CHAPTER 4
Monitoring Networks

Monitoring networks are required to better understand and evaluate changing conditions within the groundwater, surface water, and land surface systems. To optimize data collection and analysis, the network should be easily accessible, spatially and temporally relatable to other monitoring networks, sufficient for demonstrating spatial and temporal trends, and representative of actual conditions. The following sections discuss the Colusa Subbasin monitoring network objectives, requirements, monitoring protocols, network sites, data gaps, and proposed actions.

4.1 MONITORING NETWORK OBJECTIVES

Title 23 Section §354.34b of the California Code of Regulations (23 CCR §354.34(b)) states that the monitoring network objectives shall be implemented to:

(1) "Demonstrate progress toward achieving measurable objectives described in the [Groundwater Sustainability] Plan.

(2) Monitor impacts to the beneficial uses or users of groundwater.

(3) Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds.

(4) Quantify annual changes in water budget components."

Monitoring network objectives for the Colusa Subbasin were designed to address the requirements of five sustainability indicators (not including seawater intrusion, which is not applicable to the Colusa Subbasin) in support of the future measurable objectives and minimum thresholds. The overarching goals of the monitoring networks are to: (1) characterize current and historical conditions within the groundwater, surface water, and land surface systems, and (2) evaluate future impacts of implemented GSP projects on the availability and quality of the Colusa Subbasin's water supply.

The monitoring network objectives are to characterize:

- Groundwater levels, availability and flow characteristics;
- Surface water availability and interactions with groundwater;
- Quality of groundwater; and,
- Extent and rate of land subsidence.

4.2 MONITORING NETWORKS

The following sections describe the monitoring sites included in the Colusa Subbasin groundwater level, groundwater quality, land subsidence, and surface water monitoring networks. Most of the networks consist of non-GSA controlled programs and are reliant on data provided by external agencies.

4.2.1 Representative Monitoring Points

Representative monitoring points were not designated for the Colusa Subbasin monitoring networks. Per 23 CCR §354.36, "*Each Agency may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin…*" Instead of representative monitoring sites, the GSAs will use any available data collected via the monitoring networks described in the following sections, or elsewhere, to evaluate impacts to sustainability indicators.

4.2.2 Groundwater Level Monitoring

Groundwater levels will be monitored to evaluate groundwater elevations, reduction in groundwater storage, and stream-aquifer interactions throughout the subbasin. The GSP groundwater level monitoring network is based on the existing groundwater monitoring networks of Colusa and Glenn Counties.

4.2.2.1 Requirements

The groundwater monitoring network should have sufficient density to represent spatial and temporal trends through the Colusa Subbasin:

- Spatial densities should sufficiently represent both lateral and vertical extents of the groundwater basin.
  - The quantity and density of groundwater monitoring wells should be sufficient to evaluate overall static groundwater conditions for each principal aquifer and sufficiently support evaluation of impacts from implemented GSP projects and management actions.
  - The quantity and density of groundwater monitoring wells shall be sufficient to evaluate groundwater conditions for the basin and any GSP-defined management areas (23 CCR §354.34(d)).
- Groundwater monitoring network shall be designed such that the sustainability indicators are adequately covered, not just over the entire basin, but also within any specific GSP-defined management areas (23 CCR §354.34(d)). The sustainability indicators supported by the groundwater level monitoring network include:
  - **Chronic lowering of groundwater levels**
    - 23 CCR §354.34(c)(1) specifies that the groundwater monitoring network shall be sufficient to represent the seasonal occurrence, flow direction, and hydraulic gradients of groundwater within and between the principal aquifer and surface waters.
  - **Reduction in groundwater storage**
    - Data from the groundwater monitoring network shall be sufficient to enable calculations of annual changes in groundwater storage over time (Monitoring Network BMP, DWR, 2016a).
  - **Depletion of interconnected surface water**
    - The groundwater monitoring network shall be sufficient to represent the seasonal occurrence, flow direction, and hydraulic gradients of groundwater between the principal aquifer and surface waters (23 CCR §354.34(c)(6)). Per the Monitoring Network BMP (DWR, 2016a), shallow groundwater monitoring wells should be appropriately located with respect to connected streams to enable characterization of the groundwater levels adjacent to connected stream channels. The groundwater monitoring network should extend away from and along the stream course at appropriate intervals and be monitored on a frequency to capture seasonal pumping conditions (DWR, 2016a).

The Monitoring Network BMP states that the groundwater monitoring network should be able to provide data sufficient to:

- Represent the unconfined and confined parts of the principal aquifer.
- Support evaluation of Data Quality Objectives (DQOs); for example, collecting groundwater level data to support evaluation of stream-aquifer interactions.
- Support delineation of areas with declining groundwater elevations, recharge areas, and conditions at basin boundaries.
- Groundwater level monitoring frequencies shall be capable of representing:
  - Short-term, seasonal, and long-term trends (i.e., minimum of twice-annually to represent seasonal high and low groundwater conditions) per 23 CCR §354.34(c)(1)(b)).
  - Groundwater conditions, as necessary, to evaluate the progress of GSP implementation (23 CCR §354.34(a)).

In accordance with the Monitoring Network and Identification of Data Gaps Best Management Practices (Monitoring Network BMP) documentation (DWR, 2016a), groundwater monitoring network sites should be:

- Dedicated groundwater monitoring wells, if possible, with known construction characteristics:
  - Water supply wells may be used temporarily, if needed
  - Water supply wells should be screened within a single water bearing unit
  - Care should be taken to allow static water levels to recover prior to data measurement
- Monitoring wells should have depth-dependent screened intervals to enable characterization of the groundwater table or potentiometric head in the principal aquifer (23 CCR §354.34(c)(1))
- Designed considering nearby pumping wells

Monitoring sites shall include the following information (23 CCR §352.4(a) through (c):

- Unique station identifier and CASGEM Identification (ID)
- Site description, well location (North American Datum of 1983 [NAD 83], latitude and longitude decimal degrees to five decimal places)
- Well use, well status, well type
- Elevation of ground surface (accurate to 0.1 feet North American Datum of 1988 [NAVD 88])
- Elevation and description of reference point (accurate to 0.5 feet NAVD 88)
- Well construction
- Borehole and total well depth
- Well completion report ID
- Identification of principal aquifers
- Geophysical logs and other relevant information, if any
- Monitoring type
- Measurement(s) taken
- Monitoring frequency
- Description of standards used to install or construct the monitoring site

4.2.2.2 Monitoring Protocols

Data will be obtained from any non-GSA agencies that are responsible for managing the monitoring sites within the groundwater level monitoring network.

4.2.2.2.1 Methodology

The Monitoring Protocols, Standards, and Sites Best Management Practices (Monitoring Protocols BMP, DWR, 2016b) recommends the following monitoring conditions:

- Groundwater levels should be measured from a pre-established and recorded reference point.
  - The reference point elevations (RPE) need to have been surveyed to the NAVD 88, feet and shall be accurate to within 0.5 feet, at a minimum (23 CCR §352.4(a)(4).
- Groundwater levels should be measured using approved measurement equipment. Equipment should be operated and maintained in accordance with the manufacturer's instructions.
- When well caps are removed, signs of pressure release should be noted. If pressure release is noted, an appropriate time should be allowed for the water surface to equilibrate to aquifer conditions. Multiple measurements may be taken to assess whether equilibration has been reached.
  - Site-specific procedures should be developed for wells under pressure, including flowing artesian wells.
- Questionable measurements should be appropriately noted at time of monitoring.
- All salient conditions should be recorded at time of monitoring.
- Water levels shall be measured to the nearest 0.1 foot, at a minimum (23 CCR §352.4(a)(3). Measurements to the nearest 0.01 feet are preferred and should be used if the equipment allows.
  - Groundwater elevations (GWE) are calculated as the RPE minus measured depth to water (DTW).
  - All measurements should be in units of feet, tenths of feet, and hundredths of feet.
- Water level equipment should be decontaminated after each use.
- Measurements should be collected from all monitoring sites within as short a time period as possible; in general, one to two weeks is acceptable. All data should be entered into the data management system as soon as possible.

Recorded information should include:

- Well ID
- Data and time (24-hour time format)
- Field staff name/ID
- RPE
- Height of reference point relative to ground surface at time of measurement
- DTW
- GWE
- Comments regarding salient observations of nearby pumping, weather conditions, well conditions, etc.

In addition to manual measurements, pressure transducers connected to data loggers may be used to monitor groundwater levels (DWR, 2016). Pressure transducers should be installed in conjunction with manual depth to water measurements; it is recommended that groundwater elevations be calculated after data have been downloaded to prolong the battery life of the unit. The Monitoring Protocols BMP identifies the following requirements when using data loggers:

- All transducers should be installed, operated, and maintained in accordance with the manufacturer's specifications.
- The well ID, cable serial number, pressure transducer serial number, range, accuracy, and type (vented or non-vented) should be recorded.
  - Unvented pressure transducers should be corrected for barometric pressure with continuous data from a barometric transducer.
- Groundwater levels should be recorded to the nearest 0.1 foot, at a minimum.
- The pressure transducers should be assessed to determine if the unit is capable of recording data sufficient to support DQOs. Instrument drift due to groundwater conditions, battery life, and storage capacity should be taken into consideration when groundwater elevations are being calculated.
- Manual groundwater levels should be measured to maintain data logger integrity.

4.2.2.2.2 Frequency

Manual water level measurements shall be collected twice annually, at a minimum, to ensure seasonal trends are well accounted for (23 CCR §354.34(c)(1)(B)). Manual measurements for all network wells should be collected in October and March per the Monitoring Network BMP (DWR, 2016a), unless more frequent measurements are required to support DQOs.

4.2.2.3 Groundwater Level Monitoring Network

The Colusa Subbasin groundwater monitoring network wells shown on Figure 4-1 are a combination of the Colusa County groundwater monitoring network wells and the Glenn County dedicated groundwater monitoring network wells (that is, Glenn County wells that are not used for any purpose other than observation). For the Glenn County wells, these exclude the BMO water supply wells and the wells included in the Glenn County annual water quality monitoring program discussed in Section 2.2.1. The Colusa County groundwater monitoring network includes active water supply wells as part of the County's groundwater level monitoring program.

There are 106 completions in 48 wells in the Colusa Subbasin. All of these wells are currently included in the CASGEM database. Table 4-1 contains the entire current groundwater monitoring network with State well numbers, CASGEM IDs, well completion report IDs, well status and type, location information, reference point information, construction, principal aquifer designations, and assessment categories. Well completion reports for the current groundwater monitoring network wells, if available, are included in Appendix 4-A.

Table 4-2 lists the criteria used for evaluating the groundwater monitoring wells in the Colusa Subbasin groundwater monitoring network. These criteria were identified based on the groundwater monitoring network requirements discussed in the Monitoring Network BMP and 23 CCR §354.34.

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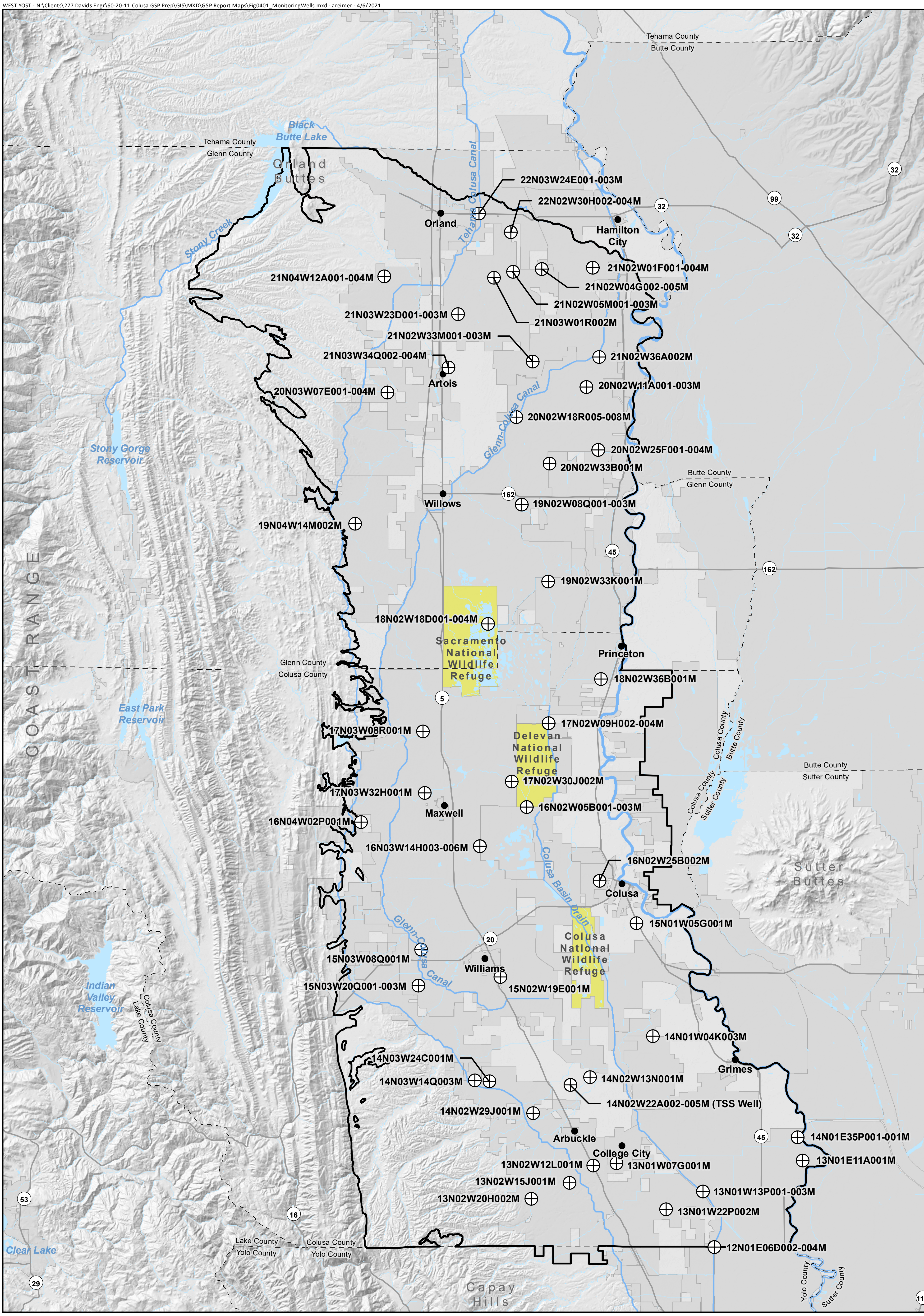

Groundwater Monitoring Network Well

Colusa Subbasin

Water Agencies

U.S. Fish and Wildlife Refuge

Horizontal Datum: North American Datum of 1983 (NAD 83), California State Plane Zone II, feet.

N

0 2.5 5

Scale in Miles

Figure 4-1

Groundwater Monitoring Network Wells

Colusa GSA and Glenn GSA

Colusa Subbasin

Groundwater Sustainability Plan

Table 4-1. Groundwater Monitoring Network Wells

No.	County	State Well Number	CASGEM[a] Station ID	Well Completion Report ID	Latitude, decimal degrees	Longitude, decimal degrees	Datum	Well Use	Well Status (active, inactive, other)	Well Type (single, clustered, nested, other)	Ground Surface Elevation, feet	Reference Point Elevation, feet	Reference Point Description	Borehole Depth, feet, bgs[b]	Completed Well Depth, feet, bgs	Screen Intervals, feet, bgs	Total Length of Screen, feet	Casing Diameter, inches	Primary Geologic Formation	Assessment Category: Existing Monitoring Network	Known Construction	Non-Pumping Well	Nested Well	Proximity to Surface Water[c]	Accessible and Usable	Notes
1	Colusa	12N01E06D002	16330	DWR, 2001[d]	38.92490	-121.91400	NAD 83[e]	Observation	active	nested	27.94	26.76	top of casing	1020	729	710-720	10	2	Tehama	x	x	x	x	x	x	Local Well LCB-4 Deep.
2	Colusa	12N01E06D003	33886	DWR, 2001	38.92490	-121.91400	NAD 83	Observation	active	nested	27.94	30.32	top of casing	1020	505	485-495	10	2	Tehama	x	x	x	x	x	x	Local Well LCB-4 Middle.
3	Colusa	12N01E06D004	16331	DWR, 2001	38.92490	-121.91400	NAD 83	Observation	active	nested	27.94	30.72	top of casing	1020	298	275-285	10	2	Tehama	x	x	x	x	x	x	Local Well LCB-4 Shallow.
4	Colusa	13N01E11A001	18534	2865	38.99371	-121.82401	NAD 83	Domestic	active	single	31.8	32.8	top of casing	158	145	136	22	8	Alluvium	x	x	-	-	x	x	Approximate screen or open hole 136-158 feet (Roy Hull, DWR, 2017)[f].
5	Colusa	13N01W07G001	36246	2868	38.99161	-122.01411	NAD 83	Irrigation	active	single	90.47	90.47	plug at top of casing, west side	180	180	108-180	72	12	Alluvium	x	x	-	-	-	x	
6	Colusa	13N01W13P001	18549	DWR, 2001	38.96935	-121.92587	NAD 83	Observation	active	nested	32.23	33.52	top of casing	1000	885	865-875	10	2	Tehama	x	x	x	x	x	x	Local Well LCB-1 Deep.
7	Colusa	13N01W13P002	25159	DWR, 2001	38.96935	-121.92587	NAD 83	Observation	active	nested	32.23	34.58	top of casing	1000	480	410-420 450-456	16	2	Tehama	x	x	x	x	x	x	Local Well LCB-1 Middle.
8	Colusa	13N01W13P003	36248	DWR, 2001	38.96935	-121.92587	NAD 83	Observation	active	nested	32.23	35.49	top of casing	1000	355	271-278	7	2	Tehama	x	x	x	x	x	x	Local Well LCB-1 Shallow.
9	Colusa	13N01W22P002	16357	40376	38.95531	-121.96311	NAD 83	Irrigation	active	single	60.46	61.16	not provided	236	236	196-236	40	12	Tehama	x	x	-	-	-	x	USBR[g] well.
10	Colusa	13N02W12L001	31899	115408	38.98981	-122.03751	NAD 83	Irrigation	active	single	135.49	135.99	not provided	778	NA[h]	NA	NA	NA	Tehama	-	-	-	-	-	x	USBR well.
11	Colusa	13N02W15J001	39884	77457	38.97631	-122.06161	NAD 83	Domestic	active	single	212.52	213.02	hole in plate	362	362	270-362	92	8	Tehama	x	x	-	-	-	x	
12	Colusa	13N02W20H002	25005	423344	38.96341	-122.10091	NAD 83	Domestic	active	single	342.58	343.58	not provided	320	320	200-260 300-320	80	5	Tehama	x	x	-	-	-	x	
13	Colusa	14N01E35P001	38718	E0109311A	39.01241	-121.82906	NAD 83	Observation	active	nested	46.88	48.74	not provided	1540	1039	985-995	10	2.5	Tehama	x	x	x	x	x	x	
14	Colusa	14N01E35P002	24655	E0109311B	39.01241	-121.82906	NAD 83	Observation	active	nested	46.88	48.36	not provided	1540	736	545-555 610-620 695-705	30	2.5	Tehama	x	x	x	x	x	x	
15	Colusa	14N01E35P003	24656	E0109311C	39.01241	-121.82906	NAD 83	Observation	active	nested	46.88	48	not provided	1540	275	135-145 215-225	20	2.5	Alluvium, Tehama	x	x	x	x	x	x	
16	Colusa	14N01E35P004	24657	E0109311D	39.01241	-121.82906	NAD 83	Observation	active	nested	46.88	47.62	not provided	1540	71	50-60	10	2.5	Alluvium	x	x	x	x	x	x	
17	Colusa	14N01W04K003	18554	USGS[i] Well Log	39.09301	-121.97671	NAD 83	Irrigation	inactive	single	37.43	37.43	top of casing, under pump base, northwest side	73	73	46-70	24	16	Alluvium	x	x	-	-	-	x	USBR well.
18	Colusa	14N02W13N001	18563	3027	39.06021	-122.04111	NAD 83	Irrigation	active	single	62.45	62.45	not provided	392	392	104-392	288	14	Alluvium, Tehama	x	x	-	-	x	x	USBR well.
19	Colusa	14N02W22A002	54756	WCR2020_ 003773	39.05398	-122.06067	NAD 83	Observation	active	nested	84	87.055	top of tallest casing	1200	1050	1020-1030	10	2	Tehama	-	x	x	x	-	x	Colusa County TSS well.
20	Colusa	14N02W22A003	54757	WCR2020_ 003773	39.05398	-122.06067	NAD 83	Observation	active	nested	84.38	86.9	top of 2nd tallest casing	1200	950	860-870 920-930	20	2	Tehama	-	x	x	x	-	x	Colusa County TSS well.
21	Colusa	14N02W22A004	54758	WCR2020_ 003773	39.05398	-122.06067	NAD 83	Observation	active	nested	84	86.825	top of 2nd shortest casing	1200	610	580-590	10	2	Tehama	-	x	x	x	-	x	Colusa County TSS well.
22	Colusa	14N02W22A005	54758	WCR2020_ 003773	39.05398	-122.06067	NAD 83	Observation	active	nested	84	86.69	top of shortest casing	1200	320	290-300	10	2	Alluvium, Tehama	-	x	x	x	-	x	Colusa County TSS well.
23	Colusa	14N02W29J001	18566	44455	39.03171	-122.09911	NAD 83	Irrigation	active	single	162.5	162.5	not provided	924	412	119-143 152-158 176-182 198-208 215-239 264-276 307.5-319.5 334.5-349.5	109	12	Tehama	x	x	-	-	x	x	
24	Colusa	14N03W14Q003	32324	20032	39.05761	-122.15861	NAD 83	Irrigation	active	single	172.52	172.52	open hole in pump base	704	685	390-480 500-590 614-685	251	16	Tehama	x	x	-	-	x	x	
25	Colusa	14N03W24C001	16691	72290	39.05691	-122.14351	NAD 83	Domestic	active	single	172.51	172.81	not provided	320	312	292-312	20	8	Tehama	-	x	-	-	-	x	USBR well. Records indicate the well is 160 feet deep (Roy Hull, DWR, 2017).
26	Colusa	15N01W05G001	14309	12982	39.18261	-121.99351	NAD 83	Domestic	active	single	47.42	48.82	not provided	140	140	75-140	65	8	Alluvium	x	x	-	-	-	x	Well is either screened or open hole after 75 feet.
27	Colusa	15N02W19E001	14319	71038	39.14011	-122.13251	NAD 83	Irrigation	inactive	single	87.46	88.11	top of casing	334	334	162-182 198-206 262-274 290-294 310-334	72	14	Alluvium, Tehama	x	x	x	-	-	x	Irrigation well with no pump installed.
28	Colusa	15N03W08Q001	NA	492125	39.16139	-122.21378	NAD 83	Irrigation	NA	single	NA	NA	NA	360	350	30-130 250-350	200	10.75 16	Alluvium, Tehama	x	x	-	x	x	x	
29	Colusa	15N03W20Q001	38293	802508C	39.13302	-122.21647	NAD 83	Observation	active	nested	128.56	130.32	top of short casing	620	424	370-410	40	2.5	Tehama	x	x	x	x	x	x	

Table 4-1. Groundwater Monitoring Network Wells

No.	County	State Well Number	CASGEM[a] Station ID	Well Completion Report ID	Latitude, decimal degrees	Longitude, decimal degrees	Datum	Well Use	Well Status (active, inactive, other)	Well Type (single, clustered, nested, other)	Ground Surface Elevation, feet	Reference Point Elevation, feet	Reference Point Description	Borehole Depth, feet, bgs[b]	Completed Well Depth, feet, bgs	Screen Intervals, feet, bgs	Total Length of Screen, feet	Casing Diameter, inches	Primary Geologic Formation	Assessment Category: Existing Monitoring Network	Known Construction	Non-Pumping Well	Nested Well	Proximity to Surface Water[c]	Accessible and Usable	Notes
30	Colusa	15N03W20Q002	24470	802508B	39.13302	-122.21647	NAD 83	Observation	active	nested	128.56	130.66	top of middle casing	620	170	130-160	30	2.5	Tehama	x	x	x	x	x	x	
31	Colusa	15N03W20Q003	38294	802508A	39.13302	-122.21647	NAD 83	Observation	active	nested	128.56	131	top of tall casing	620	82	30-80	50	2.5	Alluvium	x	x	x	x	x	x	
32	Colusa	16N02W05B001	25511	726832C	39.27527	-122.10568	NAD 83	Observation	active	nested	65	66.91	top of casing	986	797	730-750	20	4	Tehama	x	x	x	x	x	x	
33	Colusa	16N02W05B002	25512	726832B	39.27527	-122.10568	NAD 83	Observation	active	nested	65	65.55	not provided	986	535	462-472	10	2.5	Tehama	x	x	x	x	x	x	
34	Colusa	16N02W05B003	38669	726832A	39.27527	-122.10568	NAD 83	Observation	active	nested	65	66.34	not provided	986	301	174-184 246-256	20	2.5	Tehama	x	x	x	x	x	x	
35	Colusa	16N02W25B002	33868	Owner's Log	39.21651	-122.03121	NAD 83	Domestic	active	single	55.42	55.42	not provided	274	274	254-274	20	8	Tehama	x	x	-	-	x	x	Construction and lithology information provided by owner.
36	Colusa	16N03W14H003	24683	E0116237D	39.24391	-122.15401	NAD 83	Observation	active	nested	65.7	68.5	top of tallest	1500	1481	1370-1380 1410-1420	20	2.5	Tehama	x	x	x	x	x	x	Artesian flowing well.
37	Colusa	16N03W14H004	24684	E0116237C	39.24391	-122.15401	NAD 83	Observation	active	nested	65.7	68.21	top of second tallest	1500	1236	1140-1150 1170-1180	20	2.5	Tehama	x	x	x	x	x	x	
38	Colusa	16N03W14H005	37673	E0116237B	39.24391	-122.15401	NAD 83	Observation	active	nested	65.7	67.91	top of second shortest	1500	775	720-730	10	2.5	Tehama	x	x	x	x	x	x	
39	Colusa	16N03W14H006	24685	E0116237A	39.24391	-122.15401	NAD 83	Observation	active	nested	65.7	67.68	top of shortest	1500	378	295-305	10	2.5	Tehama	x	x	x	x	x	x	
40	Colusa	16N04W02P001	16308	77484	39.26291	-122.27541	NAD 83	Stock	active	single	162.53	163.03	not provided	203	203	112-203	91	8.625	Tehama	x	x	-	-	x	x	
41	Colusa	17N02W09H002	25514	726866A	39.34170	-122.08377	NAD 83	Observation	active	nested	67	69.36	top of casing	940	806	779-800	21	4	Tehama	x	x	x	x	x	x	
42	Colusa	17N02W09H003	25761	726866B	39.34170	-122.08377	NAD 83	Observation	active	nested	67	68.54	top of southernmost casing	940	578	470-480 510-520	20	2.5	Tehama	x	x	x	x	x	x	
43	Colusa	17N02W09H004	25515	726866C	39.34170	-122.08377	NAD 83	Observation	active	nested	67	68.78	top of northernmost casing	940	302	250-260	10	2.5	Tehama	x	x	x	x	x	x	
44	Colusa	17N02W30J002	16960	57983	39.29541	-122.12121	NAD 83	Domestic	active	single	63.43	63.43	not provided	182	159	157-159	2	6	Tehama	x	x	-	-	-	x	
45	Colusa	17N03W08R001	39127	49451	39.33521	-122.21241	NAD 83	Domestic	active	single	107.46	108.46	not provided	151	130	125-130	5	6	Alluvium	x	x	-	-	x	x	
46	Colusa	17N03W32H001	35475	93568	39.28610	-122.21046	NAD 83	Domestic	active	single	100.47	102.47	not provided	140	112	68-72 104-112	12	6.625	Alluvium	x	x	-	-	-	x	
47	Colusa	18N02W36B001	16914	177869	39.37721	-122.02981	NAD 83	Irrigation	abandoned	single	75.4	76	square hole in disk blade atop well	455	410	88-128 195-225 240-340	170	18 18 16	Alluvium, Tehama	x	x	-	-	x	x	
48	Glenn	18N02W18D001	24953	E045412	39.42083	-122.14578	NAD 83	Observation	active	nested	82.43	83.03	top of shortest PVC	1200	1000	975-985	10	2.5	Tuscan A	x	x	x	x	x	x	
49	Glenn	18N02W18D002	38201	E045412	39.42083	-122.14578	NAD 83	Observation	active	nested	83.43	83.43	top of second shortest PVC	1200	700	620-630 670-680	20	2.5	Tuscan C	-	x	x	x	x	x	
50	Glenn	18N02W18D003	24992	E045412	39.42083	-122.14578	NAD 83	Observation	active	nested	84.43	84.03	top of second tallest PVC	1200	530	510-520	10	2.5	Tehama	-	x	x	x	x	x	
51	Glenn	18N02W18D004	38358	E045412	39.42083	-122.14578	NAD 83	Observation	active	nested	85.43	84.43	top of tallest PVC	1200	266	246-256	10	2.5	Tehama	-	x	x	x	x	x	
52	Glenn	19N02W08Q001	25762	726952	39.51596	-122.11143	NAD 83	Observation	active	nested	108.36	120	top of casing	1000	939.7	856-876	20	2.5	Tehama	x	x	x	x	x	x	
53	Glenn	19N02W08Q002	25763	726952	39.51595	-122.11143	NAD 83	Observation	active	nested	108.36	109.38	westernmost piezometer	1000	228	208-218	10	2.5	Tehama	x	x	x	x	x	x	
54	Glenn	19N02W08Q003	25764	726952	39.51596	-122.11143	NAD 83	Observation	active	nested	108.36	109.56	easternmost piezometer	1000	97	77-87	10	2.5	Tehama	x	x	x	x	x	x	
55	Glenn	19N02W33K001	19793	581475	39.45469	-122.08402	NAD 83	Irrigation	active	single	87.41	87.11	top of western sounding pipe	300	260	160-260	100	16	Tehama	-	x	-	-	-	x	
56	Glenn	19N04W14M002	25787	816220	39.50037	-122.28269	NAD 83	Observation	active	single	185.83	187.83	top of casing	366	65	45-55	10	2.5	Alluvium	x	x	x	-	-	x	Local Well GCAB303-1.
57	Glenn	20N02W11A001	17170	3669	39.60922	-122.04491	NAD 83	Observation	active	nested	125.40	125.90	top of board on northernmost piezometer	700	90	70-90	20	1.5	Modesto	x	x	x	x	-	x	
58	Glenn	20N02W11A002	17171	3669	39.60922	-122.04491	NAD 83	Observation	active	nested	125.40	125.90	top of board on southernmost piezometer	700	160	140-160	20	1.5	Tehama	x	x	x	x	-	x	
59	Glenn	20N02W11A003	35614	3669	39.60922	-122.04491	NAD 83	Observation	active	nested	125.40	125.90	top of board on middle piezometer	700	510	490-510	20	1.5	Tehama	x	x	x	x	-	x	
60	Glenn	20N02W18R005	23986	801448	39.58552	-122.11701	NAD 83	Observation	active	nested	131.38	132.45	top of lowest casing	1020	1000	920-930 970-980	20	2	Tuscan AB	x	x	x	x	x	x	
61	Glenn	20N02W18R006	23987	801448	39.58552	-122.11701	NAD 83	Observation	active	nested	131.38	132.98	top of second lowest casing	1020	675	635-655	20	2	Tehama	x	x	x	x	x	x	
62	Glenn	20N02W18R007	24259	801448	39.58552	-122.11701	NAD 83	Observation	active	nested	131.38	133.43	top of second highest casing	1020	545	450-460 515-526	20	2	Tehama	x	x	x	x	x	x	
63	Glenn	20N02W18R008	23988	801448	39.58552	-122.11701	NAD 83	Observation	active	nested	131.38	133.97	top of highest casing	1020	201	140-150 170-180	20	2	Modesto	x	x	x	x	x	x	

Table 4-1. Groundwater Monitoring Network Wells

																				Assessment Category						
No.	County	State Well Number	CASGEM[a] Station ID	Well Completion Report ID	Latitude, decimal degrees	Longitude, decimal degrees	Datum	Well Use	Well Status (active, inactive, other)	Well Type (single, clustered, nested, other)	Ground Surface Elevation, feet	Reference Point Elevation, feet	Reference Point Description	Borehole Depth, feet, bgs[b]	Completed Well Depth, feet, bgs	Screen Intervals, feet, bgs	Total Length of Screen, feet	Casing Diameter, inches	Primary Geologic Formation	Existing Monitoring Network	Known Construction	Non-Pumping Well	Nested Well	Proximity to Surface Water[c]	Accessible and Usable	Notes
64	Glenn	20N02W25F001	23989	782025	39.55949	-122.03263	NAD 83	Observation	active	nested	102.20	105.56	top of lowest casing	1000	980	940-960	20	2	Tehama	x	x	x	x	-	x	Artesian flowing well; Data logger installed August 2016.
65	Glenn	20N02W25F002	23990	782025	39.55949	-122.03263	NAD 83	Observation	active	nested	102.20	105.86	top of second lowest casing	1000	490	420-430 460-470	20	2	Tehama	x	x	x	x	-	x	Artesian flowing well.
66	Glenn	20N02W25F003	25519	782025	39.55950	-122.03263	NAD 83	Observation	active	nested	102.20	104.58	top of second highest casing	1000	280	190-200 250-260	20	2	Tehama	x	x	x	x	-	x	
67	Glenn	20N02W25F004	23991	782025	39.55949	-122.03263	NAD 83	Observation	active	nested	102.20	105.10	top of highest casing	1000	85	55-65	10	2	Tehama	x	x	x	x	-	x	
68	Glenn	20N02W33B001	17174	3686	39.54846	-122.08307	NAD 83	Observation	active	single	105.41	107.01	bottom of box	326	320	100-120 200-320	20 120	6	Tehama	x	x	x	-	x	x	
69	Glenn	20N03W07E001	37860	E057712D	39.60475	-122.24962	NAD 83	Observation	active	nested	179.17	180.83	top of lowest casing	1400	1030	984-1014	30	2	Tehama	x	x	x	x	x	x	
70	Glenn	20N03W07E002	24329	E057712C	39.60476	-122.24962	NAD 83	Observation	active	nested	179.17	181.06	top of second lowest casing	1400	656	616-636	20	2	Tehama	x	x	x	x	x	x	
71	Glenn	20N03W07E003	24330	E057712B	39.60475	-122.24962	NAD 83	Observation	active	nested	179.17	181.47	top of second highest casing	1400	505	380-410 465-485	50	2	Tehama	x	x	x	x	x	x	
72	Glenn	20N03W07E004	37861	E057712A	39.60475	-122.24962	NAD 83	Observation	active	nested	179.17	181.75	top of highest casing	1400	138	118-128	10	2	Tehama	x	x	x	x	x	x	
73	Glenn	21N02W01F001	38535	726740	39.70439	-122.03830	NAD 83	Observation	active	nested	160.88	162.13	top of lowest casing	600	578	547-557	10	2	Tuscan C	x	x	x	x	-	x	
74	Glenn	21N02W01F002	24205	726740A	39.70439	-122.03830	NAD 83	Observation	active	nested	160.83	162.28	top of highest casing	600	318	297-307	10	2	Tehama	x	x	x	x	-	x	
75	Glenn	21N02W01F003	39954	726741	39.70439	-122.03830	NAD 83	Observation	active	nested	161.84	162.84	top of lowest casing	125	124	109-119	10	2	Modesto	x	x	x	x	-	x	
76	Glenn	21N02W01F004	40029	726741	39.70439	-122.03830	NAD 83	Observation	active	nested	161.92	163.22	top of highest casing	125	75	55-65	10	2	Modesto	x	x	x	x	-	x	
77	Glenn	21N02W04G002	24993	E044112	39.70333	-122.09103	NAD 83	Observation	active	nested	178.41	180.21	top of shortest casing	1200	948	928-938	10	2	Tuscan B	x	x	x	x	x	x	
78	Glenn	21N02W04G003	24994	E044112	39.70333	-122.09103	NAD 83	Observation	active	nested	178.41	180.51	top of second shortest casing	1200	713	674-684 693-703	20	2	Tuscan C	x	x	x	x	x	x	
79	Glenn	21N02W04G004	38359	E044112	39.70333	-122.09102	NAD 83	Observation	active	nested	178.41	180.31	top of second tallest casing	1200	289	165-175 270-280	20	2	Tehama	x	x	x	x	x	x	
80	Glenn	21N02W04G005	24995	E044112	39.70333	-122.09102	NAD 83	Observation	active	nested	178.41	181.16	top of tallest casing	1200	77	57-67	10	2	Modesto	x	x	x	x	x	x	
81	Glenn	21N02W05M001	39676	801406	39.70082	-122.12076	NAD 83	Observation	active	nested	188.93	190.43	top of shortest casing	520	473	442-452	10	2	Tehama	x	x	x	x	-	x	
82	Glenn	21N02W05M002	36588	801406	39.70082	-122.12076	NAD 83	Observation	active	nested	188.93	190.91	top of middle casing	520	153	122-132	10	2	Tehama, Modesto	x	x	x	x	-	x	
83	Glenn	21N02W05M003	23996	801406	39.70082	-122.12076	NAD 83	Observation	active	nested	188.93	191.33	top of tallest casing	520	75	44-54	10	2	Modesto	x	x	x	x	-	x	
84	Glenn	21N02W33M001	38536	726724	39.62970	-122.10045	NAD 83	Observation	active	nested	149	151.60	top of 4" casing	1020	974.2	869-890	21	4	Tuscan AB	x	x	x	x	-	x	
85	Glenn	21N02W33M002	24206	726724	39.62970	-122.10045	NAD 83	Observation	active	nested	149	151.26	top of shortest 2" casing	1020	571.1	540-550	10	2	Tuscan C	x	x	x	x	-	x	
86	Glenn	21N02W33M003	24207	726724	39.62970	-122.10045	NAD 83	Observation	active	nested	149	151.49	top of tallest 2" casing	1020	171.1	140-150	10	2	Tehama	x	x	x	x	-	x	
87	Glenn	21N02W36A002	21239	315494	39.63341	-122.03194	NAD 83	Observation	active	single	135.39	136.29	top of chip board inside casing	155	145	120-140	20	6	Tehama	x	x	x	-	-	x	
88	Glenn	21N03W01R002	25232	726894	39.69624	-122.14048	NAD 83	Observation	active	single	203.32	206.77	bottom of hole cut in casing	1530	255	235-245	10	2	Tehama	x	x	x	-	-	x	Local Well OAWD-Mon Well.
89	Glenn	21N03W23D001	23992	801404	39.66720	-122.17735	NAD 83	Observation	active	nested	204.76	205.89	top of shortest casing	420	393.5	363-373	10	2	Tehama	x	x	x	x	-	x	
90	Glenn	21N03W23D002	25233	801404	39.66720	-122.17734	NAD 83	Observation	active	nested	204.76	206.43	top of middle casing	420	191.5	142-152 160-170	20	2	Modesto	x	x	x	x	-	x	
91	Glenn	21N03W23D003	23993	801404	39.66720	-122.17735	NAD 83	Observation	active	nested	204.76	206.93	top of tallest casing	420	93.5	42-72	30	2	Modesto	x	x	x	x	-	x	
92	Glenn	21N03W34Q002	25789	816224	39.62472	-122.18714	NAD 83	Observation	active	nested	166.65	167.07	top of shortest casing	1020	980	930-960	30	2	Tehama	x	x	x	x	-	x	
93	Glenn	21N03W34Q003	25234	816224	39.62472	-122.18714	NAD 83	Observation	active	nested	166.65	167.38	top of middle casing	1020	710	620-630 650-660 680-690	30	2	Tehama	x	x	x	x	-	x	
94	Glenn	21N03W34Q004	25790	816224	39.62472	-122.18714	NAD 83	Observation	active	nested	166.65	167.63	top of tallest casing	1020	80	60-70	10	2	Alluvium	x	x	x	x	-	x	
95	Glenn	21N04W12A003	38716	E0103388	39.69716	-122.25330	NAD 83	Observation	active	nested	247.50	250.12	top of tallest casing	1080	1070	955-975 1030-1050	40	2	Tehama	x	x	x	x	x	x	
96	Glenn	21N04W12A004	24650	E0103388	39.69717	-122.25330	NAD 83	Observation	active	nested	247.50	249.62	top of shortest casing	1080	660	520-530 590-600 630-640	30	2	Tehama	x	x	x	x	x	x	
97	Glenn	21N04W12A001	24000	726739	39.69717	-122.25330	NAD 83	Observation	abandoned	nested	247.88	249.38	top of piezometer	640	629	598-608	10	2	Tehama	x	x	x	x	x	x	Local Well Big W-Deep.
98	Glenn	21N04W12A002	25725	726739	39.69716	-122.25330	NAD 83	Observation	active	nested	247.88	249.88	top of tallest casing	640	278	247-257	10	2	Tehama	x	x	x	x	x	x	
99	Glenn	22N02W30H002	25726	726922	39.73252	-122.12306	NAD 83	Observation	active	nested	204.43	205.22	top of shortest casing	920	900	850-880	30	2	Tuscan C	x	x	x	x	x	x	

Table 4-1. Groundwater Monitoring Network Wells

No.	County	State Well Number	CASGEM[a] Station ID	Well Completion Report ID	Latitude, decimal degrees	Longitude, decimal degrees	Datum	Well Use	Well Status (active, inactive, other)	Well Type (single, clustered, nested, other)	Ground Surface Elevation, feet	Reference Point Elevation, feet	Reference Point Description	Borehole Depth, feet, bgs[b]	Completed Well Depth, feet, bgs	Screen Intervals, feet, bgs	Total Length of Screen, feet	Casing Diameter, inches	Primary Geologic Formation	Assessment Category: Existing Monitoring Network	Known Construction	Non-Pumping Well	Nested Well	Proximity to Surface Water[c]	Accessible and Usable	Notes
100	Glenn	22N02W30H003	25727	726922	39.73252	-122.12304	NAD 83	Observation	active	nested	204.43	205.77	top of middle casing	920	275	130-140 150-160 250-260	30	2	Tehama, Modesto	x	x	x	x	x	x	
101	Glenn	22N02W30H004	38609	726922	39.73253	-122.12304	NAD 83	Observation	active	nested	204.43	206.43	top of tallest casing	920	80	45-55 60-70	20	2	Tehama, Modesto	x	x	x	x	x	x	
102	Glenn	22N03W24E001	25236	726923A	39.74717	-122.15597	NAD 83	Observation	active	nested	230.51	231.70	top of shortest casing	860	840	800-820	20	2	Tehama	x	x	x	x	x	x	
103	Glenn	22N03W24E002	38667	726923B	39.74717	-122.15597	NAD 83	Observation	active	nested	230.51	231.93	top of middle casing	860	195	130-150 170-180	30	2	Modesto	x	x	x	x	x	x	
104	Glenn	22N03W24E003	25758	726923C	39.74717	-122.15597	NAD 83	Observation	active	nested	230.51	232.41	top of tallest casing	860	70	50-60	10	2	Modesto	x	x	x	x	x	x	
105	Glenn	22N03W28P001	24702	801439A	39.72617	-122.20604	NAD 83	Observation	active	nested	258.22	259.49	top of shortest casing	500	421	390-400	10	2	Tehama	x	x	x	x	x	x	
106	Glenn	22N03W28P003	24703	801439C	39.72618	-122.20604	NAD 83	Observation	active	nested	258.22	260.52	top of tallest casing	500	71	30-50	20	2	Alluvium	x	x	x	x	x	x	

(a) California's Statewide Groundwater Elevation Monitoring Program (CASGEM).
(b) Below ground surface (bgs).
(c) Monitoring sites located wthin 200 feet of an existing water channel or water body.
(d) California Department of Water Resources (DWR), 2001, Lower Colusa Basin Conjunctive Use Investigation: Monitoring Network Completion Report, June 1999. (DWR, 2001)
(e) Latitude and longitude values are in North American Datum of 1983 (NAD 83), decimal degrees.
(f) Email correspondance from Roy Hull, DWR North Region Office, received November 16, 2017. (Roy Hull, DWR, 2017)
(g) U.S. Bureau of Reclamation (USBR).
(h) NA denotes field where data was not unknown or unavailable.
(i) U.S. Geological Survey (USGS).

Table 4-2. Assessment Categories of the Groundwater Monitoring Network Wells

Characteristic	Importance
Known Construction Characteristics	Known well construction characteristics will enable evaluation of groundwater conditions at specific depths within the principal aquifer. Examples of construction characteristics include borehole depth, screened intervals, and the presence of seals within the annular fill.
Nested Multiple Completion Wells	Nested, multiple completion wells allow the measurement of water levels at discrete depths within the aquifer system. The degree of confinement of the aquifer increases with depth. Multiple completion wells can provide insight into how the aquifer system is connected and allow estimates of vertical gradients and vertical hydraulic conductivity to be made.
Non-Dedicated Monitoring Wells	Pumping causes cones of depression that impact the water levels at and near the pumping well. Pumping water levels are not indicative of the static condition of the aquifer system and can skew estimates of groundwater storage. Pumping wells included in the groundwater monitoring network should be verified as inactive when measurements are made.
Proximity to Streams and Interconnected Surface Waters	Wells, including multiple completion wells, near streams or interconnected surface waters are useful for evaluating interaction between the aquifer and interconnected streams and surface waters. Vertical hydraulic gradients measured in wells near stream gages can provide insight regarding the direction of flow into or away from the surface water feature.
Lateral and Vertical Density	To characterize groundwater levels throughout the Colusa Subbasin, accessible monitoring sites should be spatially distributed throughout the area of interest. Not only should the monitoring sites be distributed laterally, but their screened intervals should also be set at representative depths within the principal aquifer.
Accessibility and Usability	The monitoring sites need to be easily accessible by field staff. Additionally, well completions should be clear down-hole to allow access of water level measuring equipment.

Known Construction. Construction details are known for all but one of the groundwater monitoring wells (Table 4-1 and Figure 4-1). Colusa County monitoring well 13N02W12L001 is a USBR well without well construction information. This well is listed in Table 4-1 and shown on Figure 4-1 because there is historical groundwater level data available for the well.

Nested Multiple Completion Wells. Of the 48 groundwater monitoring sites (106 separate completions) shown on Figure 4-1 and listed in Table 4-1, over 20 are nested multiple completion wells. These nested wells are screened at discrete depths up to a maximum depth of 1,180 feet below ground surface. The nested wells enable measurement of vertical head gradients within the principal aquifer. Additionally, the nested wells support monitoring of the groundwater system and interconnected surface waters. The current groundwater monitoring network contains wells that provide a lateral and vertical density sufficient to enable characterization of groundwater within the principal aquifer.

Non-Dedicated Monitoring Wells. The majority of the active domestic, irrigation, and stock wells included in the current groundwater monitoring network are located in Colusa County. The Monitoring Network BMP allows the temporary inclusion of water supply wells in the groundwater monitoring network if the wells are screened within a single water-bearing unit. Of these wells, three were identified to be perforated across broad depth intervals, potentially with different degrees of confinement, but all still zoned within the principal aquifer. These three wells are 18N02W36B001 (near Princeton), 15N03W08Q001 (west of Williams), and 14N02W13N001 (north of Arbuckle).

Proximity to Streams and Interconnected Surface Waters. The subbasin is bounded and traversed by irrigation canals and drains, as well as perennial, ephemeral, and intermittent streams. Many of the surface waters are near wells included in the current groundwater monitoring network, except for the surface waters within the Colusa National Wildlife Refuge, east of Williams (Figure 4-1). There are no network groundwater monitoring wells near the Colusa National Wildlife Refuge.

Lateral and Vertical Density. The groundwater monitoring network has a lateral density of approximately 9.4 completions per 100 square miles and 4.2 well boreholes per 100 square miles in the principal aquifer, averaged over the entire subbasin. These well densities are sufficient to evaluate groundwater level trends throughout the subbasin, in accordance with the recommendations listed in the Monitoring Network BMP (DWR, 2016a). Additionally, there are sufficient depth-specific wells located throughout the subbasin to evaluate groundwater elevation trends, groundwater storage, surface water connectivity, and aquifer characteristics with depth.

Accessibility. The groundwater monitoring network wells are accessible for field investigations. However, five completions within three wells included in the Glenn County or Colusa County monitoring networks may be unusable due to caved-in or collapsed casings. These include 13N02W04G001, -003, -004, 16N03W35N002, and 22N03W28P002. These wells were removed from the draft Colusa Subbasin Groundwater Monitoring Network, and are not shown on Figure 4-1, but are shown on Figure 4-2 with their location and a suggested replacement well.

4.2.2.4 Data Gaps in Groundwater Level Monitoring Network

23 CCR §354.38(b) defines data gaps as occurring where there is an insufficient number of monitoring sites, insufficient monitoring frequency, or unreliable monitoring sites. Data gaps can also occur when collected data are of insufficient quality or quantity to support evaluation of the sustainability indicators (Monitoring Network BMP, 2016a).

The groundwater monitoring network was assessed based on requirements listed in the Monitoring Network BMP and 23 CCR §354.34. Spatial or temporal density and quality of monitoring sites were then assessed to identify potential data gaps. Data gaps within the groundwater monitoring network were evaluated for all criteria and categorized as follows:

1. Usability of the monitoring site due to:
    a. Potential cave-ins
    b. Wells screened across multiple water-bearing units and principal aquifers
2. Spatial distribution of monitoring sites with regard to:
    a. Presence near a surface water body
    b. Full lateral and vertical extent of coverage

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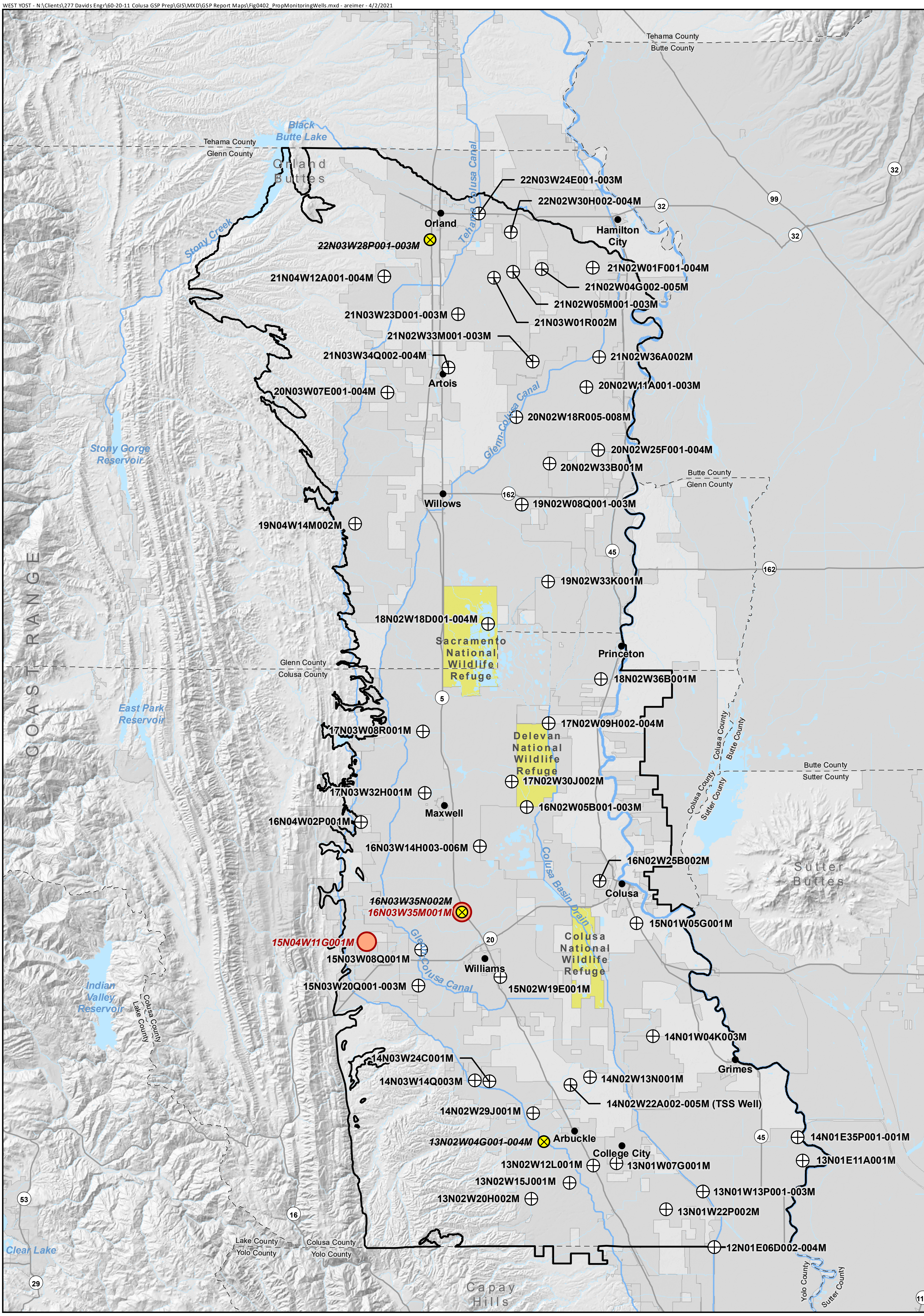

Groundwater Monitoring Network Well

Well Removed from Groundwater Monitoring Network

Potential Existing Replacement or Additional Groundwater Monitoring Network Well

Colusa Subbasin

Water Agencies

U.S. Fish and Wildlife Refuge

N

0 2.5 5

Scale in Miles

Horizontal Datum: North American Datum of 1983 (NAD 83), California State Plane Zone II, feet.

Figure 4-2

Proposed Groundwater Monitoring Network Wells

Colusa GSA and Glenn GSA

Colusa Subbasin

Groundwater Sustainability Plan

4.2.2.5 Proposed Actions to Address Data Gaps

4.2.2.5.1 Proposed Addition of Existing Wells

Figure 4-2 shows the Colusa Subbasin groundwater monitoring network, monitoring wells that were included in the preliminary groundwater monitoring network but have since been removed and potentially require replacement, and proposed existing wells that may be added to the current network. Existing wells proposed to be added to the groundwater level monitoring network are listed in Table 4-3.

Table 4-3. Existing Wells Proposed to be Added to the Groundwater Monitoring Network

State Well Number	Location	Existing Groundwater Monitoring Network	Rationale for Selection
15N04W11G001	Colusa County	DWR WDL[a]	Expand lateral monitoring network coverage towards the subbasin's western margin.
16N03W35M001	Colusa County	DWR WDL	Replacement for 16N03W35N002M, an inaccessible caved-in well. Similar location and construction characteristics.

(a) California Department of Water Resources (DWR) Water Data Library (WDL).

4.2.2.5.2 Proposed New Wells

No new monitoring wells are recommended at this time.

4.2.2.5.3 Additional Proposed Actions

It is recommended that a field survey be conducted of all current groundwater monitoring network sites to verify latitude and longitude coordinates, well depths, ground surface elevations, reference point elevations, and descriptions in accordance with the requirements described in 23 CCR §352.4(a) through (c). Monitoring frequencies should also be verified for compliance with requirements set forth in 23 CCR §354.34(c)(1)(B).

4.2.3 Groundwater Quality Monitoring

The primary groundwater quality constituent of concern within the Colusa Subbasin is salinity. Specifically, the upwelling of brackish connate water into the principal aquifer is a matter of concern. There are many existing programs that manage salinity (e.g. total dissolved solids or electrical conductivity) data in groundwater. The existing programs monitoring regularly and have decent spatial coverage throughout the subbasin. Where data gaps may exist, a discussion of potential additions to the groundwater quality monitoring network is provided.

4.2.3.1 Requirements

The groundwater quality monitoring network shall be designed such that the sustainability indicators are adequately covered not just over the entire basin, but also within any specific GSP-defined Management Areas. The groundwater quality monitoring network shall be designed to collect sufficient spatial and temporal data from the principal aquifer to enable determination of groundwater quality trends and to address known water quality issues (23 CCR §354.34(c)(4)).

In accordance with the Monitoring Network BMP (DWR, 2016a), data collected from the groundwater quality monitoring network should be sufficient to:

- Enable definition of the three-dimensional extent of impacts;
- Enable mapping of transient water quality degradation;
- Facilitate assessment of groundwater quality impacts to beneficial uses and users;
- Enable evaluation of management practice impacts to groundwater quality degradation;
- Support evaluation of DQOs.

Groundwater quality monitoring events should occur twice-annually (correlating with seasonal highs and lows) but may be more frequent, as needed, per the Monitoring Network BMP (DWR, 2016a). The Monitoring Network BMPs state that:

- Where regulated plumes exist, monitoring should coincide with regulatory monitoring.
- Where unregulated groundwater quality issues occur, monitoring should be consistent with the degree of groundwater use in the impacted area.

Monitoring sites shall include the following information (23 CCR §352.4(a) through (c):

- Unique station identifier, CASGEM ID;
- Site description, well location (NAD 83, latitude and longitude decimal degrees to five decimal places);
- Well use, well status, well type;
- Elevation of ground surface (accurate to 0.1 feet NAVD 88);
- Elevation and description of reference point (accurate to 0.5 feet NAVD 88);
- Well construction;
- Borehole and total well depth;
- Well completion report ID;
- Identification of principal aquifers;
- Geophysical logs and other relevant information, if any;
- Monitoring type;
- Measurement(s) taken;
- Monitoring frequency; and
- Description of standards used to install the monitoring site.

4.2.3.2 Monitoring Protocols

Data will be obtained from non-GSA agencies that are responsible for managing the monitoring sites within the groundwater quality monitoring network.

In accordance with the Monitoring Protocols BMP (DWR, 2016b), all water quality analyses should be performed by a State Environmental Laboratory Accreditation Program certified laboratory. Additionally, analytical methods should be similar to those used by other existing groundwater quality programs within the basin for comparative purposes.

Groundwater quality sampling protocols should follow USGS National Field Manual for the Collection of Water Quality Data (Wilde, 2005) in accordance with the Monitoring Protocols BMP (DWR, 2016a). Groundwater sampling protocols should ensure that:

- Groundwater quality data are collected from the correct location, accurate and reproducible, and represent conditions consistent with the DQOs;
- Salient data are recorded; and
- All data are handled such that integrity is maintained.

The Monitoring Protocols BMP defines the following standardized protocols:

- Prior to sampling, the appropriate laboratory should be notified and scheduled, the appropriate sampling bottles and equipment should be obtained, and sample preservation requirements and hold times should be confirmed.
- All groundwater monitoring network wells should have a unique identifier posted on the well housing or casing.
- Samples from pumping wells should be collected near the wellhead.
- All sampling equipment and ports should be free of contaminants and decontaminated between sampling locations.
- Groundwater elevations should be measured.
- Wells not equipped with low-flow sampling taps should be purged prior to sampling to ensure sampling is of ambient groundwater conditions and not borehole storage conditions. Typically, three casing volumes purged is adequate.
- If purging or pumping causes a well to be evacuated, allow 90 percent recovery prior to sampling.
- Field parameters should be collected coincident with each sample. Field parameters should include pH, EC, and temperature, at a minimum. Field instruments should be calibrated daily.
- Sample containers should be labeled prior to sampling. Sample labels should include sample ID, sample date and time, sample personnel, sample location, preservatives, analyte, and analytical method.
- Samples should be collected under laminar flow conditions.
- Samples should be collected according to appropriate standards. The sample collection procedure should reflect the type of analysis being performed and the DQOs.
- Samples should be preserved at the time of sampling. Samples should be filtered, as appropriate.
- Samples should be chilled after collection to prevent degradation.
- Chain of custody forms should be used to track procession of the samples.
- Analytical laboratories should utilize reporting limits that are equal to or less than the applicable DQOs or regional water quality objectives and screening levels.

4.2.3.3 Groundwater Quality Monitoring Network

Groundwater quality monitoring networks have not yet been formally defined, however, groundwater quality data collected under existing regulatory programs, specifically the ILRP, are applicable for SGMA compliance. The California Rice Commission has identified their ILRP groundwater quality trend network from active USGS-managed wells within and surrounding the California Rice Commission management area (CH2MHILL, 2016). Twelve of these wells are within the Colusa Subbasin (CVRWQCB, 2016). The Sacramento Valley Water Quality Coalition Groundwater Quality Trend Monitoring Program includes four wells within the Colusa Subbasin (Luhdorff and Scalmanini, 2019). Both of these programs include salinity monitoring. Table 4-4 includes the groundwater quality monitoring network wells included under these programs. Figure 4-3 shows the locations of these wells with respect to the Colusa Subbasin.

Table 4-4. Groundwater Quality Monitoring Network Well

County	Well ID	Program	Latitude [a]	Longitude	Frequency
Colusa	SVWQC00006	Sacramento Valley Water Quality Coalition Annual Groundwater Monitoring Program [b]	38.96060	-122.01810	Annual Fall
Glenn	SVWQC00005	Sacramento Valley Water Quality Coalition Annual Groundwater Monitoring Program	39.71070	-122.10610	Annual Fall
Colusa	SVWQC00021	Sacramento Valley Water Quality Coalition Annual Groundwater Monitoring Program	39.37720	-122.01330	Annual Fall
Colusa	SVWQC00019	Sacramento Valley Water Quality Coalition Annual Groundwater Monitoring Program	39.01040	-122.06760	Annual Fall
Glenn	09N1M	California Rice Commission ILRP Wells [c,d]	39.592715	-122.095328	2 Years
Glenn	25A1M	California Rice Commission ILRP Wells	39.567131	-122.026011	2 Years
Glenn	32J1M	California Rice Commission ILRP Wells	39.542665	-122.098338	2 Years
Glenn	23E1M	California Rice Commission ILRP Wells	39.490262	-122.056741	2 Years
Glenn	25E1M	California Rice Commission ILRP Wells	39.468111	-122.167419	2 Years
Glenn	25R1M	California Rice Commission ILRP Wells	39.471126	-122.139751	2 Years
Glenn	12G2M	California Rice Commission ILRP Wells	39.429497	-122.033644	2 Years
Glenn	09R2M	California Rice Commission ILRP Wells	39.421594	-122.194964	2 Years
Colusa	14G1M	California Rice Commission ILRP Wells	39.326901	-122.166317	2 Years
Colusa	35M1M	California Rice Commission ILRP Wells	39.279817	-122.174639	2 Years
Colusa	03E1M	California Rice Commission ILRP Wells	39.182201	-122.079463	2 Years
Colusa	16R1M	California Rice Commission ILRP Wells	39.147638	-122.08325	2 Years

(a) Latitude and longitude are reported in North American Datum of 1983 (NAD 83), decimal degrees.
(b) Luhdorff and Scalmanini. 2019.
(c) ILRP = Irrigated Lands Regulatory Program
(d) Central Valley Regional Water Quality Control Board. 2016.

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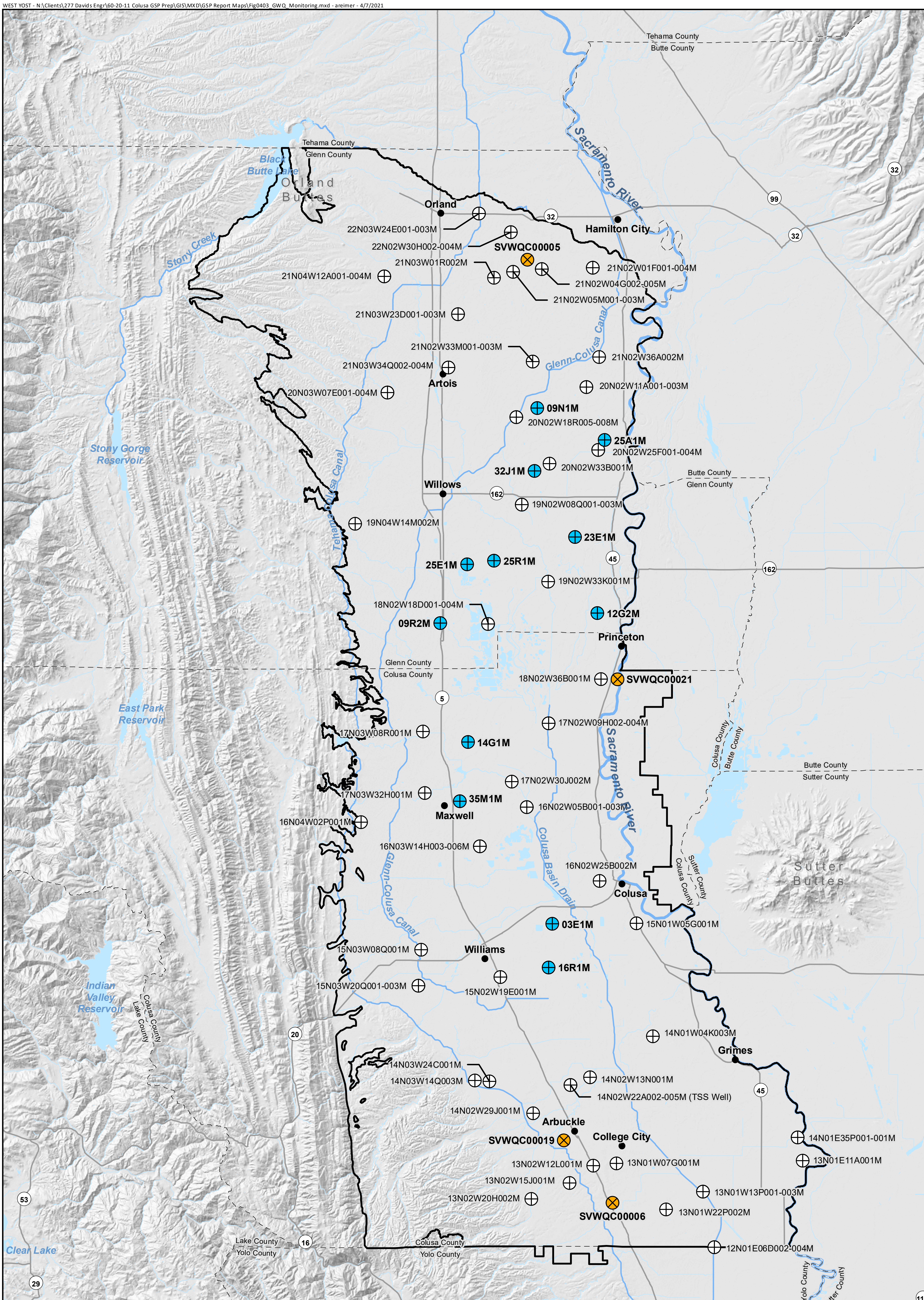

California Rice Commission Irrigated Lands Regulatory Program Wells

Sacramento Valley Water Quality Coalition Groundwater Monitoring Wells

Potential Groundwater Quality Monitoring Wells

Colusa Subbasin

Horizontal Datum: North American Datum of 1983 (NAD 83), California State Plane Zone II, feet.

Note:

1. Selected wells from the Colusa Subbasin dedicated groundwater level monitoring network may be sampled to supplement the groundwater quality data collected under existing water quality programs.

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Scale in Miles

Figure 4-3

Groundwater Quality Monitoring Network Wells

Colusa GSA and Glenn GSA

Colusa Subbasin

Groundwater Sustainability Plan

4.2.3.4 Data Gaps in Groundwater Quality Monitoring Network

Potential data gaps have been identified within the proposed groundwater quality monitoring networks:

1. The current California Rice Commission groundwater monitoring plan to collect groundwater quality samples every two years may not be sufficient to satisfy the requirements set forth in the Monitoring Network BMP (DWR, 2016a) or to satisfy the GSA's goal of identifying high concentrations of salinity with depth.
2. The existing groundwater monitoring network may not include monitoring wells in areas with salinity concerns.
3. It is possible that the monitoring networks defined by the Sacramento Valley Water Quality Coalition and the California Rice Commission may not be sufficient to adequately allow identification of upwelling or intrusion of deeper brackish/connate waters into the freshwater aquifer systems.

4.2.3.5 Proposed Actions to Address Data Gaps

Groundwater quality data collected under existing regulatory programs may be sufficient for SGMA compliance. The Colusa and Glenn GSAs will consider coordinating with the Sacramento Valley Water Quality Coalition, NCWA, and the California Rice Commission in the establishment and ongoing evaluation of these groundwater quality monitoring network sites with the goal of using data collected under the ILRP for SGMA compliance.

The wells included in the groundwater level monitoring network provide ample spatial coverage throughout the Colusa Subbasin. These wells, shown on Figure 4-3, would be good potential sites to add to the groundwater quality monitoring network in areas with identified salinity and upwelling concerns. The wells could be sampled regularly, at varying frequencies, in accordance with the needs of the GSAs and local stakeholders.

4.2.4 Land Subsidence Monitoring

Land subsidence has been measured within the Colusa Subbasin. There are several existing programs in place to monitor and measure ongoing land subsidence. Many of these existing programs are included in the Colusa Subbasin land subsidence monitoring network so that the GSAs and local stakeholders can best determine the rate and extent of subsidence within the subbasin boundaries.

4.2.4.1 Requirements

The land subsidence network shall be designed such that the sustainability indicators are adequately covered, not just over the entire basin, but also within any specific GSP-defined Management Areas. The land subsidence monitoring network shall be designed to enable the characterization of the rate and extent of subsidence by providing consistent, accurate, and reproducible results (23 CCR §354.34(c)(5); DWR, 2016).

Monitoring sites shall include the following information (23 CCR §352.4(a) through (b):

- Unique station identifier
- Site description
- Monitoring type

- Measurement(s) taken
- Monitoring frequency
- Location (NAD 83, latitude and longitude decimal degrees to five decimal places)
- Elevation of ground surface (accurate to 0.1 feet NAVD 88)
- Elevation and description of reference point (accurate to 0.5 feet NAVD 88)
- Description of standards used to install the monitoring site

4.2.4.2 Monitoring Protocols

Data will be obtained from the non-GSA agencies that are responsible for managing the monitoring sites within the land subsidence monitoring network.

The following land subsidence monitoring protocols have been established by DWR (DWR, 2016b):

- Levelling surveys should follow standards defined in the California Department of Transportation's (Caltrans) Surveys Manual (Caltrans, assorted dates).
- Continuous GPS surveys should follow standards defined in the Caltrans Surveys Manual.
- Extensometer instruments should be installed, calibrated, and maintained per the manufacturer's instructions.
- InSAR surveys should be obtained via interpretative reports for specific regions. Raw data files may be obtained and processed instead, if needed.

Land surface should be recorded to an accuracy of 0.1 feet, at a minimum, relative to NAVD 88, in accordance with the requirements described in 23 CCR §352.4(a)(3).

4.2.4.3 Land Subsidence Monitoring Network

Table 4-5 lists the benchmarks, continuous GPS stations, and extensometers included in the land subsidence monitoring network. Figure 4-4 shows these locations relative to the subbasin. The land subsidence monitoring sites are managed and maintained by non-GSA agencies.

4.2.4.4 Data Gaps in Land Subsidence Monitoring Network

Land subsidence has been measured in the greater Arbuckle and southern Colusa County area (Section 3.2.6). While there is sufficient benchmark coverage, the benchmarks must be manually surveyed in order to determine the magnitude of displacement. This is currently done on an irregular frequency and does not provide short-term insight regarding ongoing land subsidence. The installation of a continuous GPS station or extensometer would allow near real-time monitoring of subsidence in the Arbuckle area without relying on the irregular re-survey frequency of the Sacramento Valley benchmarks.

Table 4-5. Land Subsidence Monitoring Network Extensometers and Benchmarks

County	Station ID	Latitude	Longitude	Datum	Frequency	Site Type
Colusa	16N02W05B001	39.27527	-122.10568	NAD 83[(a)]	Daily	Extensometer[(b)]
Colusa	17N02W09H002	39.34170	-122.08377	NAD 83	Daily	Extensometer
Glenn	19N02W08Q001	39.51596	-122.11143	NAD 83	Daily	Extensometer
Glenn	21N02W33M001	39.62970	-122.10045	NAD 83	Daily	Extensometer
Glenn	22N02W15C002	39.76352	-122.07727	NAD 83	Daily	Extensometer
Colusa	P269	38.99953	-122.35455	NAD 83	Daily	Continuous GPS Benchmark[(c)]
Colusa	P270	39.24377	-122.05520	NAD 83	Daily	Continuous GPS Benchmark
Colusa	P272	39.14548	-121.93406	NAD 83	Daily	Continuous GPS Benchmark
Glenn	P336	39.52808	-122.43047	NAD 83	Daily	Continuous GPS Benchmark
Sutter	SUTB	39.20583	-121.82058	NAD 83	Daily	Continuous GPS Benchmark
Colusa	COLI	39.18514	-121.99461	NAD 83	TBD[(d)]	Benchmark[(e)]
Colusa	D850	39.14268	-122.21725	NAD 83	TBD	Benchmark
Colusa	DELE	39.27528	-122.10558	NAD 83	TBD	Benchmark
Colusa	DLP2	39.19113	-122.17126	NAD 83	TBD	Benchmark
Colusa	DODG	39.37739	-122.02070	NAD 83	TBD	Benchmark
Colusa	F200	39.31920	-122.19154	NAD 83	TBD	Benchmark
Colusa	FINK	39.25828	-122.19148	NAD 83	TBD	Benchmark
Colusa	GORD	39.40956	-122.00997	NAD 83	TBD	Benchmark
Colusa	GRNO	39.05664	-121.96914	NAD 83	TBD	Benchmark
Colusa	H62U	39.12059	-122.29094	NAD 83	TBD	Benchmark
Colusa	HAHN	39.08068	-122.09838	NAD 83	TBD	Benchmark
Colusa	HARB	39.24734	-122.03128	NAD 83	TBD	Benchmark
Colusa	HPKN	39.21772	-122.08883	NAD 83	TBD	Benchmark
Colusa	JRM4	38.92774	-121.84330	NAD 83	TBD	Benchmark
Colusa	LAUX	39.24547	-121.95867	NAD 83	TBD	Benchmark
Colusa	LONE	39.17702	-122.07852	NAD 83	TBD	Benchmark
Colusa	LUSA	38.97056	-122.02556	NAD 83	TBD	Benchmark
Colusa	NLD6	39.11442	-122.01828	NAD 83	TBD	Benchmark
Colusa	SECO	39.02883	-122.06393	NAD 83	TBD	Benchmark
Colusa	SR65	39.31529	-122.03400	NAD 83	TBD	Benchmark
Colusa	STEG	39.34150	-122.08425	NAD 83	TBD	Benchmark
Colusa	T644	39.13183	-122.13209	NAD 83	TBD	Benchmark
Colusa	TC22	39.05341	-122.15435	NAD 83	TBD	Benchmark
Colusa	TC23	39.01061	-122.09302	NAD 83	TBD	Benchmark
Colusa	TCCO	39.62555	-122.27261	NAD 83	TBD	Benchmark
Colusa	W850	39.37778	-122.24806	NAD 83	TBD	Benchmark
Colusa	WAYN	38.99358	-121.95819	NAD 83	TBD	Benchmark
Colusa	WDWD	38.93141	-122.06109	NAD 83	TBD	Benchmark
Colusa	WHEA	39.07662	-121.89427	NAD 83	TBD	Benchmark
Colusa	WILK	38.99058	-121.86709	NAD 83	TBD	Benchmark
Colusa	WBND	39.04187	-121.83686	NAD 83	TBD	Benchmark
Glenn	2085	39.74664	-122.12269	NAD 83	TBD	Benchmark
Glenn	6064	39.39964	-122.28803	NAD 83	TBD	Benchmark
Glenn	A107	39.58564	-122.40492	NAD 83	TBD	Benchmark
Glenn	AGUI	39.72608	-122.24058	NAD 83	TBD	Benchmark
Glenn	ARTO	39.62432	-122.20473	NAD 83	TBD	Benchmark
Glenn	B107	39.61136	-122.52858	NAD 83	TBD	Benchmark
Glenn	BIGB	39.46424	-121.87054	NAD 83	TBD	Benchmark
Glenn	BIGW	39.67254	-122.33616	NAD 83	TBD	Benchmark
Glenn	C200	39.40630	-122.19228	NAD 83	TBD	Benchmark
Glenn	CHER	39.66815	-122.25317	NAD 83	TBD	Benchmark
Glenn	CREE	39.73149	-122.41332	NAD 83	TBD	Benchmark
Glenn	EXT1	39.62967	-122.10220	NAD 83	TBD	Benchmark
Glenn	FREN	39.58243	-122.24968	NAD 83	TBD	Benchmark
Glenn	GLEN	39.52165	-122.01480	NAD 83	TBD	Benchmark
Glenn	H285	39.55203	-122.35723	NAD 83	TBD	Benchmark
Glenn	JACI	39.58242	-122.01000	NAD 83	TBD	Benchmark
Glenn	K852	39.69694	-122.19524	NAD 83	TBD	Benchmark
Glenn	KAIS	39.70917	-122.03745	NAD 83	TBD	Benchmark
Glenn	L191	39.58203	-122.12229	NAD 83	TBD	Benchmark
Glenn	LARK	39.49276	-122.08760	NAD 83	TBD	Benchmark
Glenn	M107	39.46981	-122.19286	NAD 83	TBD	Benchmark
Glenn	1118	39.65967	-122.02694	NAD 83	TBD	Benchmark
Glenn	MINO	39.46442	-122.13664	NAD 83	TBD	Benchmark
Glenn	NORM	39.40751	-122.13629	NAD 83	TBD	Benchmark
Glenn	BEND	39.62986	-121.99831	NAD 83	TBD	Benchmark
Glenn	ORLA	39.76848	-122.19233	NAD 83	TBD	Benchmark
Glenn	OWEN	39.46565	-122.24895	NAD 83	TBD	Benchmark
Glenn	P30W	39.65274	-122.15119	NAD 83	TBD	Benchmark
Glenn	PETE	39.69582	-122.10299	NAD 83	TBD	Benchmark
Glenn	PROV	39.52184	-122.08860	NAD 83	TBD	Benchmark
Glenn	PMPR	39.78431	-122.04597	NAD 83	TBD	Benchmark
Glenn	Q107	39.52422	-122.23729	NAD 83	TBD	Benchmark
Glenn	S106	39.71978	-122.54948	NAD 83	TBD	Benchmark
Glenn	U107	39.53084	-122.32621	NAD 83	TBD	Benchmark
Glenn	V380	39.78232	-122.29498	NAD 83	TBD	Benchmark
Glenn	W215	39.79579	-122.54653	NAD 83	TBD	Benchmark
Glenn	WALK	39.52420	-122.16497	NAD 83	TBD	Benchmark
Glenn	WILL	39.43593	-122.07612	NAD 83	TBD	Benchmark
Glenn	WILN	39.57084	-122.19379	NAD 83	TBD	Benchmark
Glenn	WINS	39.66351	-122.52596	NAD 83	TBD	Benchmark
Glenn	Y380	39.76272	-122.33738	NAD 83	TBD	Benchmark
Glenn	Y852	39.45718	-122.01761	NAD 83	TBD	Benchmark
Sutter	WR18	39.25300	-121.89167	NAD 83	TBD	Benchmark
Sutter	304	39.14328	-121.90174	NAD 83	TBD	Benchmark
Yolo	DRAI	38.92529	-121.91457	NAD 83	TBD	Benchmark

(a) Latitude and longitude values are in North American Datum of 1983 (NAD 83), decimal degrees.
(b) Extensometers within the study area are installed within intervals from approximately 700-800 ft, bgs.
(c) Continuous global positioning system (GPS) benchmark.
(d) Frequency to be determined (TBD). Benchmarks have historically been re-surveyed irregularly, on an as-needed or as-requested basis.
(e) Benchmarks are those listed for the Sacramento Valley Height Modernization Project within the Counties of Colusa and Glenn and within other Counties near the study area boundary.

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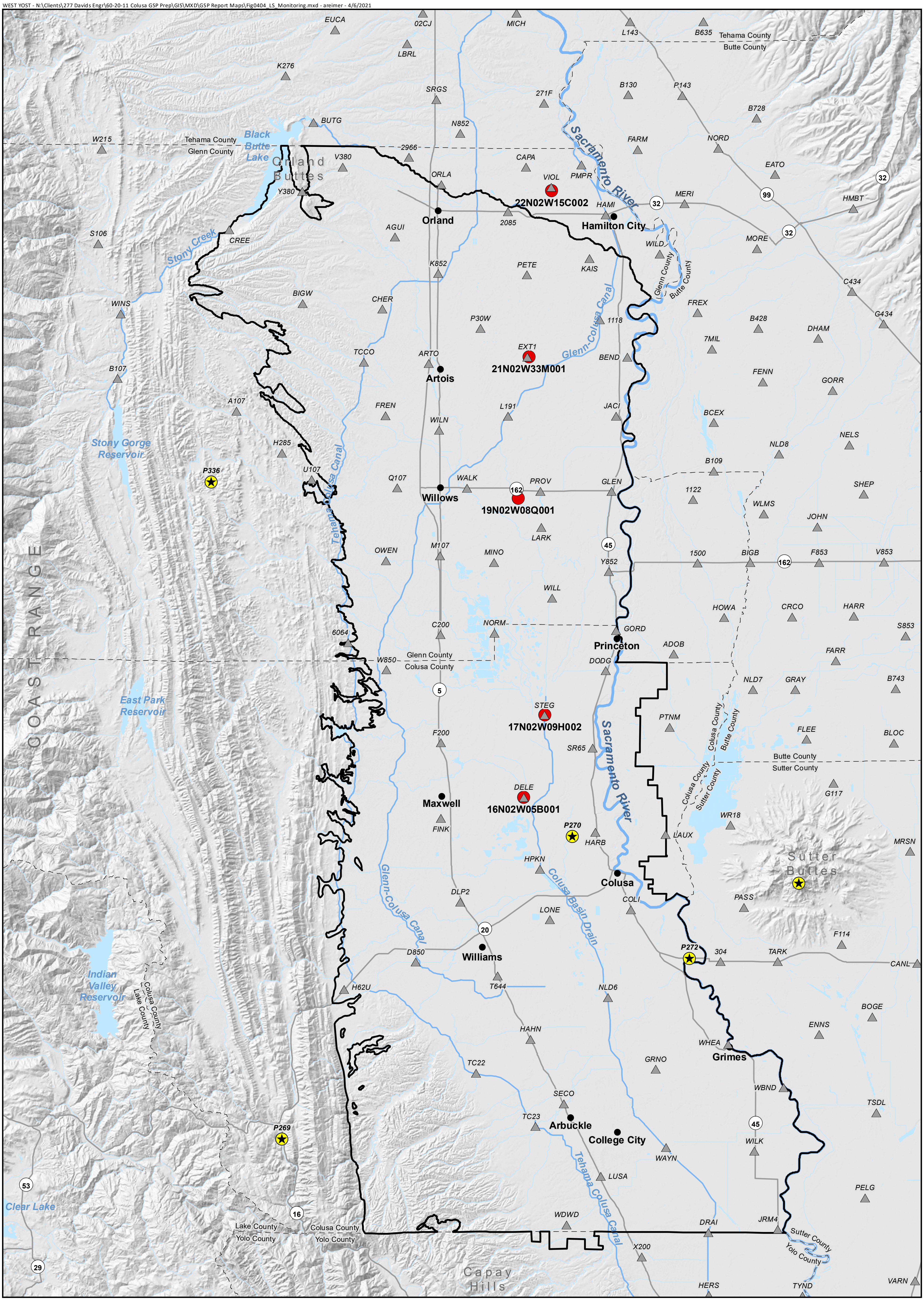

Sacramento Valley Benchmark

Extensometer

Continuous GPS Station

Colusa Subbasin

Horizontal Datum: North American Datum of 1983 (NAD 83), California State Plane Zone II, feet.

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Scale in Miles

Figure 4-4

Land Subsidence Monitoring Network

Colusa GSA and Glenn GSA

Colusa Subbasin

Groundwater Sustainability Plan

4.2.4.5 Proposed Actions to Address Data Gaps

4.2.4.5.1 Proposed Benchmarks, Extensometers, or Continuous GPS Stations

No additional benchmarks are needed at this time.

A new continuous GPS station or extensometer near Arbuckle is being investigated to allow near real-time monitoring of subsidence.

4.2.4.5.2 Additional Proposed Actions

The repeat DWR benchmark survey results will be evaluated as they are made available. Ongoing studies using InSAR data will also be evaluated as they are published.

4.2.5 Surface Water Monitoring

Surface water monitoring is conducive for evaluating stream-aquifer relations. Comparing stream flows and stages with groundwater levels from specific monitoring wells can provide insight into how the surface waters are interconnected with the groundwater system. The surface water monitoring network includes gages placed on rivers, streams, and canals. All of the stream gages included in the surface water monitoring network are managed and monitored via existing federal and state programs.

4.2.5.1 Requirements

The surface water monitoring network should be designed such that the sustainability indicators are adequately covered not just over the entire basin, but also within any specific GSP-defined Management Areas. The surface water monitoring network shall be designed to characterize spatial and temporal changes between interconnected waters such that depletions from surface waters caused by groundwater extraction can be calculated (23 CCR §354.34(c)(6); DWR, 2016a).

In accordance with the Monitoring Network BMP (DWR, 2016a) and 23 CCR §354.34(c)(6), data collected from the surface water monitoring network shall be sufficient to:

- Characterize flow conditions including surface water discharge, stage, and baseflows.
- Identify locations and flow periods of ephemeral and intermittent stream channels, if any. The Monitoring Network BMPs state that monitoring of ephemeral or intermittent streams should be conducted annually or as appropriate to characterize flow changes (DWR, 2016a).
- Identify temporal trends due to localized, regional, and seasonal surface water discharge and groundwater extraction impacts.
- Identify and collect information necessary to evaluate adverse effects to the beneficial use of surface water.
- Support evaluation of DQOs.

Stream gages should be located along stream reaches with known groundwater connection, per the Monitoring Network BMP (DWR, 2016). Locations should account for surface water diversions and return flows, if necessary. Per the Monitoring Network BMP (DWR, 2016a), surface water discharge monitoring should be accompanied by groundwater level monitoring within shallow wells.

Monitoring sites shall include the following information (23 CCR §352.4(a) through (b):

- Unique station identifier
- Site description (NAD 83, latitude and longitude decimal degrees to five decimal places)
- Monitoring type
- Measurement(s) taken
- Monitoring frequency
- Location
- Elevation of ground surface (accurate to 0.1 feet NAVD 88)
- Elevation and description of reference point (accurate to 0.5 feet NAVD 88)
- Description of standards used to install the monitoring site

4.2.5.2 Monitoring Protocols

Data will be obtained from any non-GSA agencies that are responsible for managing the monitoring sites within the surface water monitoring network.

Per the Monitoring Protocols BMP (DWR, 2016b), streamflow measurements should be collected, analyzed, and reported in accordance with procedures defined in the USGS Water Supply Paper 2175, volumes 1 and 2 (Rantz, 1982). This methodology is currently being used for both DWR and USGS surface water monitoring networks within the Colusa Subbasin.

Surface water flows shall be recorded in cubic feet per second and surface water elevations shall be recorded in feet with a minimum accuracy of 0.1 feet relative to NAVD 88, in accordance with the requirements described in 23 CCR §352.4(a). Water volumes shall be reported in acre-feet.

4.2.5.3 Surface Water Monitoring Network

Table 4-6 lists the surface water monitoring network, their locations, and monitoring frequency. These station locations are shown on Figure 4-5 and include all of the active stream gages and monitoring sites managed by CDEC, DWR, USBR, and USGS both within and upstream of the Colusa Subbasin. The surface water monitoring sites are managed and maintained by non-GSA agencies.

4.2.5.4 Data Gaps in Surface Water Monitoring Network

The temporal changes in ephemeral and intermittent stream stage and flow within the subbasin may not be sufficiently addressed by the existing surface water monitoring network to the extent required by 23 CCR §354.34(c).

Colusa Basin Drain outflows from the Colusa Subbasin are not currently monitored, and historical monitoring records for Colusa Basin Drain outflows from the Colusa Subbasin are not available within the CDEC, NWIS, and WDL databases.

4.2.5.5 Proposed Actions to Address Data Gaps

The perennial streams (Stony Creek and the Sacramento River) that bound or intersect the Colusa Subbasin and adjacent subbasins are shown on Figure 4-4. Surface water monitoring, particularly as related to streamflow depletion, should be coordinated across subbasins. The Colusa and Glenn GSAs are participating in a surface water monitoring network data gap assessment and fulfillment in cooperation with neighboring GSAs.

Additionally, existing stream and drainage reports will be evaluated for additional information on the timing, stage, and magnitude of flows in ephemeral and intermittent streams in the subbasin, if necessary to fill data gaps or support projects and management actions during GSP implementation. If necessary, site-specific studies will be conducted to fill data gaps or address requirements for monitoring of ephemeral and intermittent streams, per 23 CCR §354.34(c)(6).

DWR is reportedly in the process of evaluating the adequacy of existing stream gages to support SGMA implementation. As a result of this effort, it is anticipated that DWR will identify data gaps and develop recommendations regarding the existing stream gage networks. Actions proposed by DWR, if any, will be taken into consideration by the Colusa and Glenn GSAs.

Table 4-6. Surface Water Monitoring Network Stream Gages

County	Station ID	Station Name	Latitude[(a)]	Longitude	Site Type	Frequency	Source
Colusa	BSO; A02967	Butte Slough at Outfall Gates near Colusa	39.195161	121.936567	Discharge [(c)]	Hourly	CDEC[(b)]; WDL[(d)]
Colusa	CDR; A02976	Colusa Basin Drain at Highway 20	39.195512	122.060517	Discharge	Hourly	CDEC; WDL
Colusa	CLW; A02981	Sacramento River at Colusa Weir	39.23682	121.99476	Discharge	Hourly	CDEC; WDL
Colusa	A00647	Freshwater Creek at Leesville Road near Williams	39.129339	122.30993	Discharge	Daily	WDL
Sutter	MPS	Meridian Pumps	39.148	121.918	Discharge	Hourly	CDEC
Colusa	MLW; A02986	Sacramento River at Moulton Weir	39.33821	122.022627	Discharge	Hourly	CDEC; WDL
Glenn	BTC; A02500	Sacramento River at Butte City	39.45784	121.99416	Discharge	Hourly	CDEC; WDL
Colusa	11389500	Sacramento River at Colusa	39.214057	122.000251	Discharge	Daily	USGS
Glenn	HMC; A02630	Sacramento River at Hamilton City	39.750925	121.997877	Discharge	Hourly	CDEC; WDL
Glenn	ORD; A02570	Sacramento River at Ord Ferry	39.628132	121.993182	Discharge	Hourly	CDEC; WDL
Sutter	TIS	Sacramento River at Tisdale Weir	39.02644	121.822083	Discharge	Hourly	CDEC
Colusa	11390500	Sacramento River below Wilkins Slough near Grimes	39.009974	121.823398	Discharge	Daily	USGS
Glenn	WCF	South Fork Willow Creek near Fruto	39.541538	122.390045	Stage	Hourly	CDEC
Tehama	BBQ	Stony Creek below Black Butte Dam	39.8186	122.3239	Stage	Event	CDEC
Glenn	SCG	Stony Creek near Grizzly Flat (County Road 200A)	39.73181	122.413997	Discharge	Hourly	CDEC

(a) Latitude and longitude are reported in North American Datum of 1983 (NAD 83), decimal degrees.
(b) California Data Exchange Center (CDEC).
(c) The term "Discharge" means that stream flows are reported. If no flows are reported but stream stage is, then the term "Stage" is used.
(d) California Department of Water Resources (DWR) Water Data Library (WDL).

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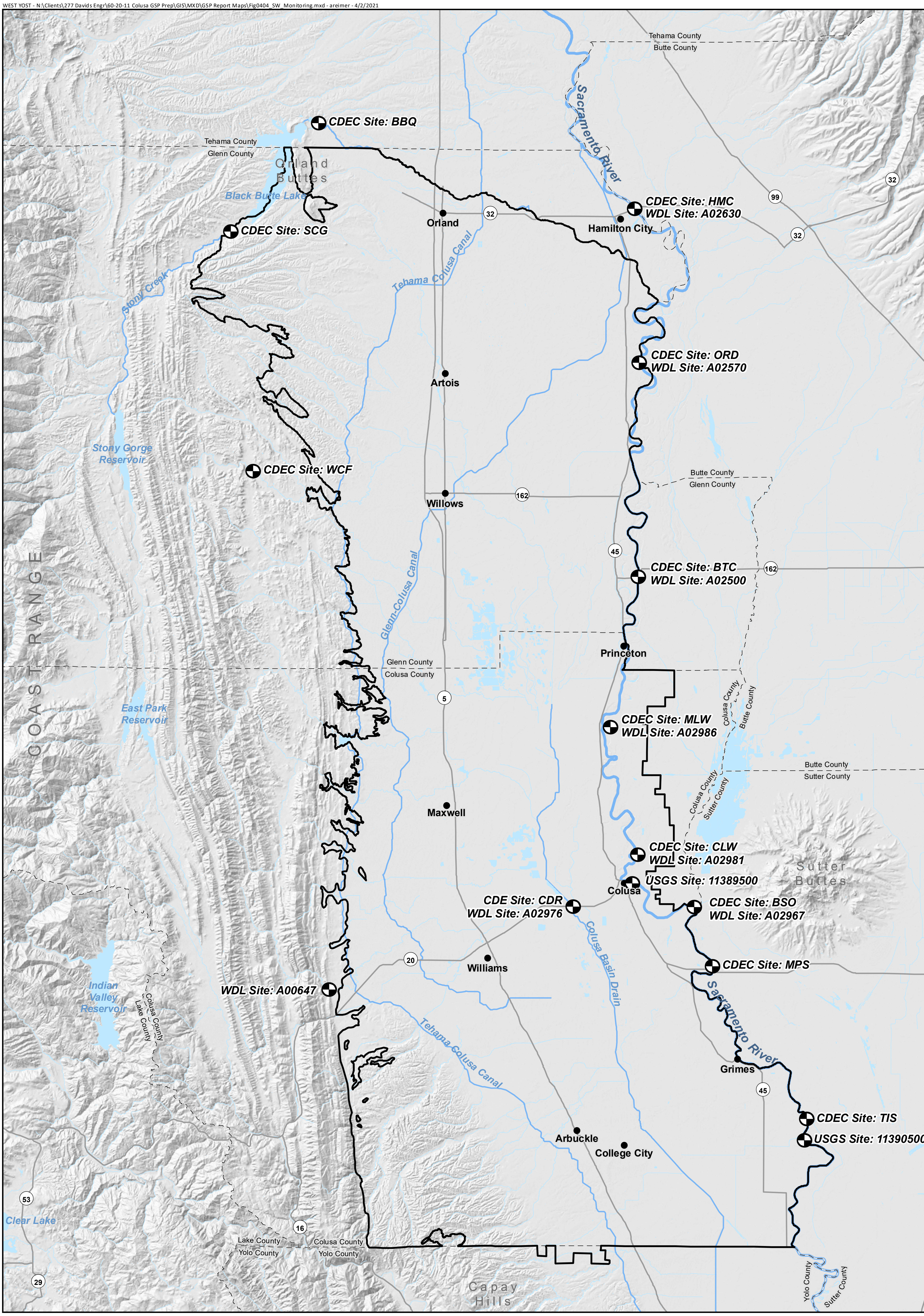

Surface Water Monitoring Stream Gage

Colusa Subbasin

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0 2.5 5

Scale in Miles

Horizontal Datum: North American Datum of 1983 (NAD 83), California State Plane Zone II, feet.

Figure 4-5

Surface Water Monitoring Network

Colusa GSA and Glenn GSA

Colusa Subbasin

Groundwater Sustainability Plan

4.3 REFERENCES

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