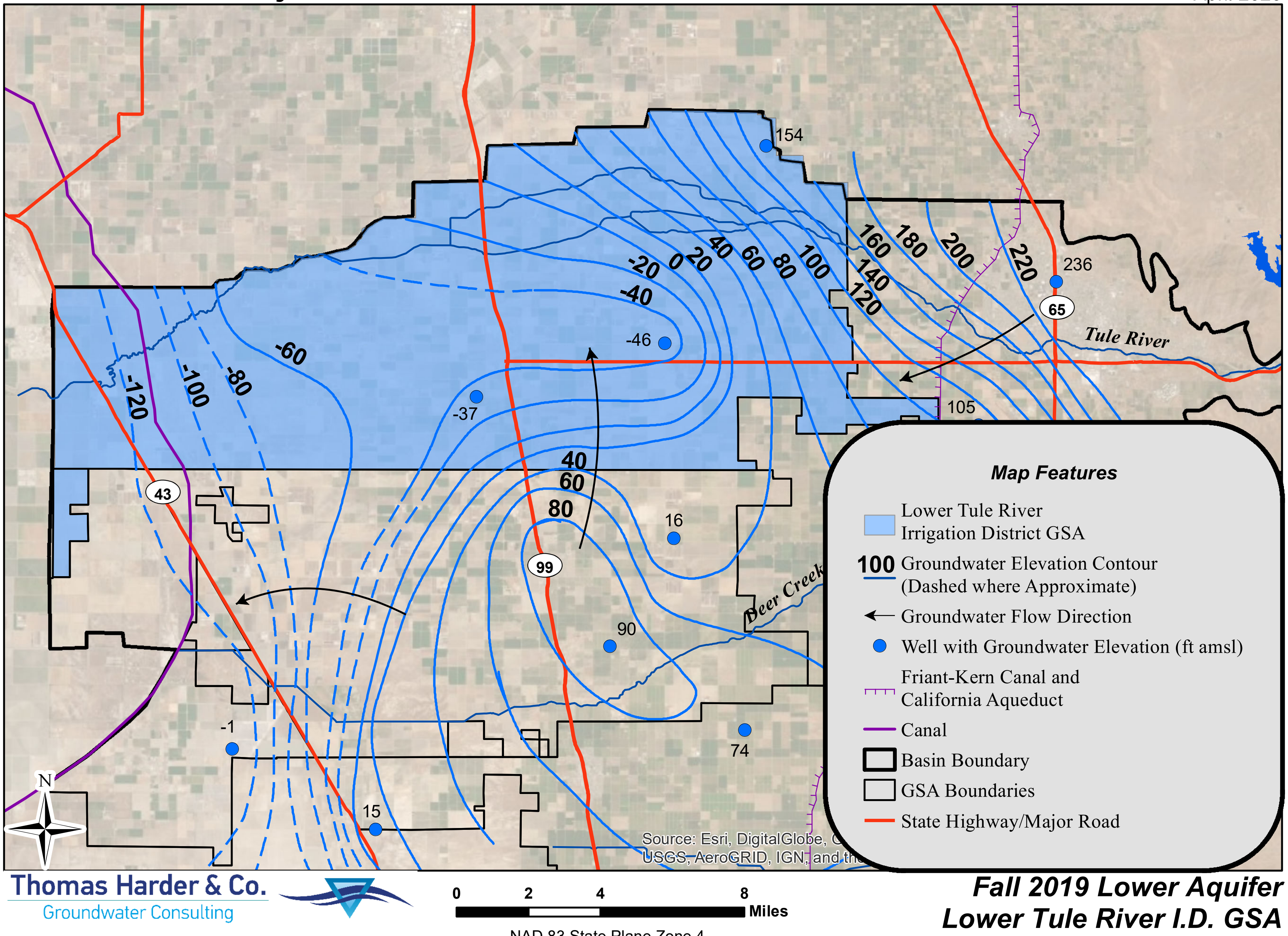
0 2 4 8 Miles
NAD 83 State Plane Zone 4

Spring 2019 Lower Aquifer
Lower Tule River I.D. GSA
Appendix A
Figure 8

Tule Subbasin
Technical Advisory Committee

2018/2019 Annual Report
April 2020



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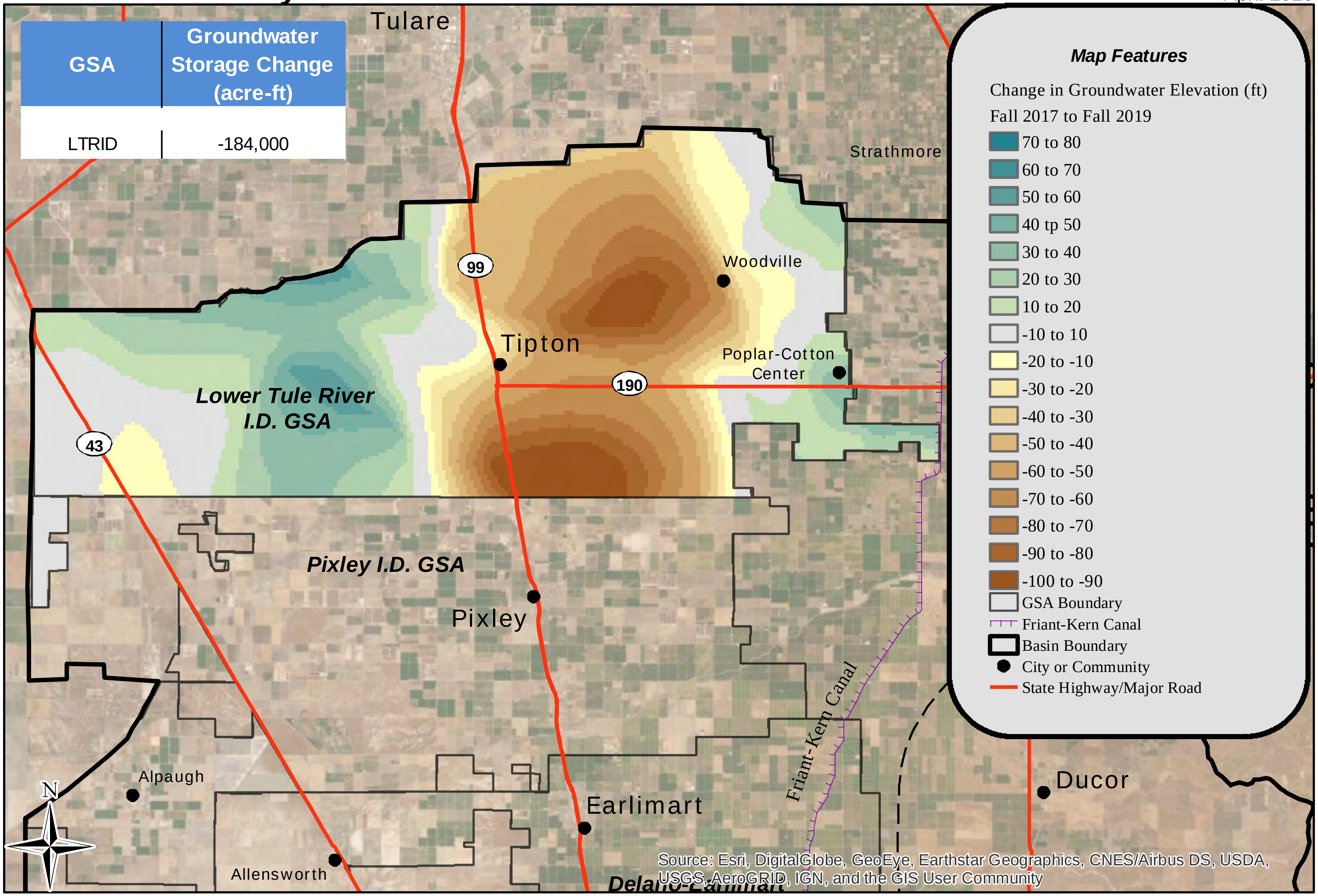
Fall 2019 Lower Aquifer
Lower Tule River I.D. GSA
Appendix A
Figure 9

Tule Subbasin
Technical Advisory Committee

2018/2019 Annual Report
April 2020



GSA	Groundwater Storage Change (acre-ft)
LTRID	-184,000

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0 2 4 8 Miles
NAD 83 State Plane Zone 4

Change in Groundwater Elevation Fall 2017 to Fall 2019
Lower Tule River I.D. GSA
Appendix A
Figure 10

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Eastern Tule GSA
2018/19 Annual Data

Eastern Tule GSA
Groundwater Extraction for Water Year 2018/2019

	Agricultural Pumping (acre-ft)	Municipal Pumping (acre-ft)	Exports (acre-ft)	Total
ETGSA	82,000	13,500	0	95,500

Eastern Tule GSA
Surface Water Supplies for Water Year 2018/2019

	Stream Diversions[1] (acre-ft)	Imported Water[1] (acre-ft)	Recycled Water (acre-ft)	Oilfield Produced Water (acre-ft)	Total Precipitation (acre-ft)	Total (acre-ft)
ETGSA	30,505	150,657	4,601	1,078	199,600	386,441

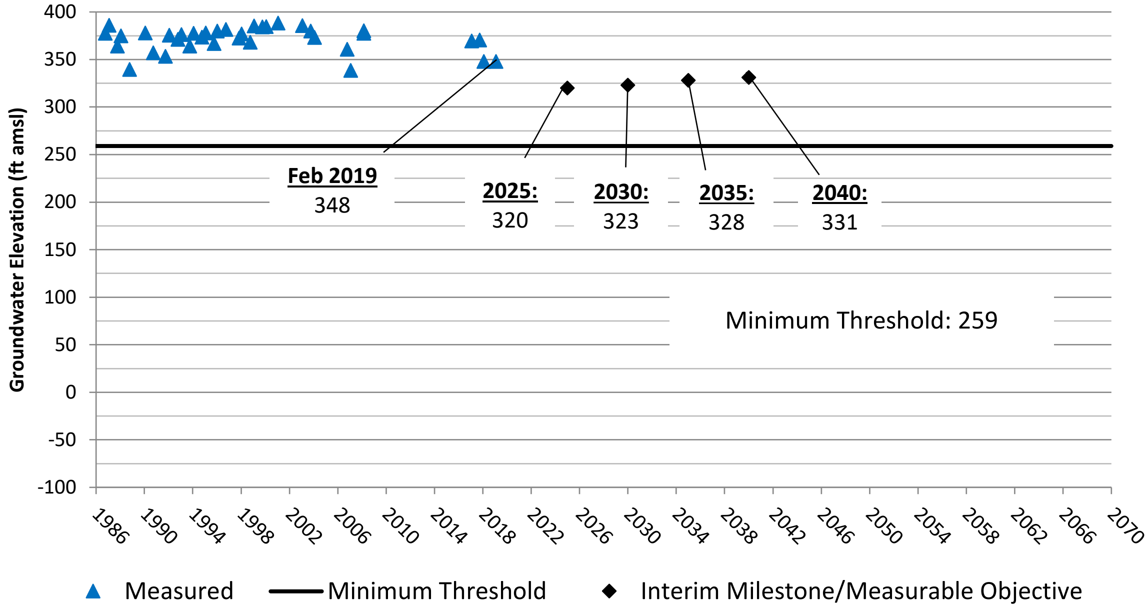
Note:
[1] Provisional subject to revision

Eastern Tule GSA
Total Water Use for Water Year 2018/2019

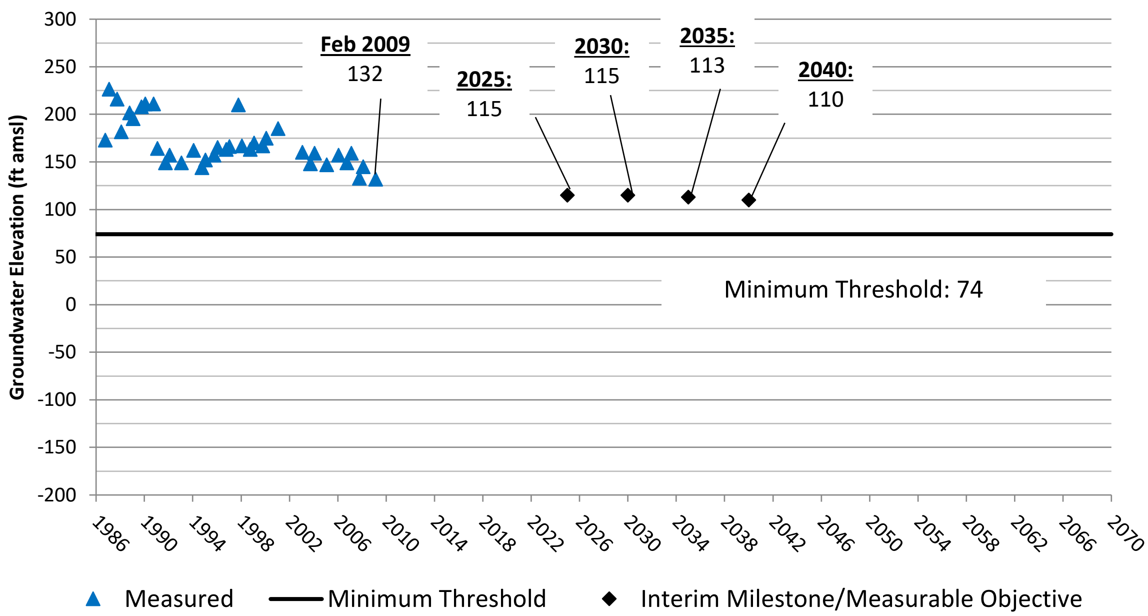
	Groundwater Extraction (acre-ft)	Surface Water Supplies (acre-ft)	Total
ETGSA	95,500	386,441	481,941

Eastern Tule GSA
RMS Groundwater Elevation Hydrographs

22S/27E-13A01 (Upper)
ETGSA

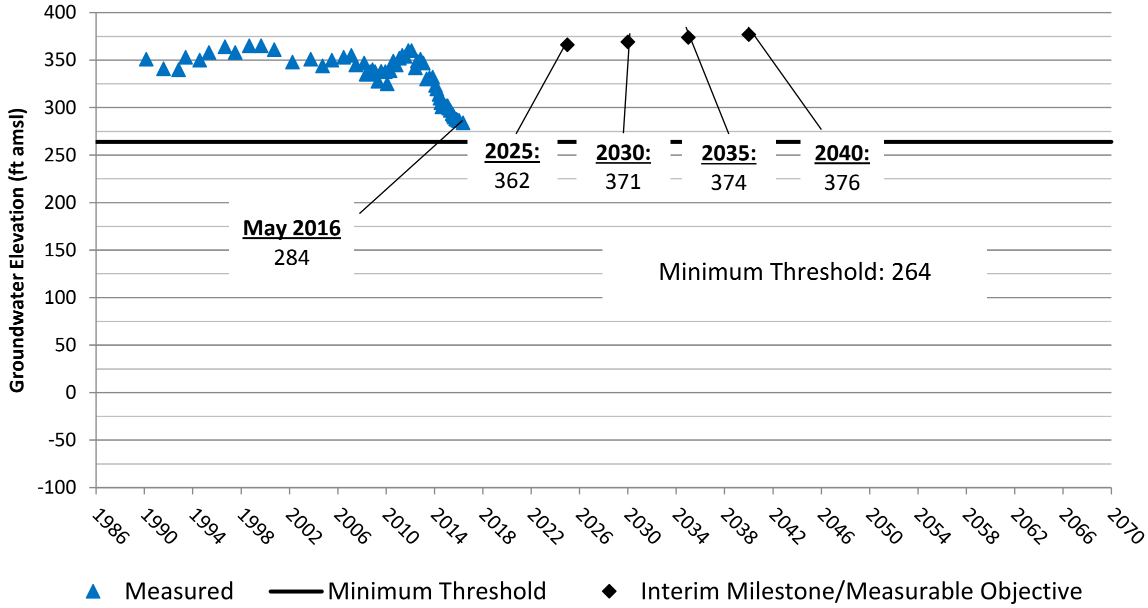


23S/26E-09C01 (Upper)
ETGSA

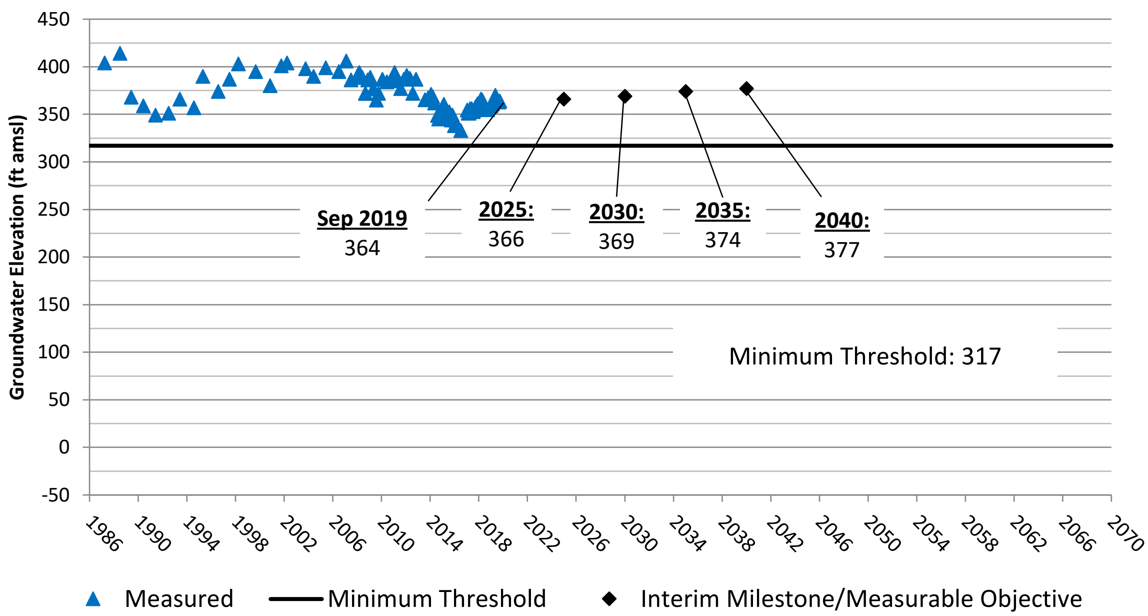


Eastern Tule GSA
RMS Groundwater Elevation Hydrographs

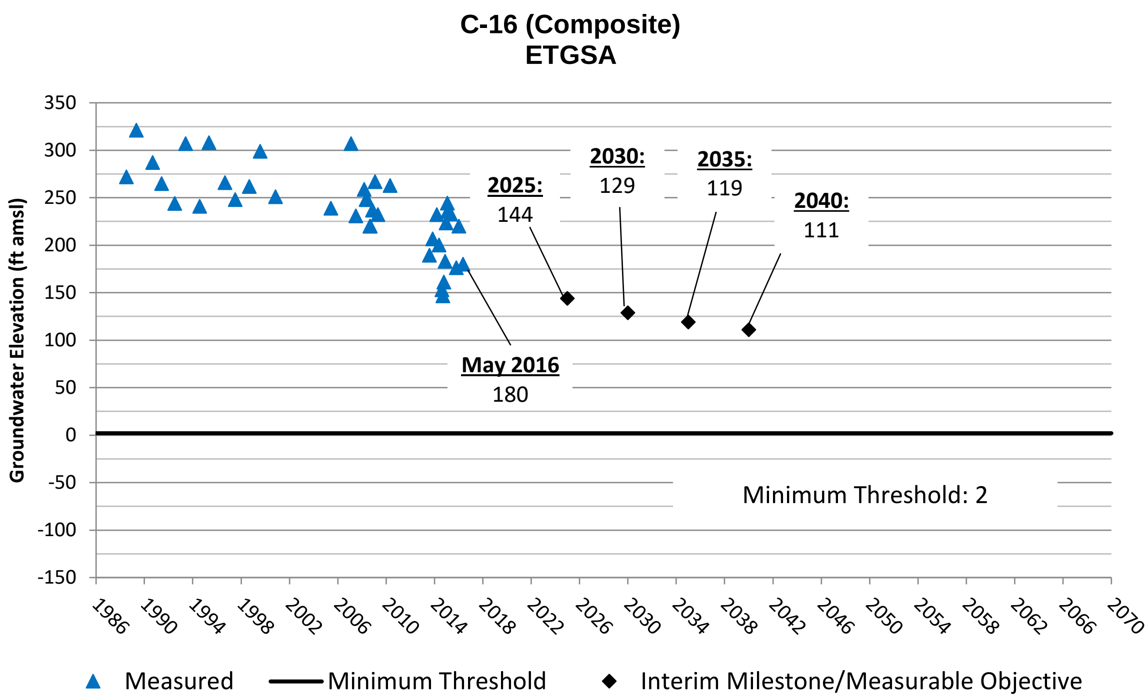
R-11 (Upper)
ETGSA

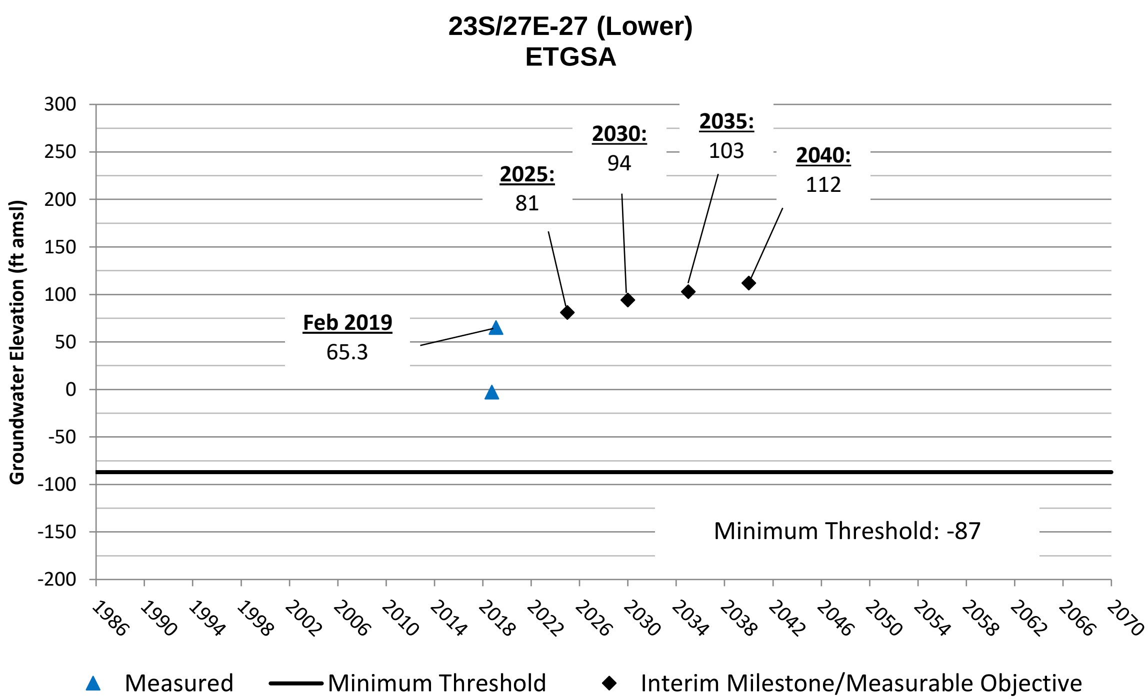


C-1 (Upper)
ETGSA

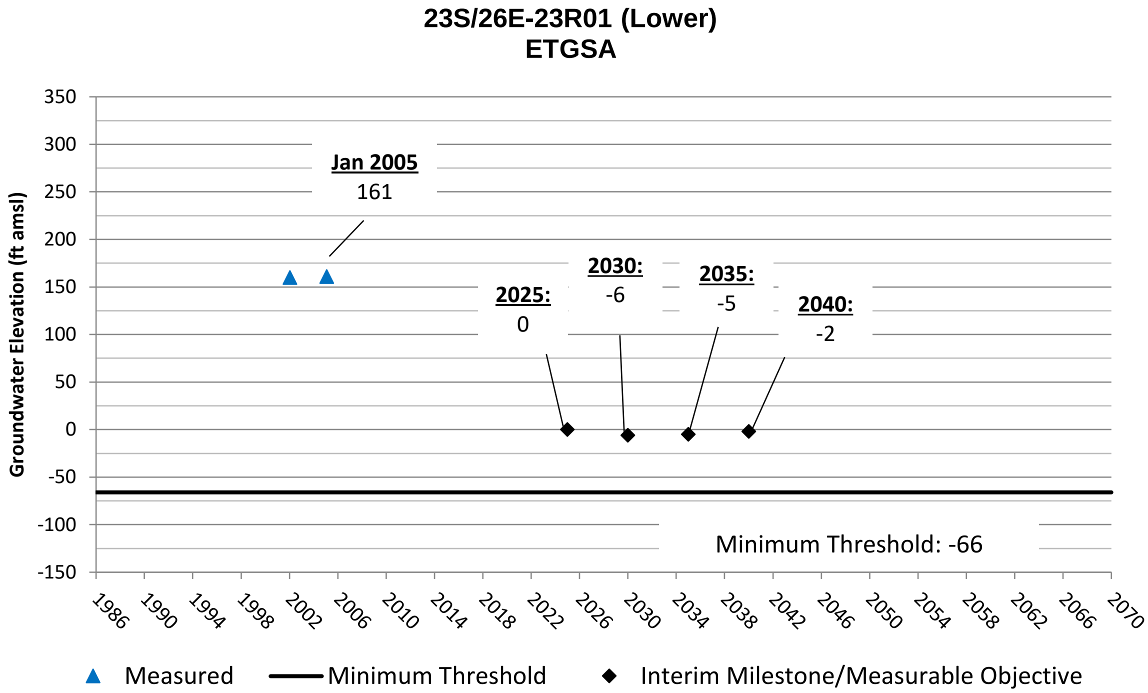


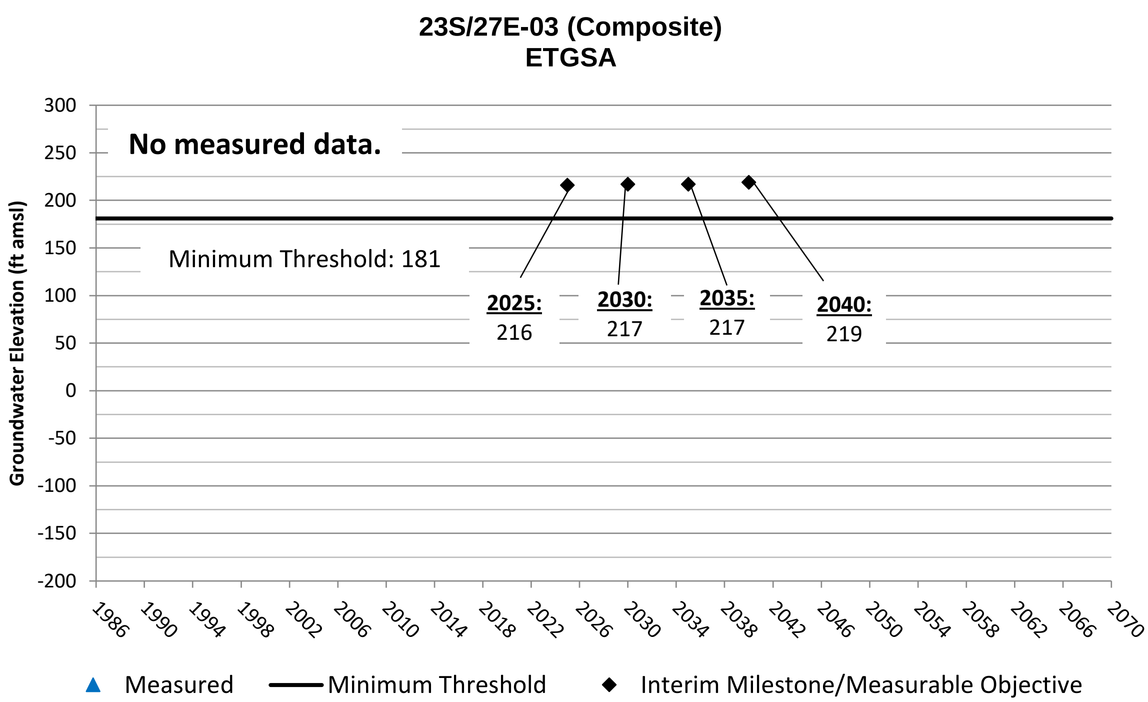
Eastern Tule GSA
RMS Groundwater Elevation Hydrographs



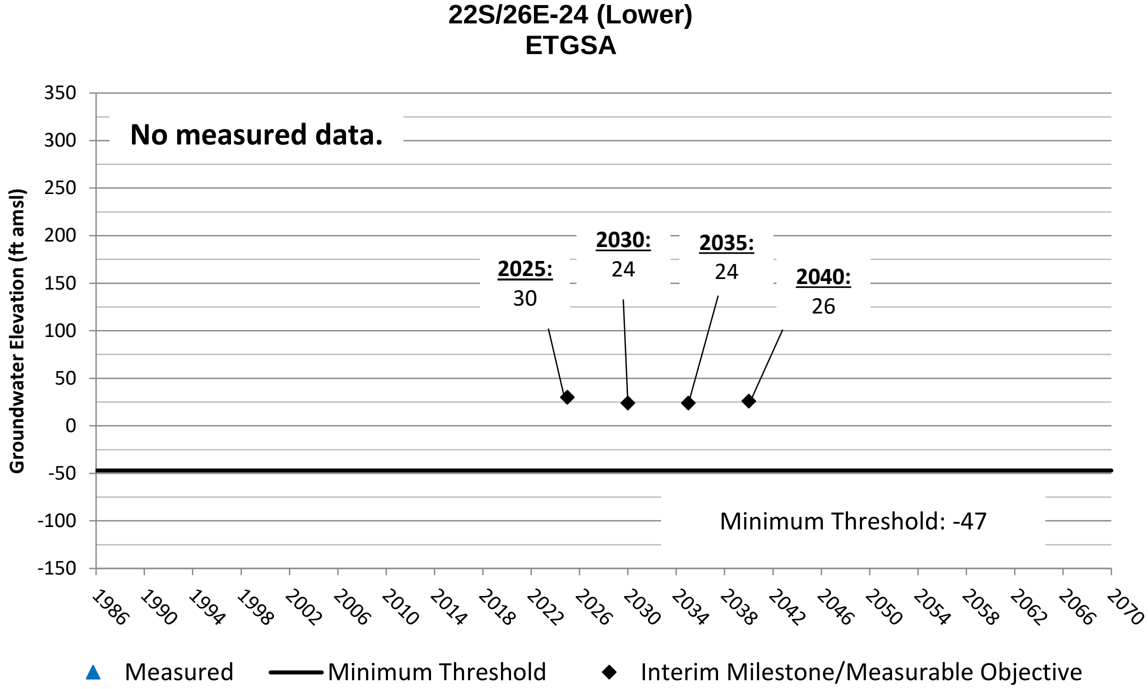


Eastern Tule GSA
RMS Groundwater Elevation Hydrographs





Eastern Tule GSA
RMS Groundwater Elevation Hydrographs



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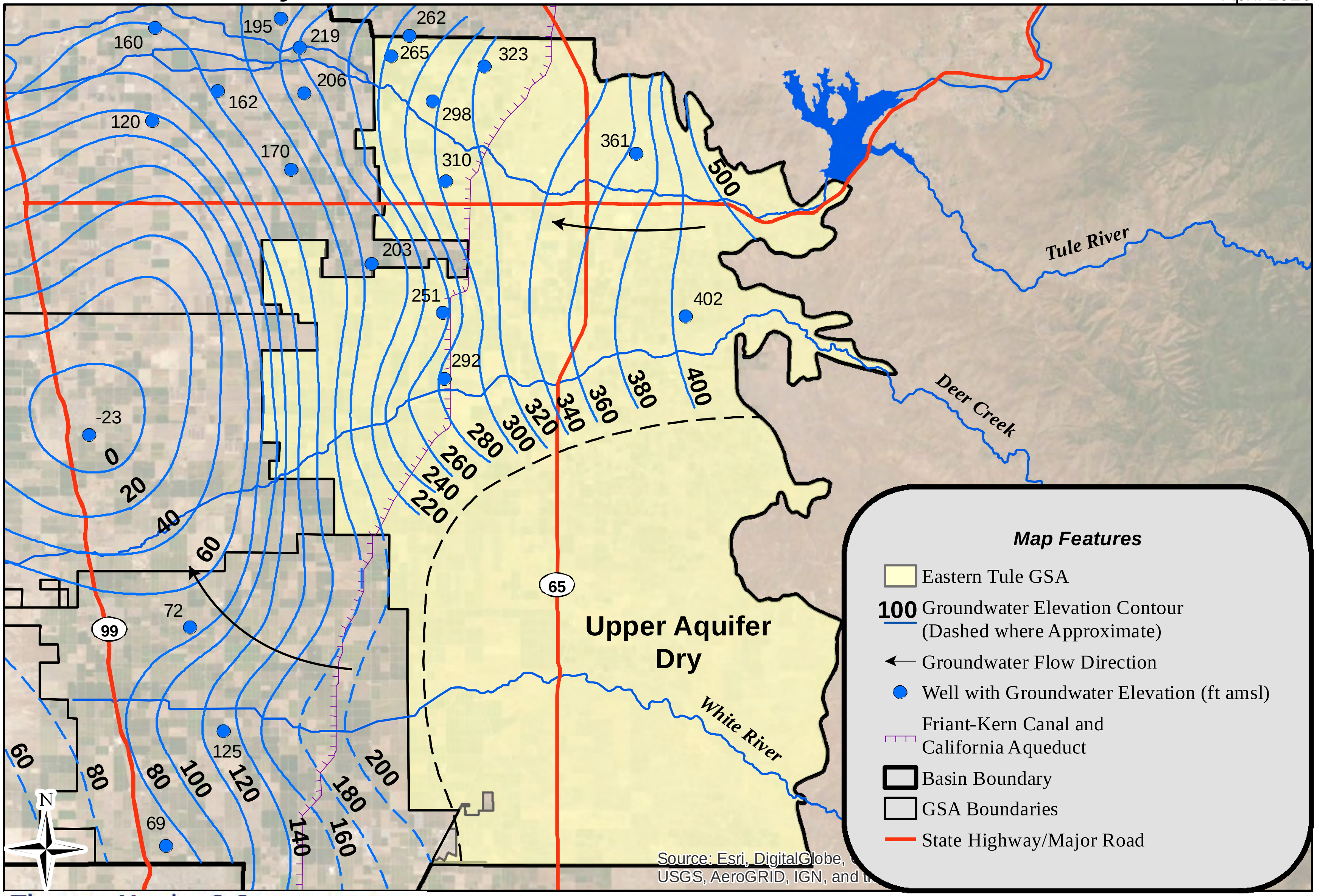

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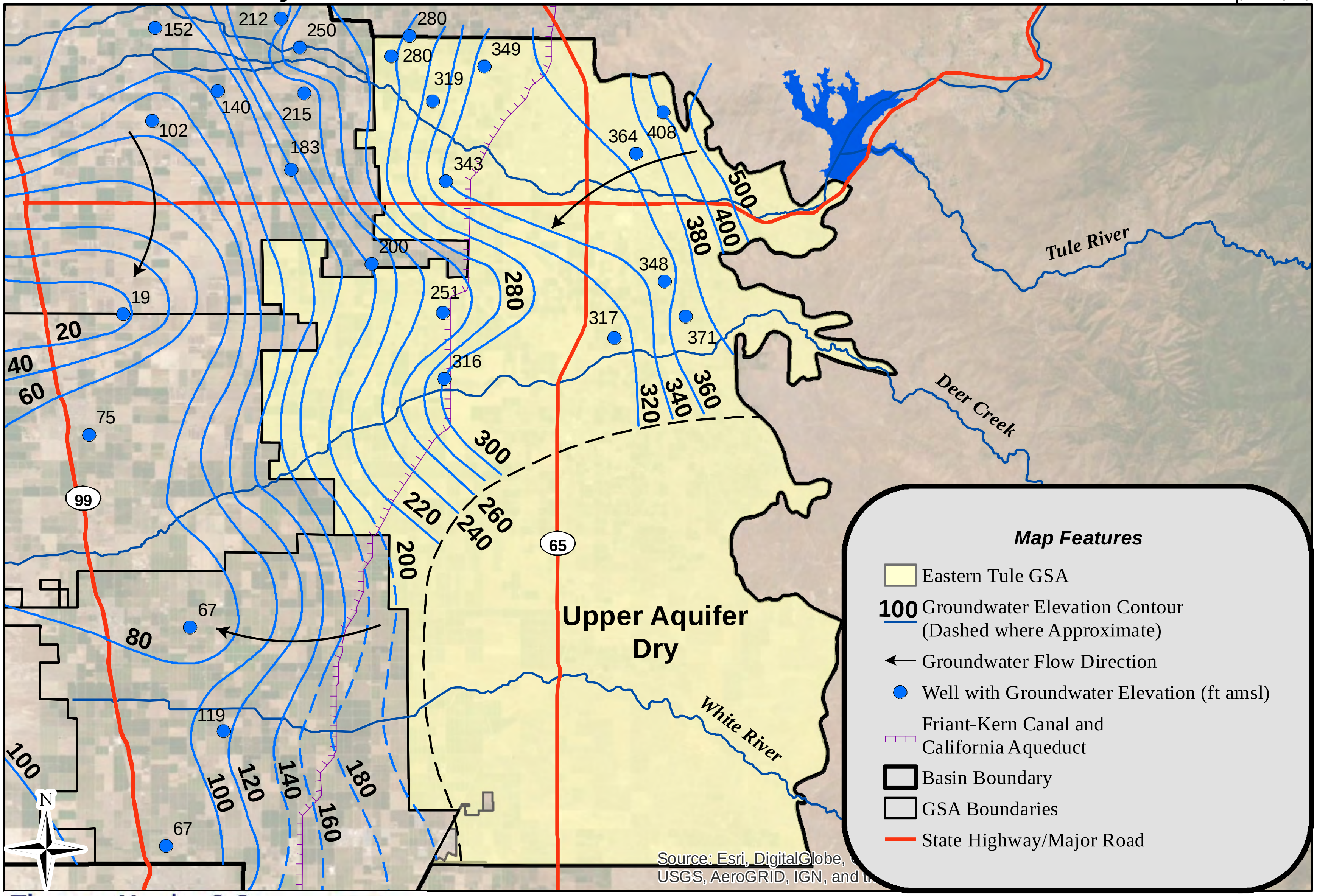
0 2 4 8 Miles
NAD 83 State Plane Zone 4

Spring 2019 Upper Aquifer
Eastern Tule GSA
Appendix B
Figure 6



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Fall 2019 Upper Aquifer
Eastern Tule GSA
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Figure 7

Tule Subbasin
Technical Advisory Committee

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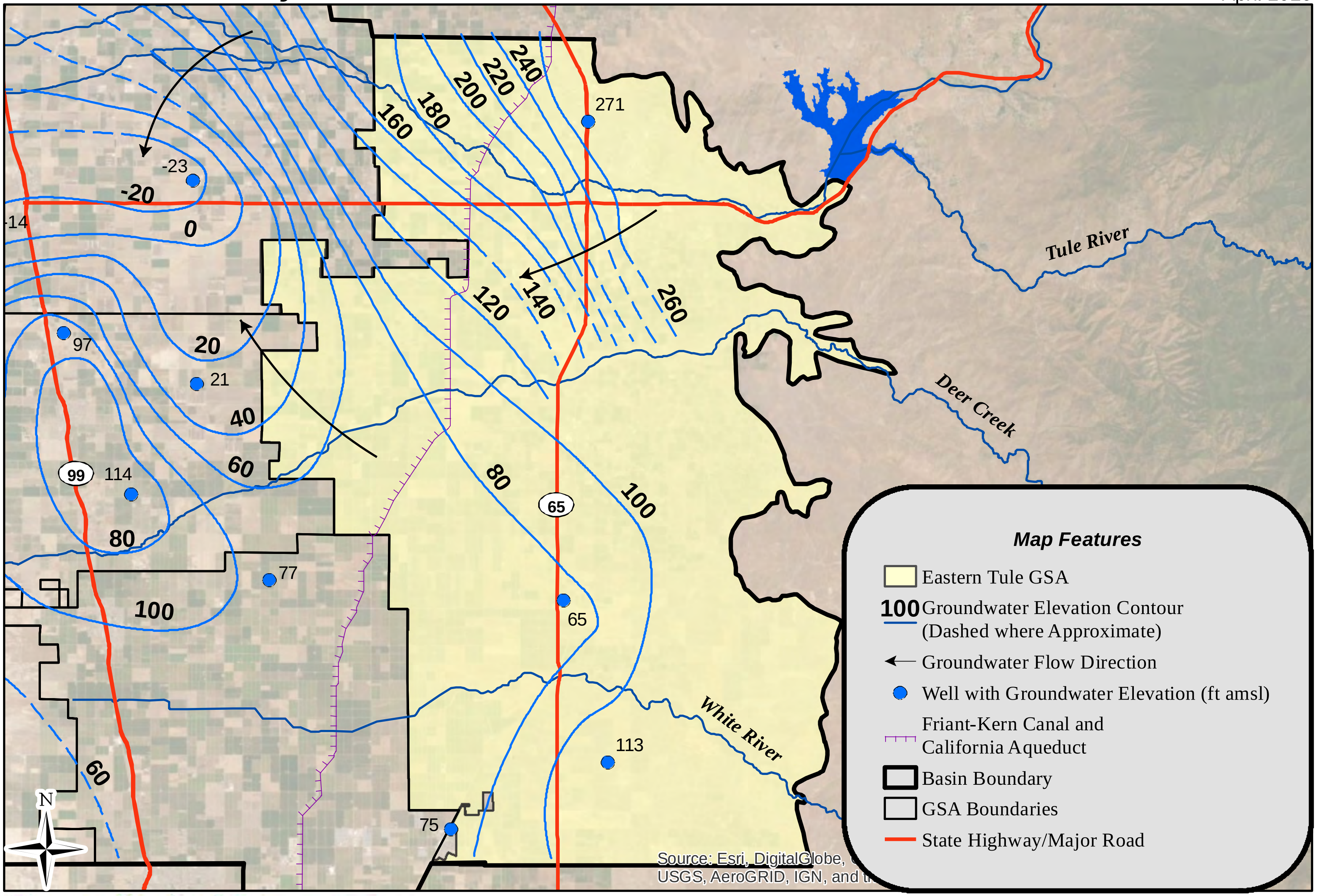
April 2020



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0 2 4 8 Miles
NAD 83 State Plane Zone 4

Spring 2019 Lower Aquifer
Eastern Tule GSA
Appendix B
Figure 8

Tule Subbasin
Technical Advisory Committee

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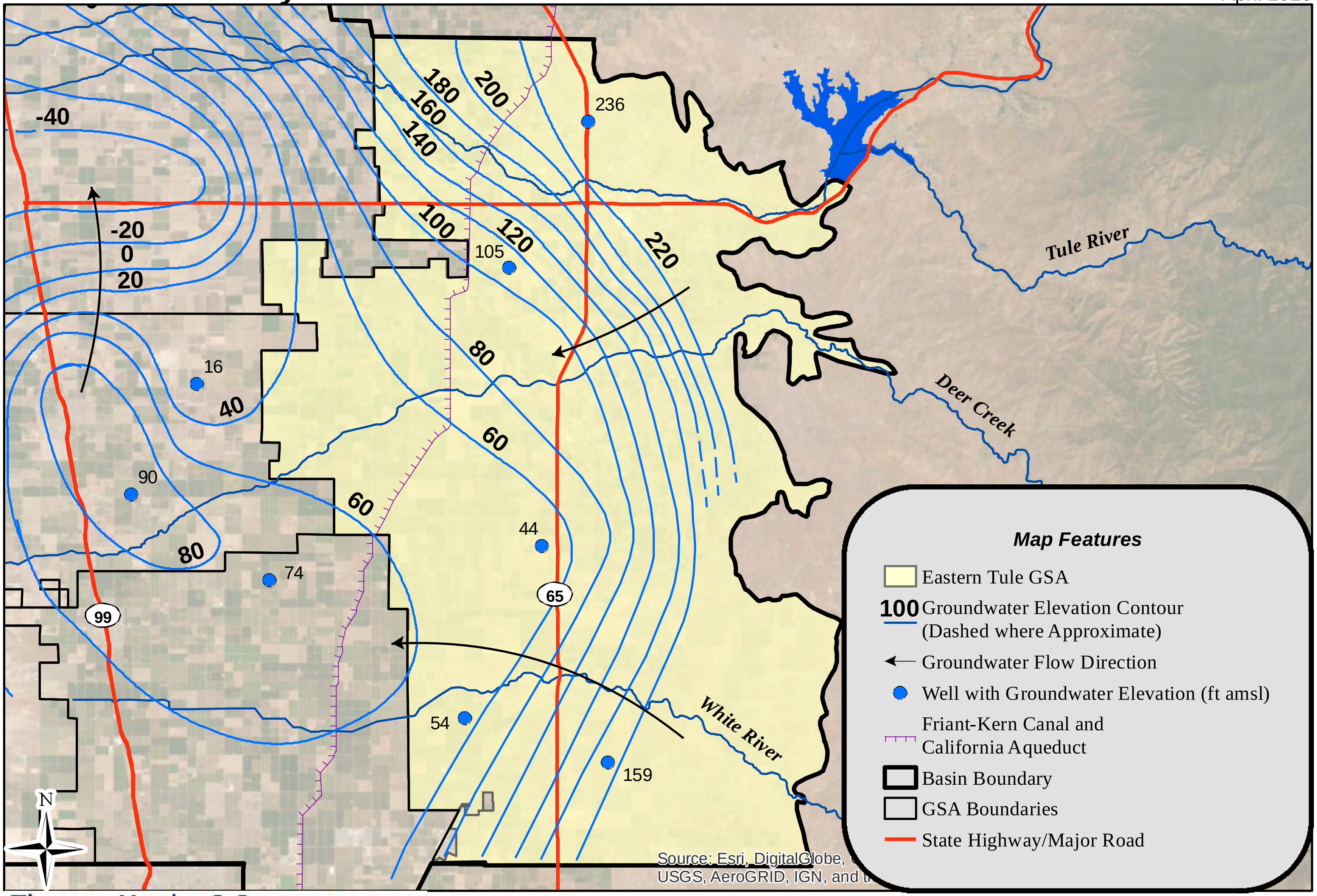

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Fall 2019 Lower Aquifer
Eastern Tule GSA
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Tule Subbasin
Technical Advisory Committee

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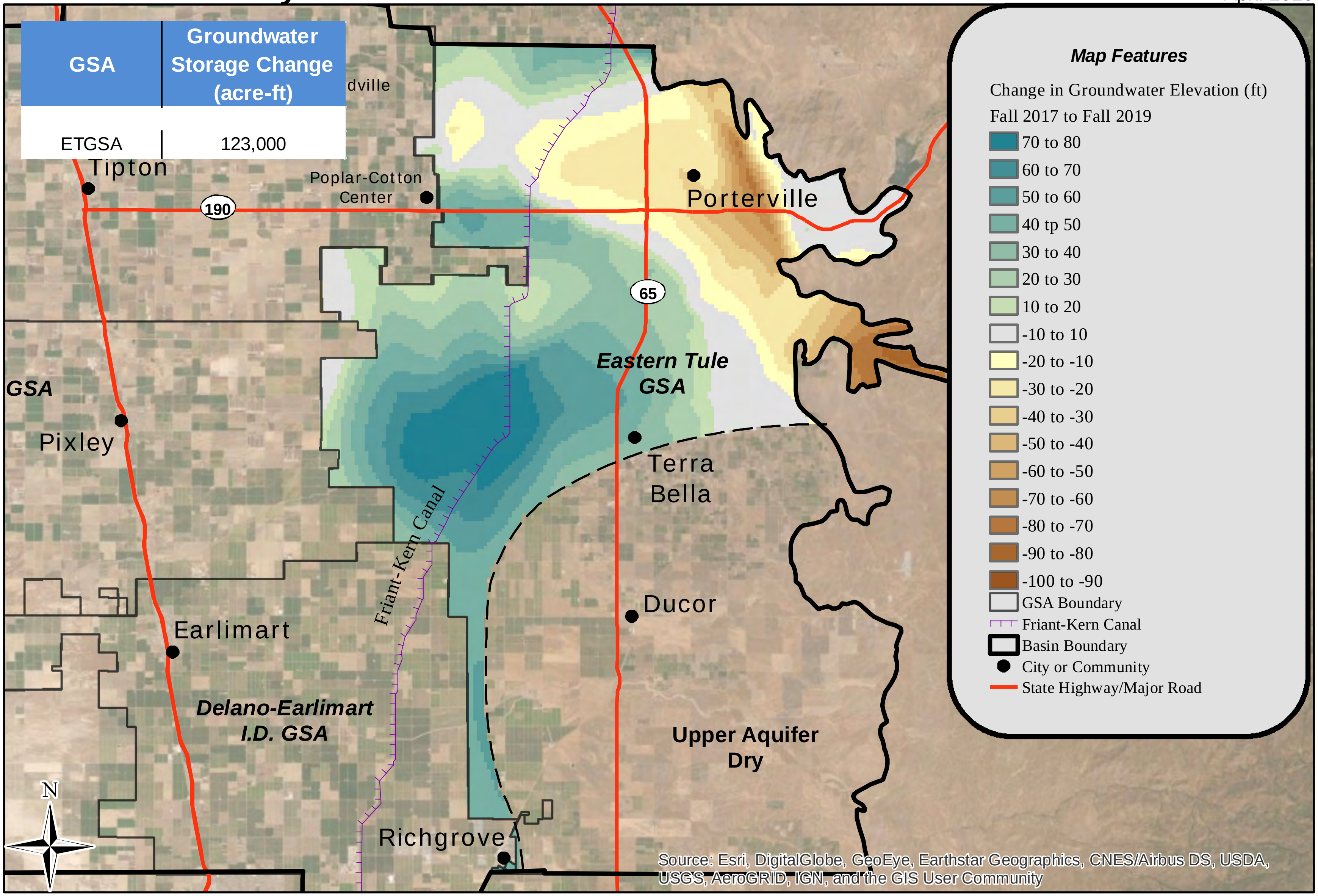

GSA	Groundwater Storage Change (acre-ft)
ETGSA	123,000

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0 2 4 8 Miles
NAD 83 State Plane Zone 4

Change in Groundwater Elevation Fall 2017 to Fall 2019
Eastern Tule GSA
Appendix B
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Appendix C

Delano-Earlimart Irrigation District GSA 2018/19 Annual Data

Delano-Earlimart Irrigation District GSA
Groundwater Extraction for Water Year 2018/2019

	Agricultural Pumping (acre-ft)	Municipal Pumping (acre-ft)[1]	Exports (acre-ft)	Total
DEID GSA	49,000	3,700	0	52,700

Note:

[1] Municipal pumping data are for water year 2016/2017.

Delano-Earlimart Irrigation District GSA
Surface Water Supplies for Water Year 2018/2019

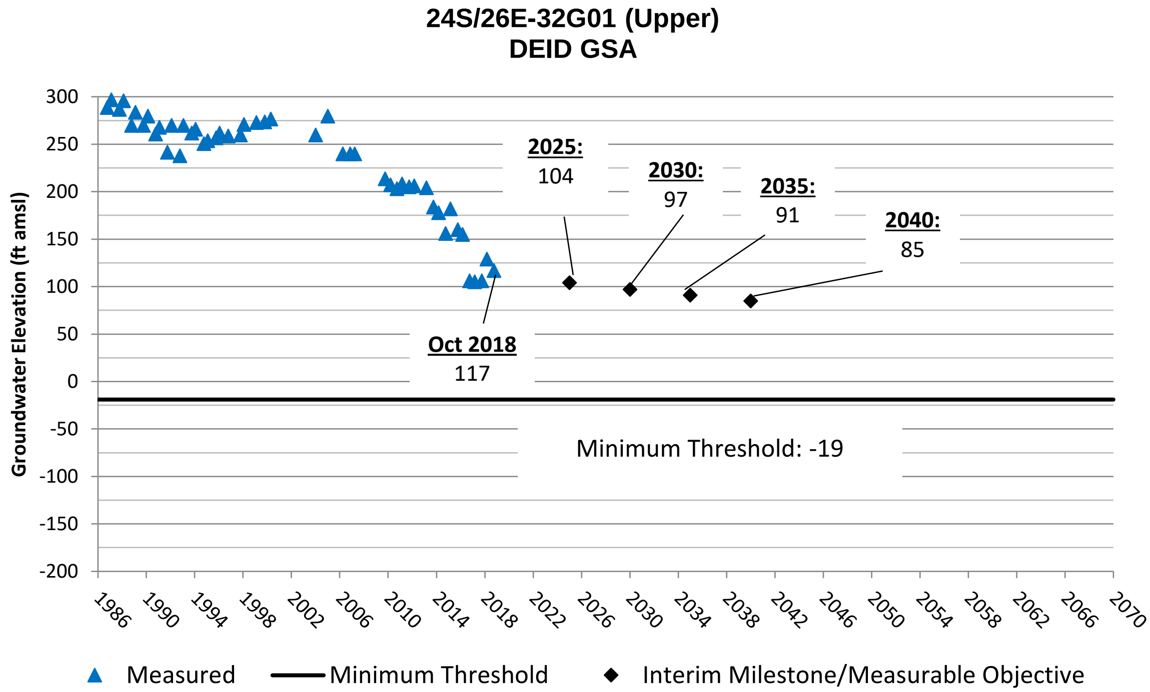
	Stream Diversions[1] (acre-ft)	Imported Water[1] (acre-ft)	Recycled Water (acre-ft)	Oilfield Produced Water (acre-ft)	Total Precipitation (acre-ft)	Total (acre-ft)
DEID GSA	0	133,860	0	0	59,600	193,460

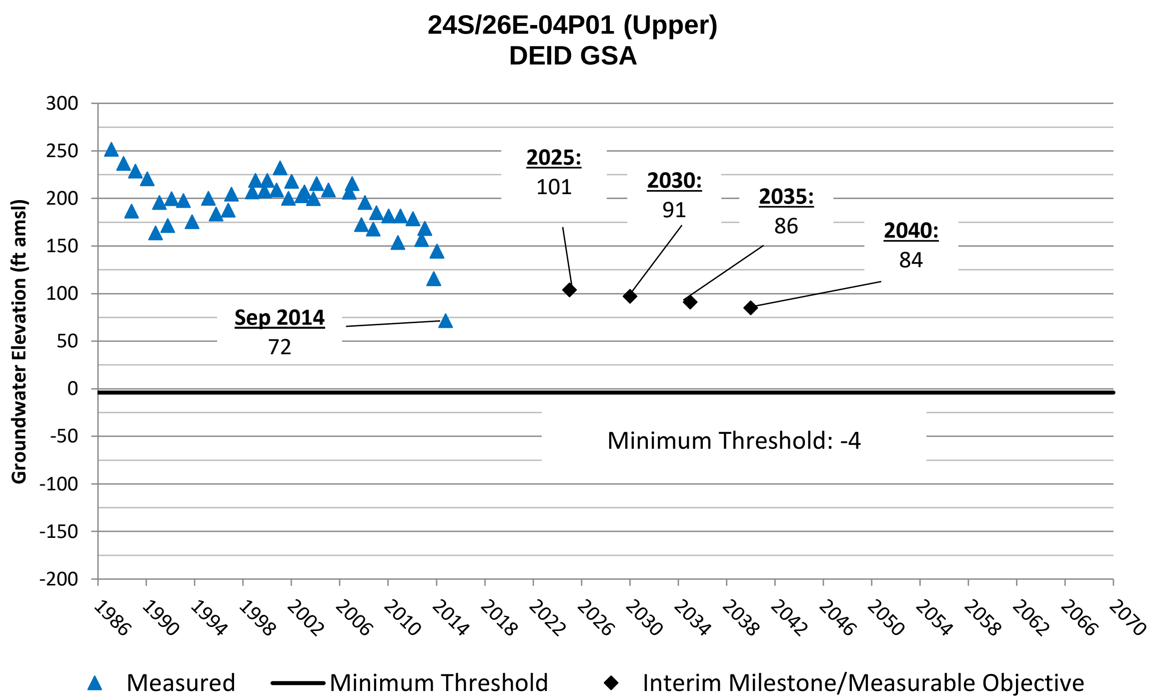
Note:
[1] Provisional subject to revision

Delano-Earlimart Irrigation District GSA
Total Water Use for Water Year 2018/2019

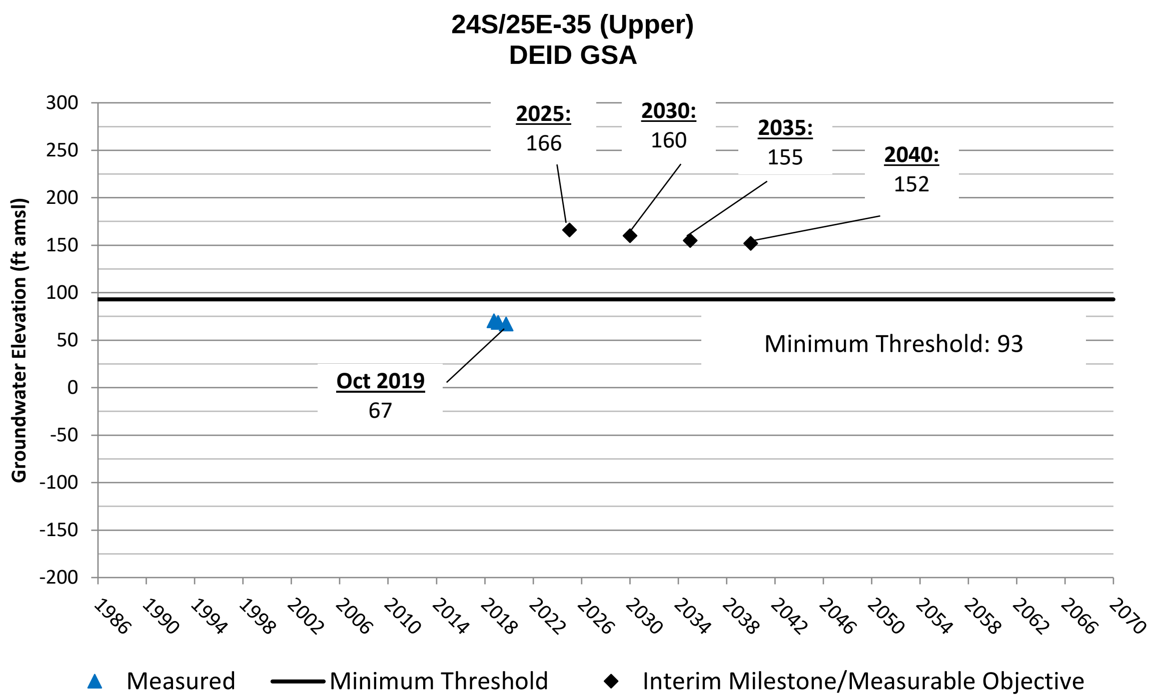
	Groundwater Extraction (acre-ft)	Surface Water Supplies (acre-ft)	Total
DEID GSA	52,700	193,460	246,160

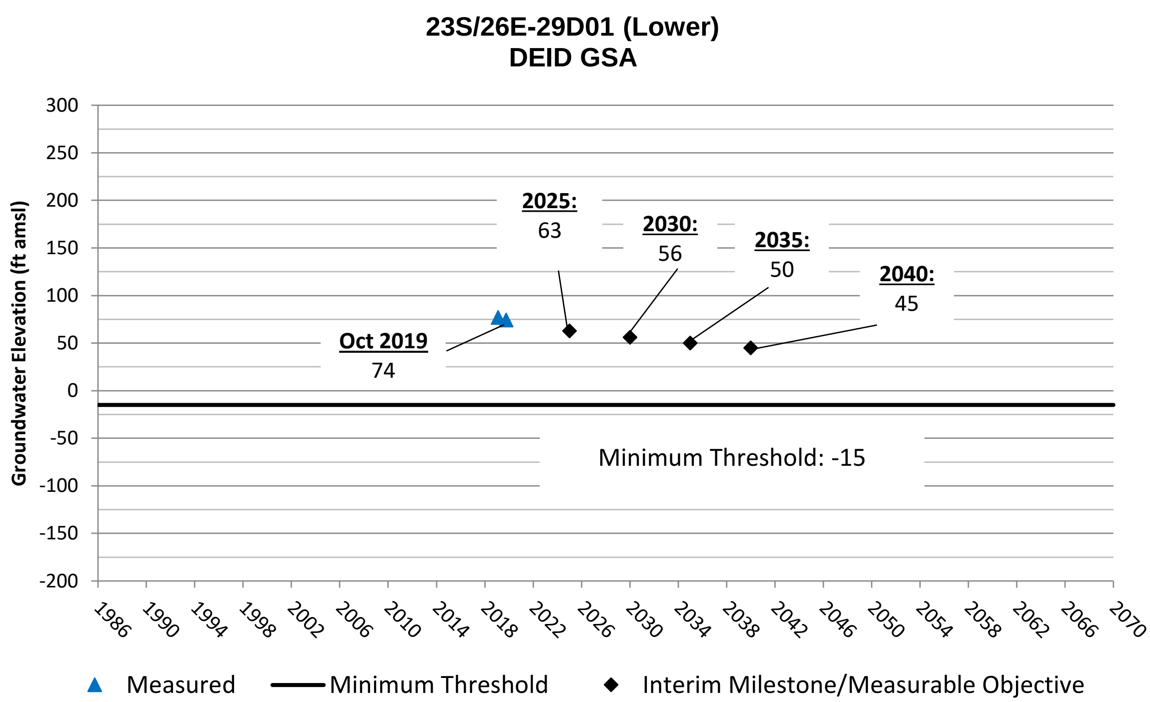
Delano-Earlimart Irrigation District GSA
RMS Groundwater Elevation Hydrographs



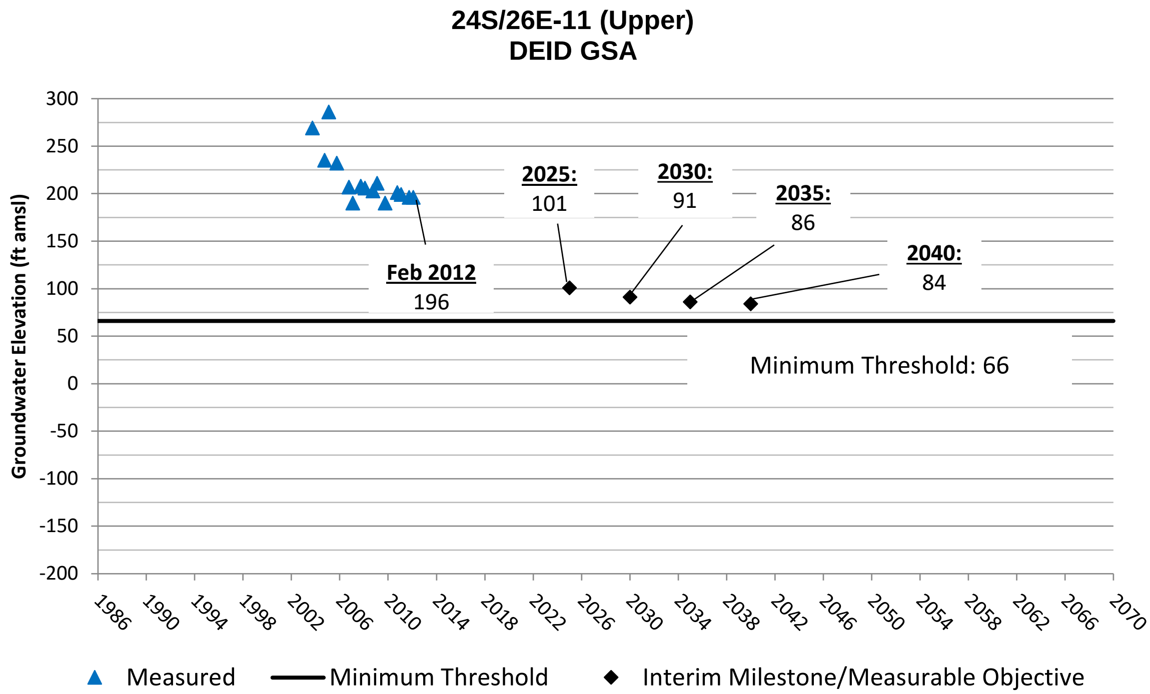


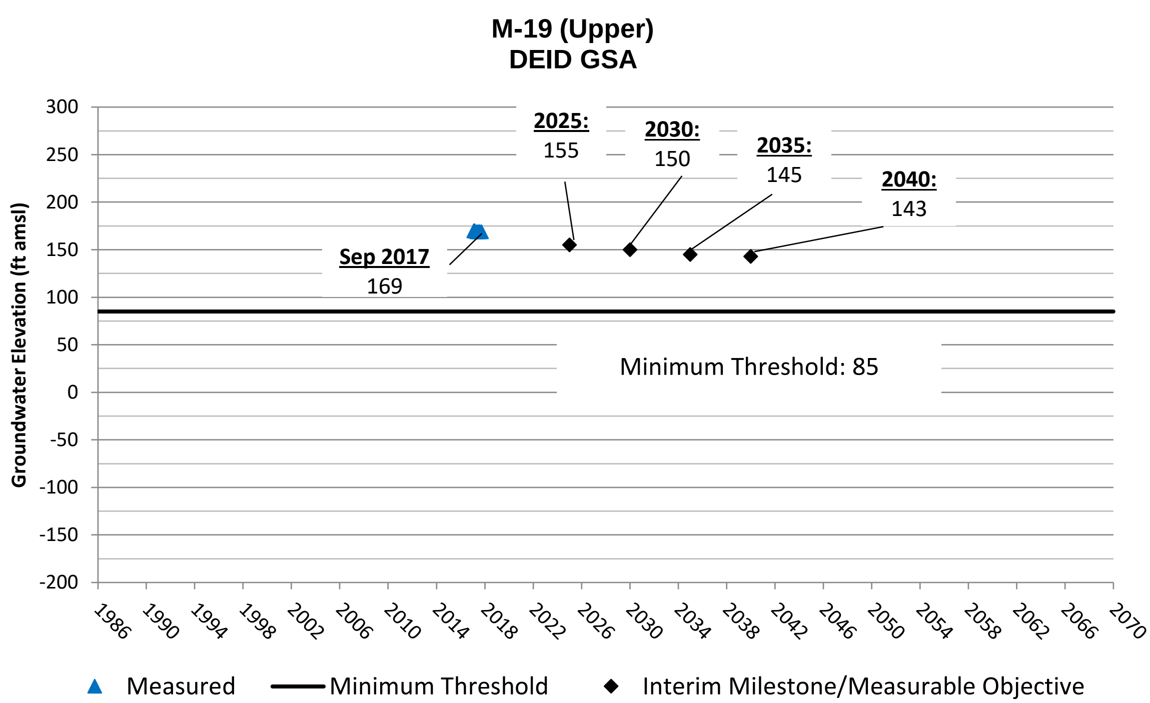
Delano-Earlimart Irrigation District GSA
RMS Groundwater Elevation Hydrographs



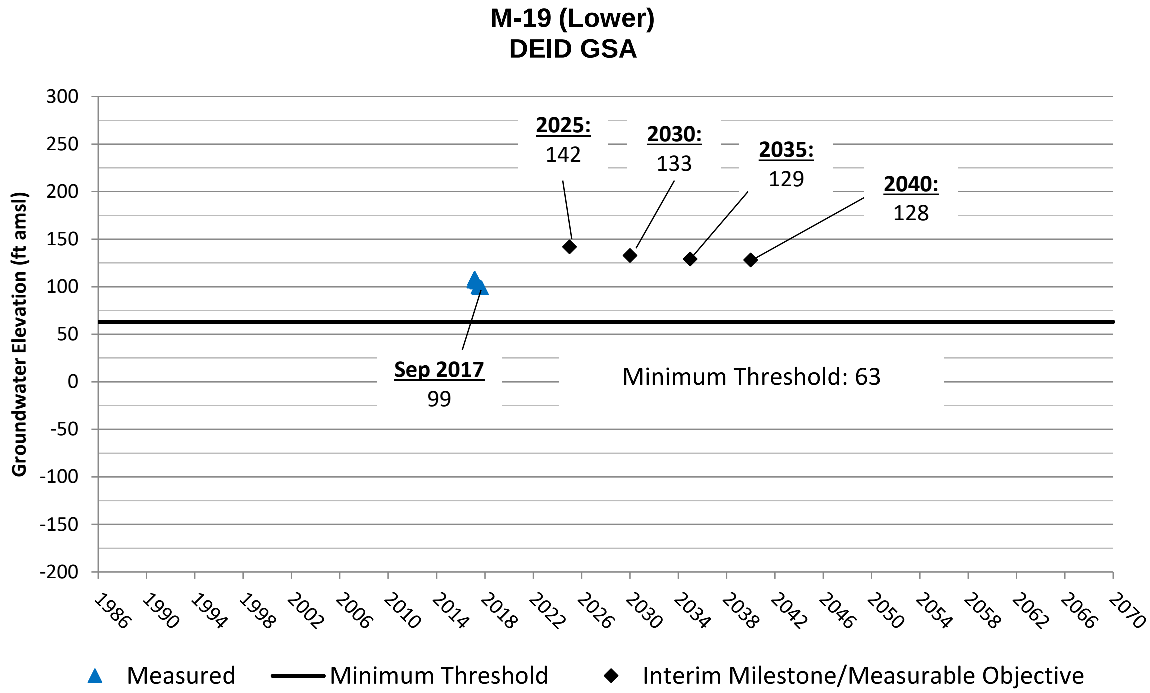


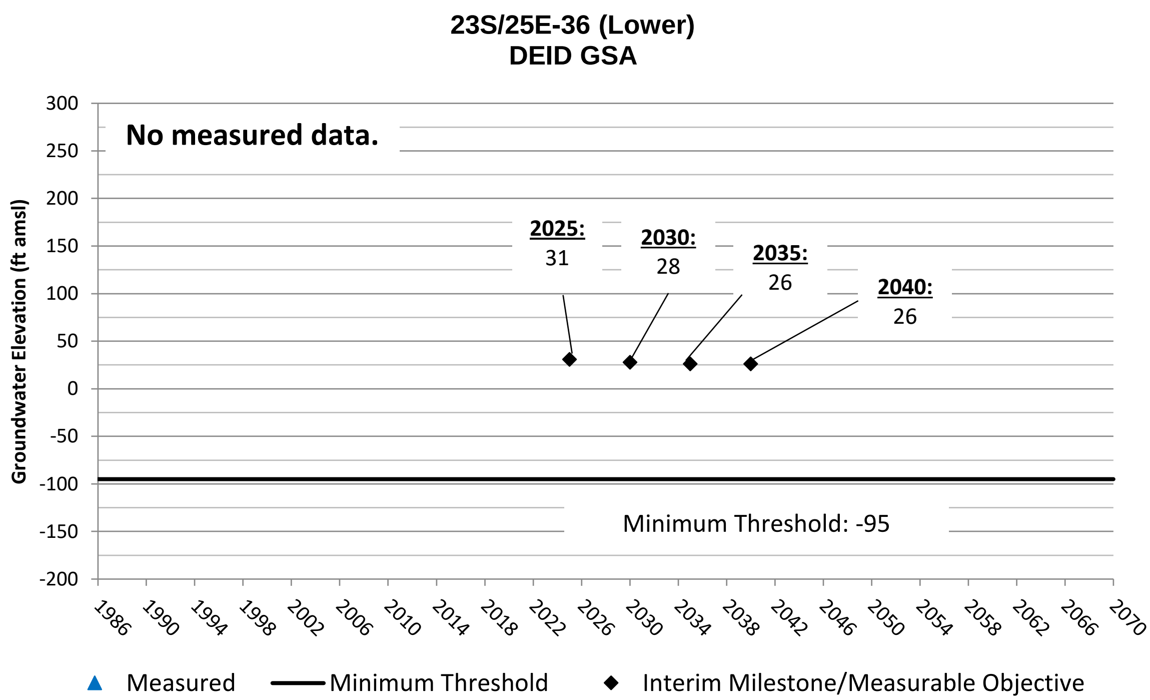
Delano-Earlimart Irrigation District GSA
RMS Groundwater Elevation Hydrographs



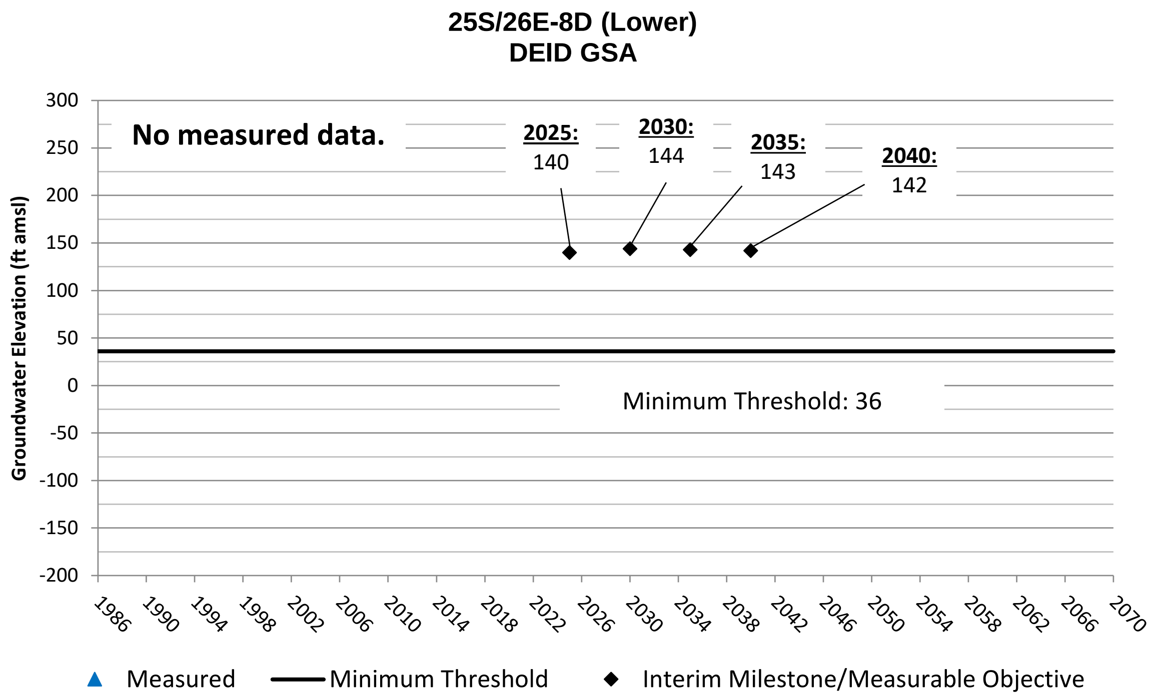


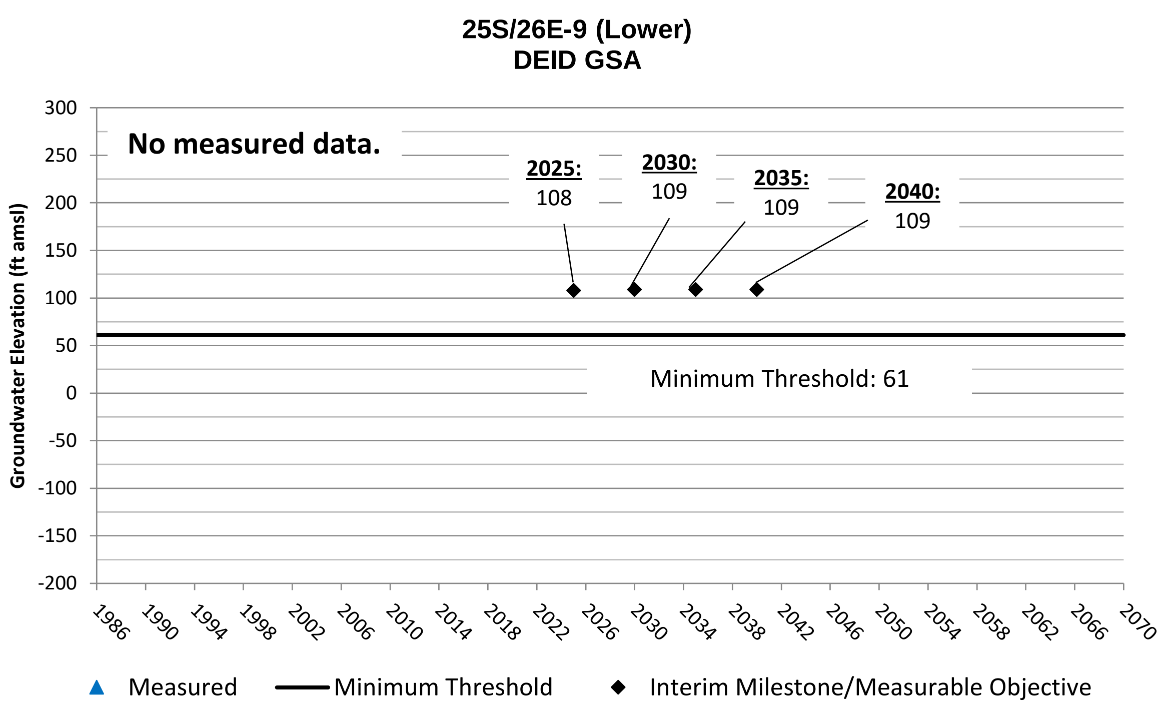
Delano-Earlimart Irrigation District GSA
RMS Groundwater Elevation Hydrographs





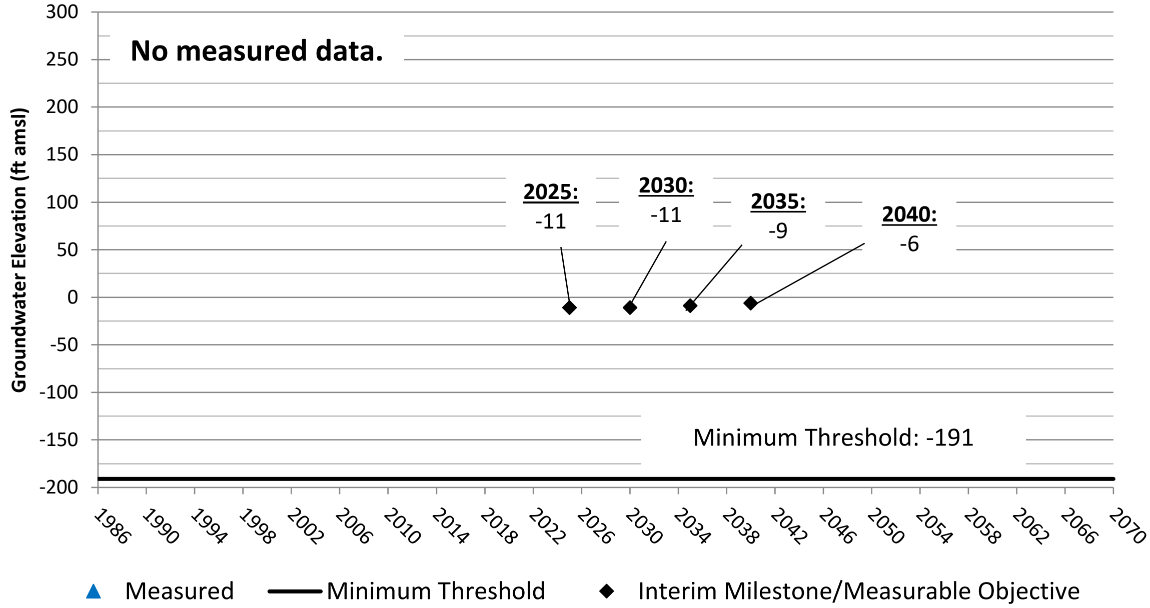
Delano-Earlimart Irrigation District GSA
RMS Groundwater Elevation Hydrographs



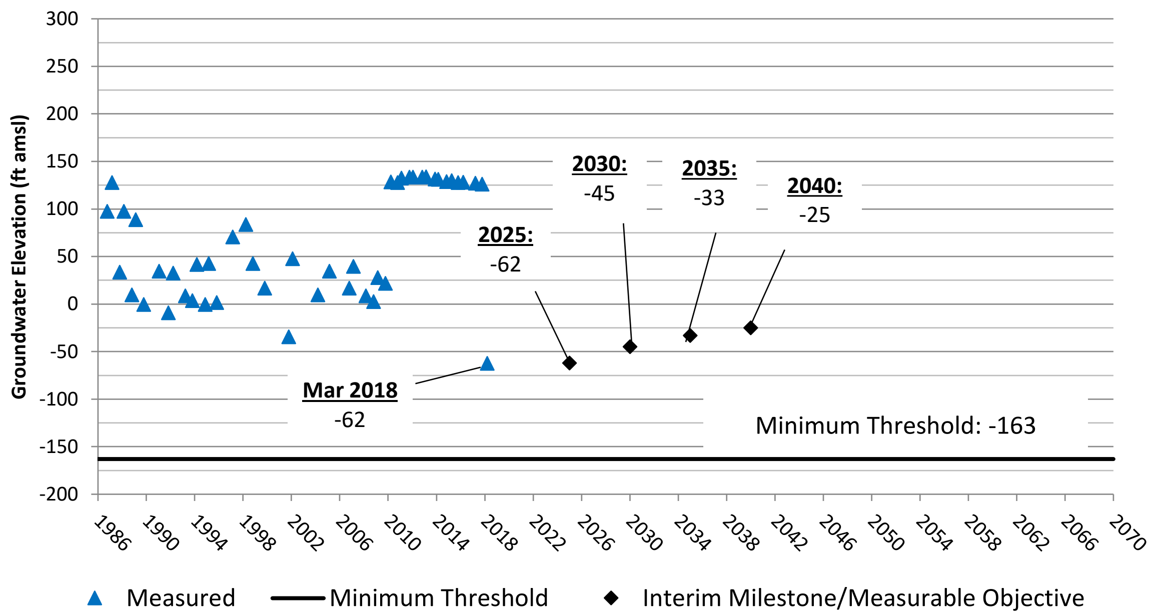


Delano-Earlimart Irrigation District GSA
RMS Groundwater Elevation Hydrographs

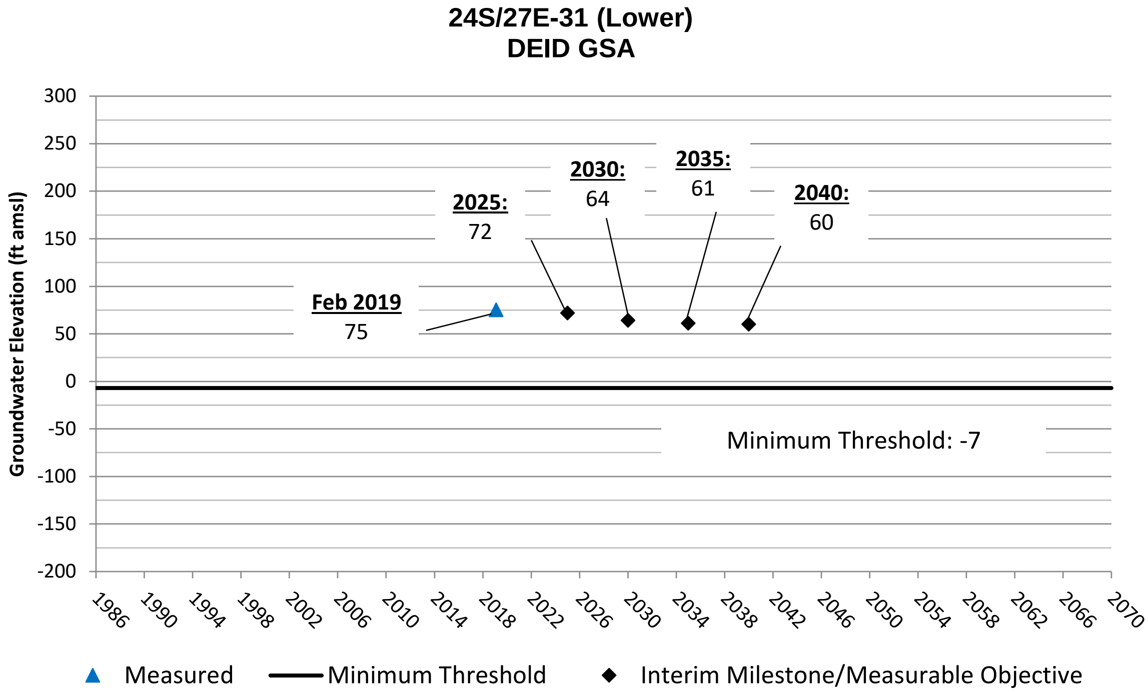
23S/25E-27 (Lower)
DEID GSA



24S/24E-03A01 (Lower)
DEID GSA



Delano-Earlimart Irrigation District GSA
RMS Groundwater Elevation Hydrographs



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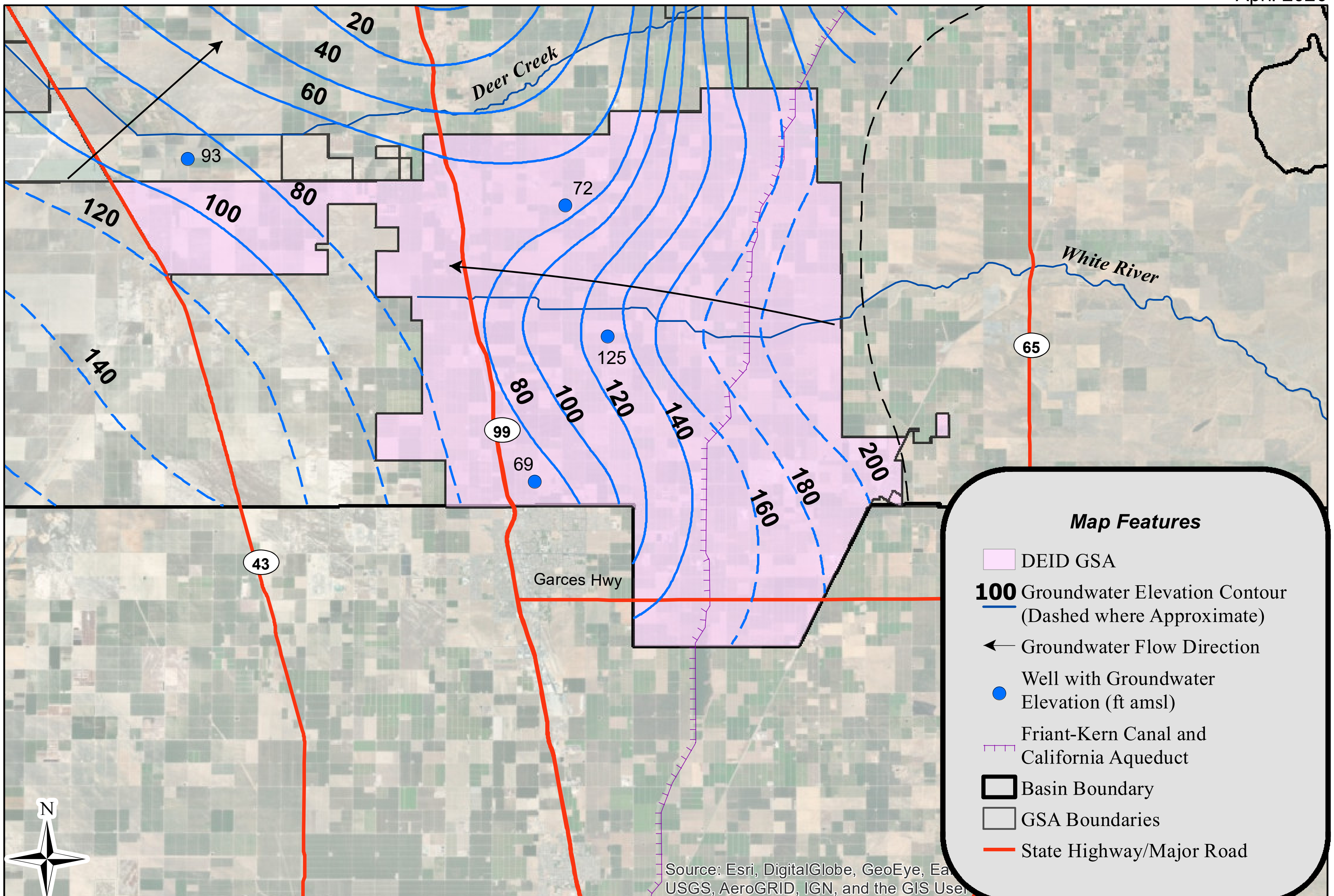

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Spring 2019 Upper Aquifer
DEID GSA
Appendix C
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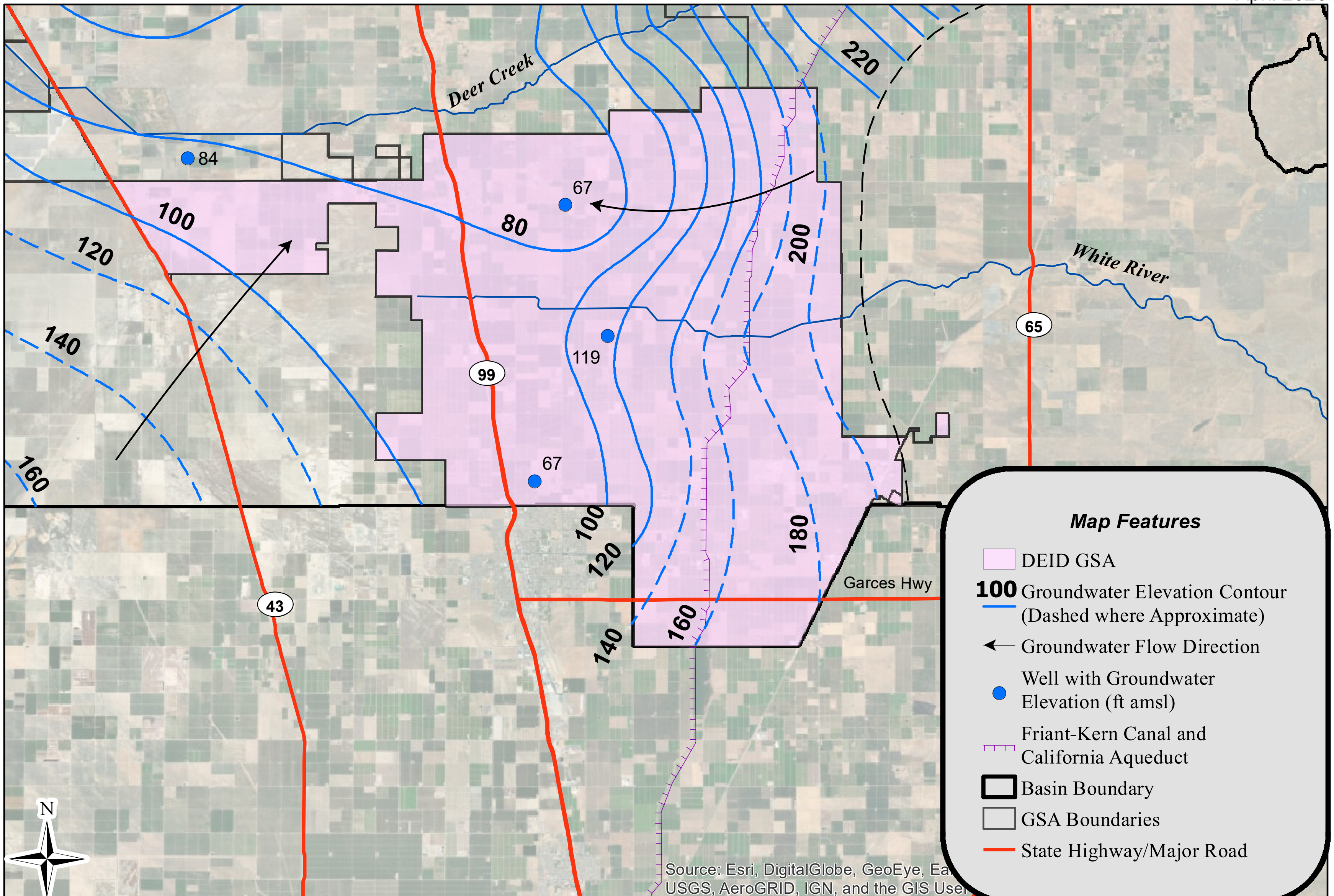

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Fall 2019 Upper Aquifer
DEID GSA
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Tule Subbasin
Technical Advisory Committee

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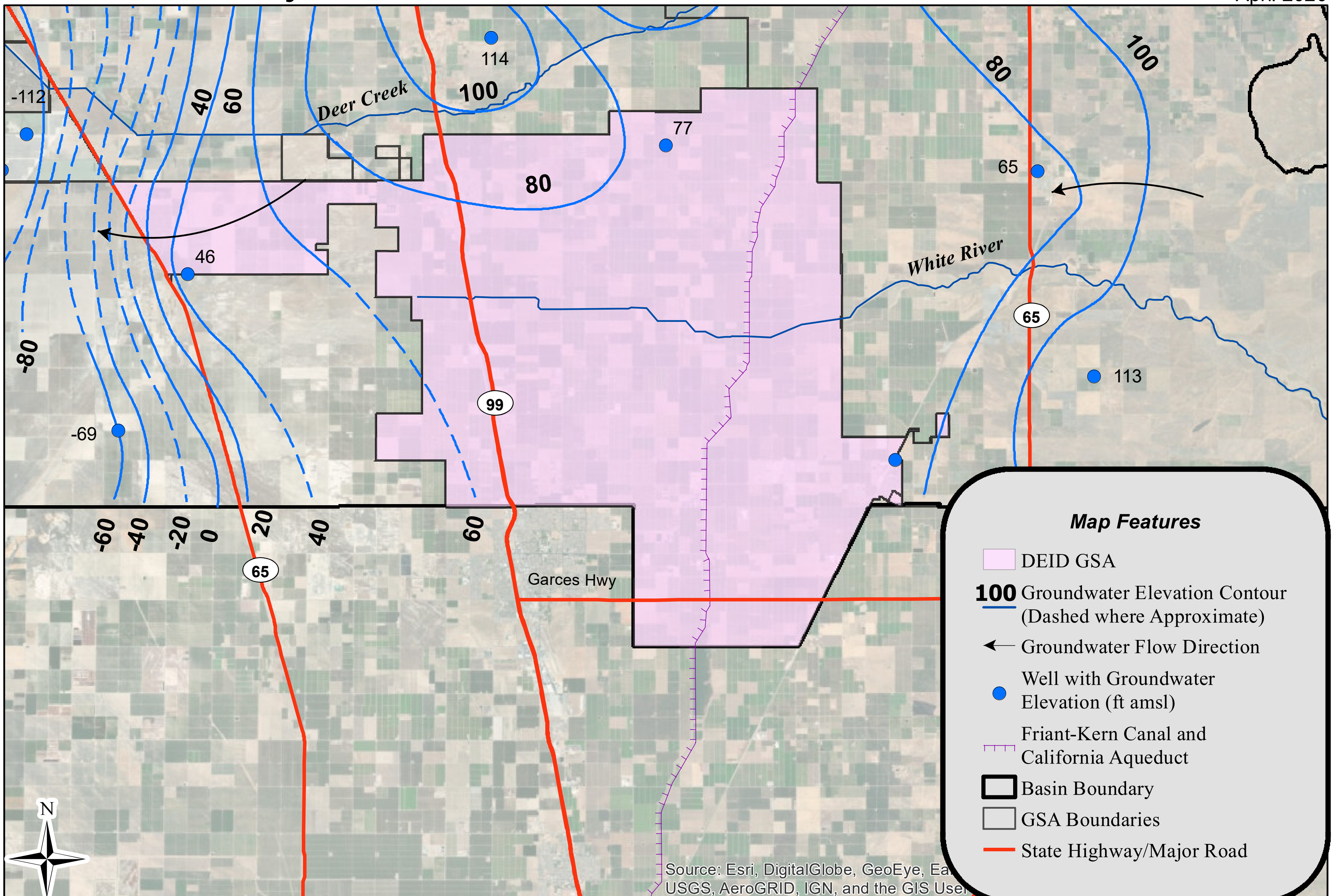

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Spring 2019 Lower Aquifer
DEID GSA
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Technical Advisory Committee

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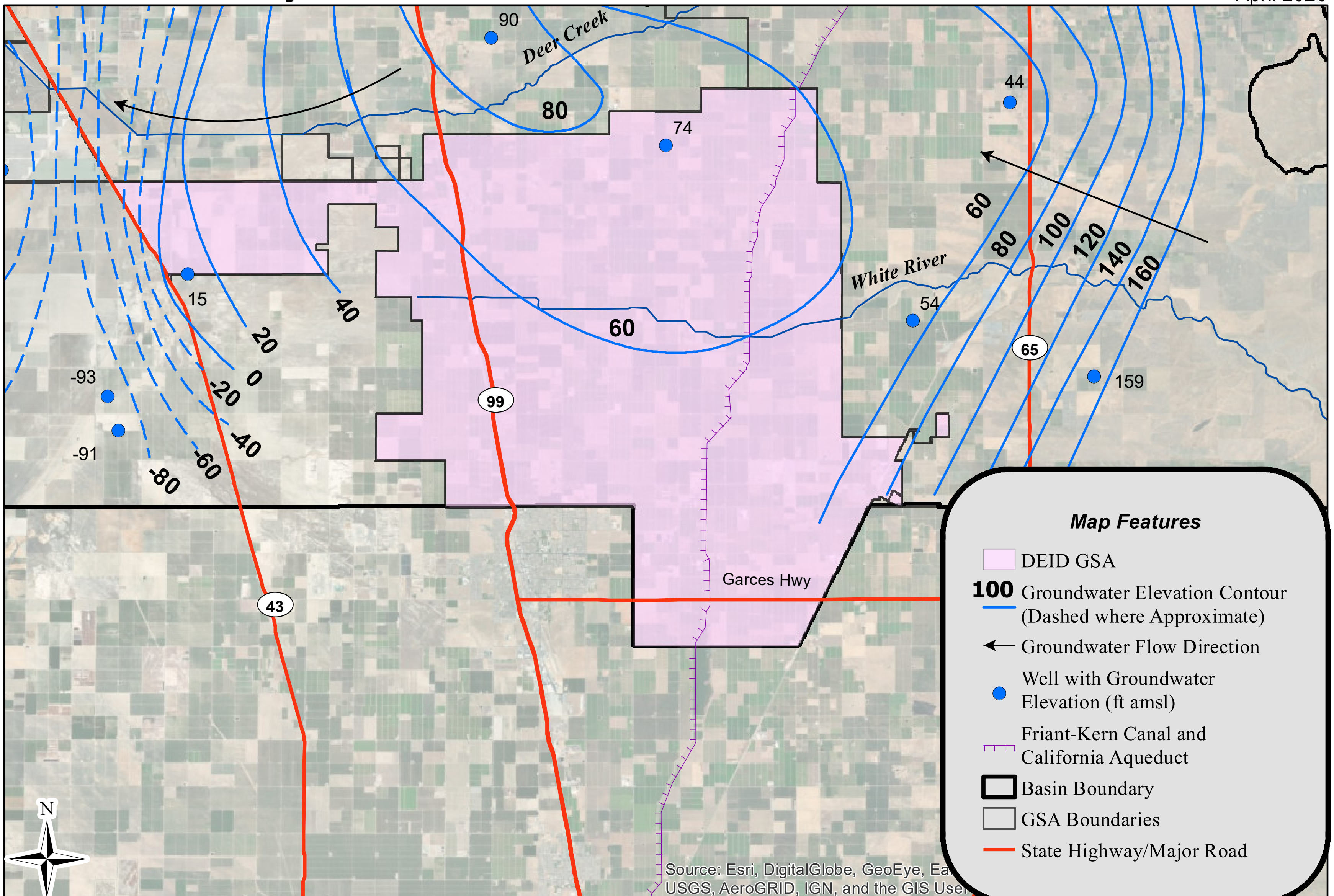

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0 1.5 3 6 Miles
NAD 83 State Plane Zone 4

Fall 2019 Lower Aquifer
DEID GSA
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Figure 11

Tule Subbasin
Technical Advisory Committee

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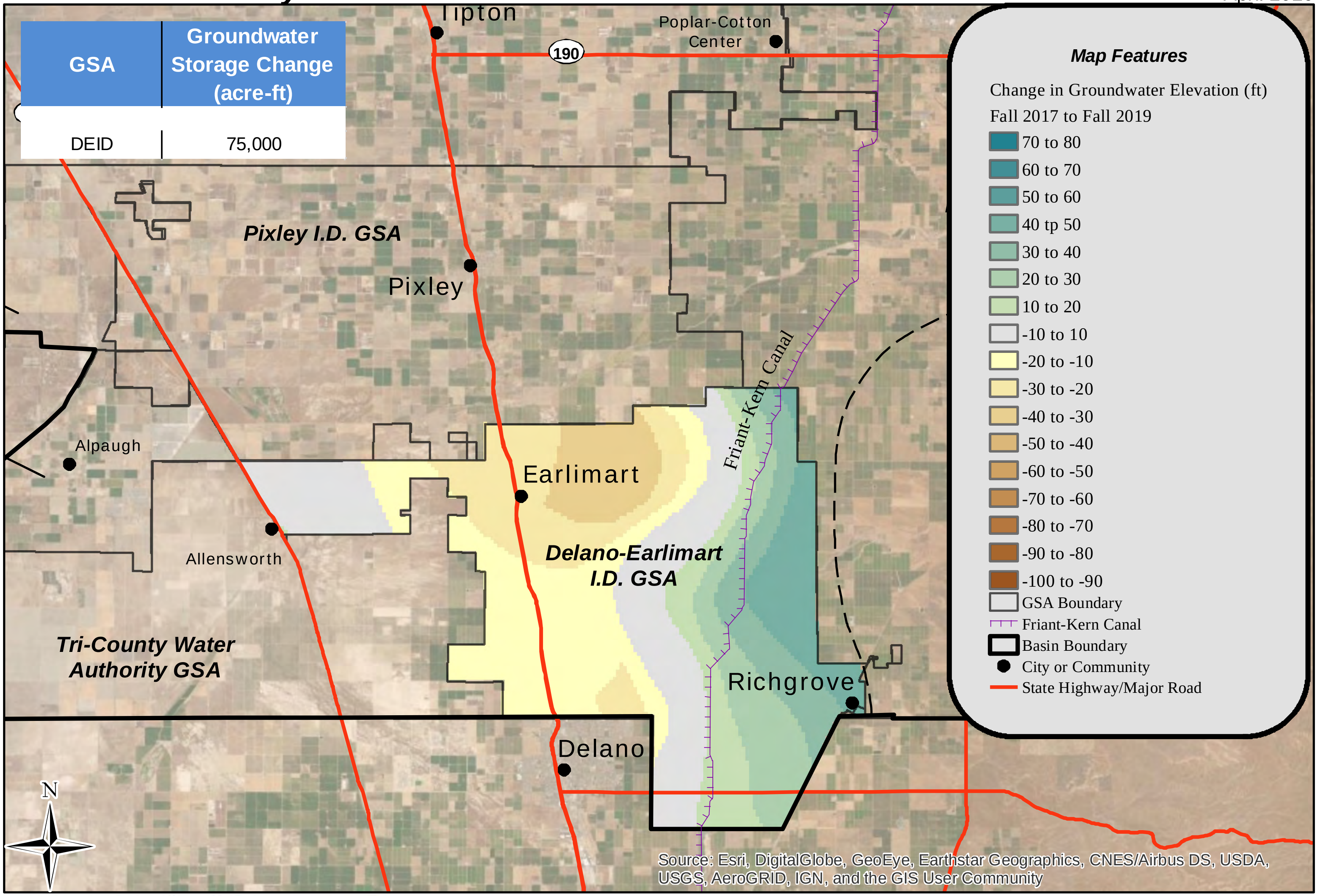

GSA	Groundwater Storage Change (acre-ft)
DEID	75,000

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0 2 4 8 Miles
NAD 83 State Plane Zone 4

Change in Groundwater Elevation Fall 2017 to Fall 2019
DEID GSA
Appendix C
Figure 12

Appendix D

Pixley Irrigation District GSA 2018/19 Annual Data

Pixley Irrigation District GSA
Groundwater Extraction for Water Year 2018/2019

	Agricultural Pumping (acre-ft)	Municipal Pumping (acre-ft)[1]	Exports (acre-ft)	Total
Pixley ID GSA	102,000	1,100	0	103,100

Note:

[1] Municipal pumping data are for water year 2016/2017.

Pixley Irrigation District GSA
Surface Water Supplies for Water Year 2018/2019

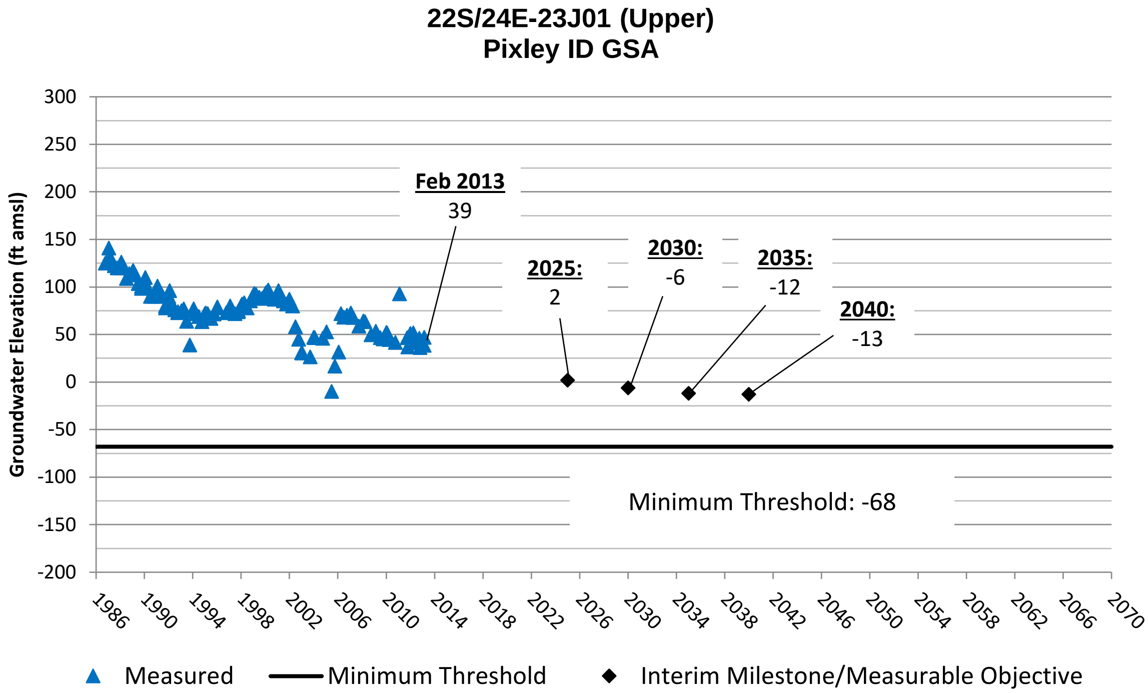
	Stream Diversions[1] (acre-ft)	Imported Water[1] (acre-ft)	Recycled Water (acre-ft)	Oilfield Produced Water (acre-ft)	Total Precipitation (acre-ft)	Total (acre-ft)
Pixley ID GSA	3,097	70,457	0	0	66,300	139,854

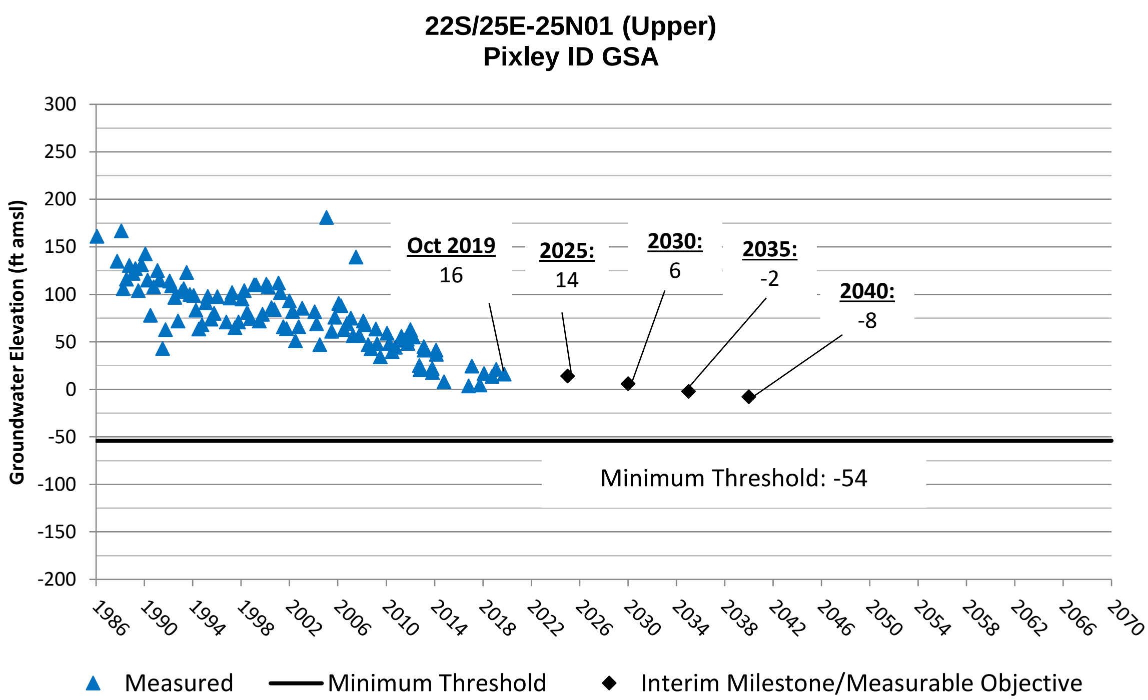
Note:
[1] Provisional subject to revision

Pixley Irrigation District GSA
Total Water Use for Water Year 2018/2019

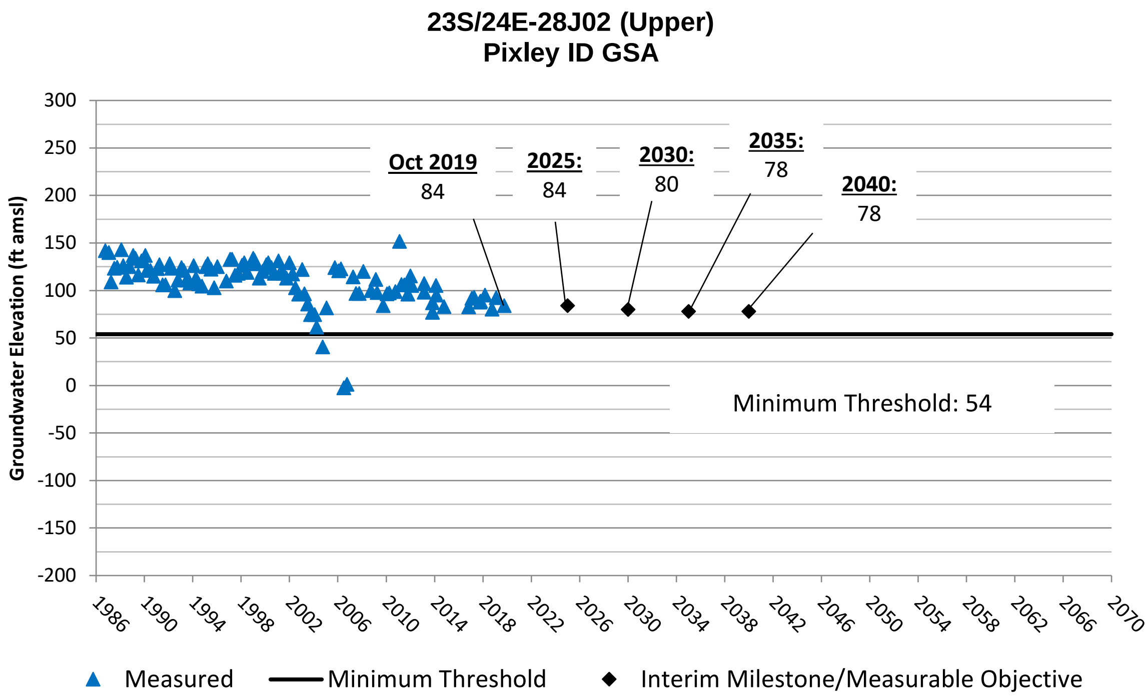
	Groundwater Extraction (acre-ft)	Surface Water Supplies (acre-ft)	Total
Pixley ID GSA	103,100	139,854	242,954

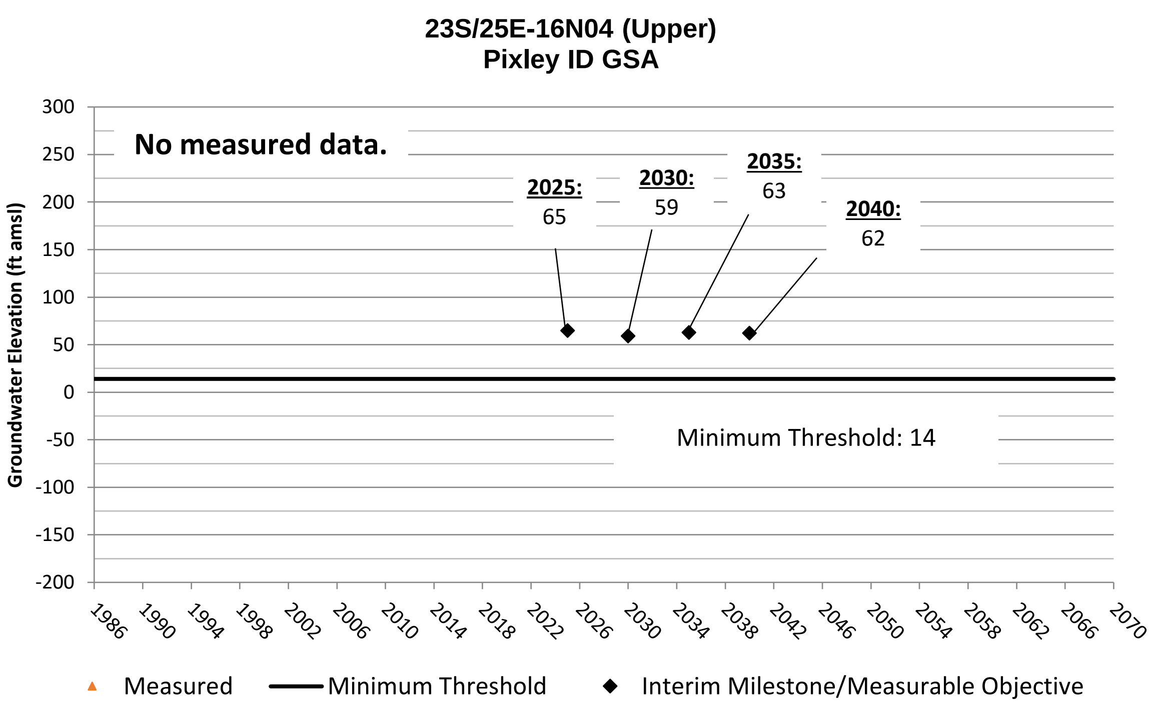
Pixley Irrigation District GSA
RMS Groundwater Elevation Hydrographs



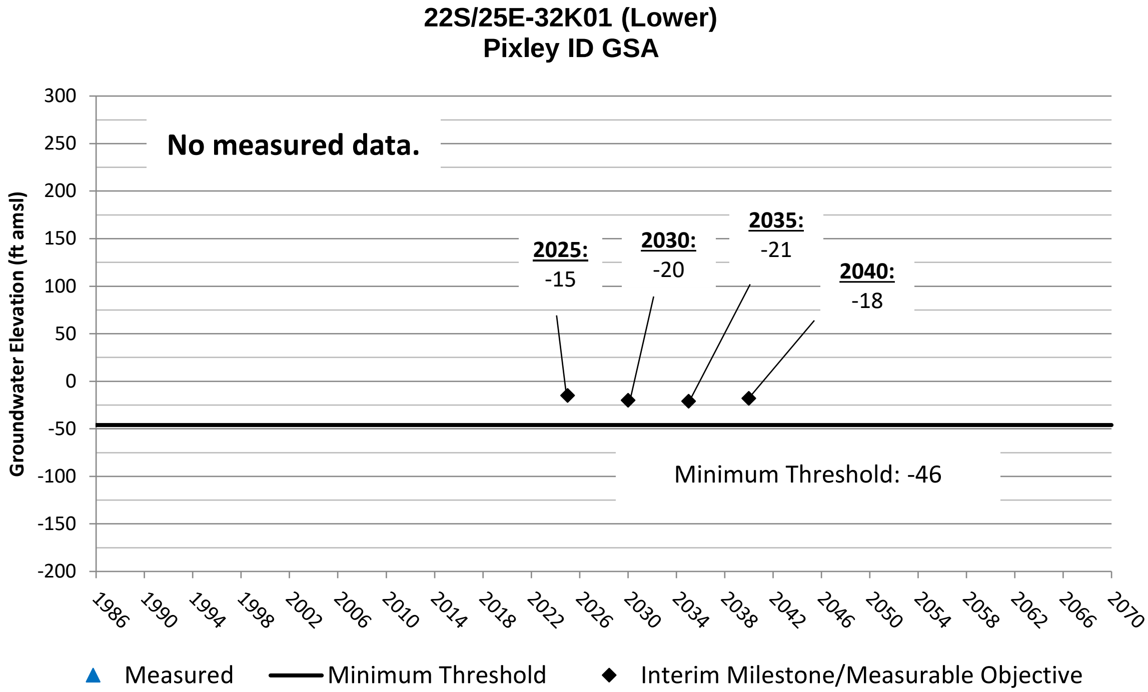


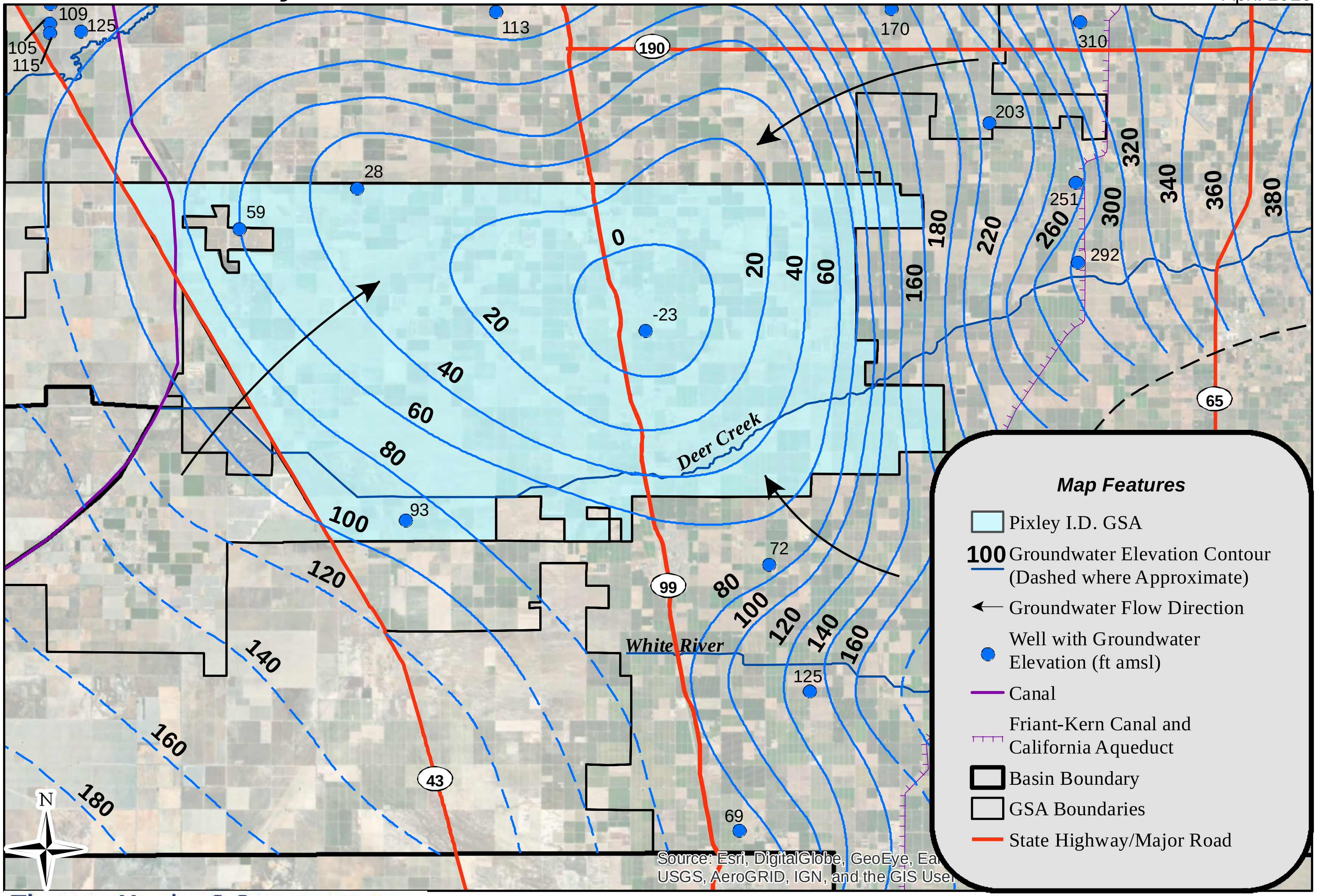
Pixley Irrigation District GSA
RMS Groundwater Elevation Hydrographs





Pixley Irrigation District GSA
RMS Groundwater Elevation Hydrographs





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Spring 2019 Upper Aquifer
Pixley I.D. GSA
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Figure 4

Tule Subbasin
Technical Advisory Committee

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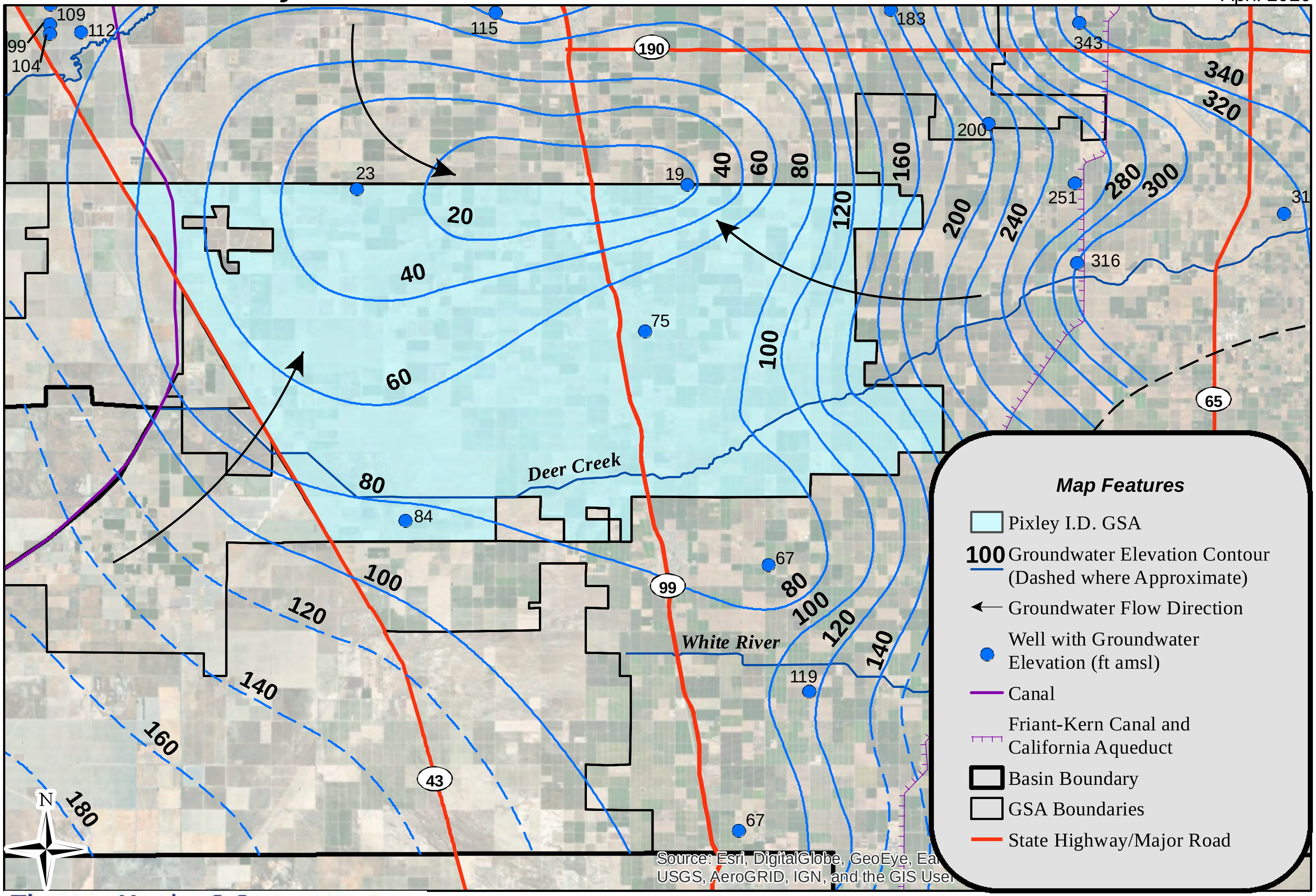

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0 1.5 3 6 Miles
NAD 83 State Plane Zone 4

Fall 2019 Upper Aquifer
Pixley I.D. GSA
Appendix D
Figure 5

Tule Subbasin
Technical Advisory Committee

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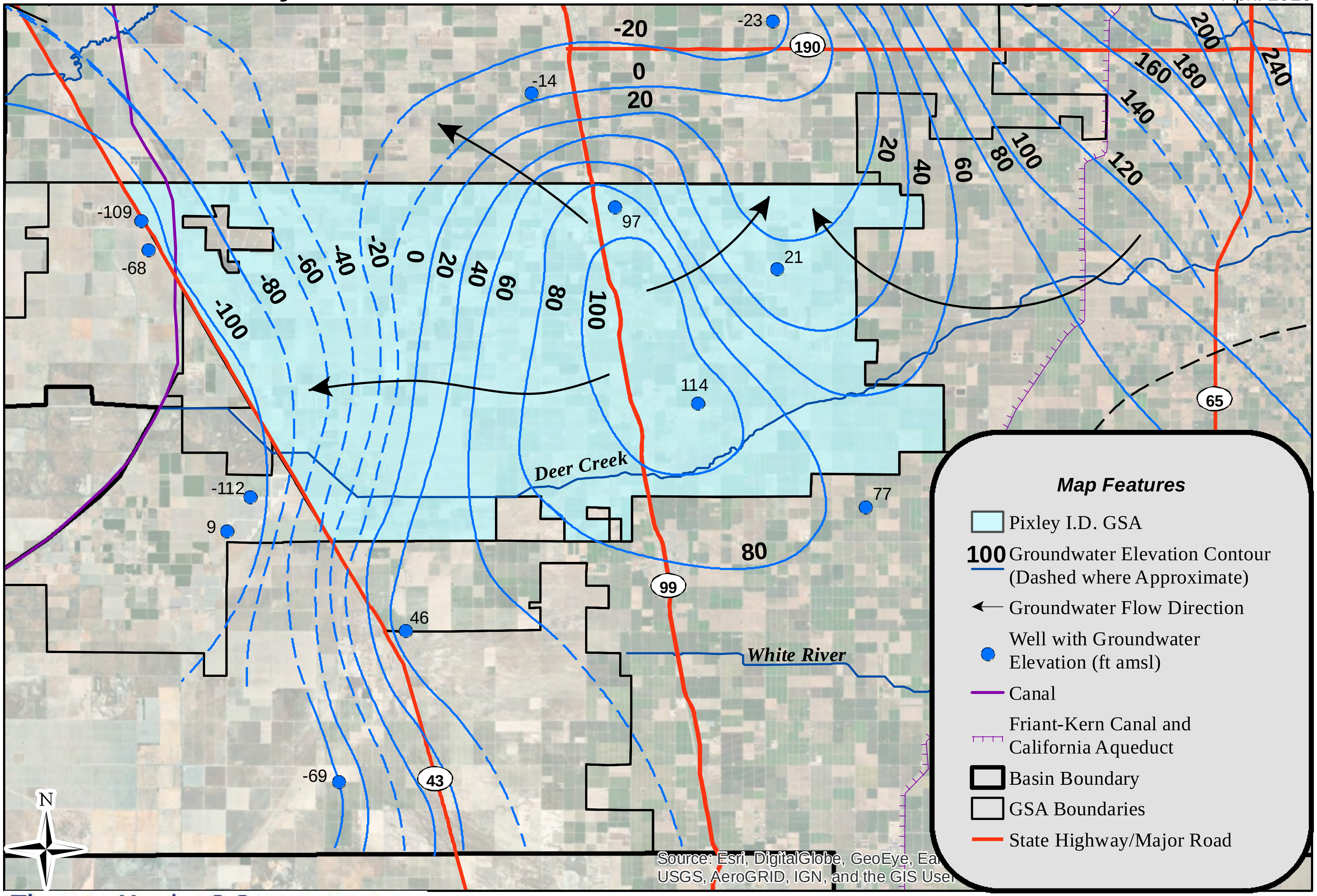

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Spring 2019 Lower Aquifer
Pixley I.D. GSA
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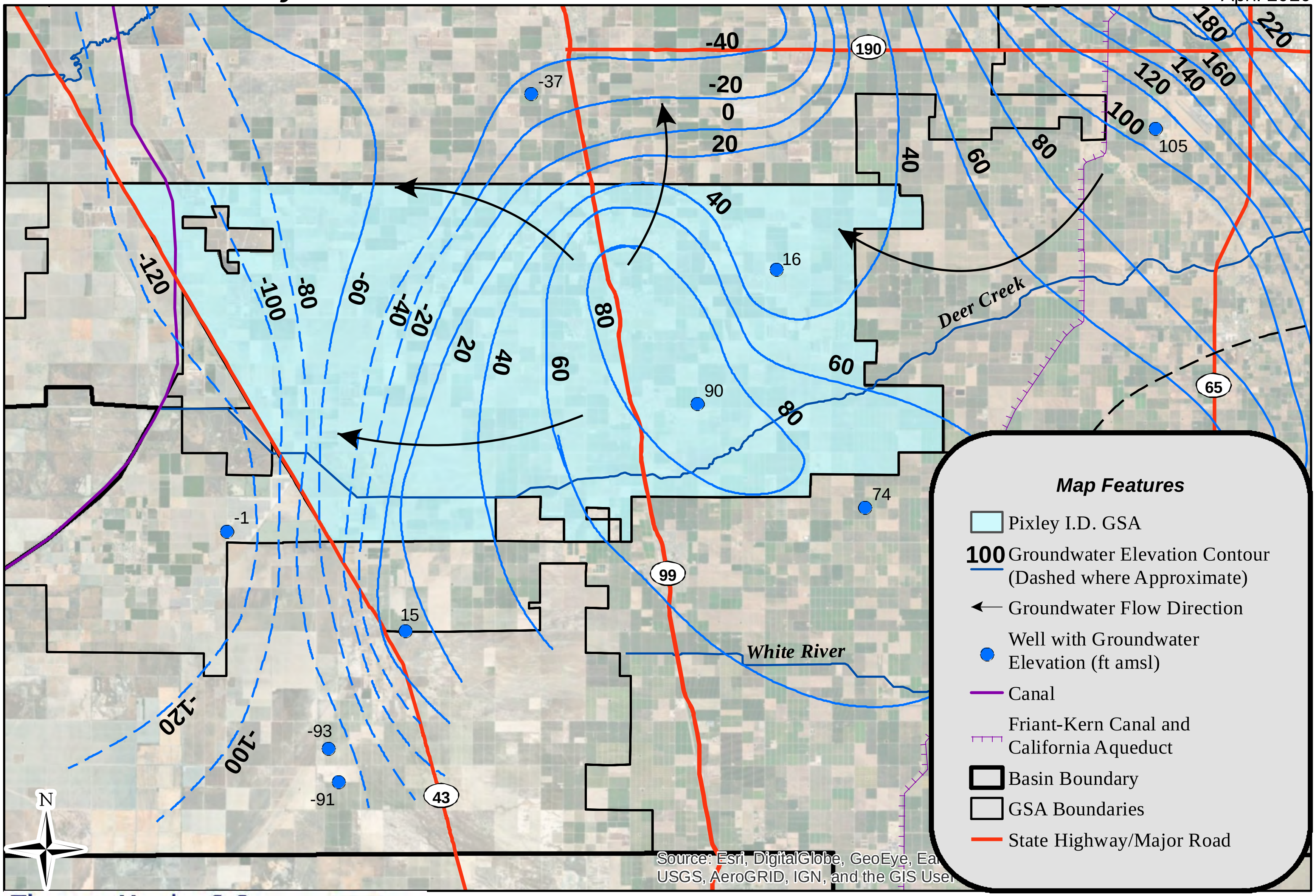
Figure 6



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Fall 2019 Lower Aquifer
Pixley I.D. GSA
Appendix D
Figure 7

Tule Subbasin
Technical Advisory Committee

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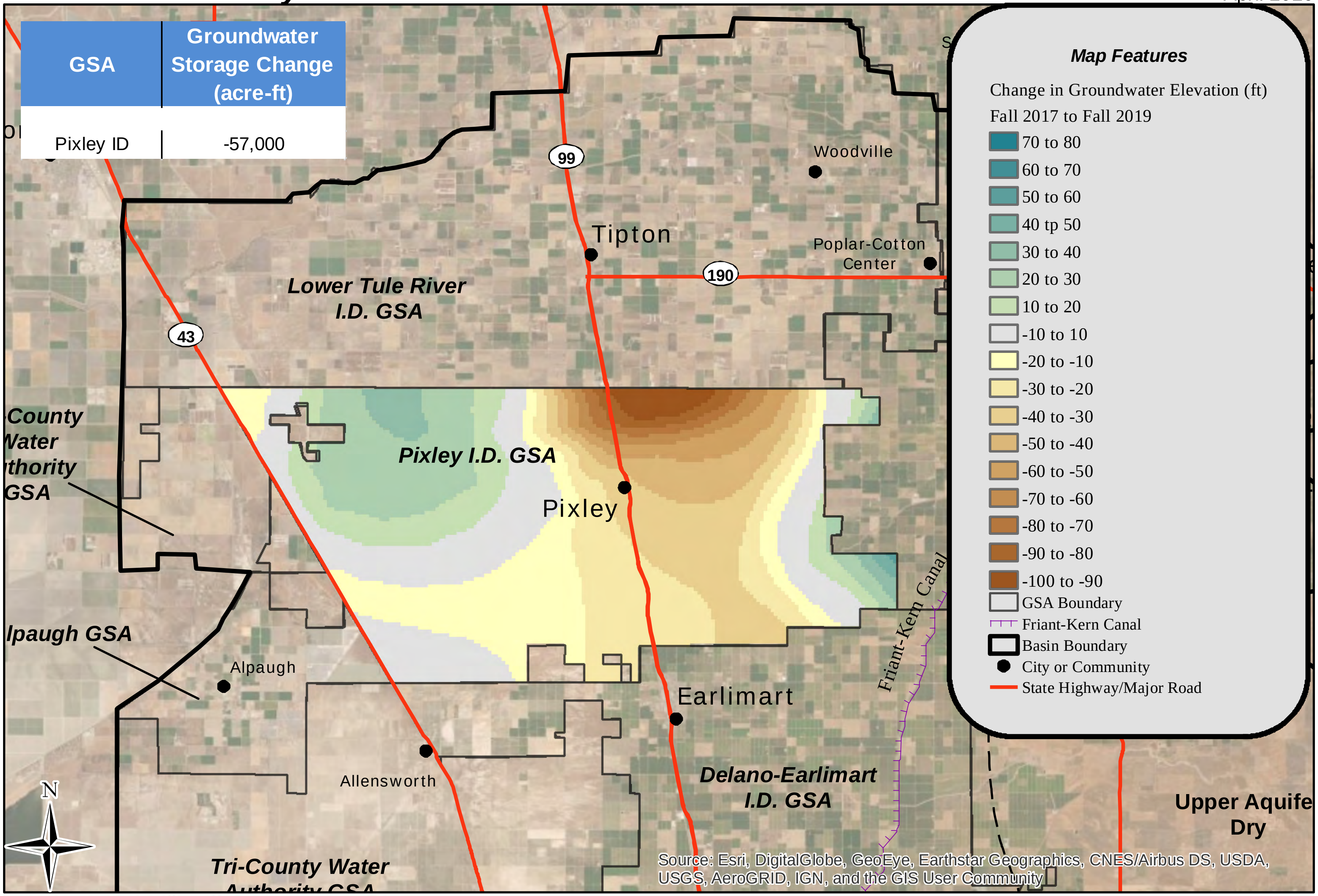
GSA	Groundwater Storage Change (acre-ft)
Pixley ID	-57,000



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0 2 4 8 Miles
NAD 83 State Plane Zone 4

Change in Groundwater Elevation Fall 2017 to Fall 2019
Pixley I.D. GSA
Appendix D
Figure 8

Appendix E

Tri-County Groundwater Authority GSA 2018/19 Annual Data

Tri-County Water Authority GSA
Groundwater Extraction for Water Year 2018/2019

	Agricultural Pumping (acre-ft)	Municipal Pumping (acre-ft)[1]	Exports (acre-ft)	Total
Tri-County GSA	91,800	300	0	92,100

Note:

[1] Municipal pumping data are for water year 2016/2017.

Tri-County Water Authority GSA
Surface Water Supplies for Water Year 2018/2019

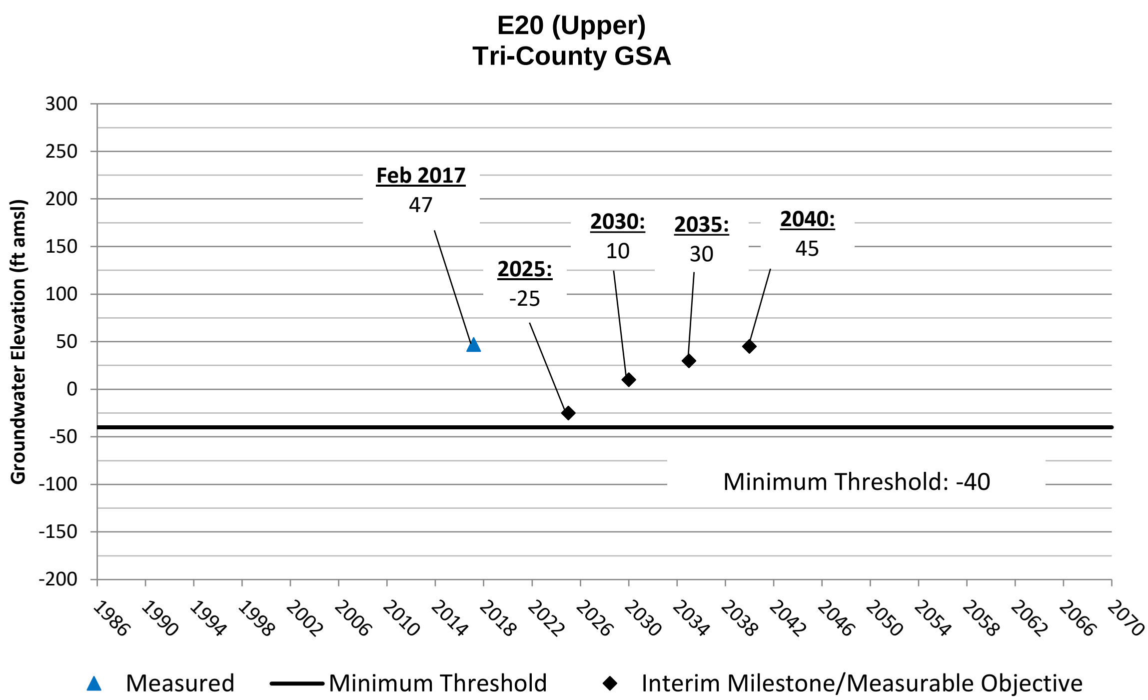
	Stream Diversions[1] (acre-ft)	Imported Water[1] (acre-ft)	Recycled Water (acre-ft)	Oilfield Produced Water (acre-ft)	Total Precipitation (acre-ft)	Total (acre-ft)
Tri-County GSA	0	4,289	0	0	51,700	55,989

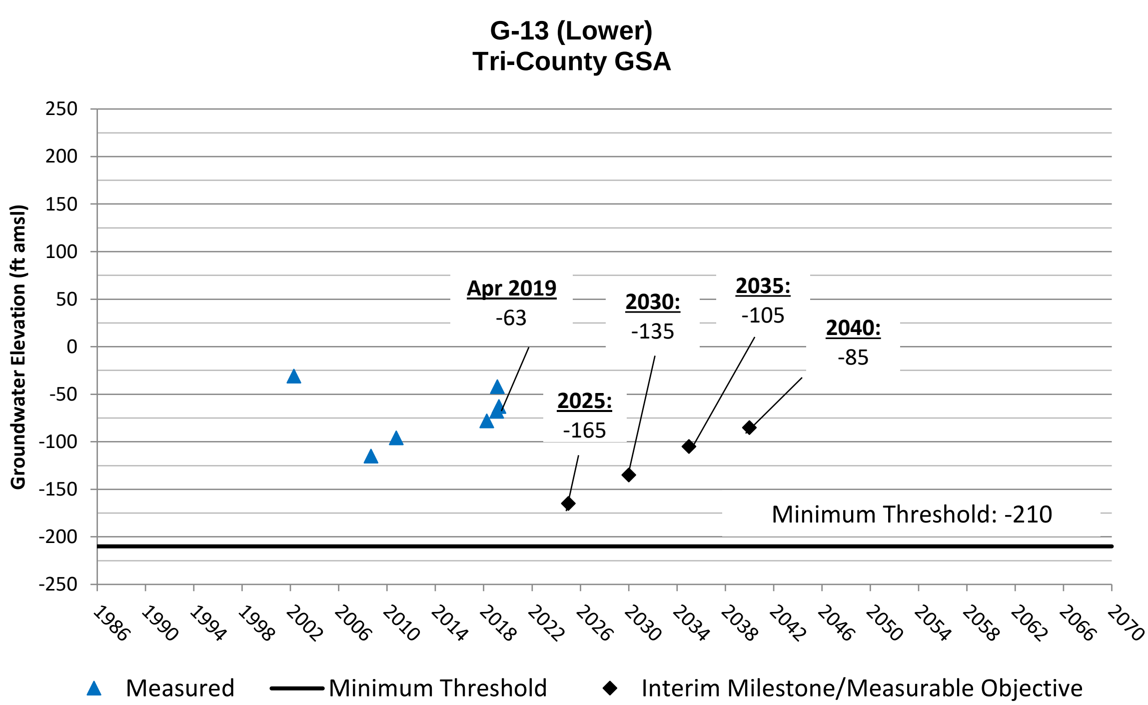
Note:
[1] Provisional subject to revision

Tri-County Water Authority GSA
Total Water Use for Water Year 2018/2019

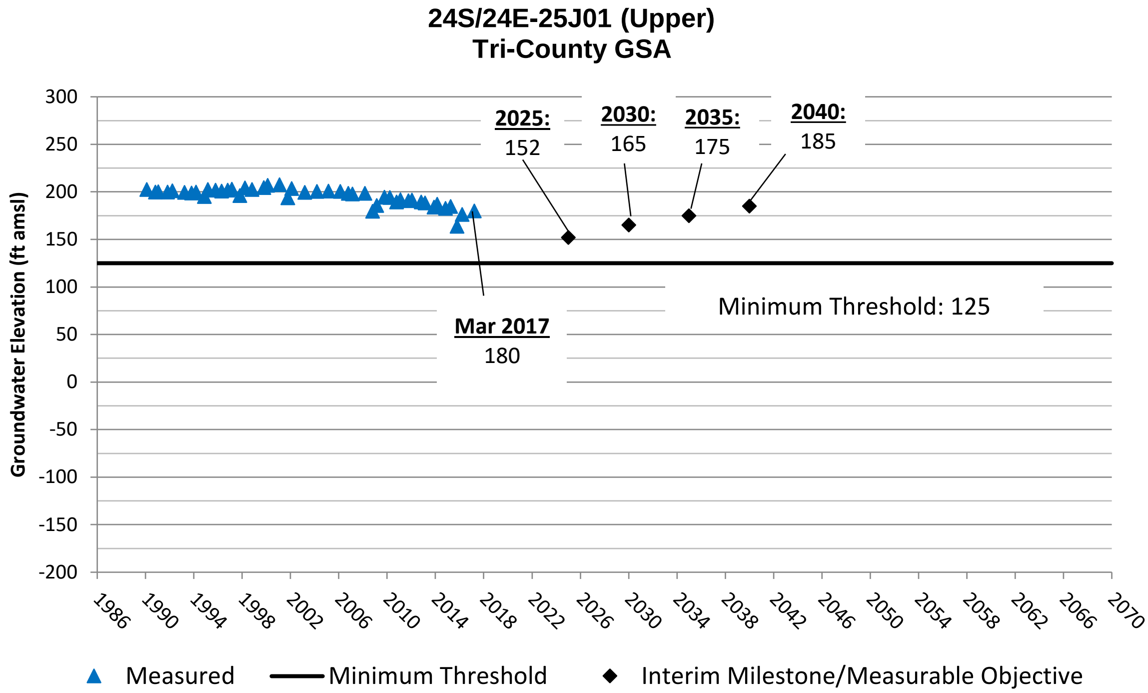
	Groundwater Extraction (acre-ft)	Surface Water Supplies (acre-ft)	Total
Tri-County GSA	92,100	55,989	148,089

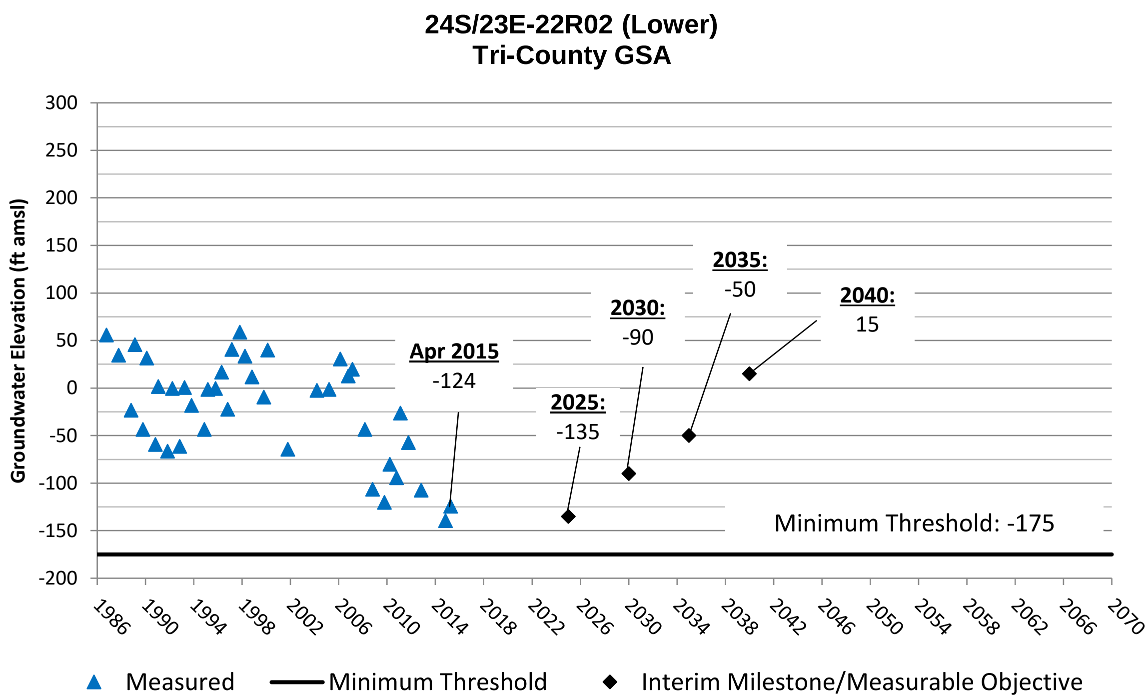
Tri-County Water Authority GSA
RMS Groundwater Elevation Hydrographs



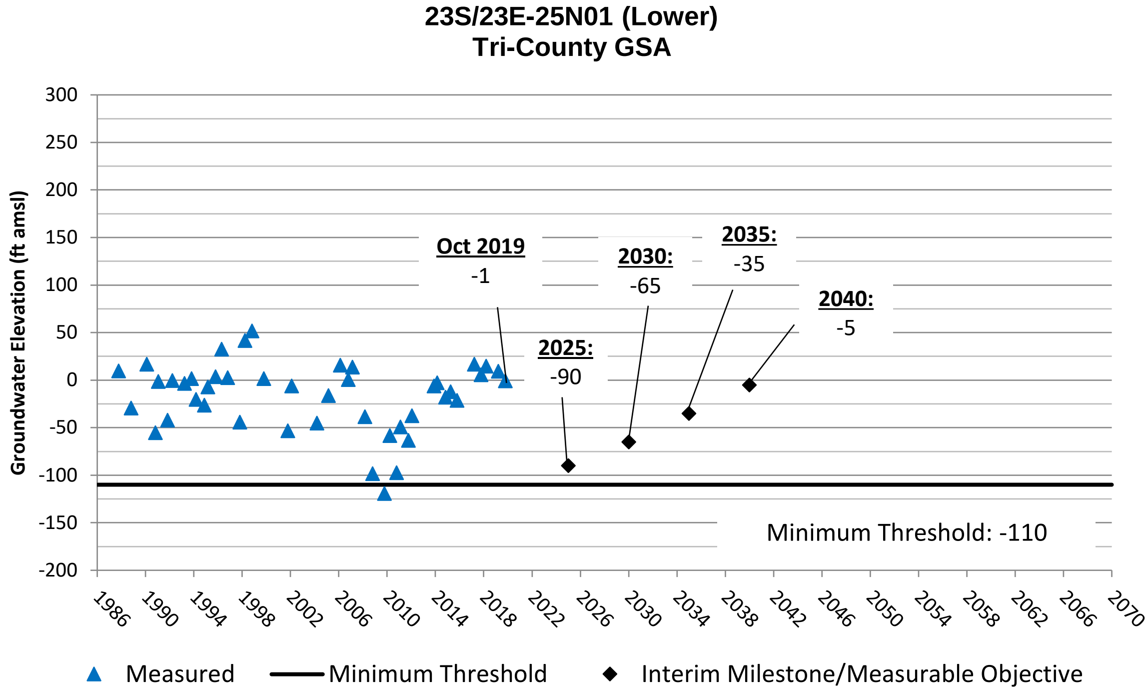


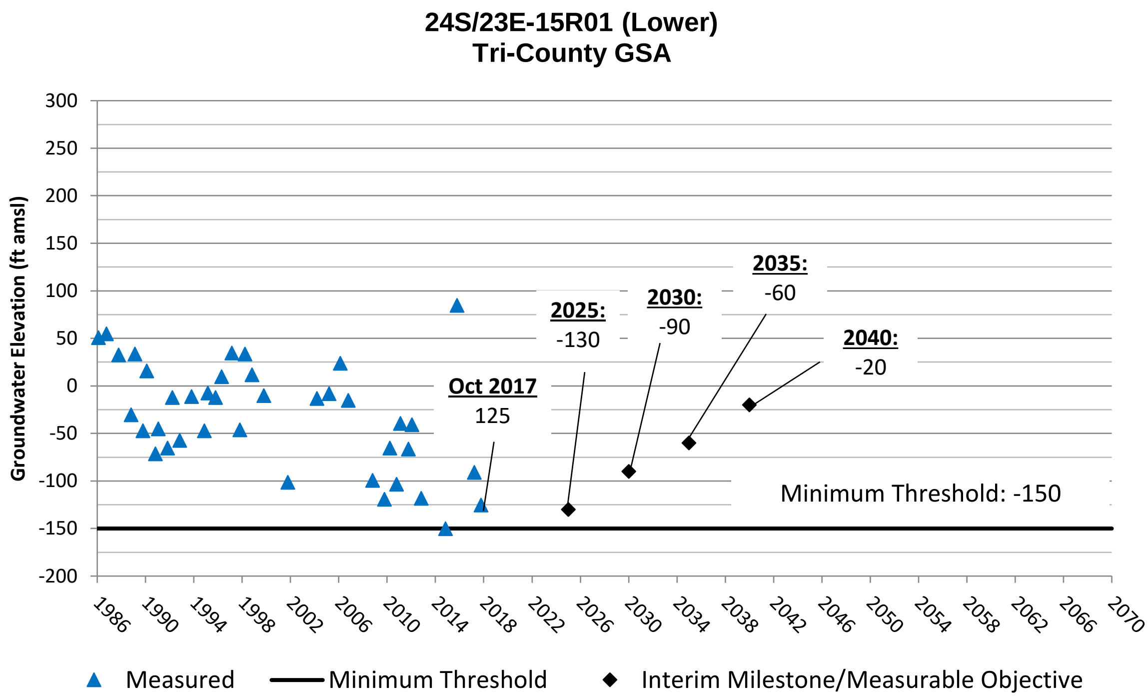
Tri-County Water Authority GSA
RMS Groundwater Elevation Hydrographs



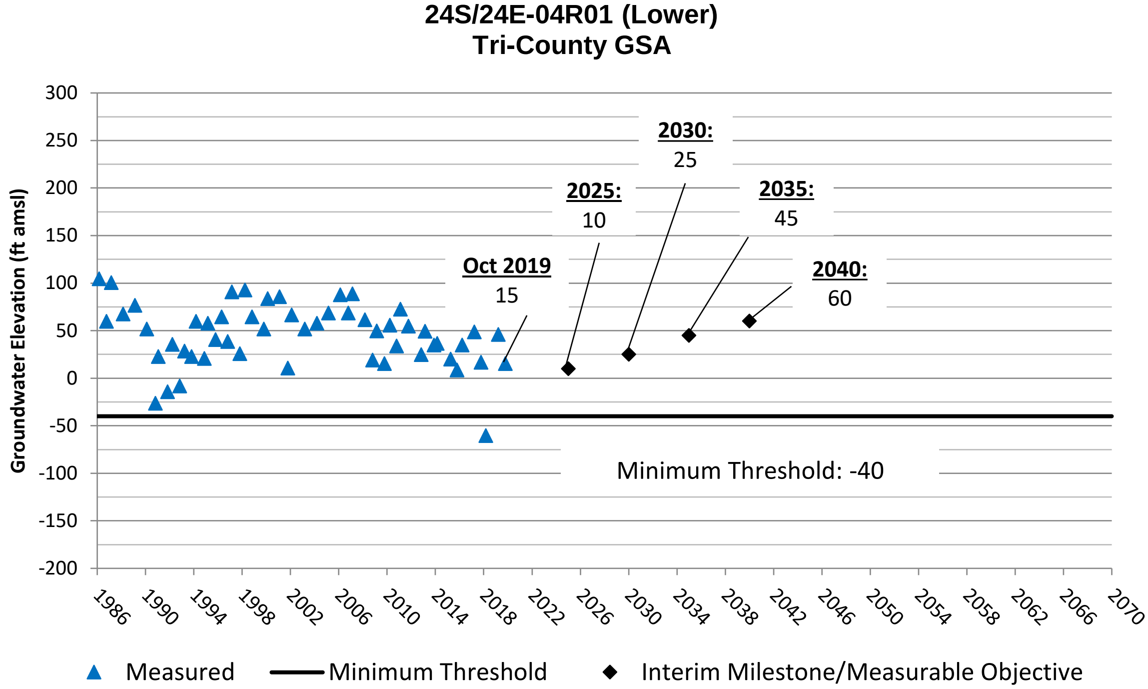


Tri-County Water Authority GSA
RMS Groundwater Elevation Hydrographs





Tri-County Water Authority GSA
RMS Groundwater Elevation Hydrographs



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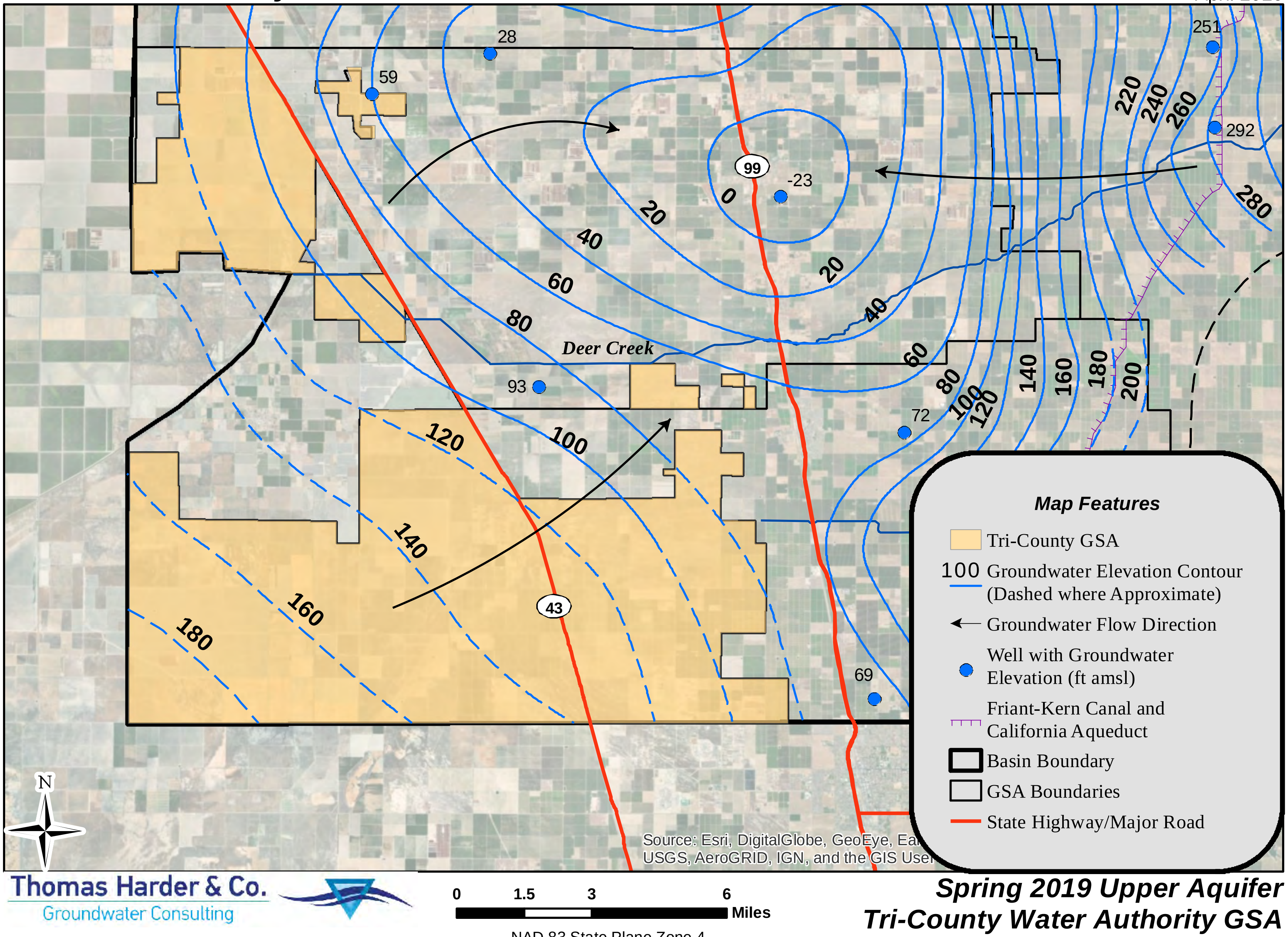
April 2020



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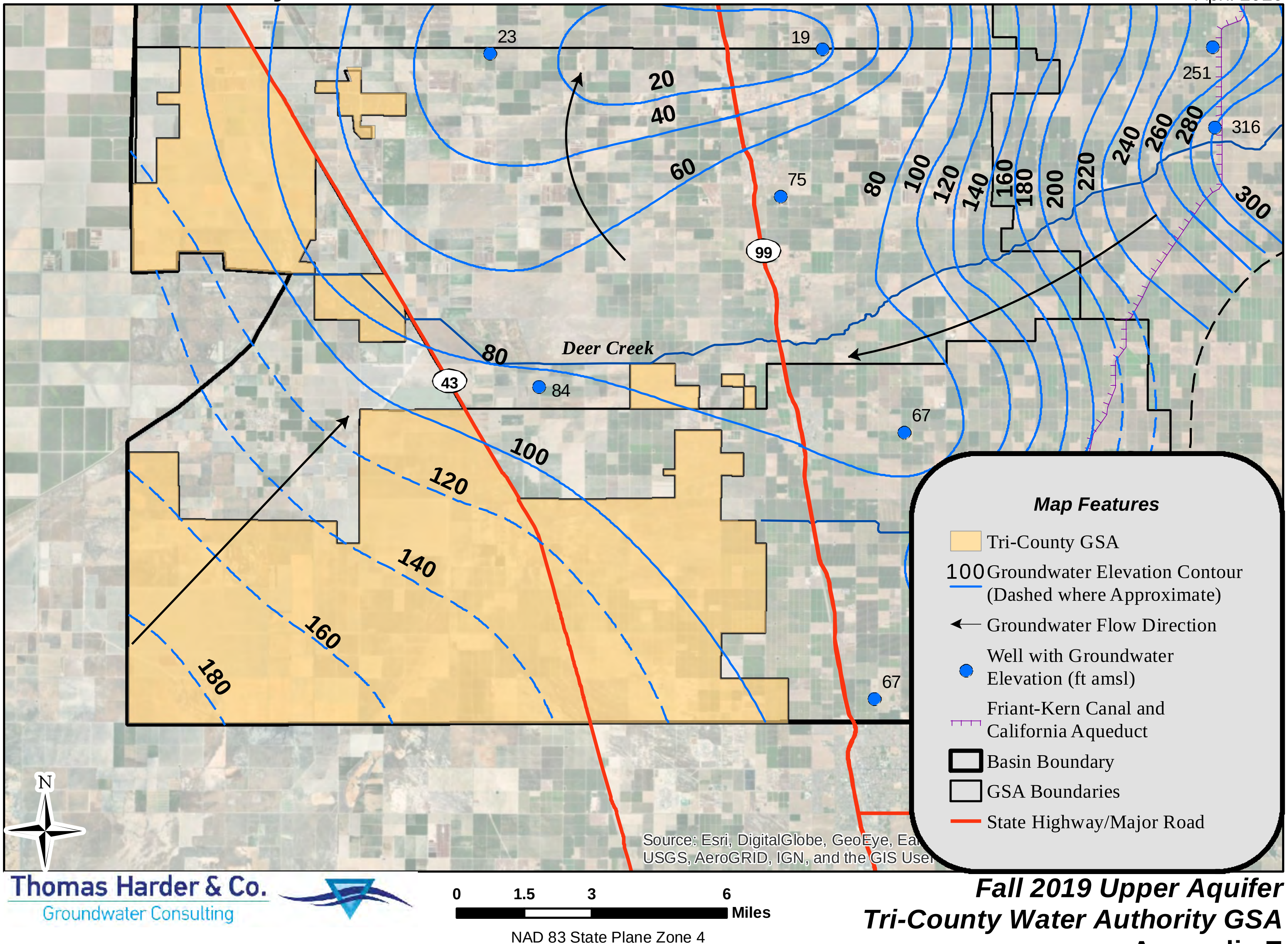
Spring 2019 Upper Aquifer
Tri-County Water Authority GSA
Appendix E
Figure 5

Tule Subbasin
Technical Advisory Committee

2018/2019 Annual Report
April 2020



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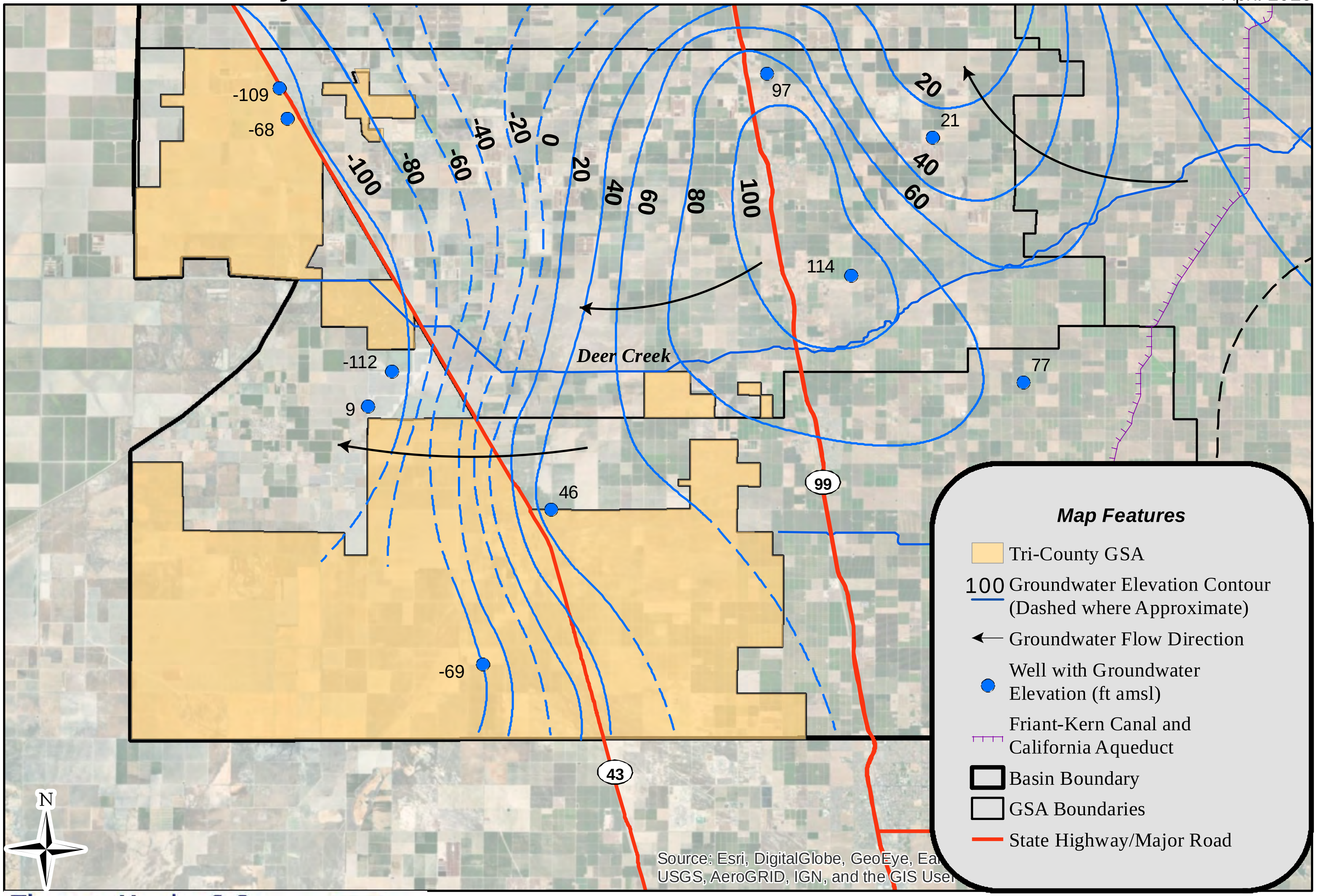
Fall 2019 Upper Aquifer
Tri-County Water Authority GSA
Appendix E
Figure 6



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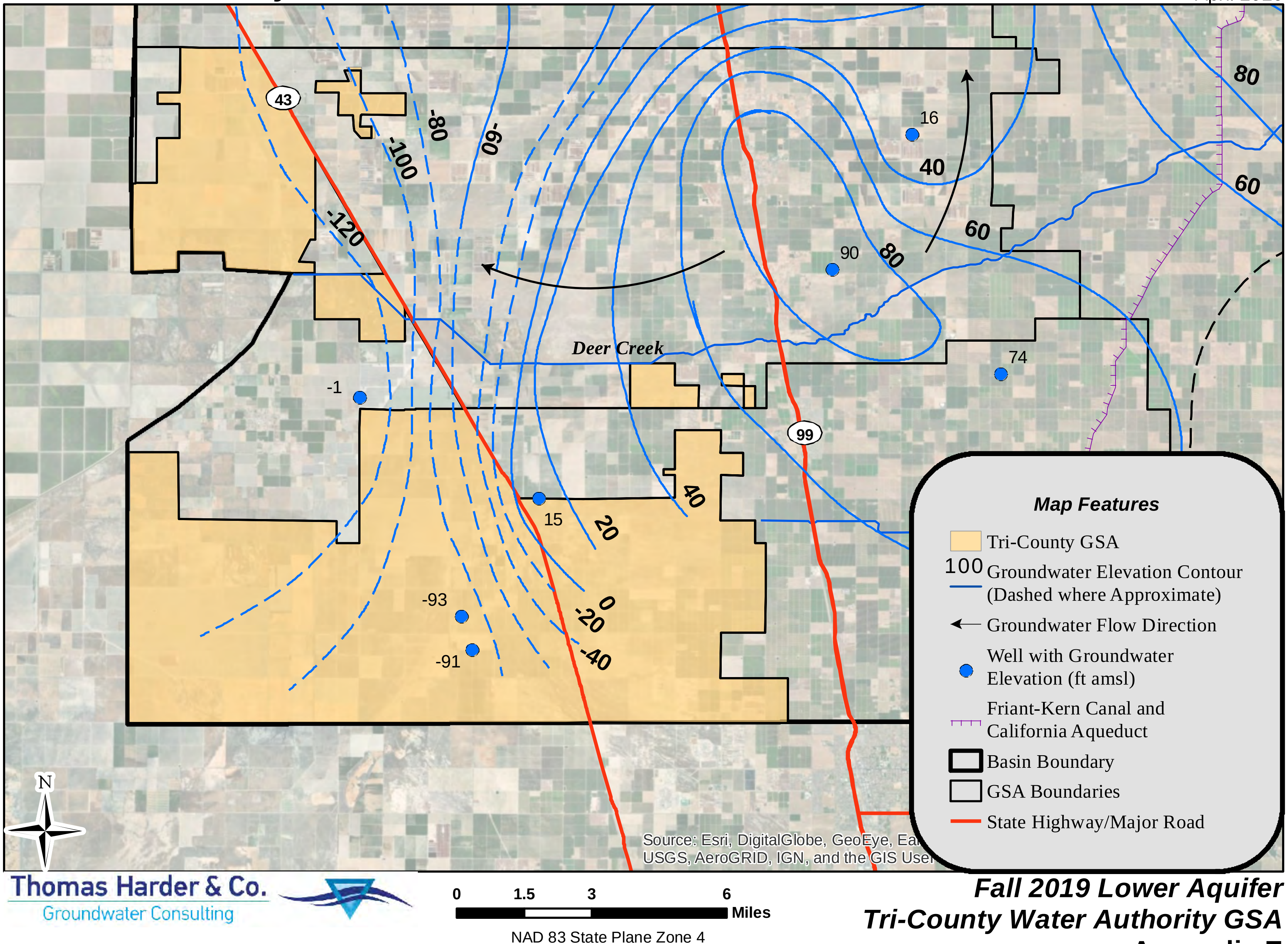
Spring 2019 Lower Aquifer
Tri-County Water Authority GSA
Appendix E
Figure 7

Tule Subbasin
Technical Advisory Committee

2018/2019 Annual Report
April 2020



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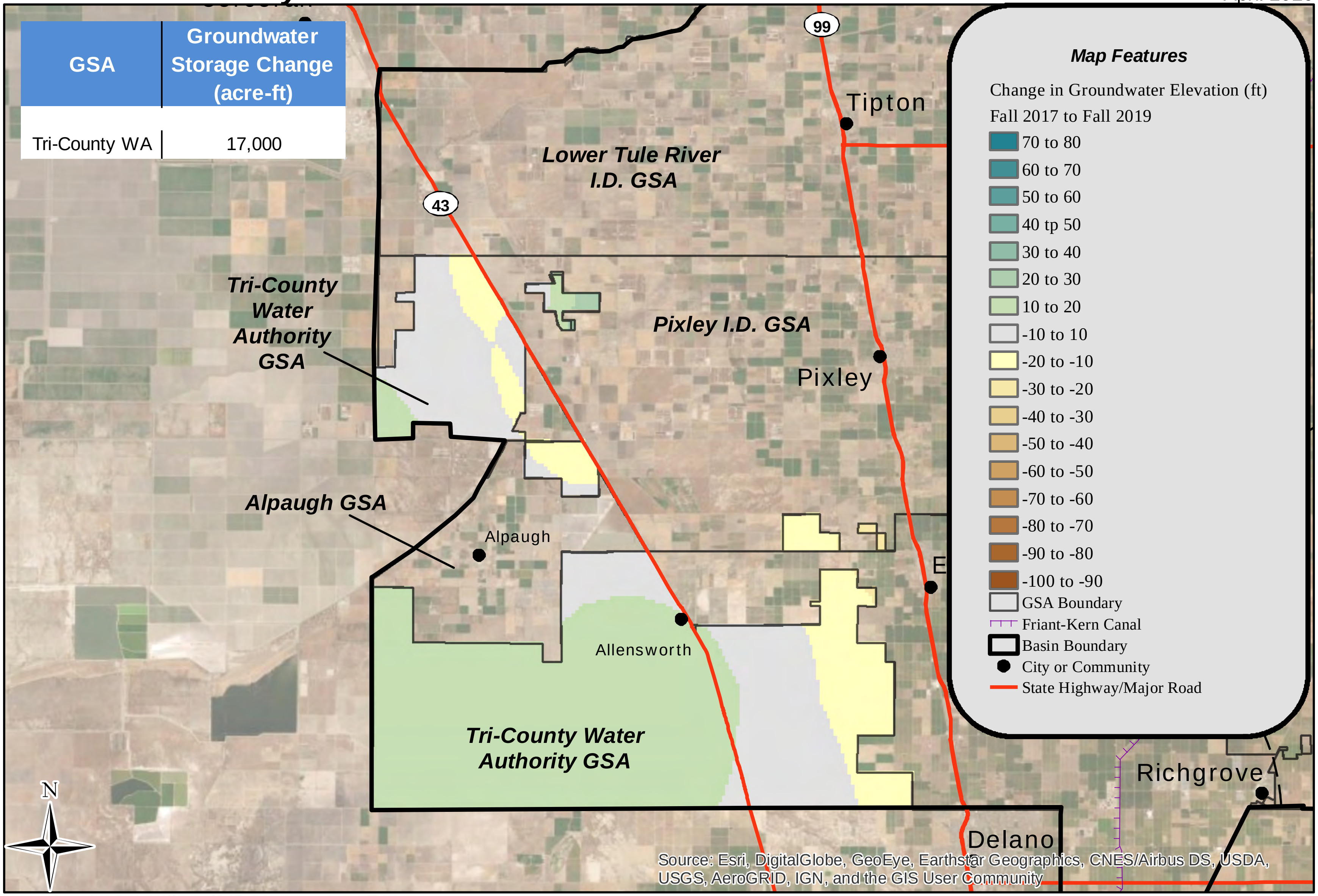
Fall 2019 Lower Aquifer
Tri-County Water Authority GSA
Appendix E
Figure 8

Tule Subbasin
Technical Advisory Committee

2018/2019 Annual Report
April 2020



GSA	Groundwater Storage Change (acre-ft)
Tri-County WA	17,000

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0 2 4 8 Miles
NAD 83 State Plane Zone 4

Change in Groundwater Elevation Fall 2017 to Fall 2019
Tri-County Water Authority GSA
Appendix E
Figure 9

Appendix F

Alpaugh Irrigation District GSA 2018/19 Annual Data

Alpaugh Irrigation District GSA
Groundwater Extraction for Water Year 2018/2019

	Agricultural Pumping (acre-ft)	Municipal Pumping (acre-ft)[1]	Exports (acre-ft)	Total
Alpaugh ID GSA	3,000	300	0	3,300

Note:

[1] Municipal pumping data are for water year 2016/2017.

Alpaugh Irrigation District GSA
Surface Water Supplies for Water Year 2018/2019

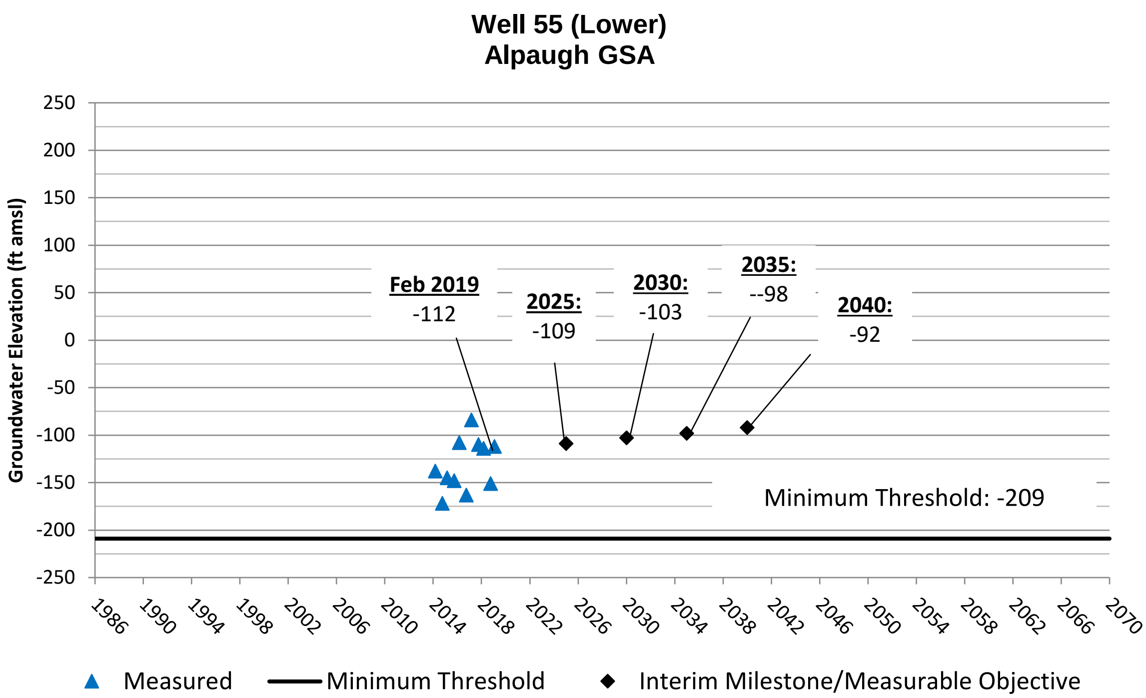
	Stream Diversions[1] (acre-ft)	Imported Water[1] (acre-ft)	Recycled Water (acre-ft)	Oilfield Produced Water (acre-ft)	Total Precipitation (acre-ft)	Total (acre-ft)
Alpaugh ID GSA	3,100	7,157	0	0	12,300	22,557

Note:
[1] Provisional subject to revision

Alpaugh Irrigation District GSA
Total Water Use for Water Year 2018/2019

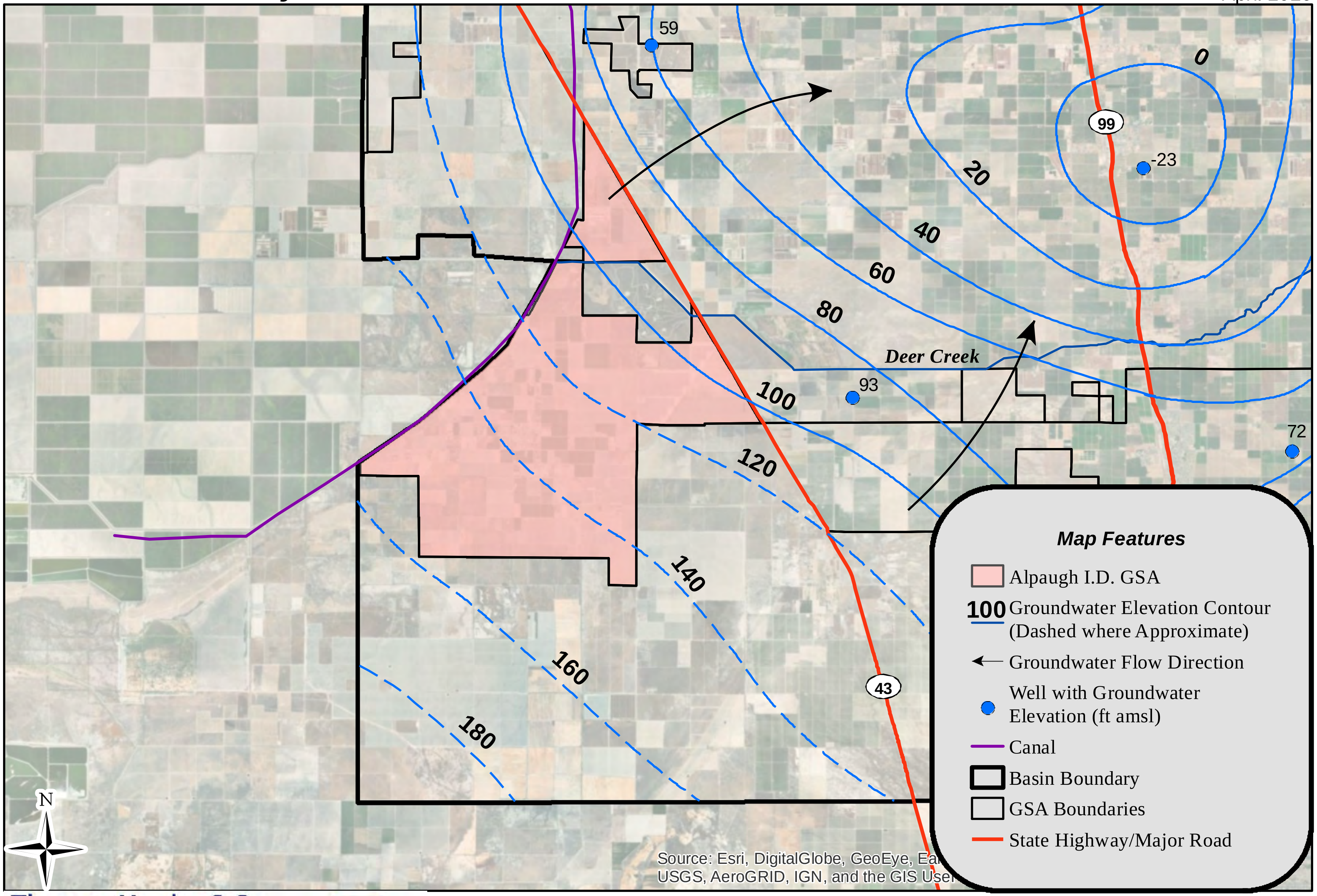
	Groundwater Extraction (acre-ft)	Surface Water Supplies (acre-ft)	Total
Alpaugh ID GSA	3,300	22,557	25,857

Alpaugh Irrigation District GSA
RMS Groundwater Elevation Hydrographs



Tule Subbasin
Technical Advisory Committee

2018/2019 Annual Report
April 2020



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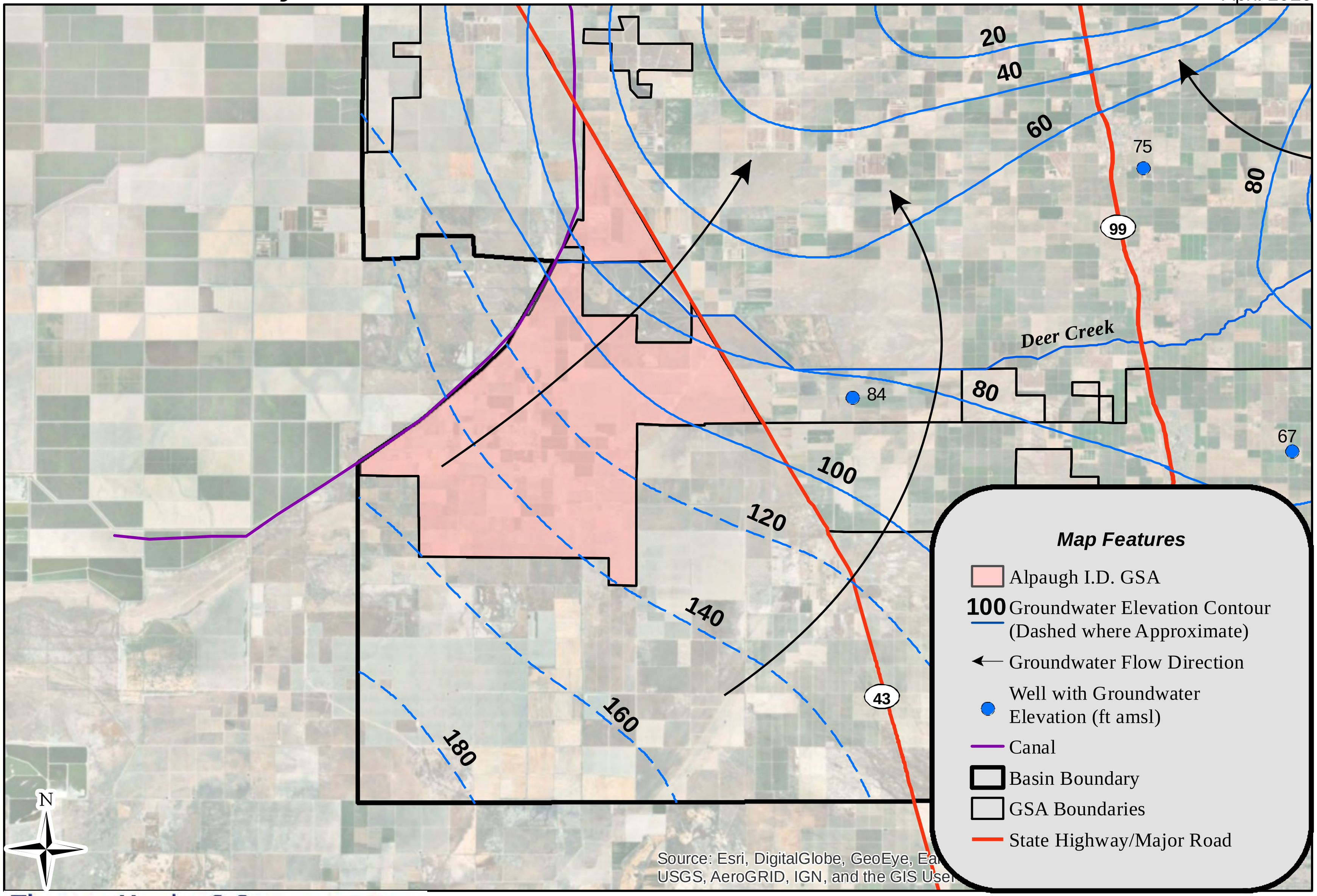
Spring 2019 Upper Aquifer
Alpaugh I.D. GSA
Appendix F
Figure 2

Tule Subbasin
Technical Advisory Committee

2018/2019 Annual Report
April 2020



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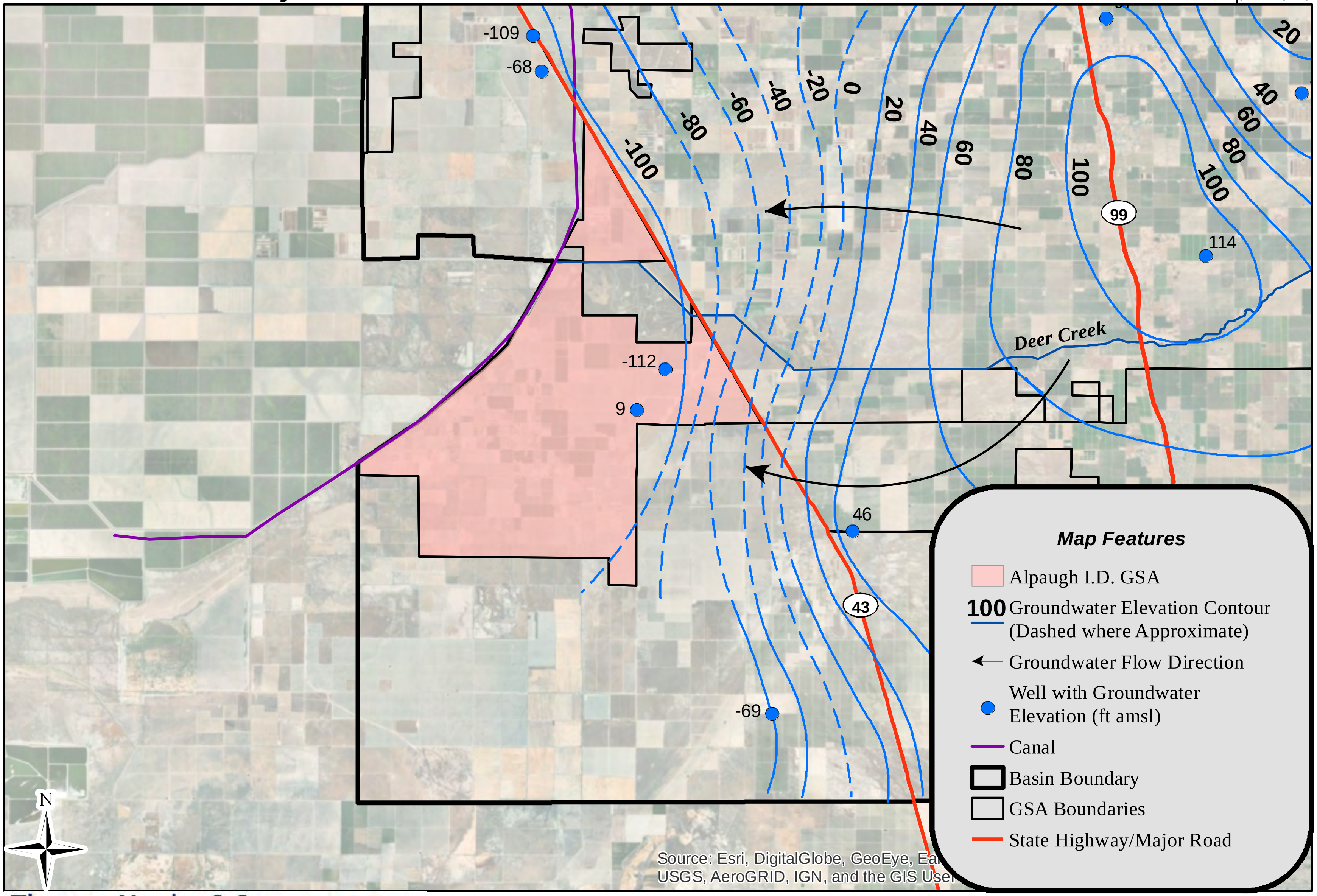
Fall 2019 Upper Aquifer
Alpaugh I.D. GSA
Appendix F
Figure 3

Tule Subbasin
Technical Advisory Committee

2018/2019 Annual Report
April 2020



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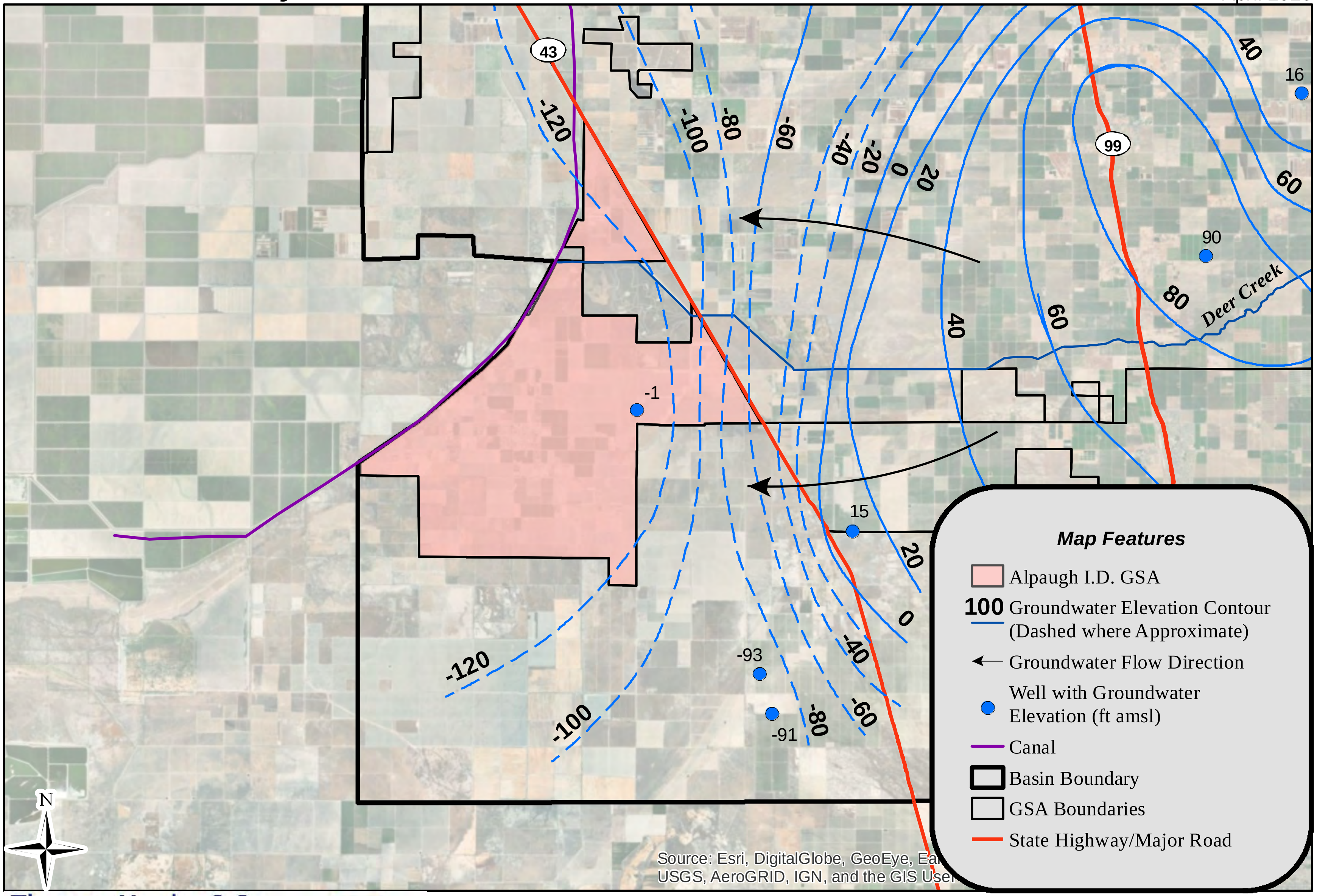
Spring 2019 Lower Aquifer
Alpaugh I.D. GSA
Appendix F
Figure 4

Tule Subbasin
Technical Advisory Committee

2018/2019 Annual Report

April 2020



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0 1.25 2.5 5 Miles

NAD 83 State Plane Zone 4

Fall 2019 Lower Aquifer
Alpaugh I.D. GSA
Appendix F
Figure 5

Tule Subbasin
Technical Advisory Committee

2018/2019 Annual Report

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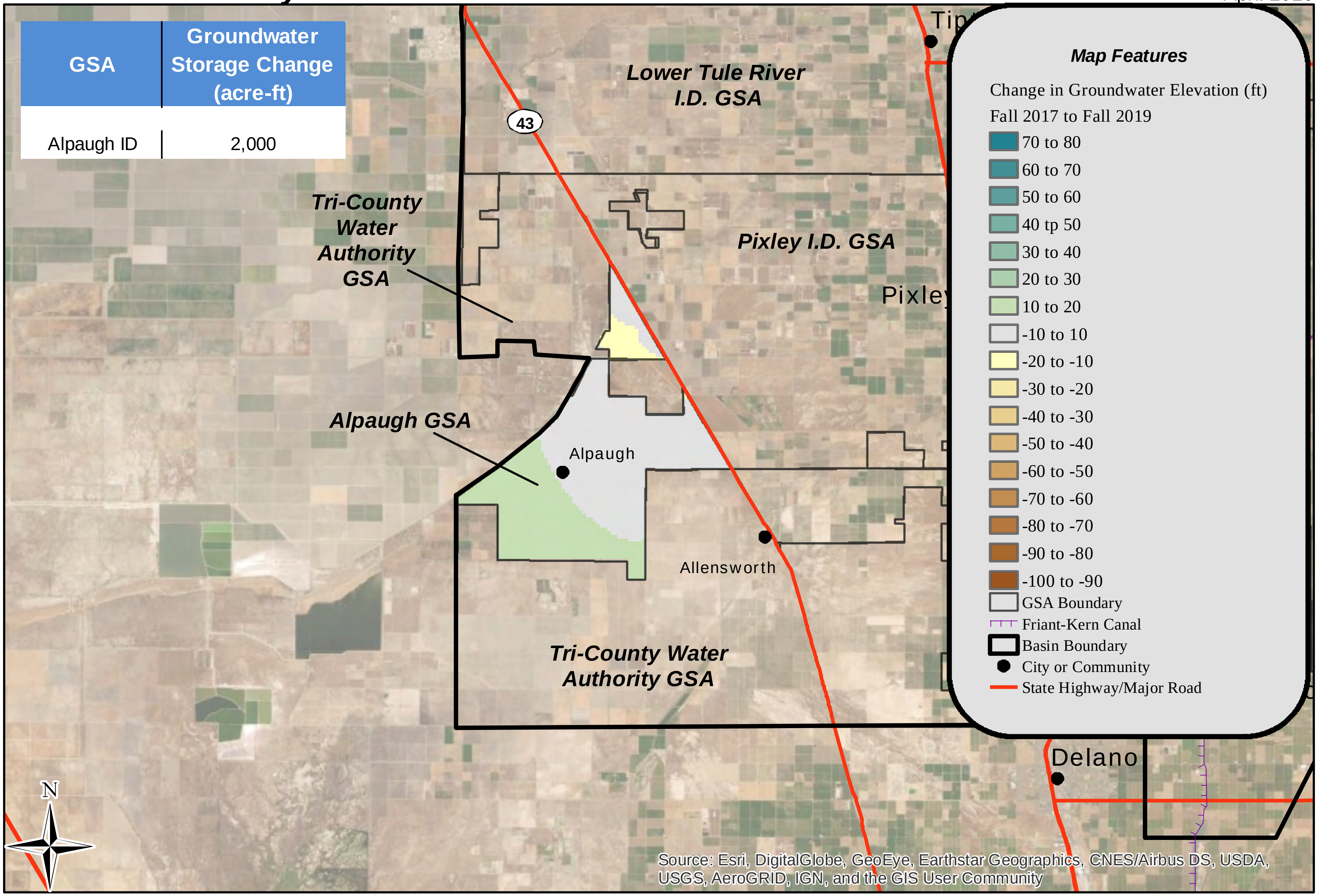

GSA	Groundwater Storage Change (acre-ft)
Alpaugh ID	2,000

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0 2 4 8 Miles
NAD 83 State Plane Zone 4

Change in Groundwater Elevation Fall 2017 to Fall 2019
Alpaugh I.D. GSA
Appendix F
Figure 6

ATTACHMENT 2 – LTRID GSA RULES AND OPERATING POLICIES

Lower Tule River Irrigation District
Groundwater Sustainability Agency

WATER MEASUREMENT & METERING

The landowners within the GSA utilize both surface water and groundwater to meet the needs of the business operations and producing agricultural products. A key component to manage the sustainability of groundwater is to measure quantitatively the total amount of water used by each landowner within the GSA. This will allow the GSA to track groundwater water usage by landowner which can then be correlated to the amounts allowed to achieve sustainability.

The GSA will utilize satellite imagery to determine crop demands at the landowner level as described in more detail below:

Calculate Groundwater Consumed using Evapotranspiration

To calculate the amount of groundwater consumed by the crop, the following equation is applied:

1. Total Applied Surface Water is supplied and metered by the Irrigation District.
2. Total Crop Demand (Evapotranspiration or ET) is calculated by CalPoly – ITRC – METRICS Program.
    a. Consumption, based on the ET calculations will be tracked and will be available in the following sequencing:
        i. Precipitation Yield
        ii. Surface water applied
        iii. Sustainable Yield credits
        iv. District allocated groundwater credits
        v. Transitional groundwater credits**
        vi. Landowner developed groundwater credits**

        **The sequencing of the Transitional water credits and Landowner developed groundwater credits can be switched at the landowner's discretion.

    b. If surface water applied is more than ET, the landowner will receive a credit for over application of surface water according to the following schedule:

    Over Application of Surface Water for Irrigation Purposes

i. The credit calculated using this equation will be tracked and will increase the landowner groundwater account managed by the GSA. For every acre-foot of over applied surface water,

   90% credit goes to the landowner account, 10% to the GSA.

ii. For all groundwater credits issued to the landowners from over application of irrigation water, the credits will be available and carried over to subsequent years. The term of the credits will be perpetual. The groundwater credits can also be transferred, sold, or leased to other landowners based upon the GSA groundwater transfer policy.

The satellite imagery used to determine the ET values, will be audited by the GSA through spot checking land use for cropping patterns and compared to District metered data.

Lower Tule River Irrigation District Groundwater Sustainability Agency

GROUNDWATER BANKING AT THE LANDOWNER LEVEL

Irrigation District Recharge

The irrigation district oversees and manages the surface water for the district, separate and apart for the Groundwater Sustainability Agency. The irrigation district recognizes the surface water supplied is very important to achieve groundwater sustainability and needed for the landowners to continue operations of their farms and that landowners need to be able to balance all of these resources to achieve sustainability under SGMA.

When surface water beyond what is needed to meet irrigation demands is available, the irrigation district will maximize the use of these surface waters and divert these waters into the natural waterways, open channel canals, and district owned recharge basins. This will occur most often during above average water years when those waters cannot be stored and are released from local reservoirs. The surface water diverted and recharged into groundwater into district owned facilities is done to benefit all the landowners within the district without regard for specific credits under SGMA. Additionally, the irrigation districts will continue to optimize the distribution systems to maximize the recharge of surface water while supplying surface water to landowners as efficiently as possible.

Landowner Groundwater Banking

During periods where surplus surface waters are available, landowners within the GSA can divert surface water into landowner owned designated recharge facilities for future groundwater credits. Surface water for banking can be:

1. Water the landowner purchases from the irrigation District through regular surface water purchase procedures.
2. Water rights water available to the landowner. E.g. Poplar Ditch share water
3. The District has established the following priority order of water service and related canal capacities:
   - Deliveries for irrigation demand
   - District recharge/banking for the benefit of all landowners
   - Landowner recharge/banking

When this occurs, the landowner can bank this surface water that is recharged to groundwater under the following conditions:

1. The surface water purchased must be applied directly to a specific groundwater recharge basin that meets the minimum GSA requirements for a groundwater

recharge basin. The location of the basin must be registered with the GSA to receive any credits.

- All surface water diverted to the landowner is required to be metered per GSA metering requirements.
- Surface water diverted will be credited to the landowner at 90% of the surface water diverted. The remaining 10% credit will remain with the GSA for the benefit of all the landowners.
- The groundwater credits issued to the landowners will be available and carried over to subsequent years. The term of the credits will be perpetual. The groundwater credits can also be transferred, sold, or leased to other landowners based upon the GSA groundwater transfer criteria.

2. Landowners can also use District owned recharge facilities to generate groundwater credits subject to the following criteria:
    - The landowner provides water from available allocation, purchase or water rights
    - Use of the District recharge facility is subject to available capacity as determined by the District
    - Groundwater credits will be credited to the landowner account at 75% of the surface water diverted. The remaining 25% credit will remain with the GSA for the benefit of all the landowners.

Lower Tule River Irrigation District Groundwater Sustainability Agency

WATER ACCOUNTING AND WATER TRANSFERS

To effectively achieve groundwater sustainability within the GSA and the Tule Subbasin, while maintaining the agriculture operations during the implementation of SGMA, each landowner within the GSA will be provided a baseline groundwater credit. These groundwater credits act as an individual water bank account for each landowner, allowing each landowner to decide how to feasibly and economically manage their farm operation within the rules established by the GSA and the Tule Subbasin.

Water Accounting:

To adequately track, monitor, and account for the water credits within the GSA, the following water budget will be established and monitored for each landowner[1] in the GSA:

Groundwater Credit Inputs:	Definition:
Tule Subbasin Sustainable Yield	Common Groundwater available to all landowners within Tule Subbasin, defined under Subbasin Coordination Agreement
Precipitation Yield	Annual average precipitation in the GSA, calculated from 1991 going forward.
Districted Allocated Groundwater Credits	Allocated by the Board annually. Based on water diverted for recharge by the District, along with canal seepage losses in District canals. Allocated amounts will be credited to landowners proportionally based on assessed acres.
Landowner Developed Credits	• Surface Water diverted by the landowner into a specified recharge basin, credited per criteria set forth in Policy 2: Banking at Landowner Level • Surface Water over-applied by landowner beyond crop demand, credited per criteria set forth in Policy 2. • Groundwater credits obtained from other landowners.

A credit or deficit for each landowner account will be accounted for on a monthly basis by the GSA.

Water Transfers:

Landowners may transfer groundwater water credits through either a direct sale or lease. The process for transferring groundwater credits is as follows:

- Groundwater credits will be tracked at a land-based level. Transfers of any credits accrued to the land requires the written approval of the landowner to transfer.
- Groundwater credits can only be transferred by a landowner that has a positive balance in their groundwater budget. Deficit groundwater credit transferring is not allowed.
- A groundwater credit transfer is a one to one transfer within the GSA. Transfers outside the GSA are subject to the Coordination with other Tule Subbasin GSAs.
- All groundwater credit transfers require formal notification (GSA approved transfer template) and approval of the GSA. The GSA will keep an account of all transfers within the GSA Water Accounting Program. The sale or lease terms of the groundwater credits is between landowners and not subject to disclosure.

Lower Tule River Irrigation District Groundwater Sustainability Agency

TRANSITIONAL GROUNDWATER CONSUMPTION

To assist landowners with the transition to implementation of the Sustainable Groundwater Management Act, groundwater use and extraction above basin wide sustainable yield will be phased based on periodic reviews of the GSP per the guidelines of SGMA.

The GSA will provide access to a water accounting program to track all water credits including District allocated groundwater credits, landowner developed groundwater credits, sustainable yield credits, precipitation yield credits, surface water allocations and transitional water consumption.

During the period of GSP implementation, transitional water credits (groundwater consumption above other available credits), may be consumed consistent with the following criteria:

1. Use will be consistent with the policies established for avoiding the undesirable effects under SGMA;
2. Transitional water will be available based on the following sequencing:
    i. Precipitation yield credits
    ii. Surface water allocation
    iii. Sustainable yield groundwater credits
    iv. District allocated groundwater credits
    v. Transitional water credits**
    vi. Landowner developed groundwater credits**
    **The sequencing of the Transitional water credits and Landowner developed groundwater credits can be switched at the landowner's discretion.
3. Transitional water credits will be available based on assessed acres and made available in 5-year blocks.
4. Transitional water credits stay with the landowner to be used on properties within the GSA and cannot be transferred to other landowners.
5. An upper limit for net groundwater use, including transitional water allocations, will be established. Exceeding this limit will result in fines and reduced allocations in the next year, per Policy #8 Implementation & Enforcement of Plan Actions.
6. There will be a phased approach to the availability of groundwater for transitional water. The GSP will provide for levels of groundwater consumption that will be higher during the initial phases and decreasing over time to reach sustainable consumption levels (as required by SGMA) by 2040. The amount of Transitional water available will be determined at the beginning of each phase.
    a. The first phase of transitional water will be from 2020 through the 2025 (2 AF/Acre/year)
    b. The second phase of transitional water will be from 2026 through 2030

(1.5 AF/Acre/year)

c. The third phase of transitional water will be 2031 through 2035 (1 AF/Acre/year)
d. The final phase of transitional water will be from 2031 through 2040 (0.5 AF/Acre/year)

7. There will be a fee schedule for transitional water consumption. The fee schedule will be implemented as described below in 2020.
    i. Tier 1 of transitional water consumption is 50% of the total transitional water allocated for the period and shall be assessed a fee of $90 per acre foot starting in 2021. The price will be adjusted annually by the Board based on a formula using the change in the Friant Class 1 water rate.
    ii. Tier 2 is transitional water consumption over Tier 1, up to the total transitional water allocation and shall be charged a fee of two times the rate of tier 1 transitional water consumption.
    iii. There will be no fee applied during 2020 for the first 2 acre-feet of Transitional water consumed. Consumption over 2 acre-feet during 2020 will follow the fee schedule above.

The above fee schedule is intended to serve as both a disincentive mechanism while also relating to the cost of mitigating the impacts of use of transitional pumping allocations. The above amounts, being based on the cost of Friant Class 1 water, were based in part on an analysis of replacement water costs, and in part on the costs of groundwater production as the basis for an effective economic disincentive. Further analysis and additional justifications for the level of the fee may be considered by the GSA between adoption of this policy and full implementation of the fee in 2021.

8. Revenues will be used to mitigate impacts and implement projects and programs including, but not limited to:
    - Friant Kern Canal capacity correction
    - Surface water development
    - Additional recharge basin construction
    - Monitoring impacts and effects of groundwater pumping.
    - Other projects that may be identified by the GSA. (examples could include water conservation grants to GSA members, land conservation and set-aside programs, or any other projects the GSA deems appropriate to help meet the sustainability goal).

A specific plan of mitigation will be developed prior to full implementation of the fee in 2021 and will be based on relative levels of impacts that can be shown to be associated with transitional pumping. Additional analysis, including technical analysis of projected impacts together with costs of effective and reasonable mitigation measures, will be completed as part of GSP implementation.

Lower Tule River Irrigation District Groundwater Sustainability Agency

LANDOWNER SURFACE WATER IMPORTED INTO THE GSA

District Landowners may participate in water exchanges or transfers outside of the GSA boundary that result in surface water being available for direct use by the landowner. Use of that water by the landowner within the GSA requires the use of Irrigation District infrastructure to divert this surface water to their land.

This surface water that is brought into the GSA by the landowner will be tracked and accounted by the GSA and applied to the landowner's water budget according to the following procedures:

1. Surface water brought into the GSA and credited to the landowner will be subject to a loss/reduction factor as determined by the Irrigation District Board of Directors.

2. Surface water brought into the GSA will be delivered to the landowner based upon canal capacity. No surface water delivery brought into the GSA will interrupt or interfere with scheduled allocations of the District surface water supplies.

3. Imported surface water may be used for groundwater recharge subject to the policies of the GSP.

Lower Tule River Irrigation District Groundwater Sustainability Agency

DISTRICT ALLOCATED GROUNDWATER CREDITS

The Irrigation District (District) owns and operates existing recharge basins. These basins, along with the open channel canal distribution systems, provide for both direct and indirect groundwater recharge. During times when surface water supplies beyond the irrigation needs of the landowners are available, the District uses the basins to divert the surface water for groundwater recharge. This happens most often in wetter years and comes in the form of Class Two under the Friant Contracts and flood releases from Lake Success. Recharge through channel loss in the distribution system occurs at all times when water is in the canals. These District owned facilities create additional opportunities for establishing groundwater credits beyond the Safe Yield of the Tule Subbasin.

Any groundwater credits developed through recharge basins and through loss in the distribution system remains with the District and will not be allocated to the landowners until a determination is made by the GSA Board that minimum threshold amounts identified in the GSP have been met.

<u>District Owned Land Based Groundwater Recharge Credits:</u>

The lands owned through fee title by the irrigation district are allocated a sub basin wide Sustainable Yield. The Sustainable Yield allocated to District owned lands by virtue of being in the Tule Subbasin, will be re-allocated back to the District Landowners proportionate to the landowner's assessed acreage in the GSA.

<u>Surface Water Recharge Groundwater Credits:</u>

The imported surface water that is diverted for recharge by the District into District owned facilities (both recharge basins and canals) will be tracked and accounted as a groundwater credits belonging to the District. The District will allocate these credits to lands within the GSA in the following manner:

- Up to 90% of the water diverted into the District groundwater recharge basins, and water accounted for as channel loss in the canals, will be available for allocation. The remaining 10% of the recharge water will not be allocated to landowners in the District as it is used to account for evaporation and other losses. Adjustments to the percent of recharge water allocated as groundwater credits may occur based on groundwater monitoring, avoiding undesirable results, and to help avoid minimum thresholds.
- The District will allocate the groundwater recharge credits proportionally to all landowners within the District by assessed acres. All District landowners pay an equal land based assessment and each landowner will be provided an equal groundwater credit based upon gross acreage owned within the District and irrespective of any

access to surface water that landowners may have through water rights, riparian water or any other surface water.

- The transfer or sale of the District groundwater recharge credits within the GSA will be permitted in accordance with Policy 3.

Lower Tule River Irrigation District Groundwater Sustainability Agency

CSD & PUD Water Use within the GSA

A community service district (CSD) is an entity formed by residents of an unincorporated area to provide a wide variety of services to its residences, particularly water and wastewater management, along with many others. A CSD may be formed and operated in accordance with the Community Services District Law (Government Code §61000-61850), which was created to provide an alternate method of providing services in unincorporated areas.

The Public Utility District Act authorizes the formation of public utility districts (PUD) and authorizes a district to acquire, construct, own, operate, and control works for supplying its inhabitants with water and other critical components for everyday life.

Within the LTRID GSA boundary are the following CSDs and PUDs ("Community):

- Tipton CSD
- Woodville PUD
- Poplar CSD

Each Community entered into an MOU with the LTRID GSA to cooperate on SGMA implementation. Consistent with Section 3 of the MOU, the Community will be considered within the boundaries of the LTRID GSA and included in the LTRID Groundwater Sustainability Plan.

Consistent with Section 6 of the MOU,_LTRID will identify the Community as a separate management area. As its own management area, LTRID will specifically address the minimum thresholds and measurable objectives for the Community to achieve sustainable management.

Reporting of Community Water Use

Consistent with Section 7 of the MOU, the Community will provide LTRID the following information for determining the net groundwater usage of the Community:

On a quarterly basis:

- Each Community will submit the total of groundwater pumped from Community wells.
- Each Community will submit the total of water discharged to the wastewater treatment system that is treated and diverted to percolation/evaporation ponds

Minimum Thresholds and Measurable Objectives

The following will be considered the minimum thresholds and measurable objectives required by the Community to meet the sustainability for the implementation of the LTRID GSP for the period from January 2020 to January 2026:

- The net of water pumped minus water discharged will be considered total Community water use

- The total of all treated water discharged to percolation/evaporation ponds, less 10%, will be available to the LTRID GSA for calculation and use in total LTRID GSA water balance.

- If the Community is providing any treated discharge to adjacent lands, the Community shall provide a regular accounting to the LTRID GSA that includes total volume amount discharged and APN(s) receiving the discharge.

- The water use will be reviewed through periodic updates to the GSP and will be compared to the available sustainable yield for the community and pumping limits acceptable to the GSA, as allowed under the regulatory code of SGMA.

- Community wells will include all wells used by the Community that are connected to the Community water distribution system.

- The Community and the GSA Board of Directors agree to cooperate on conditions of approval for future growth to ensure they are consistent with GSA and Community policies including pursing grant funding opportunities, outreach and joint projects for developing additional water supply for the Community.

Lower Tule River Irrigation District Groundwater Sustainability Agency

IMPLEMENTATION & ENFORCEMENT OF PLAN ACTIONS

This Groundwater Sustainability Plan (GSP) establishes the actions, which include the policies, projects, and implementation schedule, to achieve groundwater sustainability, in accordance with the Sustainable Groundwater Management Act (SGMA).

A major element of implantation is the establishment of the accounting system, the enforcement of regulatory fees related to that system of accounting, and identification of mitigation items to be funded through those fees. Regulatory fees, and the process for establishing them, are discussed in greater depth in Policy 4 related to Transitional Pumping policies. As noted in that policy, the level and justification for fees for transitional pumping are subject to continued analysis and decision making by the GSA governing body, and will be a major element of implementation of the GSP.

Regarding enforcement, for those landowners within the GSA who do not comply with the Actions of the GSP established to achieve sustainability, SGMA provides the GSA with the authority to enforce the approved actions. The Action of the GSP which are enforceable under the GSP include:

1. Failure to pay GSA assessments or groundwater consumption fees
2. Consumption of groundwater beyond the allowable limits set forth in the GSP
3. Failure to provide the GSA with required information

In the event of noncompliance by a landowner of the GSA, the following enforcement process will be implemented:

- At time a landowner is identified as not complying with the approved Actions of the GSP, a Notice of Non-Compliance (NONC) letter will be issued to the landowner. The NONC will identify the area(s) of non-compliance and request formal response from the landowner identifying plan to get back into compliance within 30 days.

- If the landowner does not respond to the NONC letter within 30 days, a Notice of Violation (NOV) will be issued to the landowner, stating that the landowner is now in violation of the GSP implementing SGMA. The NOV will request a meeting within 15 days to discuss a plan of action to meet compliance. At the time of issuing a NOV, an administrative fine of $5 per acre fee will be assessed to that parcel(s) in violation, to be paid within 15 days.

- If a landowner has been determined to have consumed groundwater beyond the allowable limits, the landowner will receive a penalty of $1,000 per acre-foot and a reduction of groundwater credits will be applied to the landowner account. The reduction shall be the overage of consumption plus an additional factor of 1.5 times.

- If a landowner does not correct a NOV, a lien against the property will be filed by the GSA and the GSA will pursue action according to Water Codes Sections 25500- 26677

- If a lien has been filed against the property for outstanding balances (amounts added to assessments) from the previous year, then the landowner will not be served any surface water pursuant to Irrigation District policy.

- All fees collected will be used to for GSP implementation activities, including but not limited to, GSA administration and GSP project funding and implementation.

As with regulatory fees, all enforcement actions are subject to further refinement and definition as technical data and monitoring results are collected through the various management actions identified in the GSP.