

Sutter County Alternative Submittal to a Groundwater Sustainability Plan for Sutter Subbasin

Submitted to:
California Department of Water Resources

Submitted by:
Sutter County
Feather Water District
Oswald Water District
Reclamation District 1001
Reclamation District 1500
Reclamation District 1660
Reclamation District 2054
Reclamation District 70
Reclamation District 777
Reclamation District 783
Sutter Community Services District
Sutter Extension Water District
Yuba City
Butte Water District
Reclamation District 2056

December 19, 2016

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Alternative Submittal
To a Groundwater Sustainability Plan for Sutter Subbasin
Sutter County, California

Prepared by GEI Consultants, Inc.

December 19, 2016

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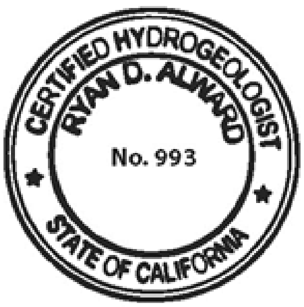
SUTTER COUNTY

ALTERNATIVE SUBMITTAL TO A GROUNDWATER SUSTAINABILITY PLAN, FOR SUTTER SUBBASIN

Certifications and Seals

This report and analysis was prepared by the following GEI Consultants Inc. professional geologists.

Report sections contained herein pertaining to the geology, hydrogeologic conceptual model, hydrology, water quality, groundwater levels, water budget and sustainability criteria based on available data and were prepared by:



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Abbreviations and Acronyms

AB	Assembly Bill
Act (or SGMA)	Sustainable Groundwater Management Act
AF	acre-feet
BWD	Butte Water District
CABY	Cosumnes American Bear Yuba governance body
CASGEM	California Statewide Groundwater Elevation Monitoring
CEQA	California Environmental Quality Act
County	Sutter County
CVHM	Central Valley Hydrologic Model
DBCP	Dibromochloropropane
DWR	Department of Water Resources
GHMWC	Garden Highway Mutual Water Company
GMP	Groundwater Management Plan
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
IRWMP	Integrated Regional Water Management Program
JPA	Joint Powers Authority
LUFTs	Leaky Underground Fuel Tanks
MCL	Maximum Contaminant Level
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
NASA	National Aeronautics and Space Administration
SB	Senate Bill
SEWD	Sutter Extension Water District
SGMP	Sustainable Groundwater Management Planning
SGWP	Sustainable Groundwater Planning
SMCL	Secondary Maximum Contaminant Level
Subbasin	Sutter Groundwater Subbasin
TDS	Total Dissolved Solids
US	United States
USGS	United States Geologic Survey
USFW	United States Fish and Wildlife Service
USTs	Underground Storage Tanks
Water Board	State Water Resources Control Board

Executive Summary

This Alternative Submittal was developed to comply with the Sustainable Groundwater Management Act of 2014, which requires that either a Groundwater Sustainability Plan or Alternative Submittal be developed for designated medium and high priority groundwater basins in California (a total of 127 groundwater basins and subbasins). An Alternative Submittal can only be developed if the entire subbasin is included and the subbasin has been sustainably managed for a minimum of 10 years without undesirable results, which are defined as chronic lowering of groundwater levels, depletion of groundwater storage, depletion of surface water, subsidence, sea water intrusion and degraded water quality. Locally formulated metrics applied to avoid these undesirable results are referred to as sustainability indicators. These sustainability indicators together with minimum thresholds and measureable objectives used to monitor the Subbasin's performance relative to the indicators, are presented in Chapter 7. This Alternative Submittal demonstrates that the Sutter Subbasin has been sustainably managed for a minimum period of 10 years. The analysis was based on best available data.

This Alternative Submittal was prepared for the Sutter Subbasin (Subbasin) located in Sutter County, California. Sutter County elected to extend this analysis to cover the County portion of the East Butte Subbasin to allow for a basin boundary change, possibly in 2018, which could incorporate this portion of the subbasin into the Sutter Subbasin. Both subbasins are located within the Sacramento Valley Hydrologic Area. The Sutter Subbasin has been managed by Sutter County and its stakeholders using their Groundwater Management Plan (GMP). The GMP contains management objectives but did not establish minimum threshold levels or quantifiable measureable objectives, because the legislation governing GMPs did not require these components be provided. The primary management objective presented in the GMP was to lower groundwater levels to protect agriculture. In addition, the sustainability of the Sutter Subbasin is being managed according to the State Board's Irrigated Lands Regulatory Program which addresses groundwater quality effects by agriculture the principal water use in the Subbasin.

Water use in the subbasin is stable due to the long history of agriculture in the area which has essentially been fully developed for over 100 years. Crop type is also very stable primarily due to the soils which limit the types of crops that can be grown. Limited urban growth is occurring near Yuba City and Live Oak. Agriculture and urban areas rely upon both surface water and groundwater. Because of the variability in surface water supplies, groundwater is used to buffer and augment surface water supplies. Again, because of the stable agriculture practices, groundwater has reached an equilibrium state and ranges from about 0 to 50 feet below ground surface, including seasonal changes and through droughts.

Groundwater levels in the Subbasin, using dedicated monitoring wells, typically fluctuate on the order of 30 feet or less. The basin contains about 600 feet of fresh water saturated sediments. Therefore, the groundwater level changes only represent about 5 percent of the total saturated sediments in the basin.

The Sutter and East Butte subbasins are located in the center and near the lowest areas of the Sacramento Valley. Because of the subbasin topographic location, groundwater flows from adjacent basins into and through these subbasins. Groundwater use in the subbasin can affect groundwater conditions in these adjacent basins.

Groundwater is recharged from precipitation, applied water, subsurface inflow from adjacent basins and from the Feather and Sacramento rivers. Groundwater pumping has increased since about 1992 and has induced additional recharge from the rivers. Although there has been increased recharge from the rivers, groundwater from the subbasin continues to discharge to the rivers providing a benefit as it reduces water temperature. Also, most of the depletion from the rivers occurs during the winter, which does not impact the rivers. In below normal and critical years, the amount of water recharged from the rivers is about five times less than in other years, but a greater proportion of the induced recharge occurs during the summer. Increasing recharge from the rivers and reducing groundwater discharges to the rivers during the summer months can affect the amount of water in the rivers and the temperature of the river water

A water budget was developed for a 21-year period, from water year 1989 through 2009, which is considered by DWR to be a representative base period. The water budget was extracted from the C2VSim groundwater model. The water budget shows that during this 21-year period the inflow and outflow from the basin was about 9,000,000 acre-feet per year (AFY). Over the same period the water budget showed the Sutter Subbasin was slightly in deficit by about 138,000 acre-feet (AF), or if averaged over the 21-year period about 6,600 AFY. There are some discrepancies in the modeling results where the model predicted a regional average decline of about 5 feet (range of 0 to -8 feet); however, changes in groundwater levels during the base period, using just wells with groundwater-level measurements at the beginning and end of the base period, showed a regional average of about plus 0.5 feet (range of +7.3 to -4.3 feet), or that there is no deficit but the basin is in surplus. The C2VSim model is currently being updated by the California Department of Water Resources.

The Sutter Subbasin has about 3.1 million acre-feet of useable groundwater storage so the deficit, if present, only represents about a 5 percent of the total storage. In 2011, the deficit was reduced to about 4,000 AFY due to a reduction in municipal groundwater pumping and increased recharge by serving residents with surface water which was recharged into the subbasin through septic systems. During the recent drought, further reductions were observed due to the reduction of rice acres.

Groundwater quality in the basin is of marginal quality when compared to drinking water standards with many areas exceeding the maximum contamination levels for salinity, nitrate, arsenic, manganese and iron. Arsenic, manganese and iron and to some extent salinity are naturally occurring and wide spread. Salinity and nitrate will be monitored to assess their extent and limit their degradation of other groundwater.

An important part of development of this Alternative Submittal was formulation of sustainability goals, and of locally defined undesirable results, measureable objectives and minimum thresholds applied as metrics in evaluating the Subbasin’s performance with respect to each of the sustainability indicators. Representative wells were selected out of 186 wells that are currently being monitored for groundwater levels in the basin. Groundwater levels were used as a proxy for most of the sustainability indicators. Measurable objectives were established to continue the management objectives from the GMP. Minimum thresholds were established to allow the Subbasin to be conjunctively used without significantly changing water budget components and transferring effects to surrounding subbasins or inducing increased depletion of surface water. The measurable objectives and minimum thresholds were established to continue to allow groundwater discharges to the rivers.

1 Introduction to Sutter County's Alternative Submittal

In 2014, the Sustainable Groundwater Management Act (SGMA) was signed by the governor, setting the framework for attaining sustainably managed groundwater in California. SGMA's requirements apply to groundwater basins/subbasins designated by DWR as medium or high priority and consists of four basic components: 1) development of a Groundwater Sustainability Agency (GSA); 2) development of a Groundwater Sustainability Plan (GSP); 3) implementation of the plan and management to quantifiable objectives; and 4) reporting of the implementation activities to California Department of Water Resources (DWR) to document whether the basin is being sustainably managed.

Chapter 10 of SGMA - State Evaluation and Assessment, describes the need for DWR to develop and adopt emergency regulations that address plan review and implementation along with Section 10733.6 – Alternative Submittals. Section 10733.6 states – *"If a local agency believes that an alternative described in subdivision (b) satisfies the objectives of this part, the local agency may submit the alternative to the department for evaluation and assessment of whether the alternative satisfies the objectives of this part for the basin."* The subdivision (b), referred to above, describes that an alternative may be completed with one of the following approaches:

1) A plan developed pursuant to Part 2.75 (commencing with Section 10750) or other law authorizing groundwater management.

2) Management pursuant to an adjudication action.

3) An analysis of basin conditions that demonstrates that the basin has operated within its sustainable yield over a period of at least 10 years. The submission of an alternative described by this paragraph shall include a report prepared by a registered professional engineer or geologist who is licensed by the state and submitted under that engineer's or geologist's seal.

This document represents Sutter County's alternative submittal pursuant to 10733.6 (b) (3) and the following report provides a narrative of the historical and current state of the Sutter Subbasin, and provides an analysis that shows the basin has operated within its sustainable yield from a period of time spanning 1989 through 2009. The current nomenclature developed as part of SGMA and the use of the term "sustainability" are relatively new and have not been part of the standard groundwater management lexicon over the period of record that is outlined in this report. As part of the narrative, this report outlines the practices that have been employed by Sutter County and its stakeholders that show that the subbasin has been operated within the spirit of sustainability without necessarily using the current terms established and associated with SGMA.

1.1 Description of Sutter Subbasin

The Sacramento Valley Groundwater Basin has been divided into subbasins, some of which have been designated as medium or high priority by DWR (see **Figure 1**). The Sutter Subbasin (Subbasin) is one of the subbasins within the Sacramento Valley Basin. The surface area is 234,400 acres (366 square miles). DWR Bulletin 118 describes the subbasin as being in the "central portion of the Sacramento Valley Groundwater Basin." It is bounded on the north by the by the confluence of Butte Creek and the Sacramento River and Sutter Buttes, on the west by the Sacramento River, on the south by the confluence of the Sacramento River and the Sutter Bypass, and on the east by the Feather River. Directly north of the Subbasin is the East Butte Subbasin, which lies mostly within Butte County with the southern portion extending into Sutter County and meeting the Subbasin north of the Sutter Buttes. For the remainder of this document, when the Subbasin is mentioned, the discussion includes the southern portion of East Butte Subbasin that lies within Sutter County.

In 2016, agencies were allowed to submit requests to DWR for basin boundary modifications, justifying the reason why a boundary should be changed. Sutter County did not request a change in groundwater basin boundaries; however, Sutter County is interested in a future basin boundary modification that would consolidate the Sutter County portion of the East Butte Subbasin into the Sutter Subbasin, where the new boundary for the Sutter Subbasin would be moved north to the Sutter County – Butte County line. Sutter County plans to submit a basin modification request when DWR allows agencies to file for modifications in the future, in or near 2018.

The very southern portion of the East Butte subbasin that lies within Sutter County is hydrologically and hydrogeologically similar to the Subbasin and the basin modification would be 'jurisdictional' and would not require significant scientific studies to be accepted as long as local affected agencies are in support of the modification. This alternative submittal has been created with the expectation that in the near future the southern portion of the East Butte Subbasin will be a part of the Subbasin south of the Sutter County line. Therefore, the water balance, well density, and groundwater level information has been included for the southern portion of the East Butte subbasin with the intention that the boundary modification will have taken place while this submittal is being reviewed by DWR.

1.2 Basin Prioritization Matrix

DWR used a scoring matrix to prioritize the basins as part of the California Statewide Groundwater Elevation Monitoring (CASGEM) program and created four priority classifications: very low, low, medium, and high priority. The higher the score, the higher priority the basin, and the scoring matrix for the Subbasin is presented in **Table 1**. The Subbasin was ranked medium priority due mainly to the acres of irrigated land, total wells per square mile, percentage of projected population growth through 2030 and volume (acre-feet per acre) of groundwater used. One criterion used to determine prioritization was "Impacts" of which Sutter Subbasin was given a zero (0), indicating no impacts.

Table 1. CASGEM Basin Summary

CASGEM BASIN SUMMARY

Basin: SACRAMENTO VALLEY
Sub_Basin: SUTTER
Basin Number: 5-21.62
Date: 5/30/2014

Hydrologic Region: Sacramento River
North Central Region Office (NCRO)
Basin Area: 234264 acres (366 miles)
2010 Population: 82125

DATA COMPONENT RANKING VALUE TABLE

Data Component		Ranking Range (x)	Units	Ranking Value	Confidence Adjustment	Average of Components	Adjusted Ranking Values
1. Population		7 ≤ x < 250	persons/sq-mi	1			1
2. Population Growth		25 ≤ x < 40	percent	4			4
3. Public Supply Wells		0.1 ≤ x < 0.25	wells/sq-mi	2			2
4. Total Wells		10 ≤ x < 20	wells/sq-mi	4	3		3
5. Irrigated Acreage		x ≥ 350	acres/sq-mi	5			5
6. GW Reliance	GW Use	0.5 ≤ x < 0.75	acre-foot/acre	4		2.5	2.5
	% of Total Supply	0.1 ≤ x < 20	percent	1			
7. Impacts*		--	--	0			0
8. Other Information**		--	--	0			0
Overall Basin Ranking Score		**13.42 ≤ x <**	**--**				**17.5**

Overall Basin Priority: Medium

Very Low Ranking Range	Low Ranking Range	Medium Ranking Range	High Ranking Range
Range < 5.75	5.75 ≥ Range < 13.42	13.43 ≥ Range < 21.08	Range ≥ 21.08

<u>Data Sources and Calculation Notes:</u>

1. Population: Department of Finance 2010 census data.
2. Population Growth: Department of Finance 2010 census data projected to 2030.
3. Public Supply Wells: Department of Public Health, 2012 Drinking Water Supply Database.
4. Total Wells: DWR 2012 Well Master database.
5. Irrigated Acreage: DWR, most recent land use projection and public comment feedback.
6. Groundwater Reliance: DWR, most recent land use projection and public comment feedback.
7. Documented Impacts: DWR Region staff review of DWR Bulletin 118-2003, Groundwater Management Plans, public comment feedback, or other readily available published information.
8. Other Information: DWR Region staff review of DWR Bulletin 118-2003, Groundwater Management Plans, public comment feedback, or other readily available published information.
9. Data component values were reduced by 25% due to data confidence, prior to calculating total groundwater basin ranking value.
10. Overall Basin Ranking = Population + Population Growth + Public Supply Wells + (Total Wells x .75) + Irrigated Acreage + (Groundwater Use + % of Total Supply)/2 + Impacts + Other information

<u>Notes on SACRAMENTO VALLEY Basin</u>

* Impacts: No impacts identified.

**Other Information: None

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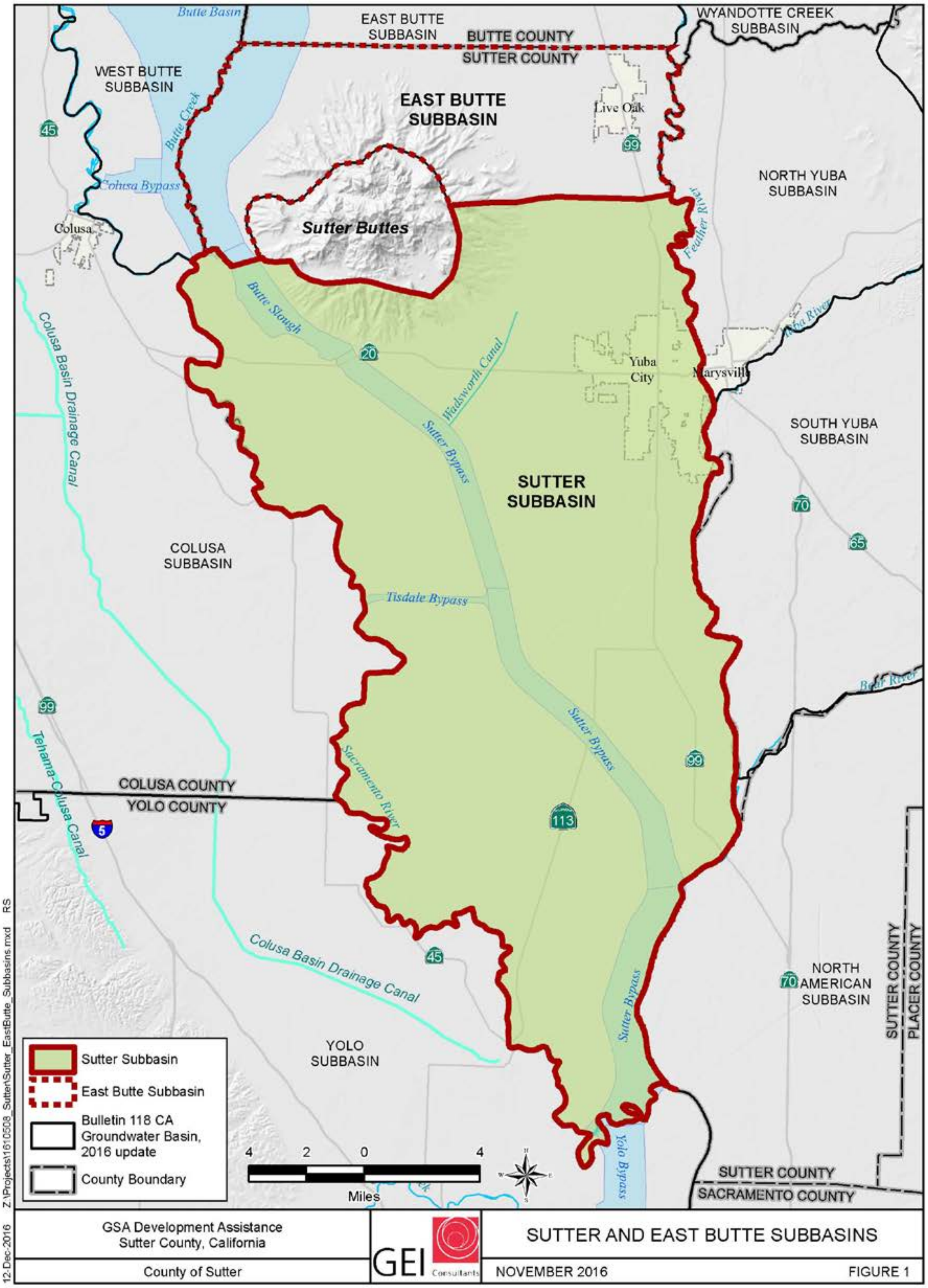


Figure 1. Sutter and East Butte Groundwater Subbasin

Of all the criteria that were scored, irrigated acreage received the highest value, a score of five (5). Sutter County is primarily an agricultural community; however, the local agencies hold senior surface water rights of which a considerable amount is used for the irrigated lands. Of this surface water that is applied, approximately 292,000 acre-feet (AF) is accounted as groundwater recharge due to infiltration from irrigation (Davids Engineering, 2014). In addition to irrigating land with surface water, the availability of surface water allows the agencies within the Subbasin to conjunctively use their groundwater through the use of short-term groundwater substitution water transfers and land fallowing water transfers. These conjunctive use strategies allow the local agencies to assist locales within the state that do not have access to the water required for their agricultural activities by allowing the transfer of a portion of their surface water allotment and pumping groundwater instead for use as their source of agricultural irrigation supply. The benefit of conjunctive use was described at the beginning of the SGMA as 'Uncodified Finding (a) (11)' which states: *"Sustainable groundwater management in California depends upon creating more opportunities for robust conjunctive management of surface water and groundwater resources. Climate change will intensify the need to recalibrate and reconcile surface water and groundwater management strategies."*

Agencies within Sutter County have been at the forefront of implementing sustainable conjunctive use strategies and, to be discussed in Section 3, groundwater levels within the Subbasin have been relatively stable and recover after periods of pumping. Groundwater substitution transfers have been conducted by Sutter Extension Water District (SEWD), Butte Water District (BWD), and Garden Highway Mutual Water Company (GHMWC). According to the SGMA 'Uncodified Finding (b) It is, therefore, the intent of the Legislature to do all of the following: *(3) To require the development and reporting of those data necessary to support sustainable groundwater management, including those data that help describe the basin's geology, the short- and long-tern trends of the basin's water balance, and other measures of sustainability, and those data necessary to resolve disputes regarding sustainable yield, beneficial uses, and water rights.*"

2 Agency Information

The following contact and fiscal information is provided for pursuant to Water Code Section 10723.8, with any updates.

2.1 Agency Contact Information

Sutter County
1130 Civic Center Blvd.
Yuba City, CA 95993

2.2 Organization and Management Structure

The Sutter County Board of Supervisors serves as the legislative body for Sutter County and provides policy direction for all branches of County government.

The Board of Supervisors has authorized the Director of Development Services to oversee the preparation of the Plan and its implementation.

2.3 Contact Information of Plan Manager

Ms. Danelle Stylos
Director of Development Services, Sutter County
1130 Civic Center Blvd.
Yuba City, CA 95993
530-822-7400
e-mail: DStylos@co.sutter.ca.us

2.4 Authority of Agency

The Sustainable Groundwater Management Act (SGMA) established a process for local agencies to develop an Alternative in lieu of a Groundwater Sustainability Plan (GSP), per Water Code §10733.6.

The County of Sutter, and stakeholders within the Sutter Subbasin, have provided this Alternative Plan as an analysis of basin conditions demonstrating that the basin has operated within its sustainable yield over a period of at least 10 years, consistent with Water Code §10733.6(b) for evaluation.

2.5 Cost of Implementation

The estimated cost of the Alternative Plan preparation, along with costs associated with the management of the Alternative and five-year updates, is $1.44M over the course of 15 years. The stakeholders within the Sutter Subbasin have reviewed the estimate and are prepared to either pay for the costs from reserve funds or provide an assessment to end users. Cost allocation to each stakeholder is based on service area covering the subbasin.

3 Description of Alternative Submittal Area

A description of the Alternative Submittal area for the Sutter Subbasin is provided in the following sections. The Sutter County portion of the East Butte Subbasin (shown on the attached maps as the Sutter Subbasin Project Area) is also discussed, but this Alternative Submittal applies only to the Sutter Subbasin until a basin boundary modification, which is contingent upon DWR allowing additional basin boundary modifications, is approved to consolidate the County portion of East Butte Subbasin with the Sutter Subbasin.

3.1 Sutter Subbasin

As outlined in Section 1.1, the Subbasin is a portion of the greater Sacramento Valley Groundwater Basin. Of the three subbasins located within Sutter County, the Subbasin is the only one to have 100 percent of the subbasin within Sutter County. Sutter County overlies portions of both the East Butte and the North American subbasins.

The majority of the Subbasin is comprised primarily of the gentle flatlands of the Sacramento River Valley (ranging in elevation from about 24 to 67 feet). The Sutter Buttes form the prominent feature near the northern portion of the subbasin and near the buttes the topographic elevation is much greater increasing from about 60 feet to about 200 feet. The Sutter Buttes is a Pliocene volcanic plug which rises 2,000 feet above the surrounding valley floor (DWR, Bulletin 118, 2004). According to DWR, the average precipitation ranges from 17 to 21 inches and rainfall increases across the basin from the southwest to the northeast (DWR, Bulletin 118, 2006).

3.2 East Butte Subbasin

The East Butte Subbasin is also in the portion of the Sacramento Valley Groundwater Basin and is bounded on the west and northwest by Butte Creek, on the northeast by the Cascade Ranges, on the southeast by the Feather River, and the south by the Sutter Buttes. The northeast boundary along the Cascade Ranges is primarily a geographic boundary with some groundwater recharge occurring beyond that boundary. The subbasin is contiguous with the West Butte and Sutter subbasins at depth. Annual precipitation is approximately 18 inches in the valley increasing to 27 inches towards the eastern foothills (DWR, Bulletin 118, 2004).

Similar topography and precipitation as in the Subbasin is present in the Sutter County portion of the East Butte Subbasin.

3.3 Adjudicated Areas

The Subbasin is not adjudicated nor are surrounding subbasins.

3.4 Jurisdictional Areas

This Alternative Submittal is for only the Subbasin. Sutter County has elected to include in this submittal the Sutter County portion of the East Butte. The Subbasin is managed by Sutter County and 16 stakeholder agencies, including water districts, reclamation districts, mutual water companies, private water companies, and municipalities. **Figure 2** shows the areas managed by each stakeholder agency. Sutter County has and will continue to manage those “white” areas not within the stakeholder service areas.

The Subbasin is surrounded on all sides by other DWR designated groundwater subbasins. To the north is the East Butte Subbasin, to the east is the Yuba North (newly revised boundary north to the Butte/Yuba County line), and the Yuba South Subbasins (minor boundary revision) and the North American Subbasin. To the west is the Colusa Subbasin. Also west and south of the Subbasin is the Yolo Subbasin. **Figure 2** shows the locations of the adjacent subbasins.

3.5 Land Use

Land use is managed by the City of Live Oak, Yuba City, and by the County for the remaining portions of the Sutter Subbasin, the County portion of the East Butte Subbasin, and also a portion of the North American Subbasin. The Subbasin and County portion of the East Butte Subbasin cover approximately 70 percent of the total acreage in the County.

The total acres by each significant land use category are summarized in **Table 2** for the period of 1988 through 2014. **Figures 3 through 6** show the distribution of land use through the County. Overall, farmlands declined by about 31,000 acres (-10%) while grazing lands increased by about 3,000 acres (6%). Urban development increased by about 5,000 acres (59%), habitat preservation areas (Other Land) increased by about 22,000 acres (235%), and water-covered area increased by about 100 acres (6%).

The water sources to the lands include surface water from the Feather and Sacramento r4ivers and groundwater. The areas that are served by surface water are located within those water districts and agencies shown on **Figure 2** with the exception of Yuba City, Sutter Community Services District, and the city of Live Oak. Most of the white areas shown on the map use groundwater; however, there are large areas of ranchland surrounding the Buttes that do not irrigate. Although surface water is provided in these areas, some growers may augment their supply or, for operational purposes, use groundwater.

All of the cities and rural communities use groundwater as their source of water supply to some extent:

- **Sutter -** The community of Sutter has three wells.
- **Robbins -** The community of Robbins has two wells. The Sutter County Development Services Department is currently prohibiting further development within Robbins due to their high wastewater treatment usage compared to their treatment capacity.
- **Live Oak –** Live Oak has five groundwater wells to carry them through the 2030 General Plan.

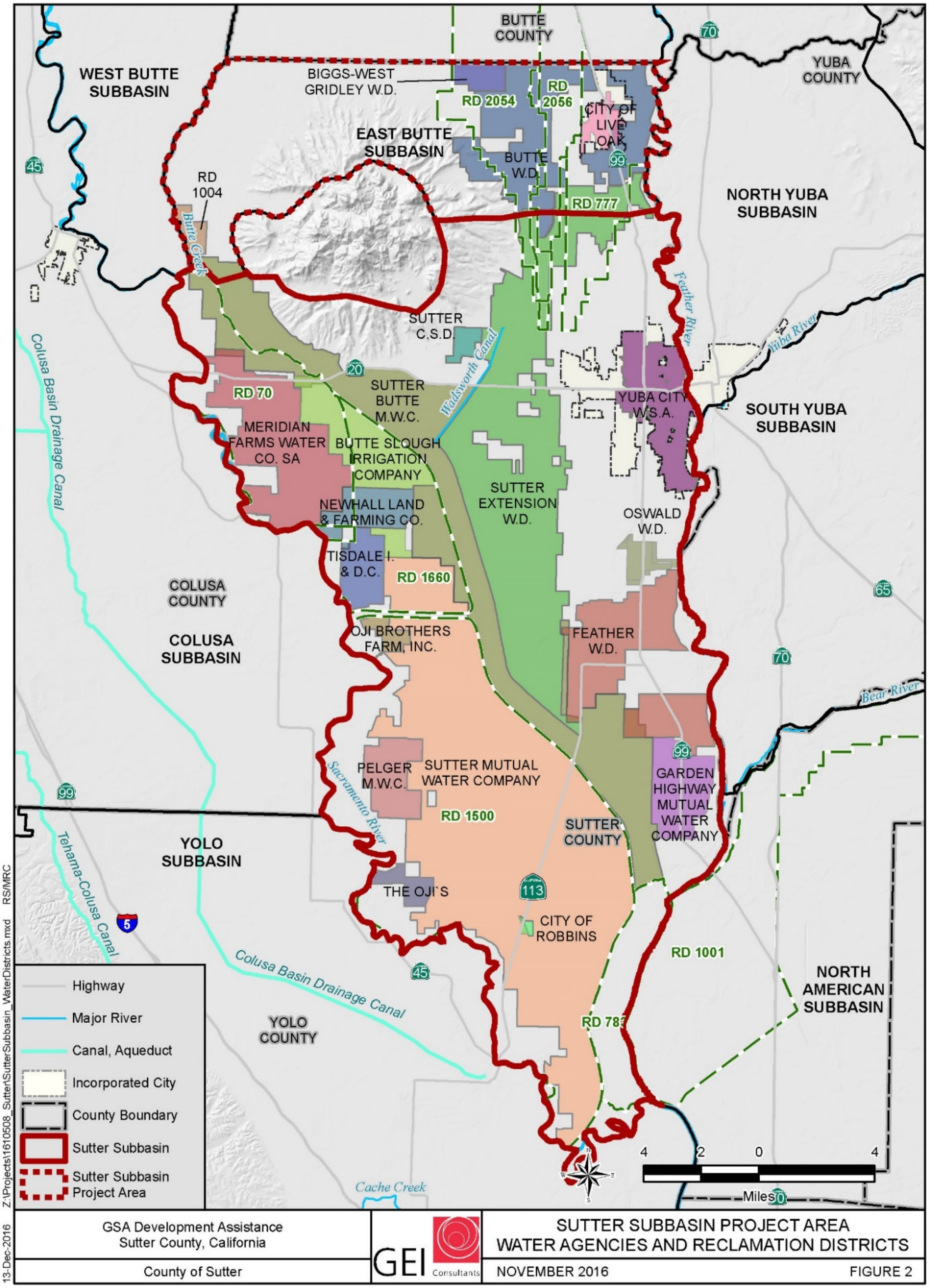


Figure 2. Water Agencies and Districts in Subbasin

Table 2. Land Use Summary

SUTTER COUNTY

1988-2014 Land Use Summary

Farmland Mapping and Monitoring Program

CALIFORNIA DEPARTMENT OF CONSERVATION

LAND USE CATEGORY	1988	1990	1992	1994	1996	1998	2000 (2)	2002	2004	2006	2008 (3)	2010	2012	2014	1988-2014 NET ACREAGE CHANGED	AVERAGE ANNUAL ACREAGE CHANGE
Prime Farmland	170,907	170,754	170,714	170,554	170,171	170,229	168,493	166,019	166,202	165,817	165,315	162,673	161,503	161,019	-9,888	-380
Farmland of Statewide Importance	116,559	115,773	114,777	114,027	113,441	113,680	111,505	109,760	107,742	107,194	106,597	105,395	104,576	104,003	-12,556	-483
Unique Farmland	24,147	24,171	23,107	23,354	23,252	22,235	21,178	19,917	19,480	19,244	19,156	17,753	16,035	16,087	-8,060	-310
Farmland of Local Importance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Important Farmland Subtotal	311,613	310,698	308,598	307,935	306,864	306,144	301,176	295,696	293,424	292,255	291,068	285,821	282,114	281,109	-30,504	-1,173
Grazing Land	51,188	51,590	50,224	49,734	49,478	49,821	50,958	50,317	50,636	51,518	52,571	53,538	53,232	54,327	3,139	121
Agricultural Land Subtotal	362,801	362,288	358,822	357,669	356,342	355,965	352,134	346,013	344,060	343,773	343,639	339,359	335,346	335,436	-27,365	-1,053
Urban and Built-Up Land	8,533	9,010	9,948	10,354	10,618	10,669	11,362	11,850	12,582	12,928	13,230	13,559	13,611	13,607	5,074	195
Other Land	16,327	16,333	18,861	19,610	20,718	21,044	24,060	29,693	30,914	30,855	30,562	34,514	38,475	38,386	22,059	848
Water Area	1,779	1,808	1,808	1,807	1,762	1,762	1,883	1,883	1,883	1,883	1,883	1,883	1,883	1,883	104	4
Total Area Inventoried	389,440	389,439	389,439	389,440	389,440	389,440	389,439	389,439	389,439	389,439	389,314	389,315	389,315	389,312	-128	-5

(1) Figures are generated from the most current version of the GIS data. Files dating from 1988 to 1992 were reprocessed with a standardized county line in the Albers Equal Area projection, and other boundary improvements.

(2) Due to the incorporation of digital soil survey data (SSURGO) in 2000, acreages for farmland, grazing and other land categories may differ from those published in the 1998-2000 California Farmland Conversion Report.

(3) Total Area Inventoried changed in 2008 due to adoption of updated county boundary file; adjacent counties gained or lost corresponding acreages.

PERCENTAGE OF COUNTY INVENTORIED: 100%

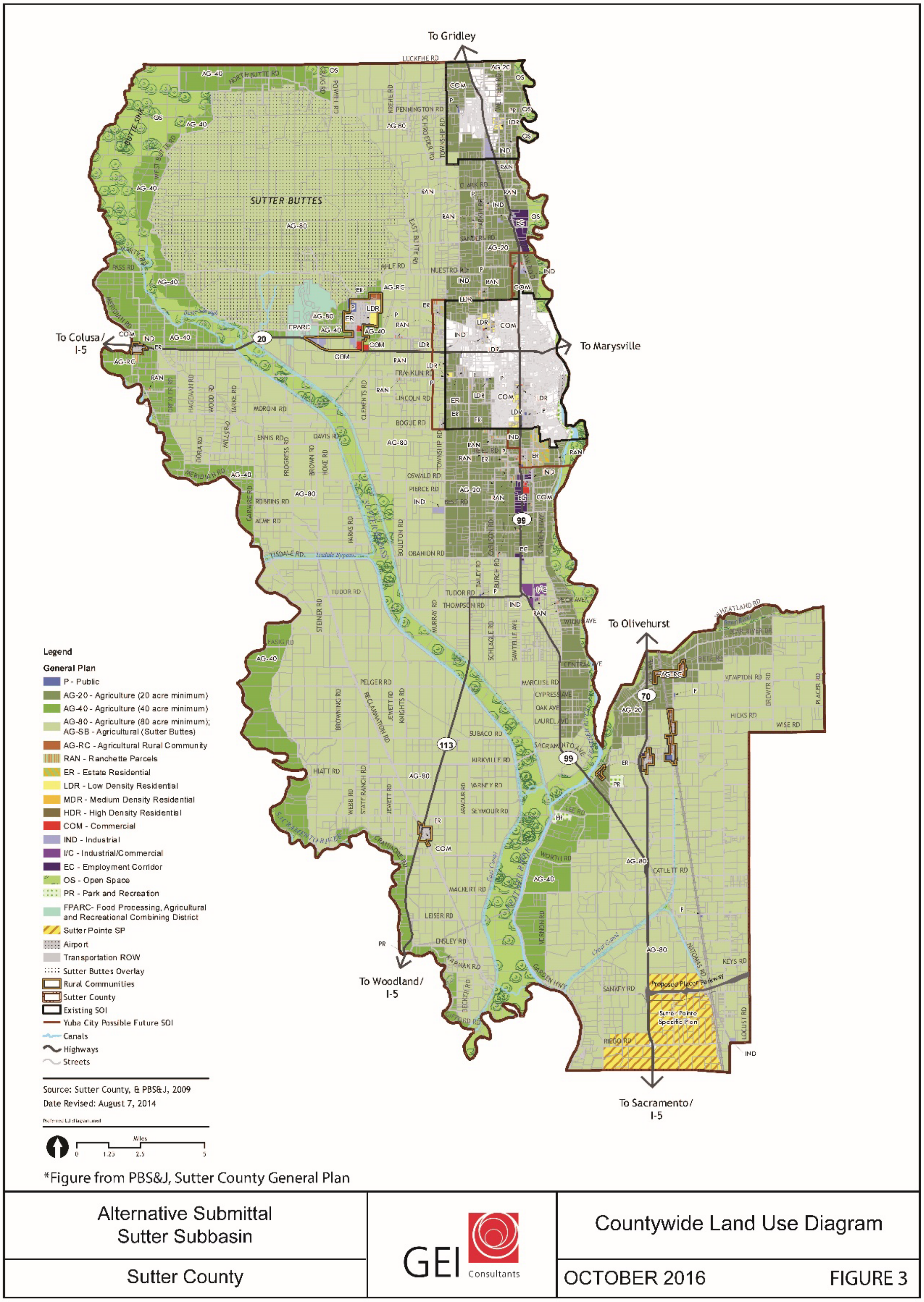
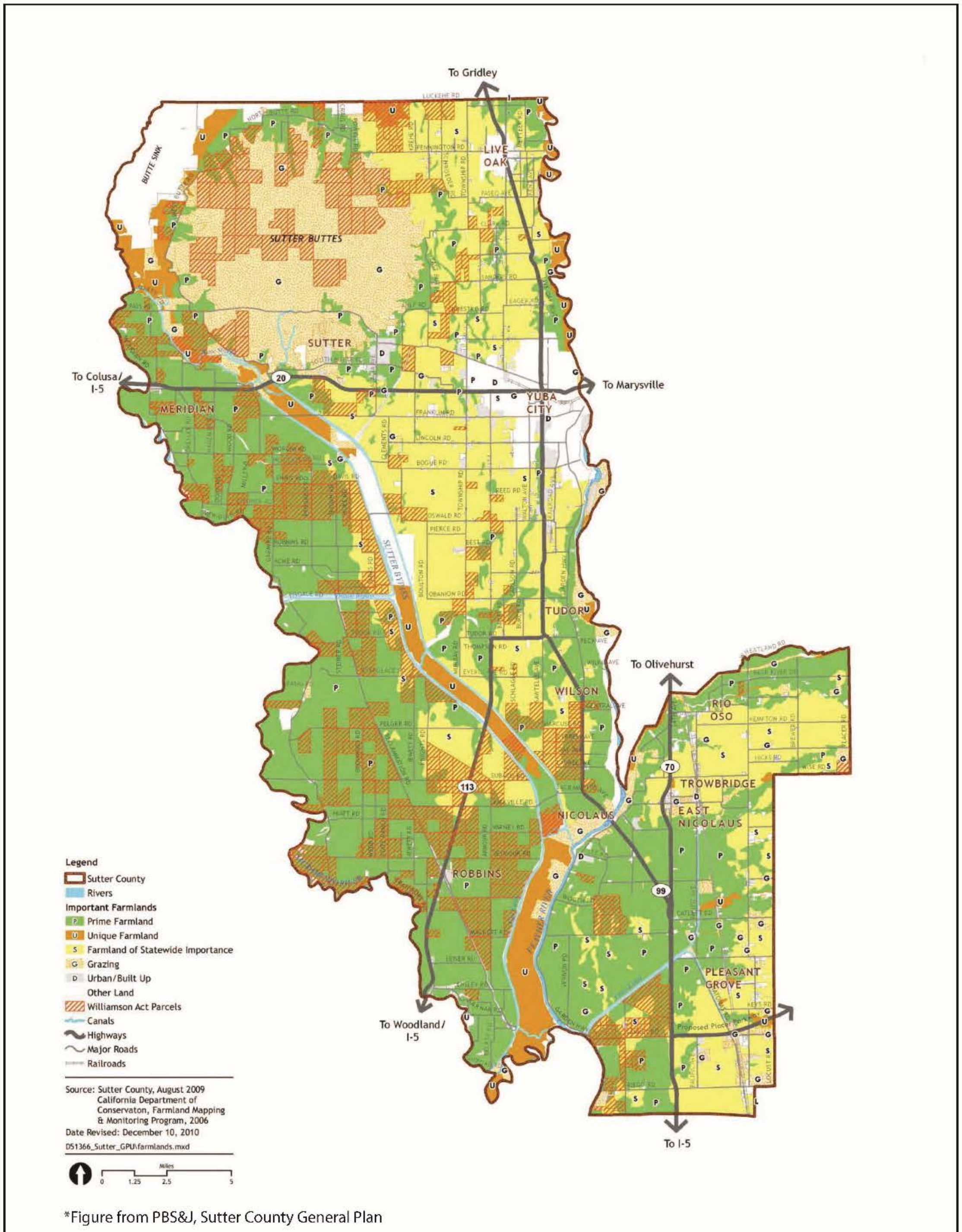
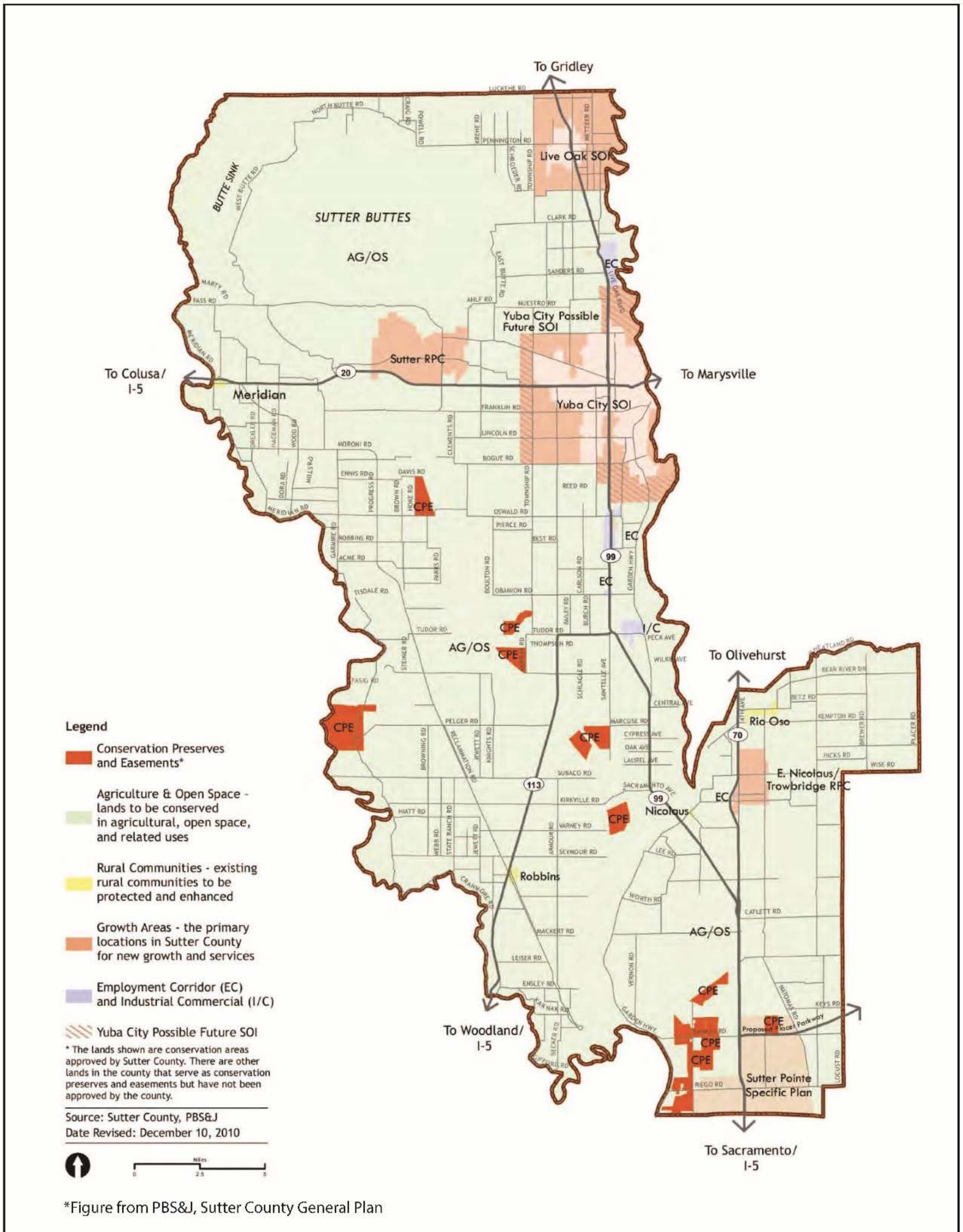


Figure 3. Countrywide Land Use Diagram



Alternative Submittal Sutter Subbasin	GEI Consultants	Important Farmlands and Willamson Act Lands
Sutter County		OCTOBER 2016 FIGURE 4

Figure 4. Important Farmlands and Williamson Act Lands



Alternative Submittal Sutter Subbasin	GEI Consultants	Habitat Conservation Preserves and Easements
Sutter County		OCTOBER 2016 FIGURE 5

Figure 5. Habitat Conservation Preserves and Easements

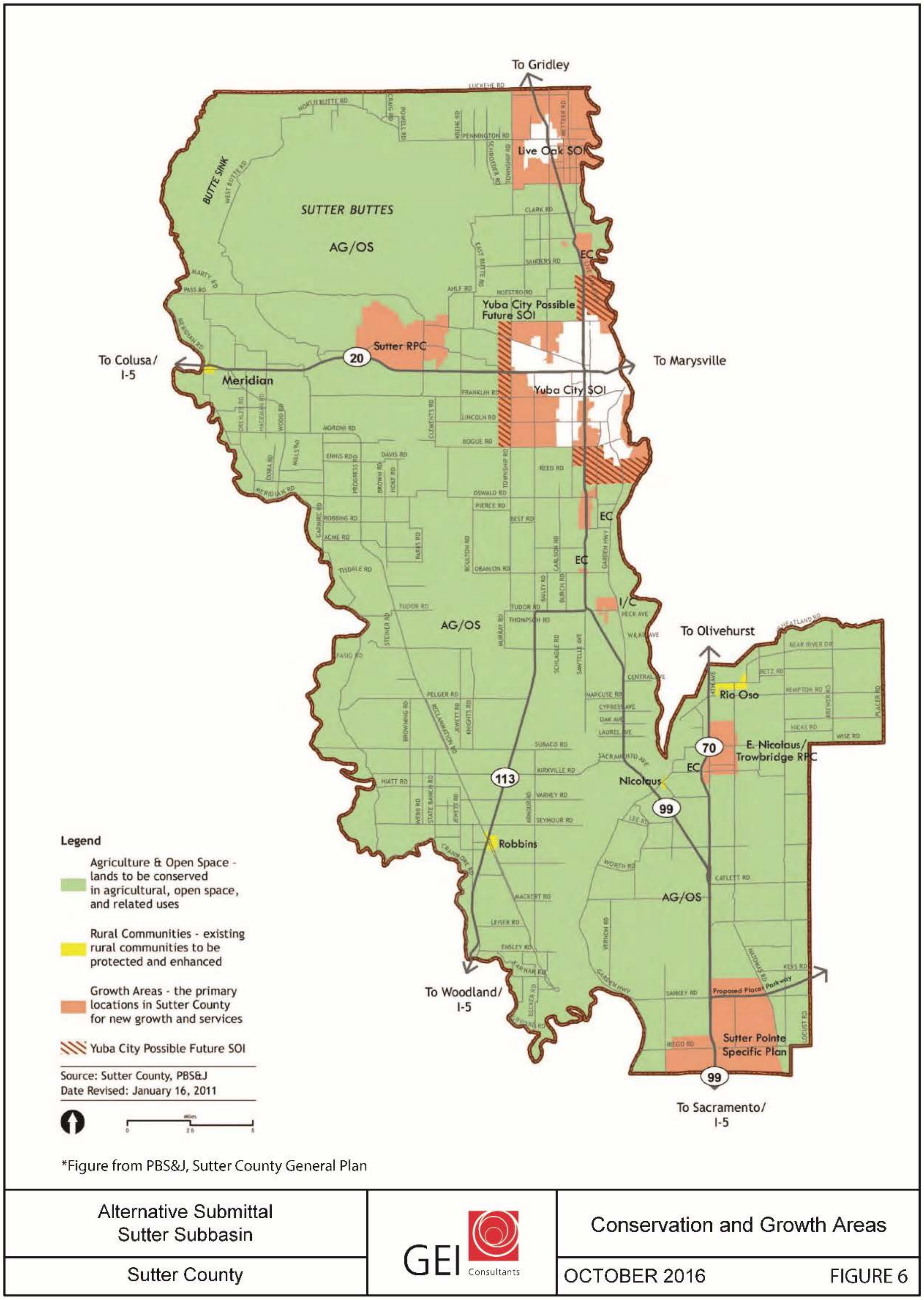


Figure 6. Conservation and Growth Areas

- **Yuba City –** Yuba City is the largest city in Sutter County, with a total area of 14.9 square miles, and surface water from the Feather River is the primary water supply source since 1969. Prior to 1969, the city utilized groundwater. Since 1969, the City has stopped using groundwater with the exception of one well. In 2001, the City acquired the Hillcrest Water Company (HWC), which was within the City's Sphere of influence. HWC used 13 wells to supply water. In 2010, the City completed conversion of all of HWC groundwater usage to surface water. Future growth is expected to be supplied by surface water under existing water rights.

Wastewater from urban water use is mostly returned to the rivers. Yuba City's two wastewater treatment plants are located between State Route 99 and the Feather River. The wastewater discharge areas are the Feather River Flood Plain (May – October) and the Feather River, downstream of the confluence with the Yuba River (November – April). Their current peak wastewater discharge is 23 million gallons per day. Many of the County's residents pump groundwater and utilize private septic systems that returns much of the water to the aquifers. Many of the County's residents utilize private septic systems and the water is returned to the aquifers.

The community of Sutter residents use private septic systems. Twice during the 1990s, residents rejected establishment of a municipal sewer system. The absence of a municipal sewer system will minimize growth.

3.6 Density of Wells

Groundwater in the subbasin is used for municipal, industrial, irrigation, domestic, stock watering, frost protection, and other purposes. The total number of wells (approximation as some wells may have been destroyed) in the Subbasin, from a database of digitized well logs obtained from DWR in 2016, is about 6,700. **Table 3** summarizes the types of well uses. **Figures 7** and **8** show the distribution of wells in the Subbasin and their types of use.

In the entire Sutter County, pre-2012, there were about 1,200 irrigation, municipal, and industrial water supply wells in the basin that could pump significant volumes of water from the subbasins. This is a potentially low estimate as there are about 850 wells with unknown use types. Most of the wells in the subbasins are domestic wells, which would be classified as de-minimis extractors (less than 2 AFY). During the 2010 drought, no wells were voluntarily reported by the public to DWR to have gone dry (DWR, 2015).

As shown in **Table 3**, the number of wells increased by over 900 since 2010, including a substantial number of irrigation and "Other" wells along with domestic wells.

The communities reliant upon groundwater include Sutter, Robbins, and Live Oak. Yuba City's water supply comes almost entirely from the Feather River, but it does use some limited groundwater from one well.

Table 3. Types of Wells

Type of Well	Number of Older Wells (pre 2012) [1]	Number of Recent Wells (2010 to 2016) [2]	Total Wells
Sutter Subbasin			
Domestic	3344	155	3499
Irrigation	1167	296	1463
Public Supply	75	9	84
Industrial	34	3	37
Unknown	854	83	937
Other	342	371	713
TOTAL	5816	917	6733

Notes:
[1] From 2012 Sutter County GMP
[2] From Sutter County - Filed Well Permits
N/A = Not available

3.7 Description of Alternative Submittal Area

The written description of the area covered by this Alternative Submittal is described in Section 3.3. **Figure 2** shows the locations of these stakeholder agencies. A summary of the jurisdictional areas for the Sutter Subbasin stakeholder agencies and those in the Sutter County portion of the East Butte Subbasin (**see Table 4**).

3.8 Existing Water Resources Monitoring and Management Programs

Sutter County has water resources monitoring, management plans, and programs. The County is also the land use management agency. Other agencies also have management and monitoring plans which are described below. Some agencies just provide monitoring data.

3.8.1 Existing Management Plans

Sutter County developed a Groundwater Management Plan (Wood Rodgers, 2012) that is compliant with AB3030, SB1938, and AB359 legislation. The plan covers the entire County, and includes both the Subbasin and the Sutter County portion of the East Butte Subbasin. **Appendix A** contains a copy of the plan. The GMP was used in development of this Alternative Submittal and will continue to be used until which time DWR provides comments to this submittal.

GMPs have also been developed and groundwater has been managed by Biggs West Gridley Water District, Butte Water District, Feather Water District, Reclamation District 1005 (which includes Pelger Mutual Water District, Sutter Mutual Water Company, OJI, and white areas along the western edge of the RD which is known as the Rim Landers) and Sutter Extension Water District.

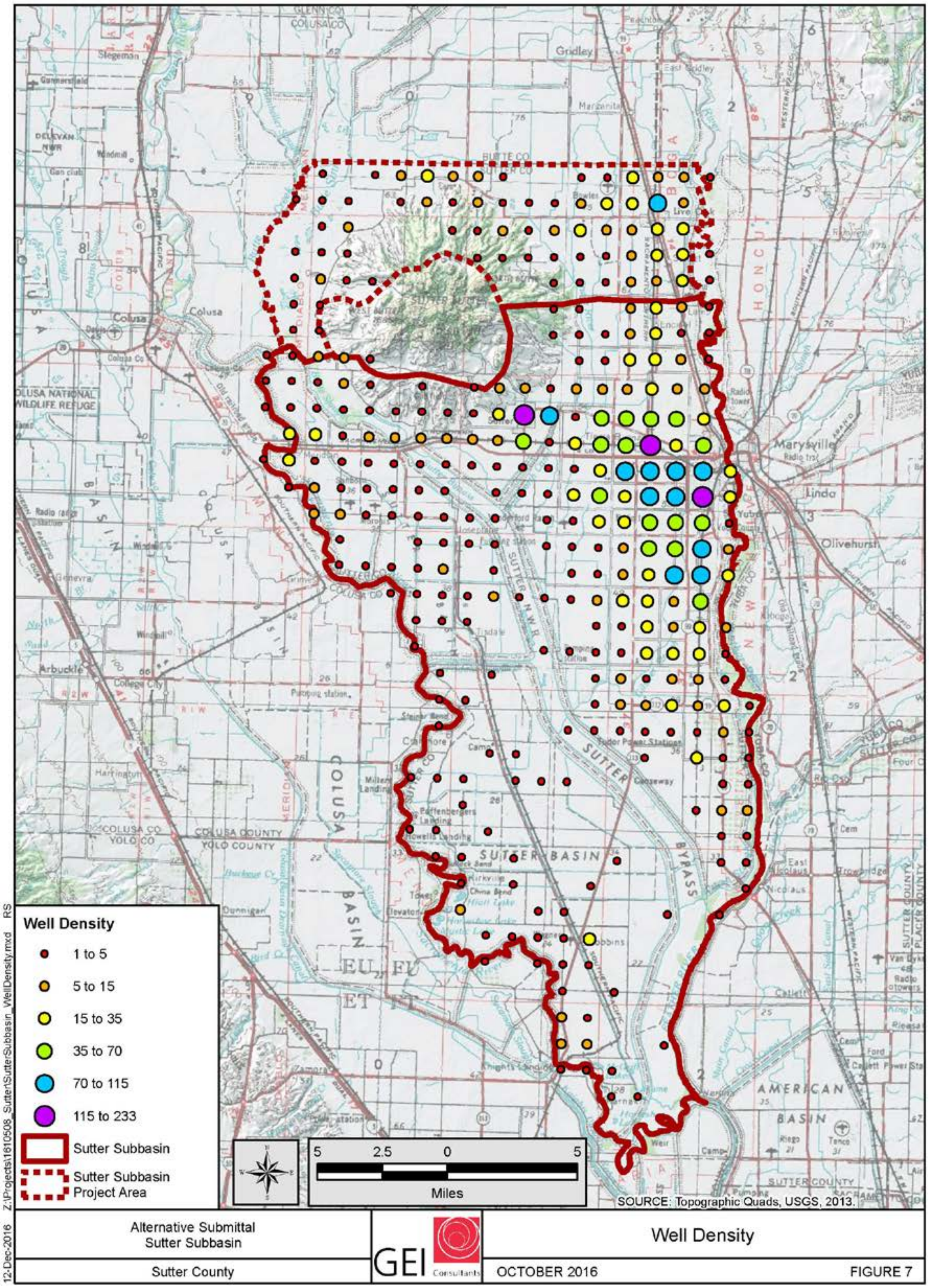


Figure 7. Well Density

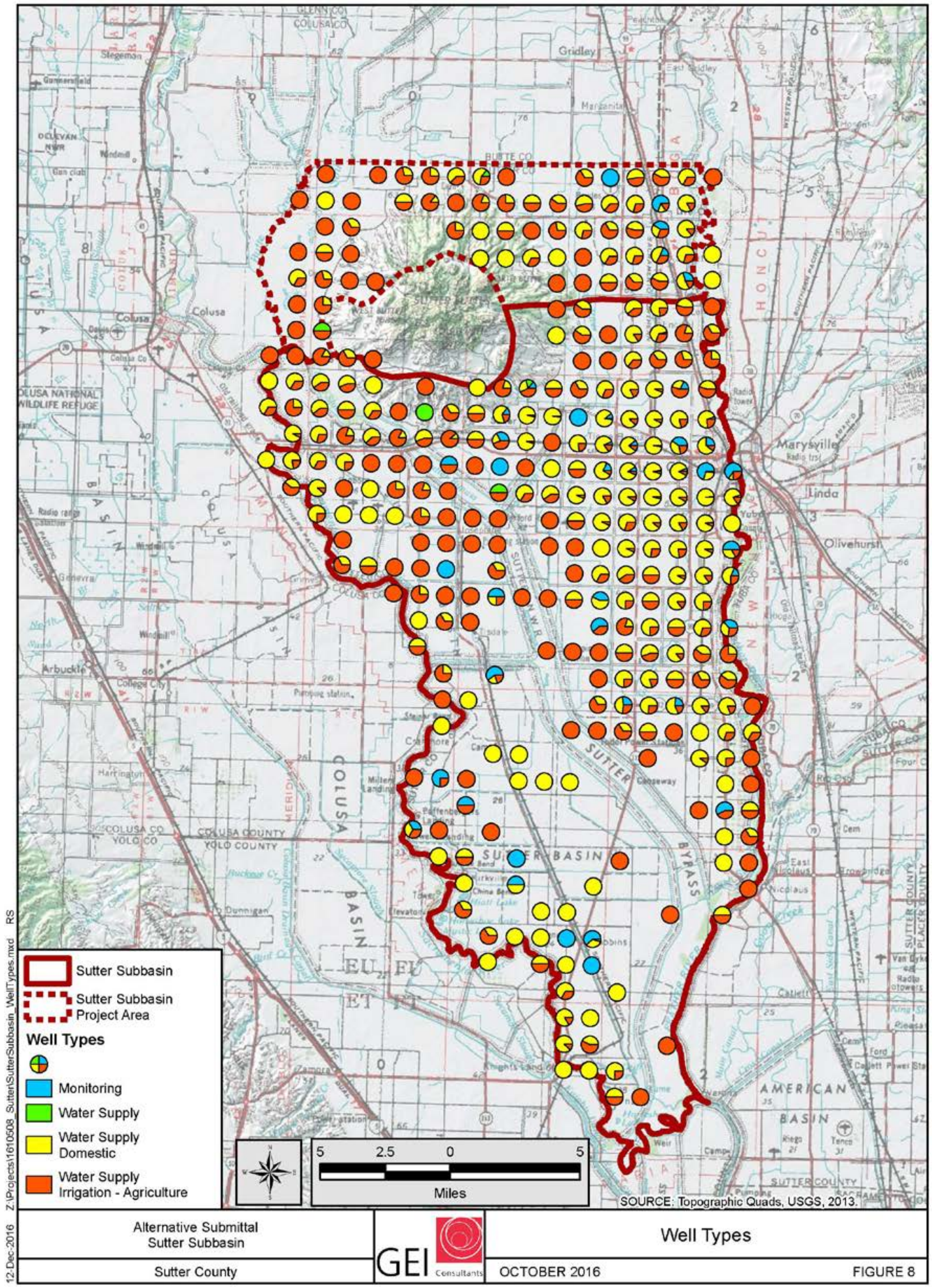


Figure 8. Well Types

Table 4. Summary of Jurisdictional Areas

Sutter Subbasin	Total Acres	East Butte Portion	Total Acres
Sutter County (White areas)	69,010	Sutter County (White areas)	32,652
Feather WD	8,204	RD 777	1,805
Oswald WD	1,037	RD 2056	1,287
RD 1001	76	City of Live Oak	1,185
RD 1500	65,664	RD 883/RD 1004	748
RD 1660	14,870	RD 2054	1,938
RD 2054	1,042	Butte WD	12,098
RD 70	20,337	Biggs-West Gridley WD	813
RD 777	3,487	Sutter Extension WD	1,696
RD 783	5,356		
Sutter CSD	489		
Sutter Extension WD	26,255		
Yuba City	7,777		
Butte WD	446		
RD 2056	701		
Town of Robbins (Sutter County Water District No. 1)	156		
Total Acres	**224,905**	**Total Acres**	**54,222**

Groundwater quality from agricultural lands in the area is managed under the Irrigated Lands Program, which has separate requirements for rice land and irrigated land. Groundwater quality sampling in selected monitoring wells occurs every two years. Their monitoring program is incorporated into the water level and water quality monitoring program contained in this submittal. Oversight of this program is by the Water Board. This program is adopted as part of this submittal.

3.8.2 Groundwater Level Monitoring Program

Sutter County established a groundwater monitoring network and is a DWR designated monitoring entity for the California Statewide Groundwater Elevation Monitoring (CASEM) program. Groundwater level measurements from these wells are used by Sutter County to manage the subbasins and are used in this Alternative Submittal.

Groundwater levels are measured in 168 active monitoring wells in the Subbasin. One well has a record extending back as far as 1929 but most wells have shorter periods of record. Of the 168 wells, 38 are designated as CASGEM wells, and 126 are voluntary wells and 4 are United States Geologic Survey (USGS) dedicated monitoring wells. The location of these monitoring wells are presented on **Figure 9**.

In the County portion of the East Butte Subbasin, 23 wells are active for water level monitoring. One well has a record extending back as far as 1984. Of the 23 wells, 2 nested wells provide water level measurements for discrete depth intervals and can be used to assess vertical flow gradients. The location of these monitoring wells are presented on **Figure 9**.

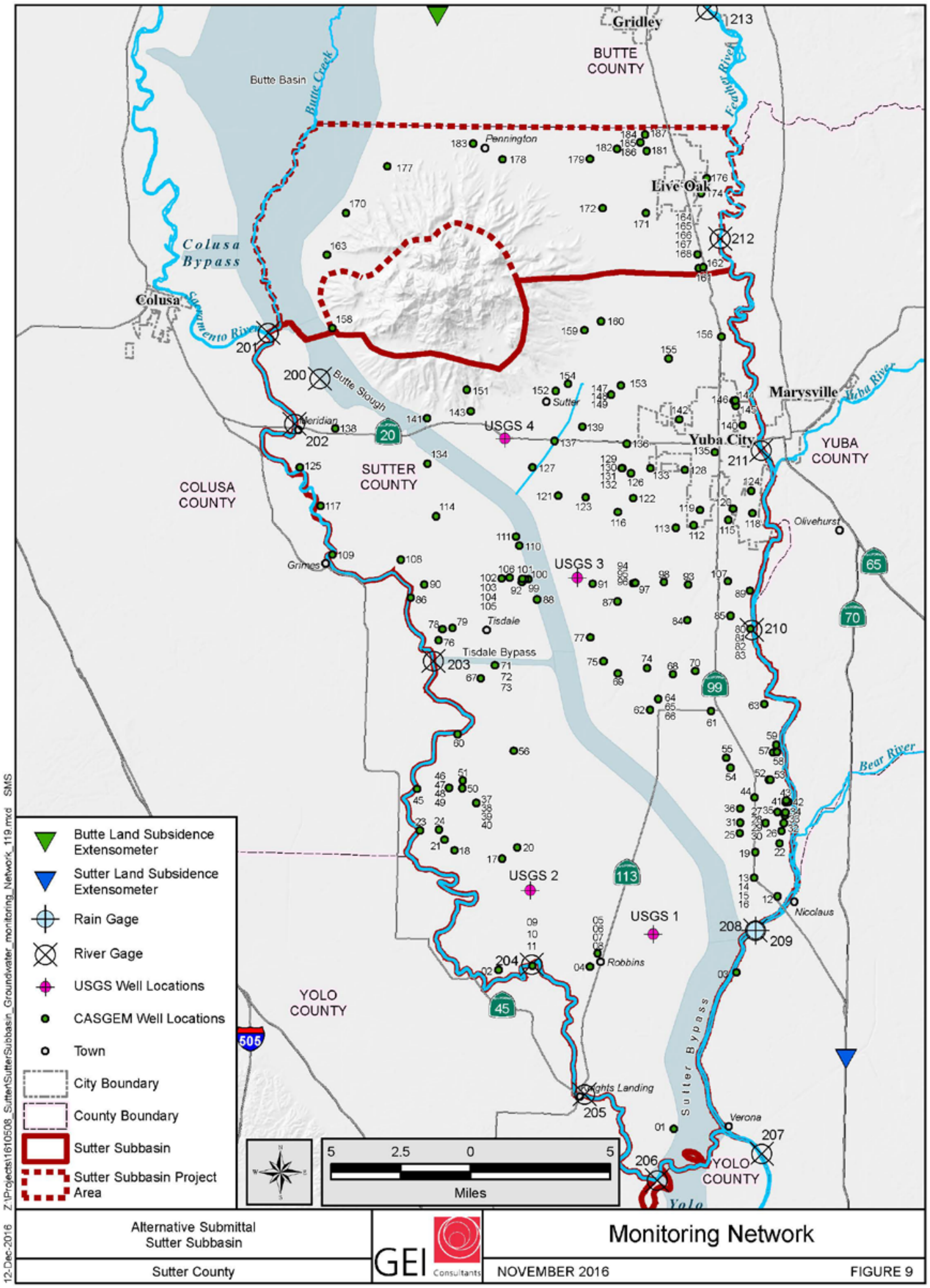


Figure 9. Groundwater Monitoring Network

DWR's Water Data Library contains other wells with a few or short-term periods of groundwater level measurements. This submittal did not rely upon these measurements.

3.8.3 Surface Water Monitoring

The USGS National Water System Information website contains surface water gaging stations that monitor flows in rivers, streams and creeks. Gages are present upstream and downstream of the Subbasin. Gage information is available for monitoring purposes, but was not used as part of development of this submittal. **Figure 9** shows the river gaging stations.

3.8.4 Precipitation

DWR identified a statewide base period of water years (1988-1989 to 2008-2009) for evaluation of critically overdrafted basins. This 20-year period included wet and dry periods and has the same mean precipitation as the long-term mean (1906 to 2015). DWR also consulted with the State Climatologist to determine the base period (DWR, website, 2016).

Precipitation has been historically recorded at two rain gages (at the same location) at the edge of the Sutter Subbasin, on the Feather River, just south of the crossing of Highway 99. Only the Nicolaus 2 gage is currently active. The locations are shown on **Figure 9**.

3.8.5 Sacramento River Index and Water Year Type

The GSP regulations require the analysis and presentation of groundwater conditions and the water budget to be water year classification or type.

The 'water year type' as defined by DWR is presented as the Sacramento Valley Water Year Index (SRI). The following description of the Sacramento Valley Water Year Index was extracted from the California Water Plan Update, 2005 (Volume 14). The water year sum is also known as the Sacramento River Index (SRI). The SRI was previously called the 4 River Index or 4 Basin Index as it is the sum in million acre-feet (maf) of Sacramento River at Bend Bridge, Feather River inflow to Lake Oroville, Yuba River at Smartville, and American River inflow to Folsom Lake.

The calculation for the index is:

> "Sacramento Valley Water Year Index also commonly known as the Sacramento River Index = (0.4) x Current Apr-Jul runoff forecast (in million acre-feet) + (0.3) x Current Oct-Mar runoff (in million acre-feet) + (0.3) x Previous Water Year's Index (if the Previous Water Year's Index exceeds 10.0, then 10.0 is used)."

Water-year classification systems provide a means to assess the amount of water originating in a basin. Because water-year classification systems are useful in water planning and management, they were developed for the Sacramento Valley by the State Water Resources Control Board (Decision 1485) for the Sacramento River hydrologic basin as part of SWRCB's Bay-Delta regulatory activities. The system defines one "wet" year classification, two "normal" classifications (above and below normal), and two "dry" classifications (dry and critical), for a total of five water year types.

The SRI is available from 1906 to 2015 (California Water Data Exchange WSIHIST website, 2016). The long-term average index for this period is 8.06 (unitless). The average SRI index for the base period selected by DWR is 7.88, slightly less than the long-term SRI index indicating less surface water would have been available during the base period. **Table 5** provides the index for this and the base period selected by DWR based on precipitation.

3.8.6 Limits to Operational Flexibility

Limits to operational flexibility are few. DWR has improved levee structural stability through the recent installation of slurry walls along the Feather River, which may reduce the groundwater recharge from the Feather River. For the groundwater to reach a new equilibrium it may take many years, perhaps up to 30 years. The CEQA analysis for the levee stabilization projects did not quantify an effect. Groundwater level monitoring is in progress, but to date no effects have been documented.

3.9 Conjunctive Use Programs

Several agencies within the Subbasin conduct short-term groundwater transfer programs as part of conjunctively using the groundwater in the subbasin. These agencies are Sutter Extension Water District (SEWD), Butte Water District (BWD), and Garden Highway Mutual Water Company (GHMWD). These substitution transfers are completed by these agencies not using their full allotment of surface water. These agencies transfer a portion of their allotment to agencies south of the delta and pump groundwater in-lieu of using their surface water. These agencies began the water transfers in 2009 and have conducted these transfers in years 2009, 2010, 2013, 2014, and 2015. The volume of water transferred is presented in **Table 6**.

Yuba City completed an ASR feasibility assessment and is developing plans for an ASR demonstration project in one or two targeted aquifer zones at the City's WTP site. In 2015, the City completed construction of three multiple-completion groundwater monitoring wells at the WTP site for the purpose of more fully characterizing the hydrogeology of the site and to assess groundwater flow gradients and groundwater quality in the two targeted aquifer zones. The City is conducting ongoing groundwater monitoring to establish baseline conditions prior to implementing an ASR demonstration project.

3.10 Land Use Plans

Sutter County has developed a General Plan to plan and guide land use. The following sections provide a general description of the land use and how implementation may affect groundwater.

3.10.1 Applicable Plans

The following land use plans govern development in the subbasins:

- Sutter County, 2011. Sutter County General Plan
- Yuba City, 2016. 2015 Urban Water Management Plan Update, (Public Review Draft)
- City of Live Oak, 2030 General Plan.

Table 5. Sacramento River Index (SRI) and Precipitation

Water Year	SRI		Precipitation	
	SRI (unitless)	Water Year Type	NICOLAUS 2 Station No. 46194 (inches)	FEATHER RIVER NR NICOLAUS NIC (inches)
1989	6.13	D		21.02
1990	4.81	C	13.45	15.88
1991	4.21	C	15.99	15.99
1992	4.06	C	16.97	16.97
1993	8.54	AN	26.57	26.57
1994	5.02	C	13.44	13.44
1995	12.89	W	30.39	31.57
1996	10.26	W	22.94	22.94
1997	10.82	W	21.28	21.63
1998	13.31	W	21.13	31.02
1999	9.8	W	14.62	14.62
2000	8.94	AN	19.51	19.07
2001	5.76	D	13.93	13.62
2002	6.35	D	16.11	16.60
2003	8.21	AN	18.59	
2004	7.51	BN	15.06	17.56
2005	8.49	AN	19.40	19.00
2006	13.2	W	23.31	23.31
2007	6.19	D	10.04	7.13
2008	5.16	C	14.89	14.98
2009	5.78	D	13.95	13.95
2010	7.08	BN	16.65	16.61
2011	10.54	W	20.50	25.51
2012	6.89	BN	7.11	13.55
2013	5.83	D	13.26	14.67
2014	4.07	C	9.80	
2015	4.01	C	15.06	
	1906 to 2015, 109 years		**1990 to 2015 (inches)**	**1964 to 2013 (inches)**
min	3.11		7.11	6.97
average	8.06		17.07	19.07
max	15.29		30.39	35.27
	1989 to 2009, 20 years		**1989 to 2009, 20 years**	**1989 to 2009, 20 years**
min	4.06		10.04	7.13
average	7.88		18.08	18.84
max	13.31		30.39	31.57
	2010 to 2015, 5 years		**2010 to 2015, 5 years**	
min	4.01		7.11	NA
average	6.40		13.73	NA
max	10.54		20.50	NA

Table 6. Water Transfers

Water Year	Sutter Subbasin			E. Butte Subbasin	Total Water Transfers (AFY)
	SEWD (AFY)	GH (AFY)	Subtotal (AFY)	BWD (AFY)	
2009	4,105	2,730	**6,835**	4,068	**10,903**
2010	2,870	4,082	**6,952**	3,846	**10,798**
2011	-	-	**-**	-	**-**
2012	-	-	**-**	-	**-**
2013	2,863	3,854	**6,717**	3,837	**10,554**
2014	4,105	3,971	**8,076**	5,364	**13,440**
2015	1,725	1,140	**2,865**	-	**2,865**

3.10.2 Plan Implementation Effects on Existing Land

The vast majority of the land uses in the County will be preserved for agriculture (Sutter County General Plan, 2011). Sutter County consists of 389,120 acres that overlie three groundwater subbasins. The General Plan and the following discussion covers the entire County and does not divide the information by subbasin.

Approximately 92 percent of the total County area is predicted to remain stable and is not expected to change in character within the timeframe (25 year planning horizon) of the General Plan. The areas of change are relatively few and small in size. In total, approximately 32,681 acres, or slightly over 8 percent of unincorporated lands, have been identified as potential urban growth areas. **Table 7** provides the projected growth areas and population (Sutter County General Plan, 2011).

3.10.3 Plan Implementation Effects on Water Supply

Implementation of the land use and other plans is unlikely to affect the water supply and groundwater sustainability over the planning and implementation horizon. The largest planned changes are related to urban growth with a reduction of agricultural lands. No urban growth is planned on groundwater in the Sutter Subbasin. In the Sutter County portion of the East Butte Subbasin, the rural community of Live Oak was projected to increase groundwater use by about 2,200 AF from 2015 to 2025 (Live Oak, 2009). The projection of growth was made at the start of the 2008 recession when the full effects of the recession and duration were unknown and the effects were often under-predicted. The projected increase in demand was indicated to be linear, but in 2030 the groundwater pumping was projected to increase to about 4,000 AFY. To approximate the amount of potential groundwater pumping reduced by this land conversion from agriculture to urban, agricultural pumping has averaged about 169,000 AF from 1989 to 2009 over a total of about 280,000 acres, or about 0.6 AF/acre. About 3,400 acres of agricultural land may be converted to urban in the Live Oak area or possibly up to 2,000 AF of groundwater pumping reduction, which is almost in balance with the projected urban groundwater use increase through 2025.

Table 7. Sutter County Population

Town or City	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Live Oak	4,090	4,280	4,543	4,842	4,976	5,282	5,536	5,698	5,865	5,971	6,090	6,229
Yuba City	26,000	27,000	28,728	30,180	31,385	33,395	34,071	34,543	35,030	35,574	36,040	36,758
Balance Of County	31,700	32,450	32,888	33,575	34,217	33,525	33,941	34,332	34,804	35,112	35,333	35,943
County Total	**61,800**	**63,700**	**66,159**	**68,597**	**70,578**	**72,202**	**73,548**	**74,573**	**75,699**	**76,657**	**77,463**	**78,930**

Town or City	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Live Oak	6,295	6,339	6,380	6,473	6,603	7,266	7,890	8,255	8,355	8,422	8,517	8,243
Yuba City	45,506	46,792	48,505	51,034	57,975	60,197	61,835	62,974	64,042	64,818	65,487	66,096
Balance Of County	27,921	27,955	28,133	27,590	22,519	21,901	21,838	21,754	21,521	21,525	21,587	21,609
County Total	**79,722**	**81,086**	**83,018**	**85,097**	**87,097**	**89,364**	**91,563**	**92,983**	**93,918**	**94,765**	**95,591**	**95,948**

Town or City	2013	2014	2015	2016	2020	2025	2030	2035	2040
Live Oak	8,184	8,339	8,331	8,346	8,441	8,558	8,765	8,792	8,909
Yuba City	66,513	66,716	67,779	68,052	82,390	95,513	110,725	128,361	148,806
Balance Of County	21,490	21,470	20,838	20,910	18,108	15,342	13,610	14,299	14,760
County Total	**96,187**	**96,525**	**96,948**	**97,308**	**108,939**	**119,413**	**133,100**	**151,452**	**172,475**

Urban Water Supply

The County has had limited urban growth since 1989 with its population only increasing by about 50 percent. Urban development has occurred in Yuba City, Live Oak and a few small towns and communities including Robbins, Sutter, and Tisdale. **Table 7** provides the historic and projected future population for the entire Sutter County. Urban growth in the Subbasin and the Sutter County portion of the East Butte Subbasin are summarized in **Table 7**, while the remaining “Balance of County” is essentially within the North American Groundwater Subbasin. The population in the Sutter County portion of the Sutter Subbasin is projected to double by 2040, almost entirely in Yuba City.

The source of water for the increased population in Yuba City will be surface water. Groundwater is not anticipated to be used for future growth (Yuba City, 2016), but a couple of wells will be maintained for use during droughts.

The town of Live Oak is located in the East Butte subbasin and is planning to support their growth with their five existing wells (Sutter County, 2008). The estimated groundwater supply is expected to increase from 3,100 AF in 2015 to 11,800 AF by 2030 (EcoLogic, 2009). By 2040, the groundwater demand may be 20,400 AF.

Population in the Sutter Community Services District area has the capacity to grow on groundwater, but without a new wastewater treatment plant the community will not be allowed to increase its population. The Sutter County Development Services Department is currently prohibiting further development within Robbins due to their high wastewater treatment usage compared to their treatment capacity. Again without a new wastewater treatment plant the community will not be allowed to increase its population.

Agricultural Water Supply

The County has been historically an agricultural community and the County continues to support agriculture. Irrigated agricultural land accounts for about 70 percent of the total area in the County. The remaining land is used for habitat preserves, open range land grazing, roads and other infrastructure. The historic agricultural land uses by general crop types are shown with **Figure 10**. The largest land use is for rice production, averaging about 40 percent of the total County and has ranged from 31 to 46 percent. Pasture land is the next largest land use followed by orchards which, average about 16 percent and has ranged from 12 to 19 percent. Since about 1994, the agricultural land use has been relatively stable, but with a slight decline in rice acreage and a slight increase in orchards.

The existing agricultural irrigation entities in Sutter County include the following: Garden Highway Mutual Water Company; Meridian Farms Water Company; Sutter Bypass Butte Slough Water User Association; Butte Slough Irrigation Company; Sutter Extension Water District; Sutter Mutual Water Company; Tisdale Irrigation and Drainage Company; Tudor Mutual Water Company; Butte Water District; Feather Water District; and Oswald Water District. These entities supply surface water from the Feather and Sacramento Rivers. Reclamation Districts have the capacity to place pumps in drainage canals and reuse water.

The types of crops that can be grown are determined by soil types, water supply market conditions, availability of surface water, and water quality. In many areas, the soil types are conducive to rice production, and access to good quality surface water has been secure relative to many other areas of California. These conditions have supported stability in both the amount of land devoted to agricultural production and in the types of crops grown on these lands.

As noted above, an important reason for the stability of both irrigated acreage and of cropping patterns in the Subbasin is the large area within the subbasin having soils suitable for rice cultivation. Rice is mainly grown on soils favorable to the maintenance of standing water: specifically, clay soils with low vertical hydraulic conductivity. Soil features such as fine-texture or cemented layers with low vertical hydraulic conductivity are common over broad areas in the subbasin and are considered advantageous for flooded rice culture. Although deep ripping of restrictive layers can make these soils more suitable for non-flooded crops, it would also reduce suitability for rice planting.

Sacramento Valley rice farmers use mainly surface water for irrigation. The quality of this water is generally high having been derived from melting snow that enters rivers through managed reservoir discharge (DWR 2009, USGS 2000). Salinity is removed from the land in runoff and percolating water, mostly fairly early in the reclamation process, so there is little residual salinity in established rice fields.

Sutter County's agricultural water usage for the entire county is approximately 60 percent surface water, 20 percent groundwater, and 20 percent that is irrigated by both surface water and groundwater. The predominant source of water for permanent crops is groundwater (Wood Rodgers, 2012). Groundwater use has varied from 122,000 to 235,000 AFY.

3.10.4 Well Permitting

Sutter County Environmental Health Division (SCEHD) is the well permitting agency for the area. One permit application is used for a new well or to deepen, reconstruct, recondition, or destroy a well. The permit application requires a site plan showing the location of the well and the accessor's parcel number. A C-57 Water Well Contractor's license and signature of licensee

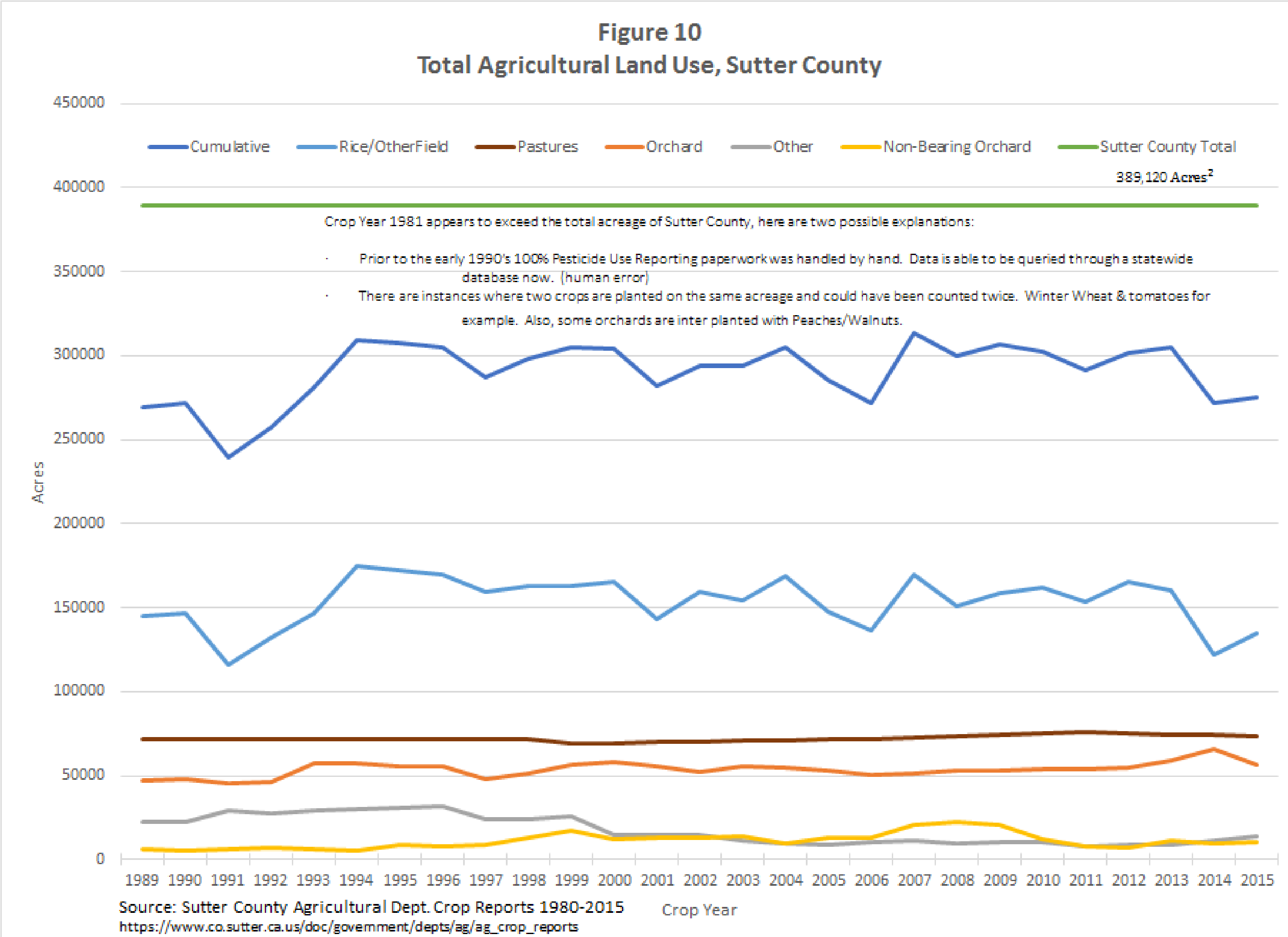


Figure 10. Total Agricultural Land in Sutter County

is required by the contractor completing the permit and work. The design and construction of the well shall be in conformance with the California Department of Water Resources Bulletin 74-81, "Water Standards: State of California" as outlined in the County of Sutter Department of Public Works Improvement Standards (2005, rev. 2010).

3.10.5 Land Use Plans Outside of Basin

The stakeholders submitting this alternative have not included information regarding the implementation of land use plans outside the subbasins, as these adjacent subbasins are also required to implement SGMA and their GSPs will require them to achieve sustainable groundwater management.

4 Hydrogeologic Conceptual Model

A hydrogeologic conceptual model is described in the sections below to characterize the physical components and interaction of the surface water and groundwater systems in the subbasin. The soil type, regional geology, geologic structure, and aquifer characteristics are presented as the framework for the sections that follow. These sections illustrate the reasoning for the claim that the Subbasin has been sustainably managed and qualifies for the DWR's acceptance of this Alternative Submittal.

4.1 Basin Boundaries

As part of the greater Sacramento Valley Groundwater Basin, the boundary of the Subbasin is coincident with the six adjacent subbasins and is not separated by any distinct geologic features. The following basin boundary description not only discusses the aerial extent of the subbasin, but also describes the extent of the subbasin at depth. The majority of the Subbasin consists of sedimentary deposits with the exception of the Sutter Buttes, which outcrop in the northern portion of the subbasin just south of the Sutter County-Butte County line. The Sutter Buttes were created by rhyolitic and andesitic intrusive and extrusive igneous magmatic processes (Springhorn, 2008). The project area including the subbasin boundary and location of the Sutter Buttes is presented in **Figure 1**. The topographic map of the basin is shown on **Figure 11**. The bottom of the basin is the base of fresh water (Berkstresser, 1973), below which the water is brackish and not suitable without treatment for either agriculture or potable water use, as shown on **Figure 12**.

4.2 Soils

Soil characteristics play a major role in cropping patterns and farming practices and influence the retention or infiltration of water and nutrients/pesticides through the subsurface. In general:

- The soils in the Subbasin mainly consist of clay and clay loam soils but near the rivers, loam to sandy loam may be present

- Most of the soils consist of poorly and very poorly drained soils. Along the rivers the soils are well drained.

Hydrologic grouping of the soil types and their distribution are provided on **Figure 13**. About 70 percent of the soils in the Subbasin are characterized as having slow to very slow infiltration.

4.3 Regional Geology and Structure

The regional geology of the Subbasin is similar to the greater Sacramento Valley with the exception of the volcanic rocks of the Sutter Buttes. This section provides a description of the regional geologic formations and structure. **Figure 14** shows the geologic map for the subbasins. **Figure 15** provides a stratigraphic correlation of the formations. Geologic profiles, shown on **Figures 16 through 19** are provided to illustrate the relationship of these formations and the

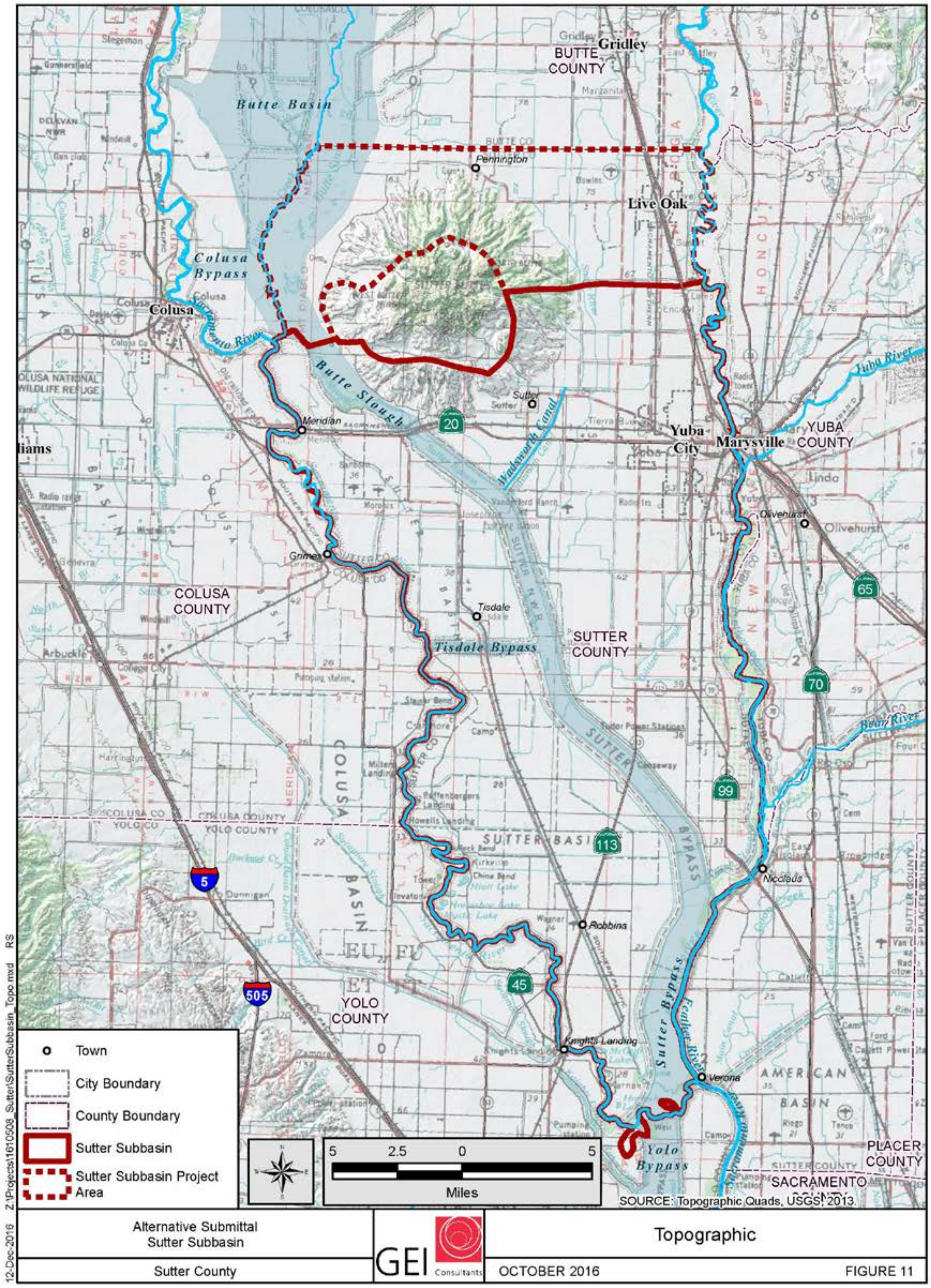


Figure 11. Topographic

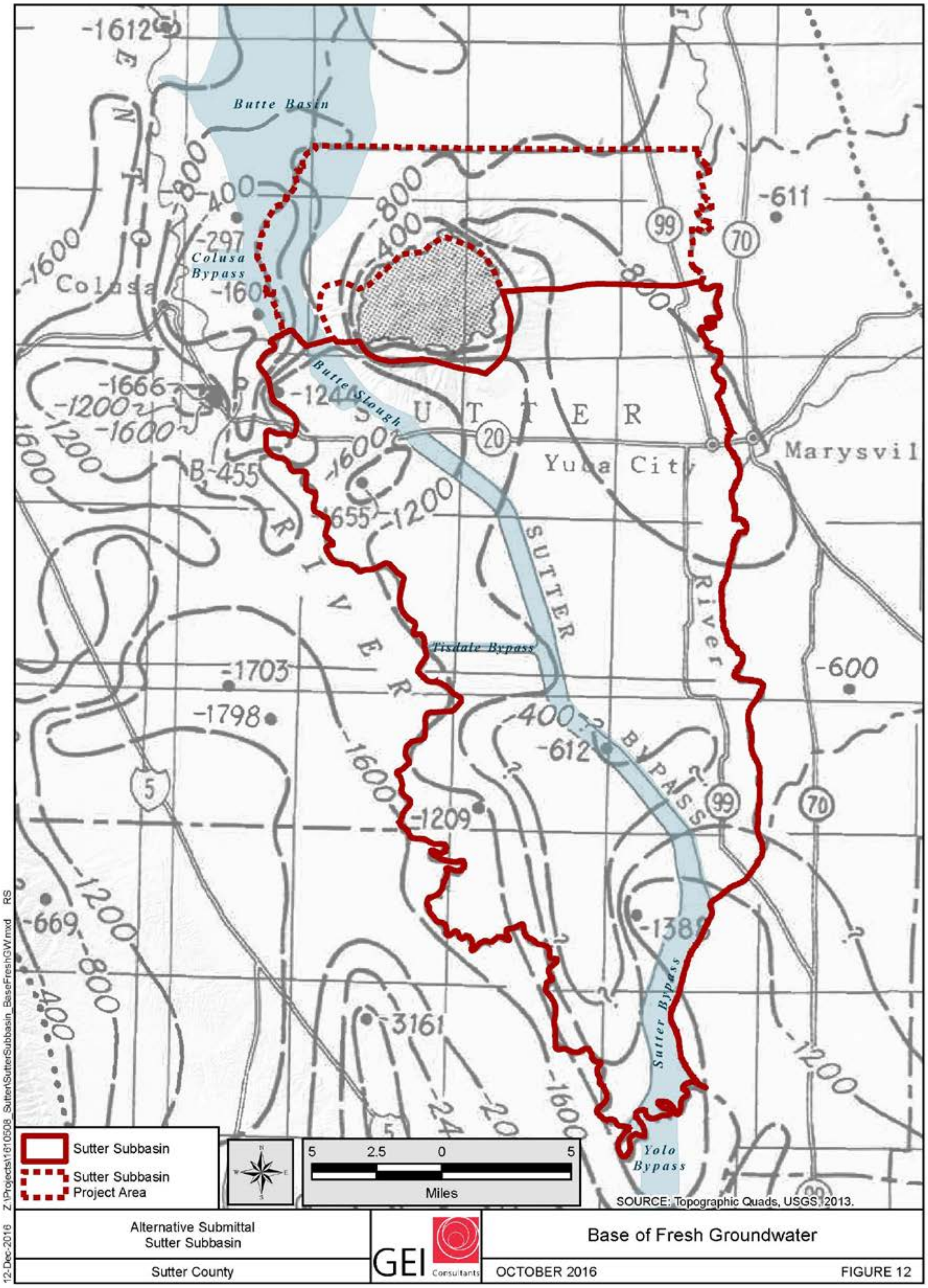


Figure 12. Base of Fresh Groundwater

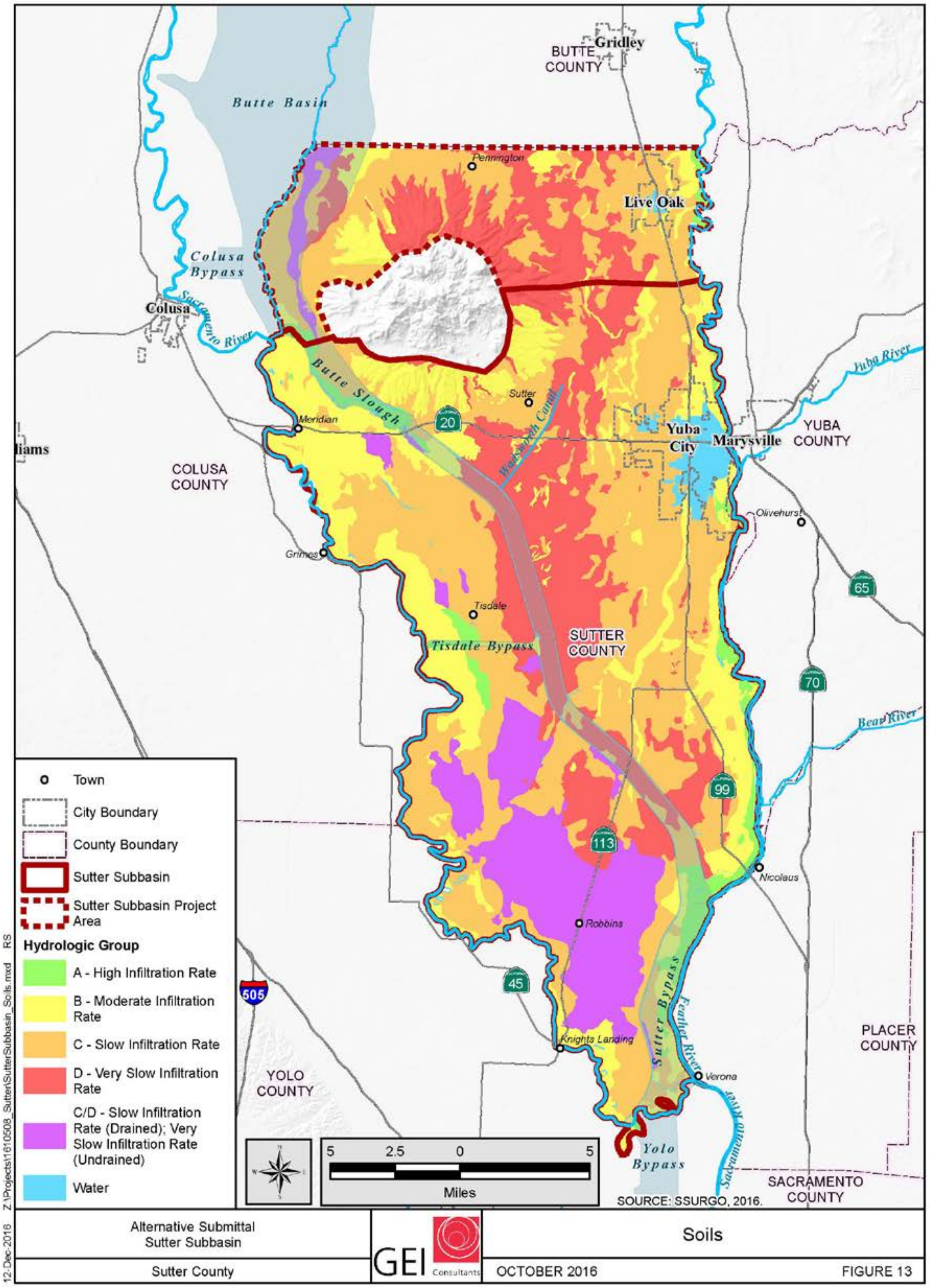


Figure 13. Soils

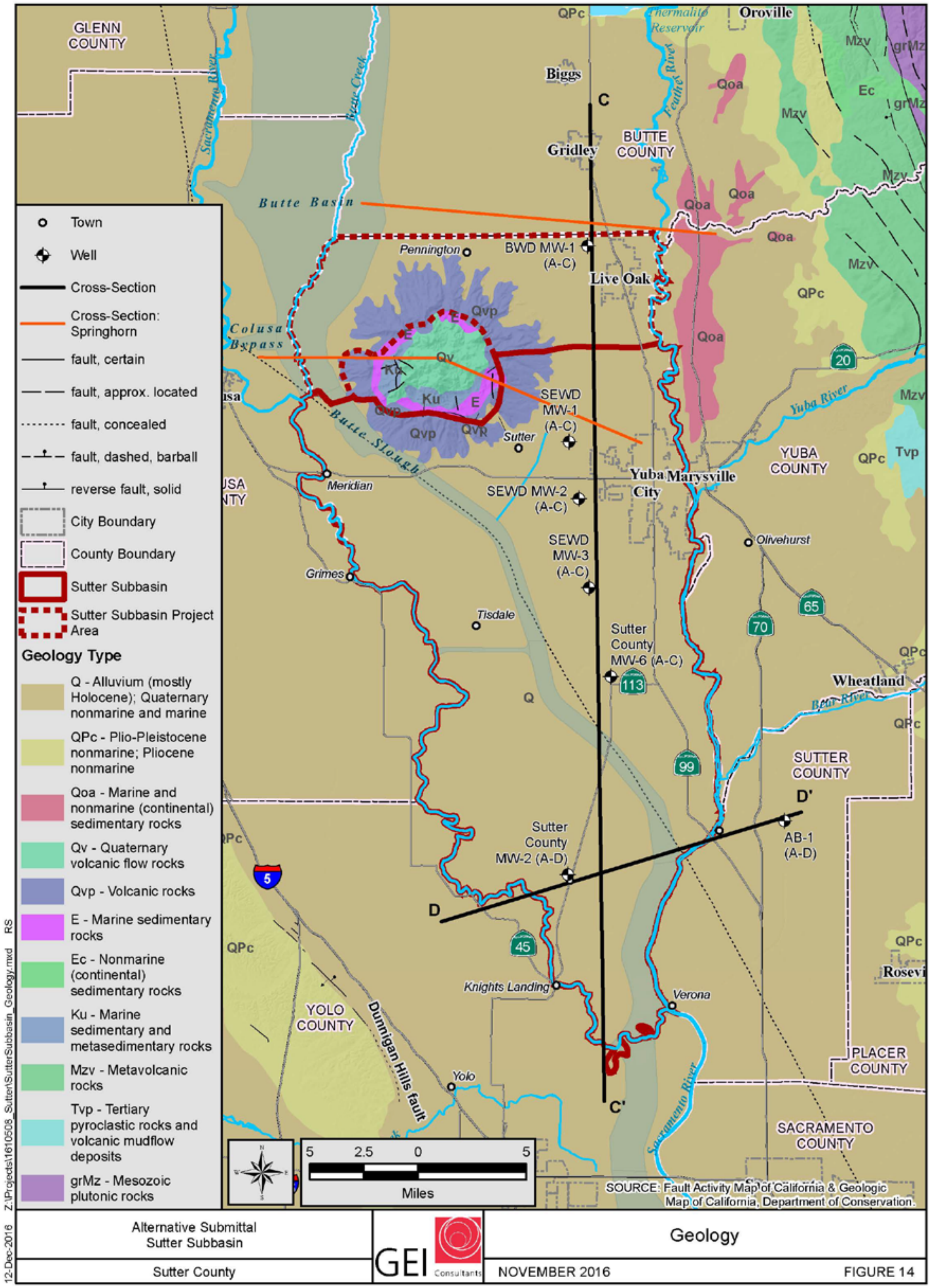
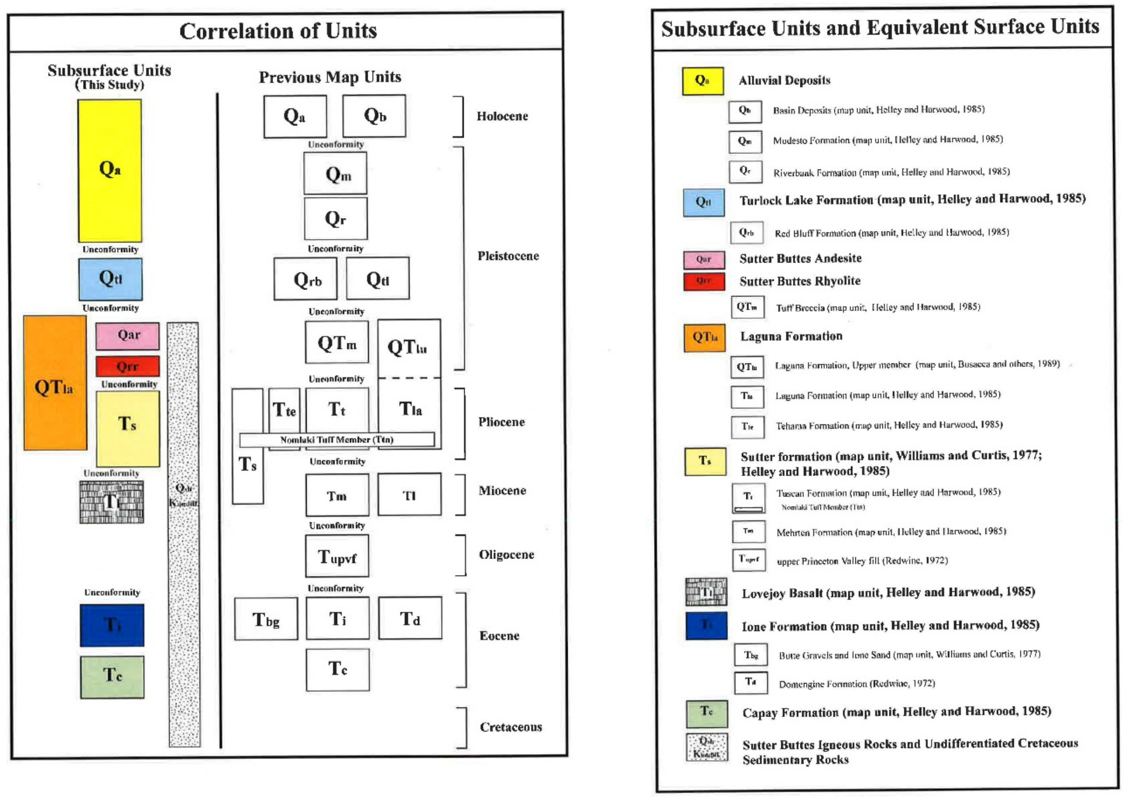


Figure 14. Geology



* Figure from *Stratigraphic Analysis and Hydrogeologic Characterization of Cenozoic Strata in the Sacramento Valley Near the Sutter Buttes*, Springhorn, 2005

Alternative Submittal Sutter County	GEI Consultants	Stratigraphic Correlations	
Sutter County		OCTOBER 2016	FIGURE 15

Figure 15. Stratigraphic Correlations

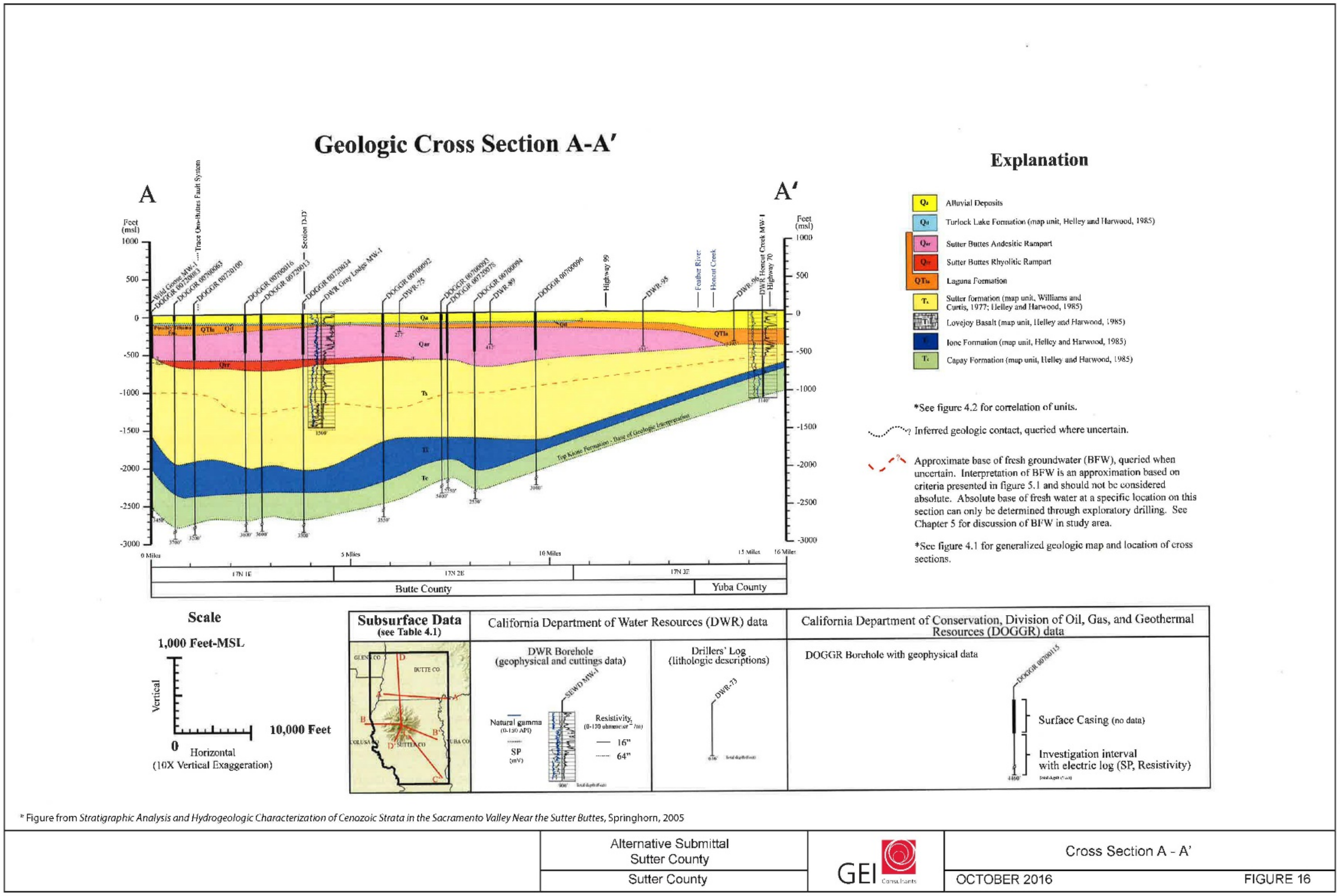


Figure 16. Cross Section A – A'

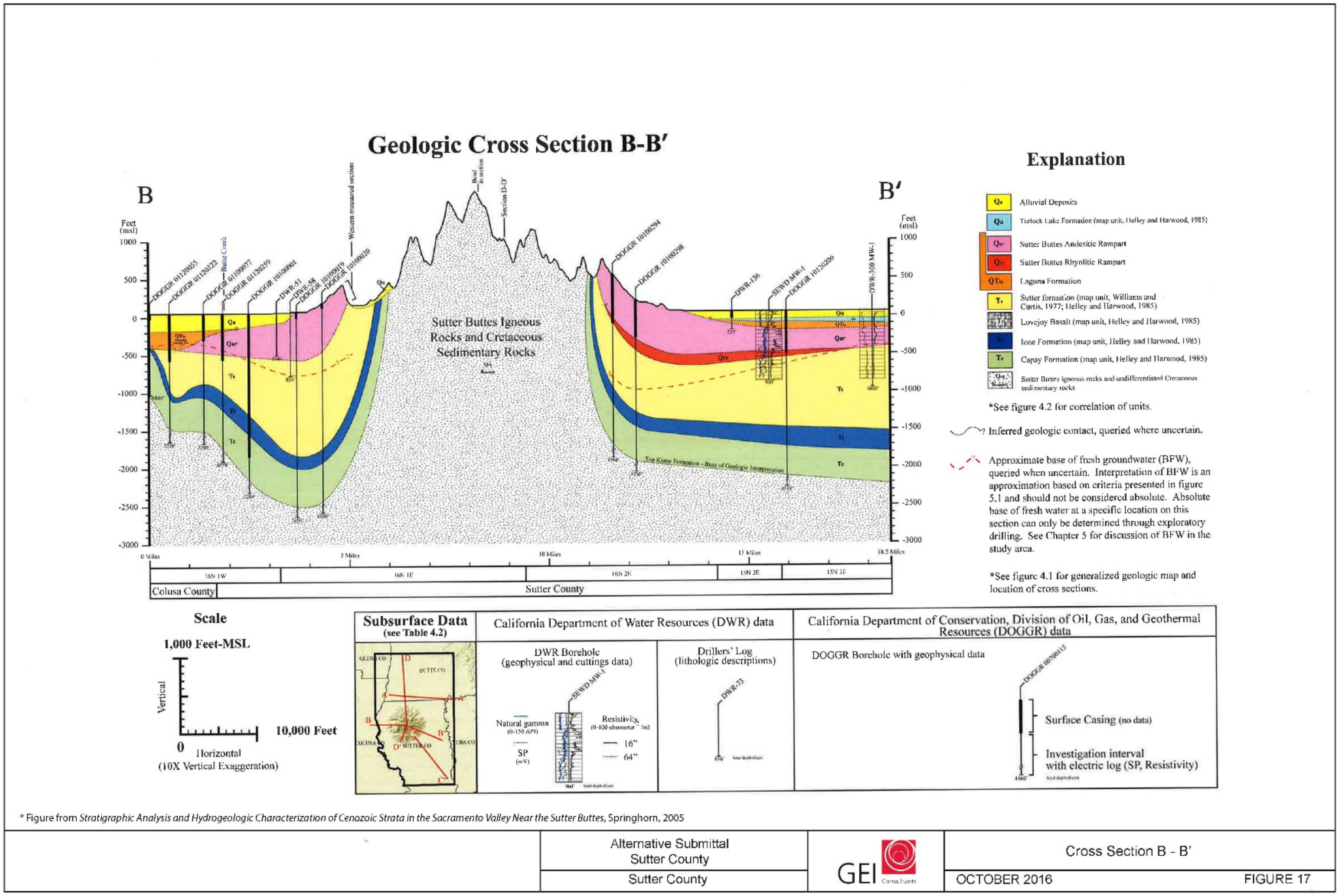


Figure 17. Cross Section B – B'

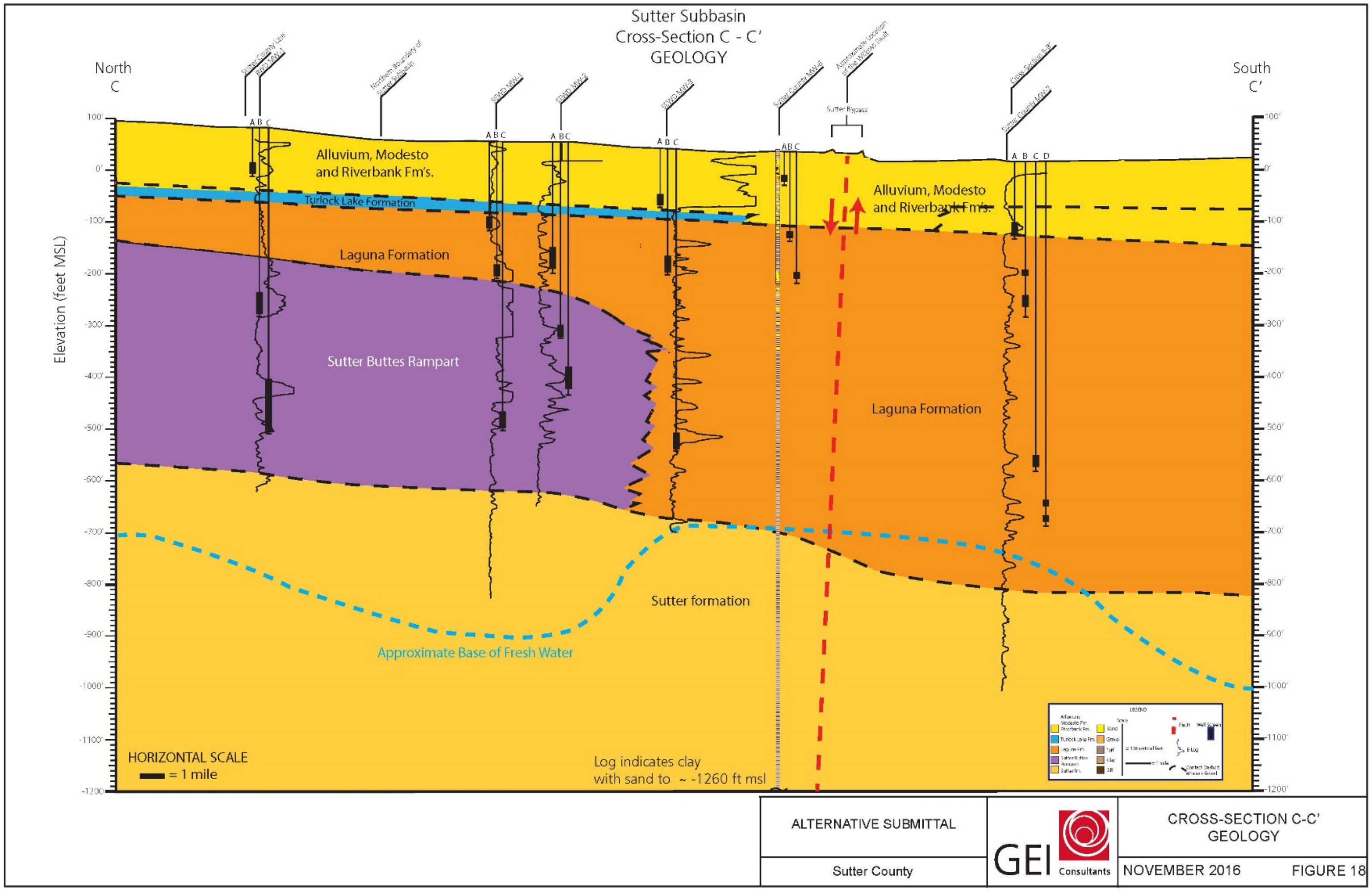


Figure 18. Cross Section C – C' Geology

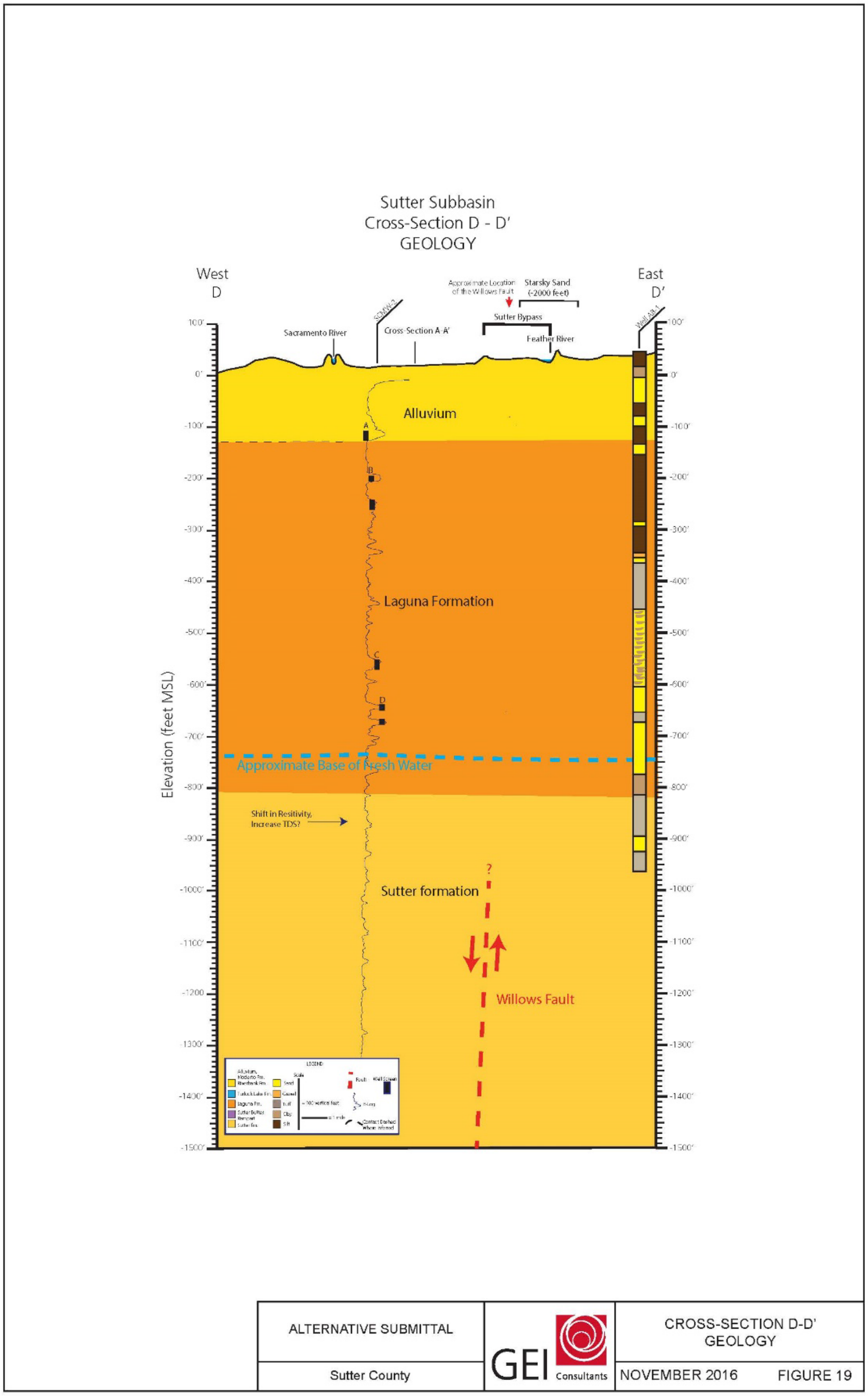


Figure 19. Cross Section D – D' Geology

principal aquifers from which the majority of the subbasin groundwater is produced. **Appendix B** contains the well logs used to create **Figures 18** and **19** which cross the entire subbasins.

The Subbasin and the Sutter County portion of the East Butte Subbasin consist of unconsolidated and consolidated freshwater bearing sediments that are underlain by marine sediments and igneous or metamorphic rocks. The freshwater bearing sediments consist of the volcanoclastic rocks of the Sutter Buttes and sediments weathered from the Sierra Nevada to the east. The sediments derived from the Sutter Buttes consist of debris (sand to boulder size blocks) and sedimentary deposits of the volcanic apron that extends radially about 10 miles to the north to 8 – 10 miles to the south from the Sutter Buttes (Springhorn, 2008).

The Subbasin lies within the Sacramento Valley Groundwater Basin, which is a north-south trending structural trough that is filled with marine and non-marine sediments. The oldest and deepest sediments were emplaced under a marine sedimentary depositional environment. Marine sediments in the deepest portions of the basin generally range in age from Late Jurassic to early Miocene (160 million years ago to 24 million years ago) (Wood-Rodgers, 2012). Younger non-marine sediments and the volcanic rocks are of early Miocene to Holocene age (Harwood and Helley 1987). Within the greater Sacramento Valley Groundwater Basin, the deposits have been disrupted by deformational stresses derived from east-west compressional forces associated with regional uplift along the western margin of the valley and extensional forces to the east, within the Basin and Range Province (Harwood and Helley 1987). The result of these forces have created fold and fault structures.

The Willows Fault is the primary fault structure within Sutter County, discovered in the 1950s during the development of a nearby gas field, and lies to the southwest and west of the Sutter Buttes. The fault is active and northwest-trending with a 74 degree or steeper dip to the northeast and exhibits approximately 1,610-feet of reverse displacement, indicating the ground east of the fault has moved up relative to the west side (Redwine, 1972). The Willows Fault enters into the County from Colusa County southwest of the Sutter Buttes and extends to the southeast portion of the County towards Sacramento, presumably following the boundary between the ophiolite basement of the west and the Sierran basement to the east (Harwood and Helley, 1987).

The Sutter Buttes is the prominent topographic feature in Sutter County, rising from the valley floor to an elevation of 2,100 feet, over 2,000 feet higher than the valley floor. The Sutter Buttes are composed of late Cenozoic volcanic rocks emplaced between 2.4 and 1.4 million years ago over a northwest-trending tectonic boundary that juxtaposes a basement of dense magnetic, presumed oceanic crust on the west against metamorphic and plutonic rocks of the Sierran basement on the east (Harwood and Helley 1987). When the volcanic rocks rose, they folded upward and exposed at ground surface older marine sediments including the Ione and Capay Formations. They also created an apron of volcanic sediments, the Sutter Buttes Rampart Formation that extends outward in a shield like apron.

4.3.1 Water Bearing Formations

Many reports have described the water bearing sediments within the subbasin and this report has distinguished between five stratigraphic units that have been identified using geophysical logs and lithologic logs for groundwater wells within the subbasin. From youngest to oldest the units are: Alluvium, Modesto Formation, Riverbank Formation, Laguna Formation, Sutter Buttes Rampart, and Sutter formation. The Sutter formation is an informal stratigraphic unit that describes the sediments in the Sutter Buttes area from the Oligocene to the initiation of the Quaternary volcanism of the Sutter Buttes (Springhorn, 2008). North of the Sutter Buttes within the Sutter County portion of the East Butte Subbasin, the distal portion of the Tuscan Formation is also present and grades into the Sutter formation. A formation is the fundamental unit of lithostratigraphy and consists of rock types with comparable lithology, facies or other similar properties. **Figure 14** shows a geologic map of the project area (reference), location of geologic cross-sections and wells and borings used for the geologic cross-sections.

Various reports describe the stratigraphic units within the east-central Sacramento Valley from the 1960s through present. In these different reports, numerous formations have been described sedimentary deposits during the Quaternary and Tertiary time periods. These stratigraphic units are described below and are referenced from the DWR Bulletin 118 description for the Sacramento Valley Groundwater Basin, Sutter Subbasin:

Alluvium (Holocene Stream Channel and Floodplain Deposits) – The younger Alluvium consists of coarse sand and gravel from present-day Yuba, Feather, and Sacramento Rivers. Sediments are up to about 100 feet thick near the river beds (Harwood and Helley, 1987). Deposits further from the river beds thin in thickness and also become finer gained. These sediments are highly permeable and provide areas where groundwater can be recharged and wells can yield from 2,000 to 4,000 gpm (DWR, Bulletin 118 – 2006 Update).

Older Alluvium (Pleistocene Floodplain Deposits) [Modesto and Riverbank Formations and Victor Formation] – The Older Alluvium consists of the Modesto and Riverbank Formations, and the Victor Formation. These sediments are fairly similar and grouped together in the cross sections.

In the study area, the Modesto Formation is characterized mostly by gravels, cobbles, and sand with some silt and clay. It was encountered from the ground surface to about 70 to 120 feet bgs just to the west of Yuba City near SEWD Well #1. The formation is thicker to the south and thins to the north, with beds that are generally flat-lying (GEI, 2008).

In the study area, the Riverbank Formation underlies the Modesto Formation, and is also sedimentary in origin, and is composed of silts and clays with 10- to 20-foot thick sand and gravel layers. The sand and gravel beds of the Riverbank Formation are thinner and less laterally extensive than those of the overlying Modesto Formation, and are therefore more difficult to predict where they may occur. Similar to the Modesto Formation, the Riverbank Formation is thicker to the south, and thins closer to the Sutter Buttes, with beds that are generally flat-lying (GEI, 2008).

The Victor Formation is approximately 100 feet of Sierran alluvial fan deposits consisting of loosely compacted silt, sand, and gravel with lesser amounts of clay deposits. The deposit thins with distance to the west of the Yuba River and the foothills and wells can yield up to 1,000 gpm.

Laguna Formation – The formation occurs above the Sutter Buttes Rampart and is unconformably overlain by the Riverbank Formation. The formation consists of two alluvial units and the Nomlaki Tuff Member which is a regional tuff that is a time correlative marker. The Nomlaki Tuff is also present in the Tuscan Formation which is part of the Sutter formation in the study area. Each of the two units create fining upward packages with basal gravels fining up through sand, silt and clay (Busacca, others. 1989). The Laguna Formation in the study area is thinner to the north and thickens to the south with the thickness ranging from about 80-feet in the north to almost 700-feet to the south.

Sutter Buttes Rampart - Beneath the Alluvium, is the Sutter Buttes Rampart, which consists of volcanic debris shed off the Sutter Buttes in a radial pattern. The volcanic debris consists of sand to boulder size material, which slopes and thins to the south, away from the buttes. The gamma log signature of the Sutter Butte Rampart has a recognizable and correlative "kick," which was more distinct near the Sutter Buttes. Few wells in the area use this formation for water supply.

Sutter formation - The Sutter formation is generally characterized by black, blue, gray and greenish gray, angular to sub-rounded sand gravel. The Sutter formation is an informal unit and consists of sediments interpreted to be the distal portion of the upper Princeton Valley Fill, Mehrten Formation, Nomlaki Tuff, and Tuscan Formation (Springhorn, 2008). The presence of either of these units varies with the relative location of the Sutter Formation with the Sutter Buttes.

The upper Princeton Valley Fill is in the lower portion of the Sutter Formation and lies unconformably above the Lovejoy Basalt (Williams and Curtis, 1977). It consists of fluvially derived sands, conglomerates, and shales up to 1,400 feet thick (Redwine, 1972). The Valley Springs Formation of the Sierra Nevada, located greater than 2,000 feet deep in the Sacramento Valley or found shallower near the eastern margin of the valley, consists of tan, white, and green rhyolitic fragments and is the equivalent to the Princeton Valley Fill (Springhorn, 2008).

The Mehrten Formation consists of fluvial deposits, cobble tuff breccia deposits, tuff deposits, and tuff breccia deposits from the Sierra Nevada (Moses, 1985). The deposits primarily consist of clastic and pyroclastic andesitic fragments that have been deposited as sandstone, siltstone, conglomerate, and tuff breccia.

The Nomlaki Tuff, found in the lower to middle portion of the Sutter formation, consists of white to light gray dacitic pumice tuff dated at 3.4 Ma (Harwood, 1981). The Nomlaki Tuff is near the bottom of the Tuscan Formation.

The Tuscan Formation, a primary aquifer in the northeastern Sacramento Valley, is composed of volcanic sediments derived from Mount Yana located south of Lassen Peak (Lydon, 1968). The Tuscan Formation is subdivided into Unit A through Unit D and mostly consists of interbedded lahars, volcanic conglomerate, volcanic sandstone, and siltstone with slightly varying mineral compositions and a couple notable tuff members (Harwood, 1981).

4.3.2 Non-Water or Non-Fresh Water Bearing Geologic Formations

The Princeton Submarine Valley was filled with various marine and near continental formations. All of these formations have been folded and faulted by both regional tectonics and also during intrusion of the Sutter Buttes volcanics.

Tertiary formations include the Eocene Capay, Ione, and Lovejoy Basalt. The Ione formation underlies the Sutter formation. For most of the area, this boundary marks the base of the fresh water; the Ione Formation typically has brackish water with an anomalous exception just south of the Sutter Buttes. Underlying the Ione Formation, the Capay Formation consists predominantly of a black to greenish black to greenish-gray marine claystone and shale with fossiliferous intervals (Springhorn, 2008).

Upper Cretaceous formations and units include the Forbes, Kione, Sacramento Shale, Winter Sands and Shales, and the Starsky Sands. Many of these formations are the source of natural gases. The locations of gas exploration borings and wells are shown on **Figure 20**. Many of these formations are exposed in a circular pattern around Sutter Buttes due to the folding and faulting associated with the emplacement of the Buttes. The Starsky Sands are not exposed at ground surface but are projected to be in contact with the freshwater aquifers within the Sutter Subbasin.

All of the formations and sediments mentioned above are underlain by igneous rocks from the Sutter Buttes or igneous and metamorphic rocks, potentially similar to those exposed in the Coast Ranges and in the Sierra Nevada mountains.

4.3.3 Geologic Profiles

Geologic profiles (cross sections) have been developed for the subbasin by many authors. Pertinent profiles are discussed and presented to illustrate the relationships and distribution of the formations and coarse grained sediments that will constitute principal aquifers. The location of the profiles are shown on **Figure 14**.

More regional geologic sections have been prepared across the subbasin that show the geologic formation names and some lithologic indications. East-west geologic profiles (Springhorn, 2008) across the northern Subbasin boundary and along the Sutter and Butte County lines where inflow to the Subbasin occurs are provided on **Figures 16 and 17.**

Basin-level profiles that show sediment types and formation were developed that cross the entire subbasin. **Figure 18** shows a regional northwest-southeast profile. **Figure 19** shows a regional east-west profile.

In addition to these geologic profiles, geotechnical investigations (to depths of up to 140 feet) have been performed along significant portions of the Feather and Sacramento River levees, along the east and west sides of the subbasin. Profiles were developed along the Sutter Bypass levees, located in the central portion of the basin. The investigations show sediment types where groundwater and surface water interactions occur, and where the river (bathometric elevations) has incised partially or entirely through coarse grained sediments that make up the shallow

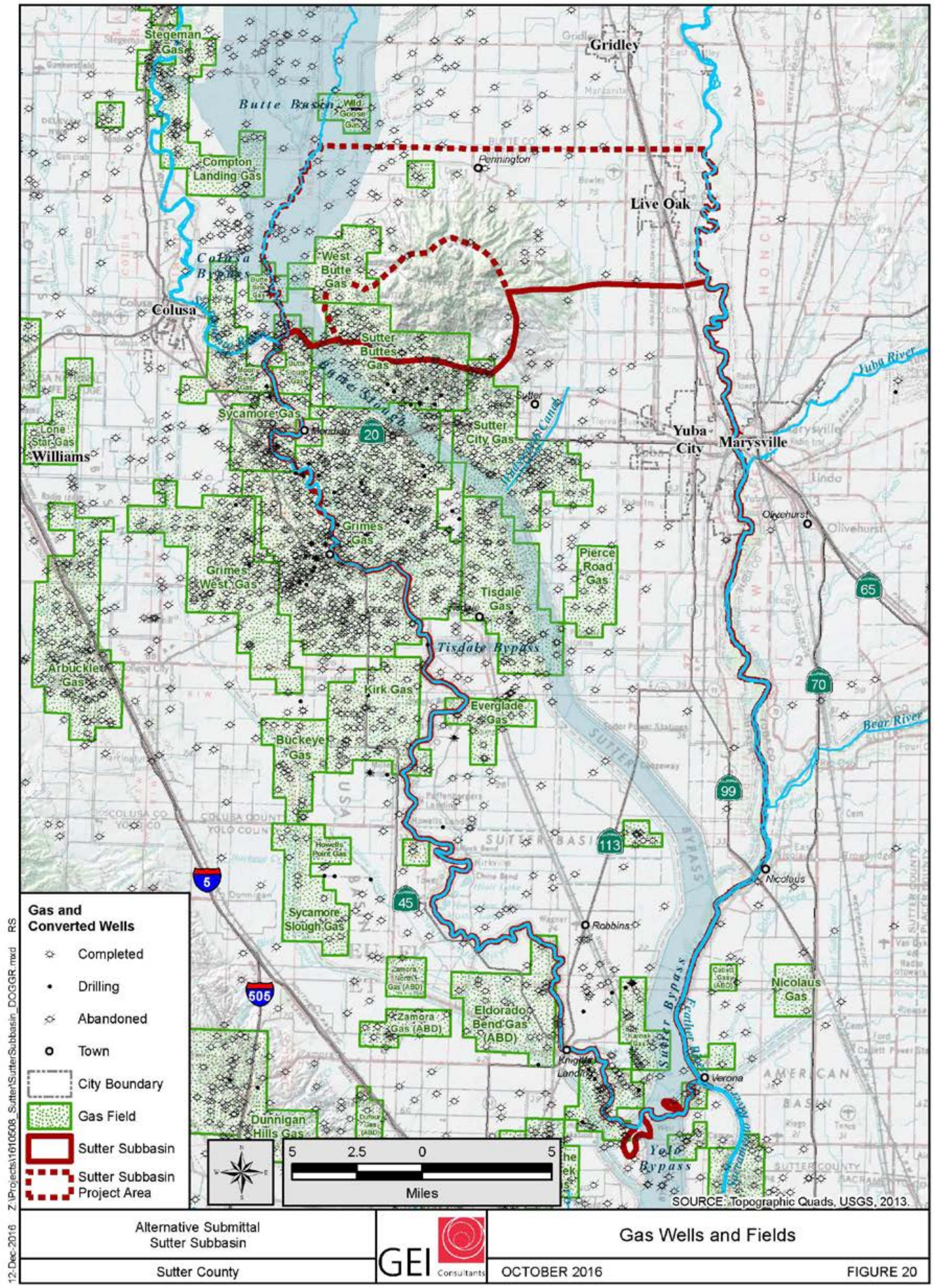


Figure 20. Gas Wells and Fields

principal aquifer. They also show where slurry walls have been constructed and where they are planned to be built. **Appendices C** through **E**, provide these geologic profiles for each of the rivers and the bypass. The sections do not contain a break out of the geologic formations but in general, dependent upon the location, would include Alluvium, Older Alluvium.

4.4 Principal Aquifers

Sand and gravel beds are generally grouped together to form aquifers that may display similar characteristics. The aquifers are separated by single or multiple layers of silt and clay (or aquitards) that can slow or prevent vertical movement of groundwater between aquifers. Three distinct aquifers are present beneath the site, the shallow aquifer (Alluvium including the Modesto Formation, Riverbank Formation) [Principal Aquifer 1], the intermediate aquifer (consisting of the Sutter Buttes Rampart and Laguna Formation, which overlap and are likely interconnected) [Principal Aquifers 2A and 2B, and the deep aquifer (consisting of the Laguna Formation, Sutter Buttes Rampart and Sutter Formation) [Principal Aquifer 3]. **Figures 21** and **22** shows the aquifers, which are interpreted from the geology, electric log responses, groundwater levels, and water quality.

The shallow aquifer is present within the Modesto Formation and Riverbank Formation, between ground surface to a depth of about 50 feet at MW-1, nearest the Sutter Buttes, and to a depth of about 150 to 190 feet at MW-3, furthest from the Sutter Buttes. It is unconfined to semi-confined.

The intermediate aquifer is present within the Laguna and Sutter Buttes Rampart aquifers, which slopes away in a radial pattern and becomes increasing confined with distance from the Sutter Buttes. The intermediate aquifer is semi-confined to confined. This aquifer extends from about 150 to 400 feet bgs.

The deep aquifer consists of the lower portion of the Sutter Butte Rampart and Sutter formation where north of the Sutter Buttes is considered to be the distal portion of the Tuscan Formation while to the south the Mehrten Formation sediments are present. South of SEWD MW-3 the Laguna Formation is present in the deep aquifer. The deep aquifer is confined. The deep aquifer extends from 400 to about 700 feet or more beneath the basin.

4.5 Aquitards

The shallow aquifer is separated from the intermediate aquifer by a 20- to 60-foot thick layer of fine-grained sediments (silts and clay) as shown on **Figure 21**. The intermediate aquifer is separated by a 30- to 80-foot thick layer of fine-grained sediments (silts and clay) as shown on **Figure 21**. These fine-grained layers produce semi-confined to confined conditions.

4.6 Aquifer Hydraulic Characteristics

Limited aquifer tests with observation wells are available to provide reliable estimates of the aquifer characteristics. The aquifer characteristics are summarized in **Table 8** by principal aquifer.

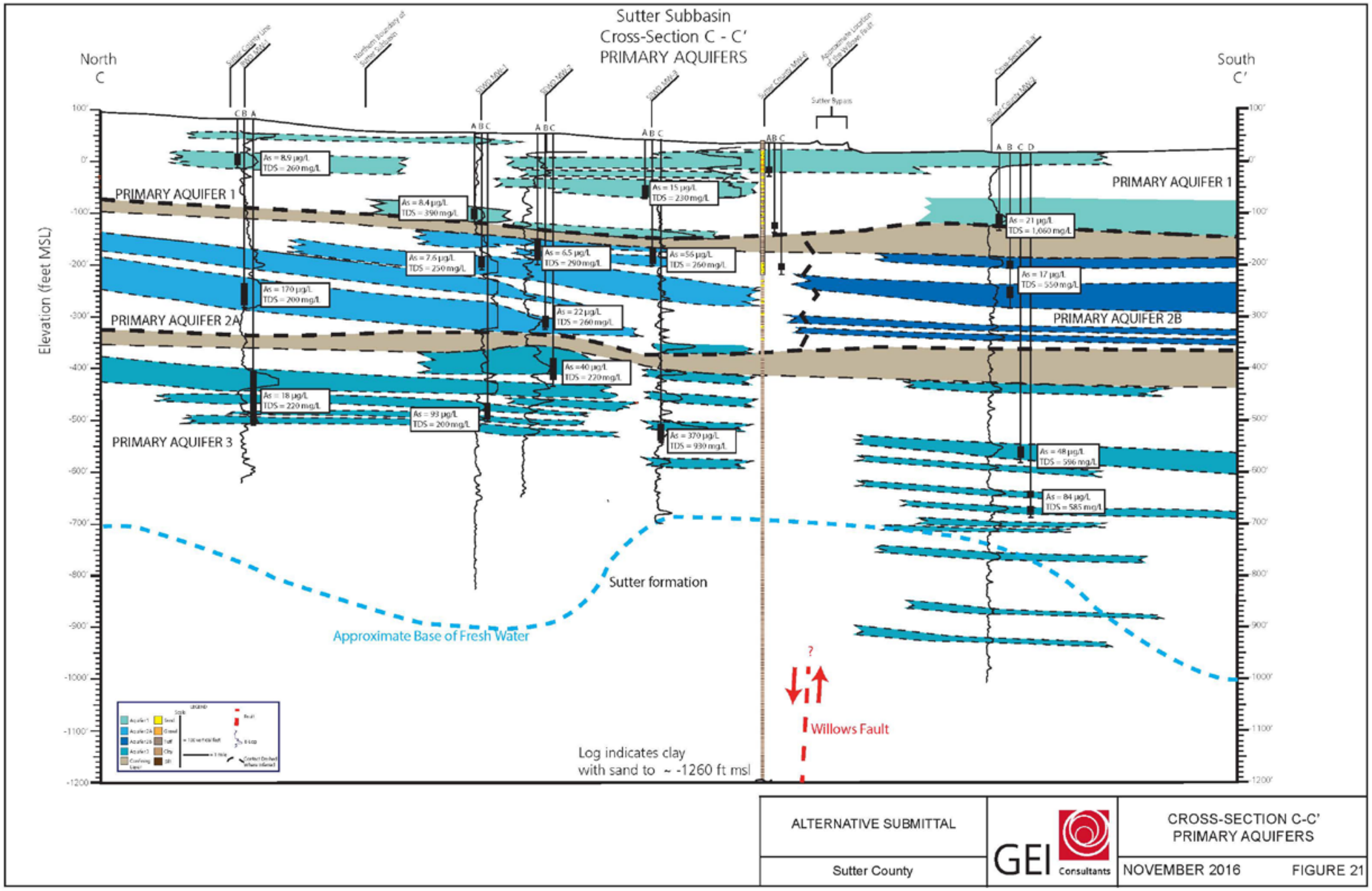


Figure 21. Cross Section C – C' Primary Aquifers

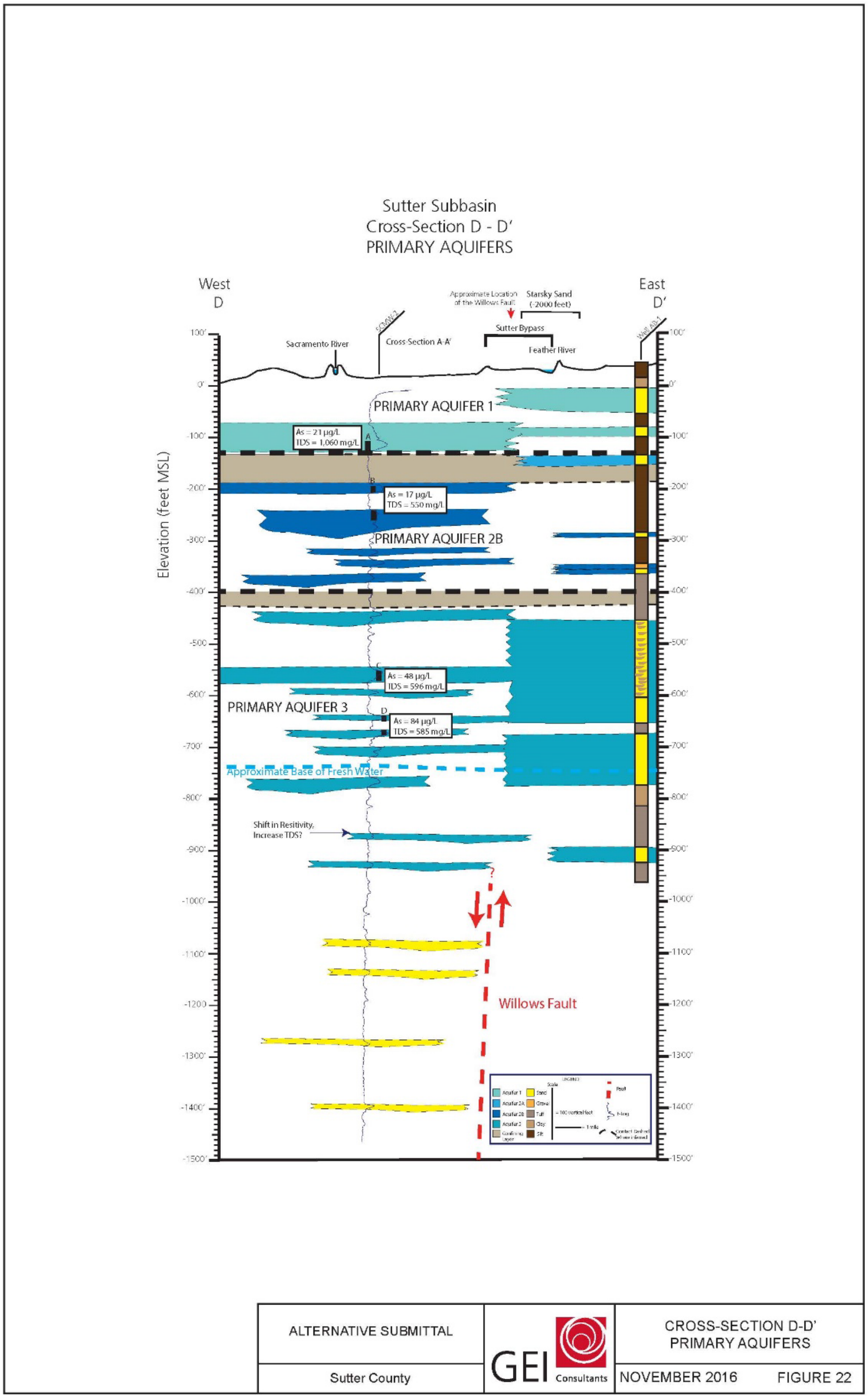


Figure 22. Cross Section D – D' Primary Aquifers

Table 8. Principal Aquifer Hydraulic Characteristics

Principal Aquifer	Transmissivity (gpd/ft/day)	Specific Yield or Storativity (unitless)	Source
Shallow	NA	NA	
Intermediate	NA	NA	
Deep:			
Sutter Buttes Rampart and Sutter Formation	57,000 to 67,000	5.56×10^{-4} to 8.98×10^{-4}	SEWD, Well #1, 2007
	55,000 to 64,000	1.08×10^{-3} to 9.78×10^{-4}	SEWD, Well #2, 2007

Note: NA = No aquifer tests available.

Specific yield estimates of the sediments present in the Sacramento Valley were compiled by the USGS. The specific yields of the sediments range from 3 percent for clays to 25 percent gravels (Johnson, 1967).

The C2VSim model was designed with three layers. **Table 9** summarizes the model layers and aquifer characteristics. Layer 1 represents the shallow unconfined aquifer. Layer 2 represents a confined aquifer where pumping is occurring and Layer 3 represents a confined aquifer where pumping does not occur (RMC, 2016). Layer characteristics (thickness and depth) do not match the principal aquifers in this report, but the information is generally applicable to the Sutter Subbasin. Calibrated model hydraulic conductivities range from as low as 4 feet/day to as high as 100 feet/day.

Table 9. Model Layer Hydraulic Characteristics

Layer	Thickness (feet)	Average Depth (feet)	Hydraulic Conductivity (feet/day)	Specific Yield or Storativity
Layer 1	226-411	226-411	45-100	0.16
Layer 2	230-481	456-836	47-100	0.12
Layer 3	90-808	714-1476	4-7	0.12-0.15

4.7 General Water Quality

Groundwater quality sampling has been conducted by multiple agencies over the last 50 years. The sampling of wells has varied from investigation to investigation so development of trends is at times challenging. This section describes the current water quality sampling network and the results from previous and on-going investigations.

Most of the area east of the Feather River and between the Yuba and Bear Rivers is farmland. Sutter County includes about 7,900 acres of rice overlying High Vulnerability Areas (HVAs), as defined by the Irrigated Lands Regulatory Program. These HVAs were evaluated against NRCS drainage classes, and 3,000 acres were found to be poorly drained and somewhat poorly drained soils, while 4,900 acres were found to moderately well-drained and well-drained soils. Note that approximately 75,800 acres of moderately well-drained and well-drained soils were not designated an initial HVAs, nor were 71,900 acres of poorly drained and somewhat poorly drained soils.

Rice agriculture in the Sacramento Valley generally utilizes high-quality surface water to maintain a standing flood in the rice fields and a productive cropping system. This use of high-quality irrigation water, combined with subsurface drainage water, ensure that salts do not build up in the soil water These observations are consistent with the low levels of total dissolved solids (TDS) observed in the USGS Rice Wells and with other studies showing that TDS is generally at concentrations below 500 mg/l in Sacramento Valley groundwater.

Potential sources of groundwater contamination from farmlands include salinity, nitrate and from the use of pesticides, fungicides, and herbicides.

Urban and rural area communities of Yuba City, Live Oak, Sutter, and the town of Robbins may contribute to increases in nitrate from private septic systems. Industrial activities such as landfills, underground storage tanks, dry cleaners, have also had releases of contaminants to groundwater but are regulated by the Regional Water Quality Control Board. Discussion of groundwater contamination from these sources are discussed in **Section 5.3.**

4.7.1 Current Groundwater Quality Monitoring Network

Groundwater monitoring in Sutter County is achieved by several efforts. Sutter County itself does not maintain any groundwater monitoring wells. All groundwater monitoring wells are sampled by DWR or USGS (California Rice Coalition, 2013). Additionally, the Feather Water District currently monitors groundwater levels in four wells and Sutter Extension Water District monitors groundwater levels at the beginning and end of the irrigation season. Water supply wells under the preview of the California Department of Drinking Water (DDW) are required to be sampled regularly for numerous water quality constituents.

According to the Sutter County GWMP, groundwater samples have historically been collected for analysis in a total of 133 wells. DWR has sampled 34 of these wells in Sutter County, 14 of which are multiple-completion (nested) monitoring wells. USGS has sampled 94 wells, and the remaining wells were sampled by water purveyors who have shared their data.

Currently water quality sampling by DWR is expected to occur every three years or as funds are available. The water quality data are disseminated on the DWR Water Data Library (online) (Sutter County 2012). **Figure 23** shows the locations of the active water quality monitoring well network.

Rice Well Program - The USGS installed 28 monitoring wells in the Sacramento Valley rice-growing areas as part of a 1997 National Water Quality Assessment (NAWQA) Program land use study (USGS 2001a). The purpose of the study was to assess shallow groundwater quality and to determine whether any effects on water quality could be attributed to rice agriculture, among other human activities (USGS 2001a). The Rice Wells were constructed to sample shallow groundwater characteristic. The sampling depths of the USGS Rice Wells ranged between approximately 29 and 50 feet bgs (CH2MHILL, 2013). Four rice wells are located in the Sutter Subbasin, Rice Wells Nos. 02, 03, 05 and 20. **Figure 23** show their locations. Two

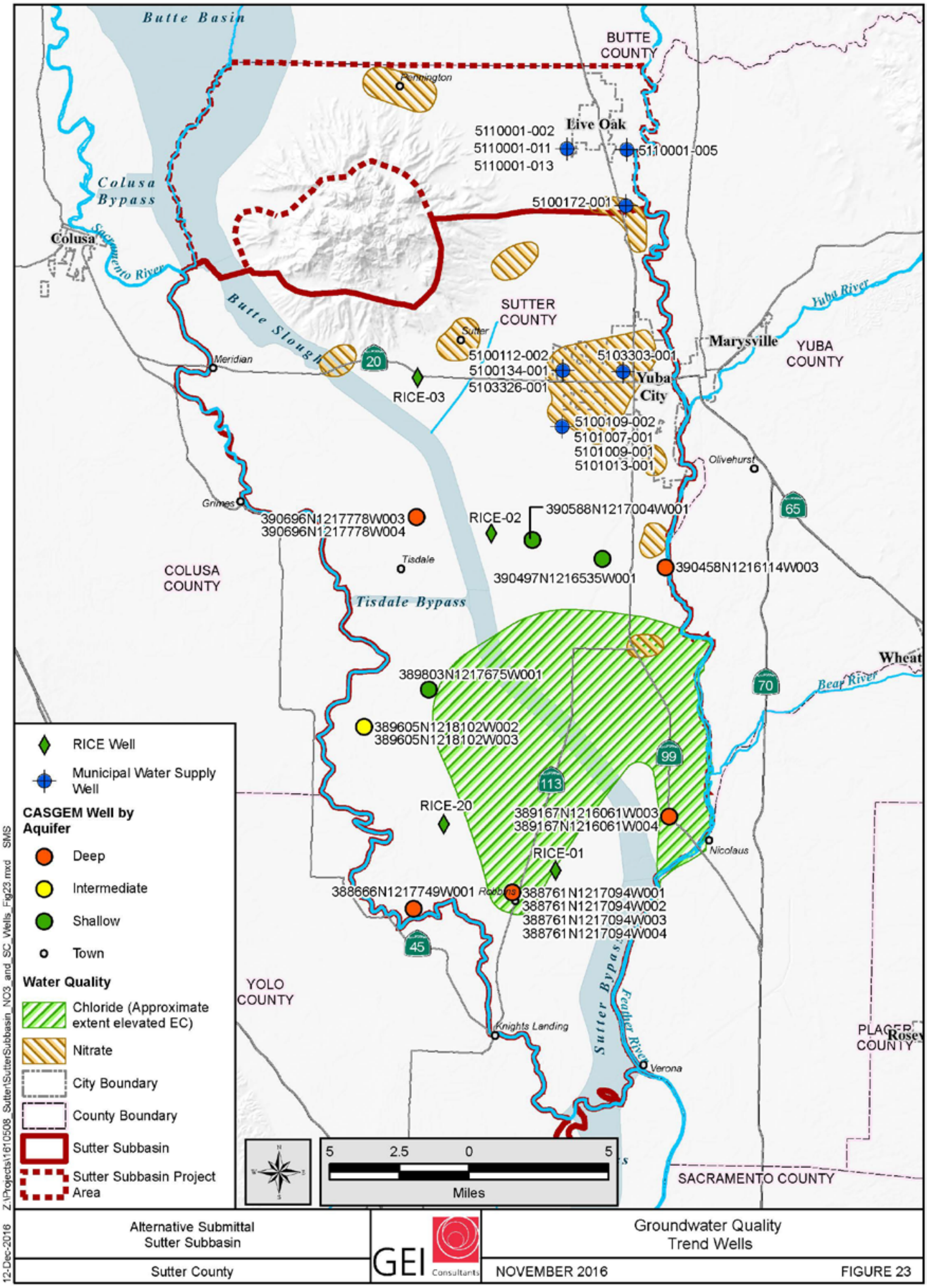


Figure 23. Groundwater Quality Monitoring Network

water quality samples were collected from each of these wells during the period from 1997 and 2010 with the exception of Rice Well No. 03 which was sampled nine times. Well construction details are provided in **Appendix F** for the Sutter Subbasin and in **Appendix G** for the Sutter County portion of the East Butte Subbasin.

Subsequent to this initial study, the network has continued to be used for further monitoring. Of the original 28 monitoring wells drilled by the USGS, some were destroyed or damaged and are no longer in use, but 23 wells remain in the network. These wells are sampled annually for water levels. A subset of five wells is sampled every two years for water quality.

Shallow Domestic Well Program – As part of the Rice Well Program, shallow domestic wells are also monitored in the Sutter Subbasin and include Wells Nos. 11, 14, 16, 19, 21, 23, 24 and 26. Well No. 27 lies in the Sutter County portion of the East Butte Subbasin. Appendix F contains their well construction details.

Gamma Wells – USGS develop a spatially distributed, randomized grid-based method to provide statistical representation of their study area (grid wells), and to aid in evaluation of specific water-quality issues (understanding wells). All wells sampled were existing wells.

CASGEM Monitoring Wells - Only a few of the CASGEM groundwater monitoring wells have been routinely sampled for water quality but typically for limited constituents. Water quality samples typically are collected from nested monitoring wells shortly after their construction and provide vertical profiling of water quality in the aquifers.

Municipal Drinking Water Supply Wells - Water quality is more routinely sampled when used for drinking water and can be used to assess trends. These municipal wells typically provide composite water quality of multiple aquifers and only represent those aquifers where the water quality meets drinking water standards or is the best water available.

4.8 Water Quality Distribution and Trends

Groundwater quality samples have been collected and analyzed for general minerals, metals, volatile organic compounds and pesticides. A brief summary of the elements and compounds have been detected in the Subbasin and their sources are described as an introduction to their distribution and trends.

Water quality was evaluated in the Sutter County GMP (Wood Rodgers, 2012) and during the preparation of the Rice Coalition Groundwater Assessment Report. The County GMP utilized the available data and developed water quality for three general depths that correspond to the primary aquifers to show their distribution. The water quality compilation is a composite of sampling events that span almost 40 years. The GMP identified several constituents within the Subbasin that exceed the maximum contaminant level for drinking water, the highest beneficial use category. The constituents include arsenic, boron, total dissolved solids, nitrate iron and manganese. All of the constituents were detected in historic studies but later found to be naturally occurring, other than for nitrate. The water quality analyses where generally sorted by those less than the MCL and above the MCL with some intermittent values. The general distribution of water quality within the County, regardless of the date sampled, are shown on **Figures 24** through **28** from the County's General Plan. **Figures 29 through 33** show the distribution by principal aquifer. Isoconcentration contour maps have not been developed for the

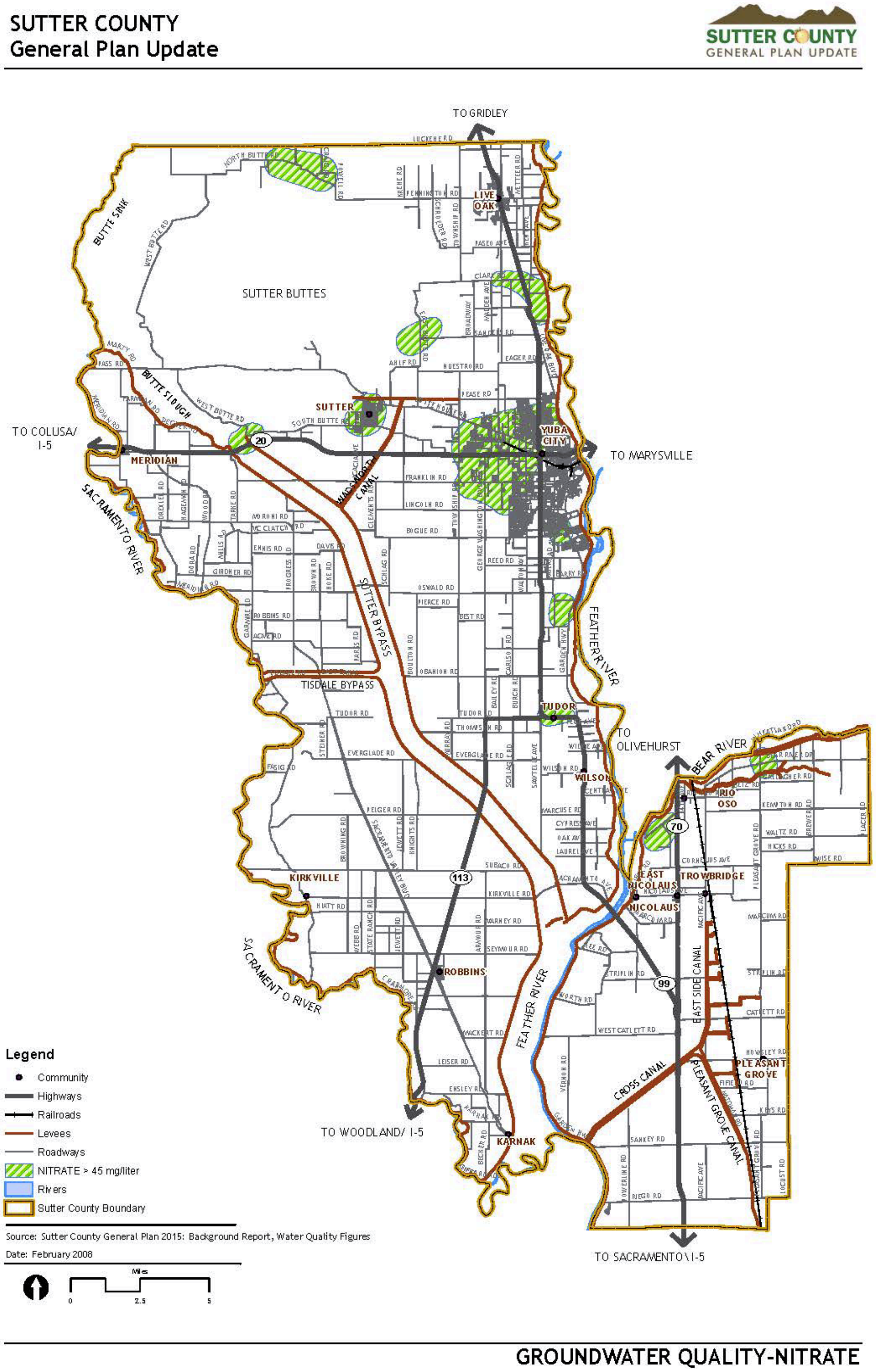


Figure 24. Groundwater Quality - Nitrate

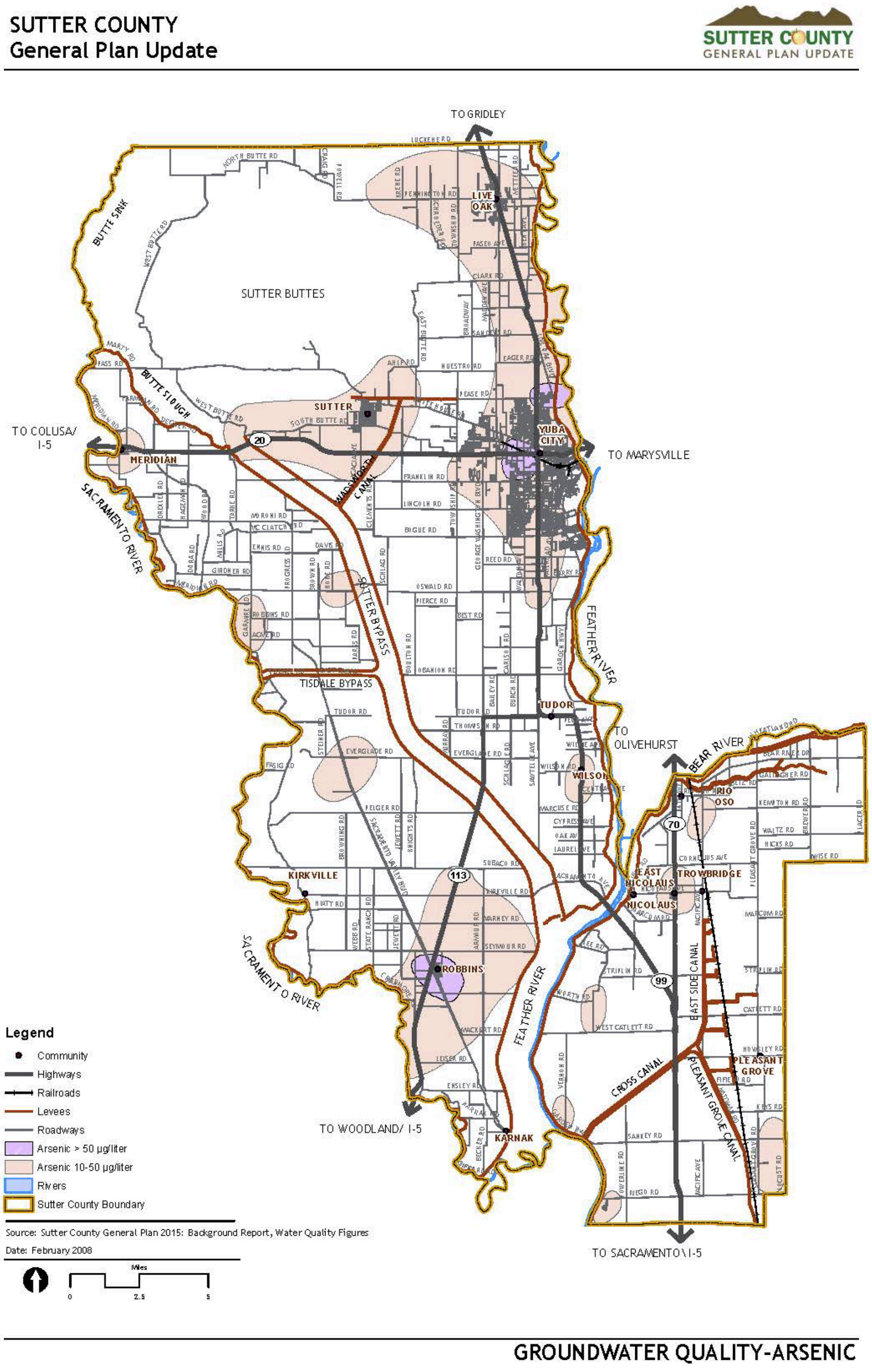


Figure 25. Groundwater Quality – Arsenic

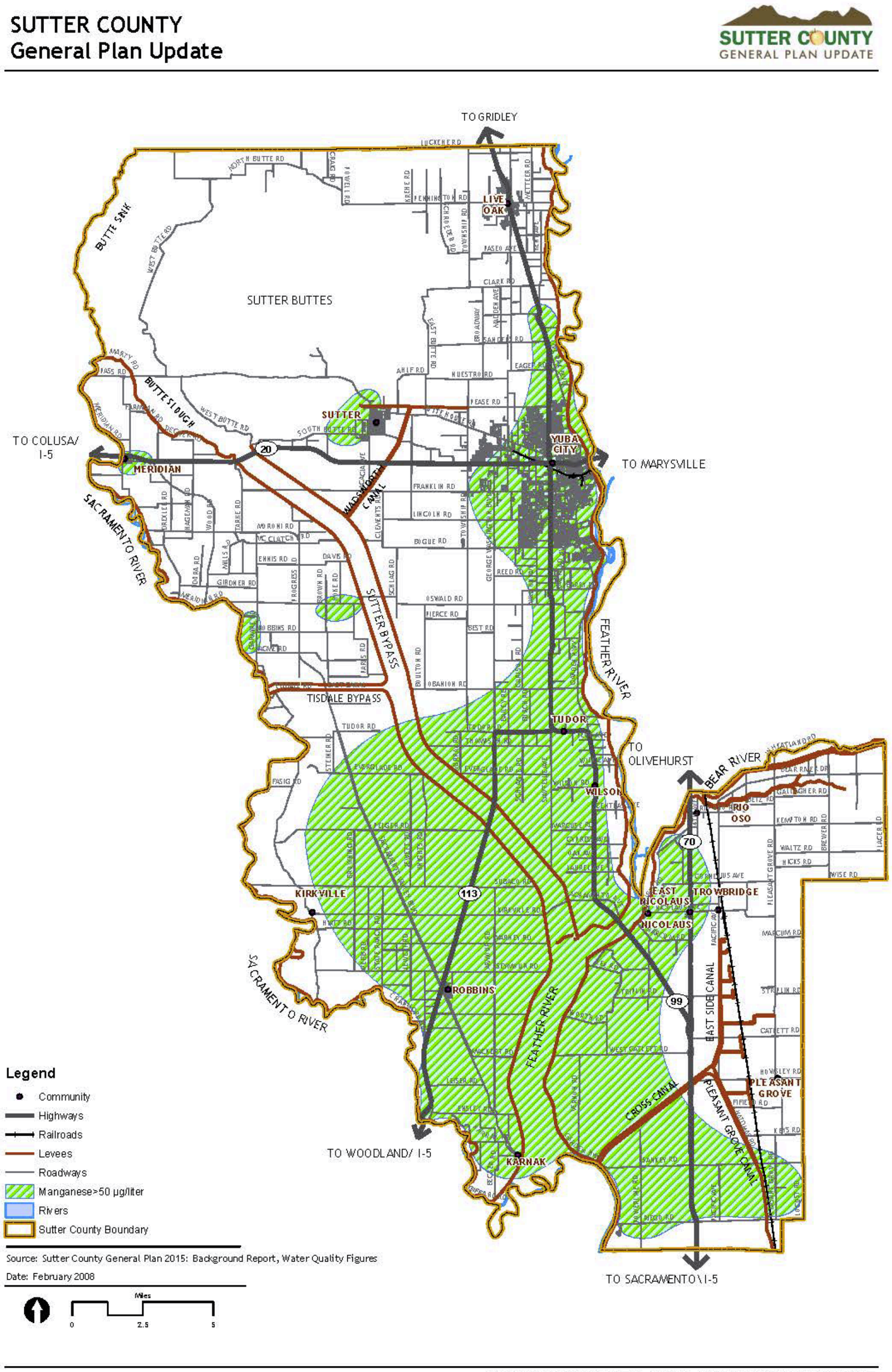


Figure 26. Groundwater Quality – Manganese

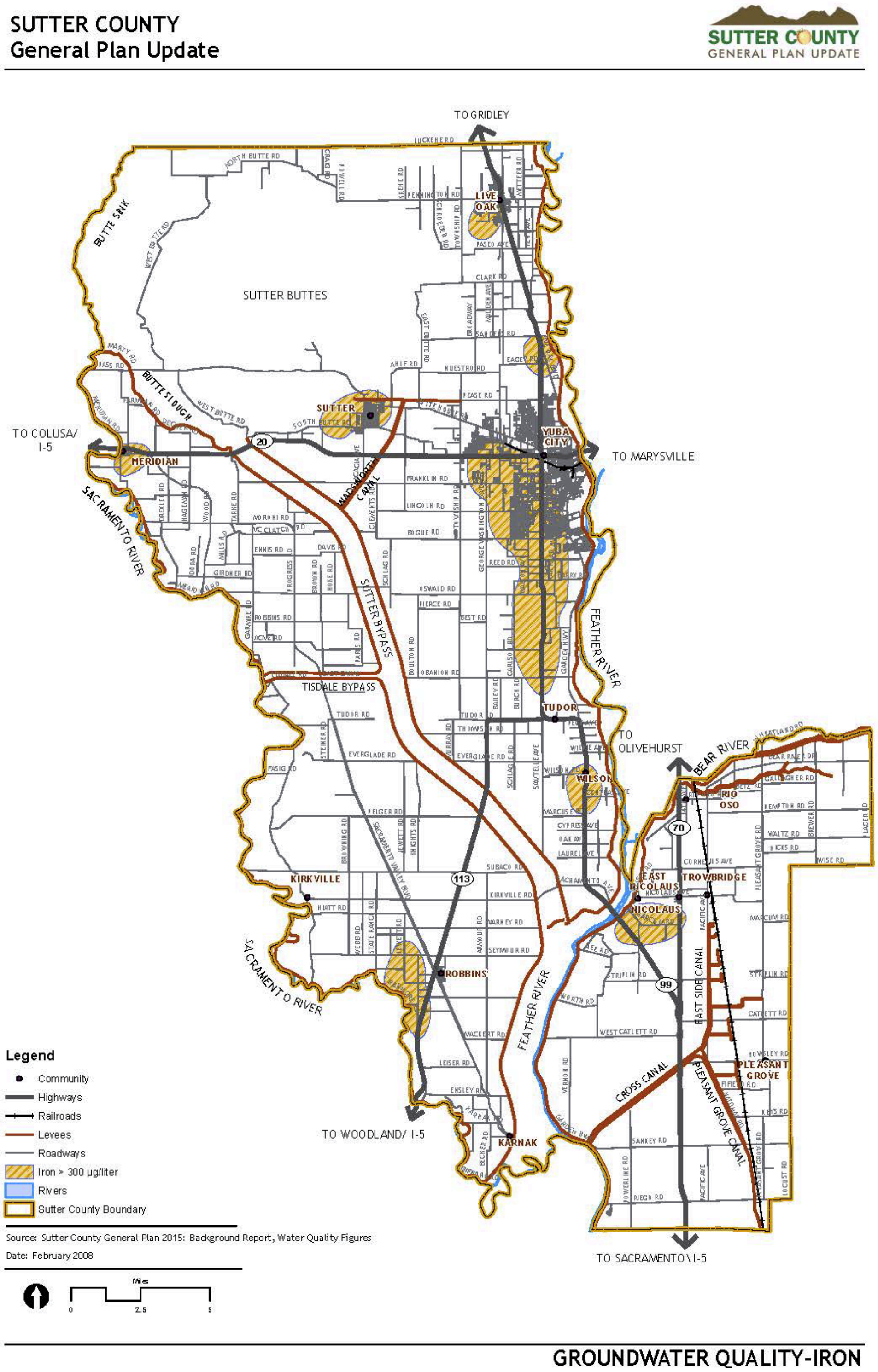


Figure 27. Groundwater Quality - Iron

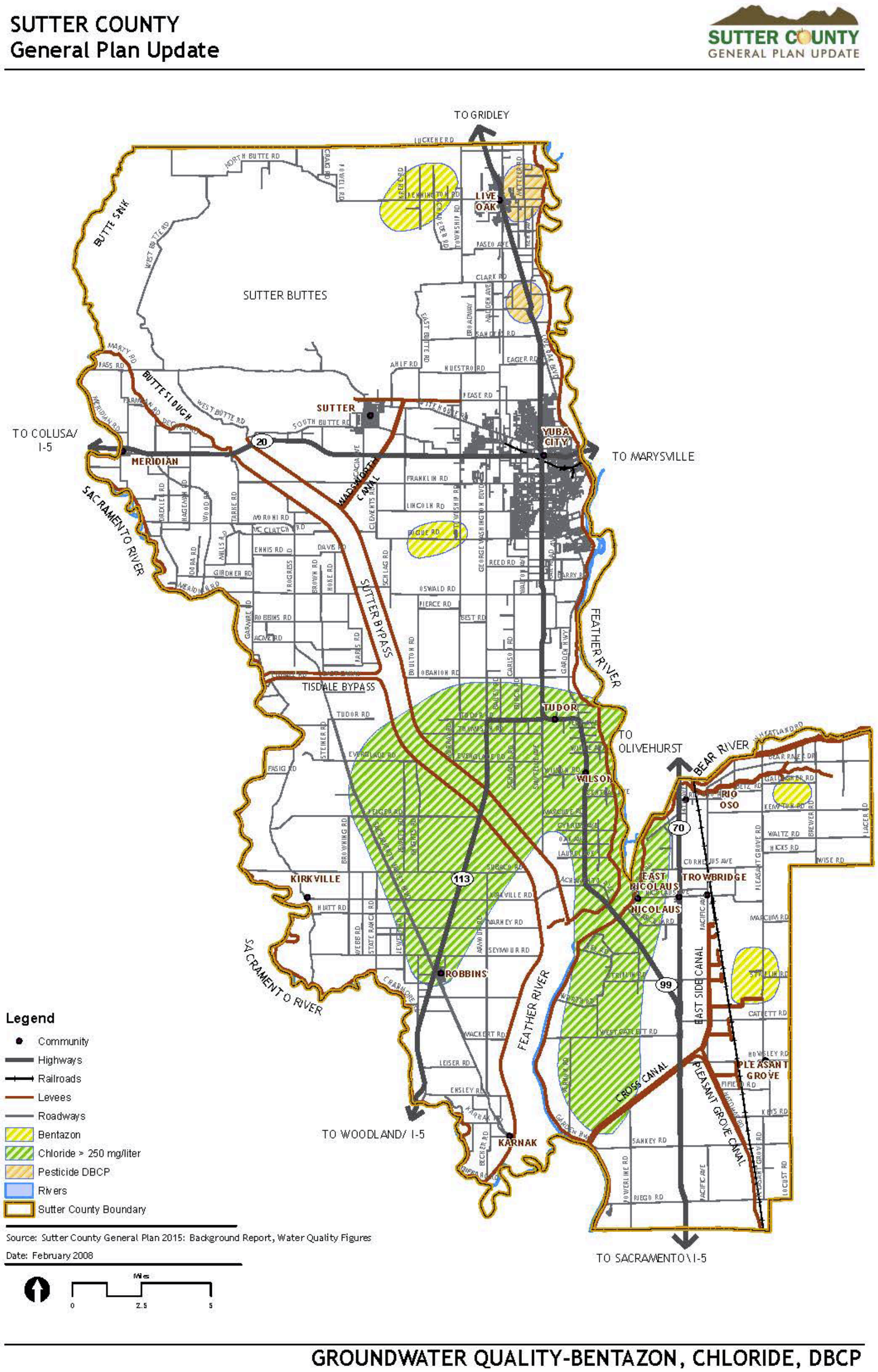


Figure 28. Groundwater Quality – Bentazon, Chloride, DBCP

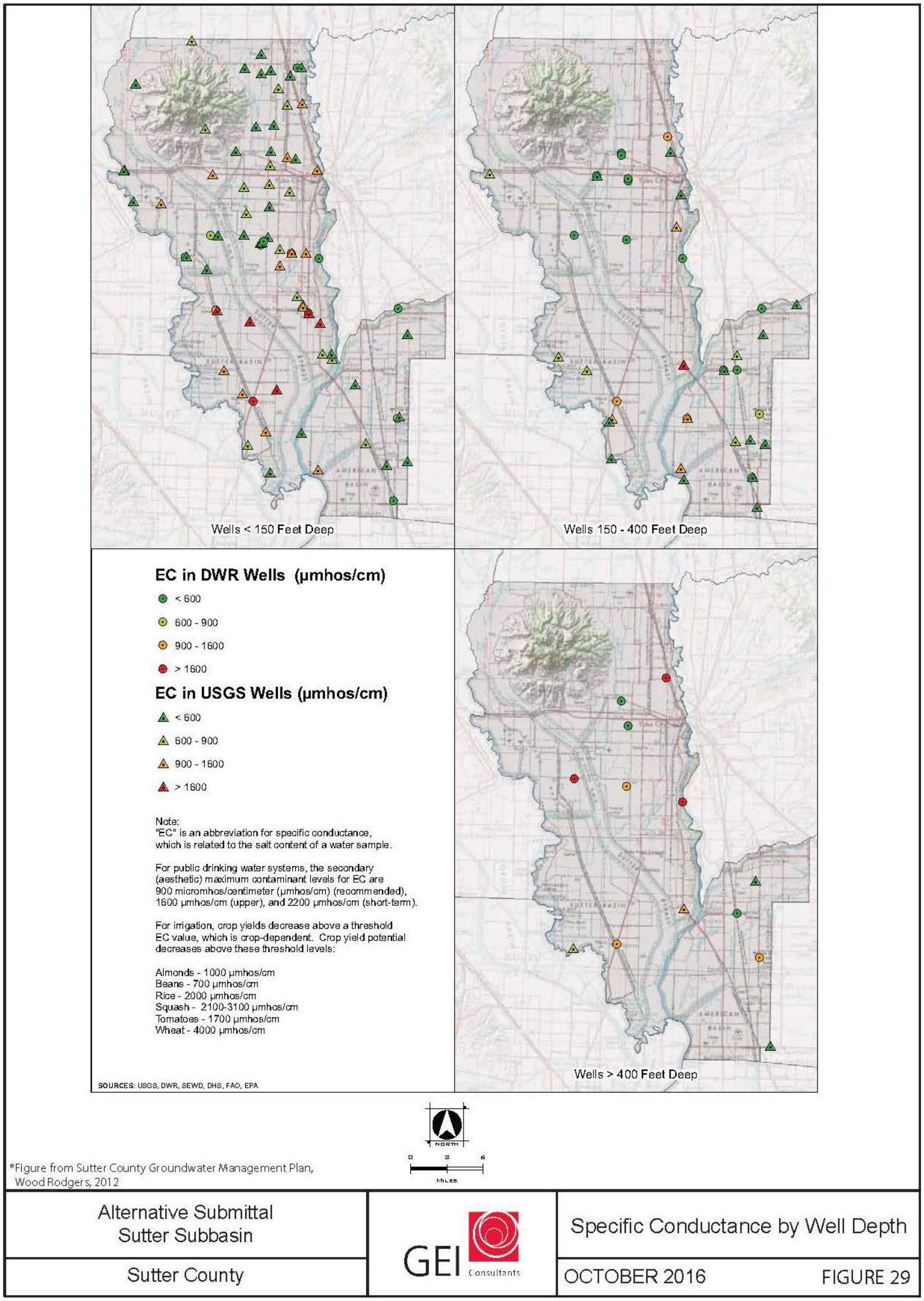


Figure 29. Specific Conductance by Well Depth

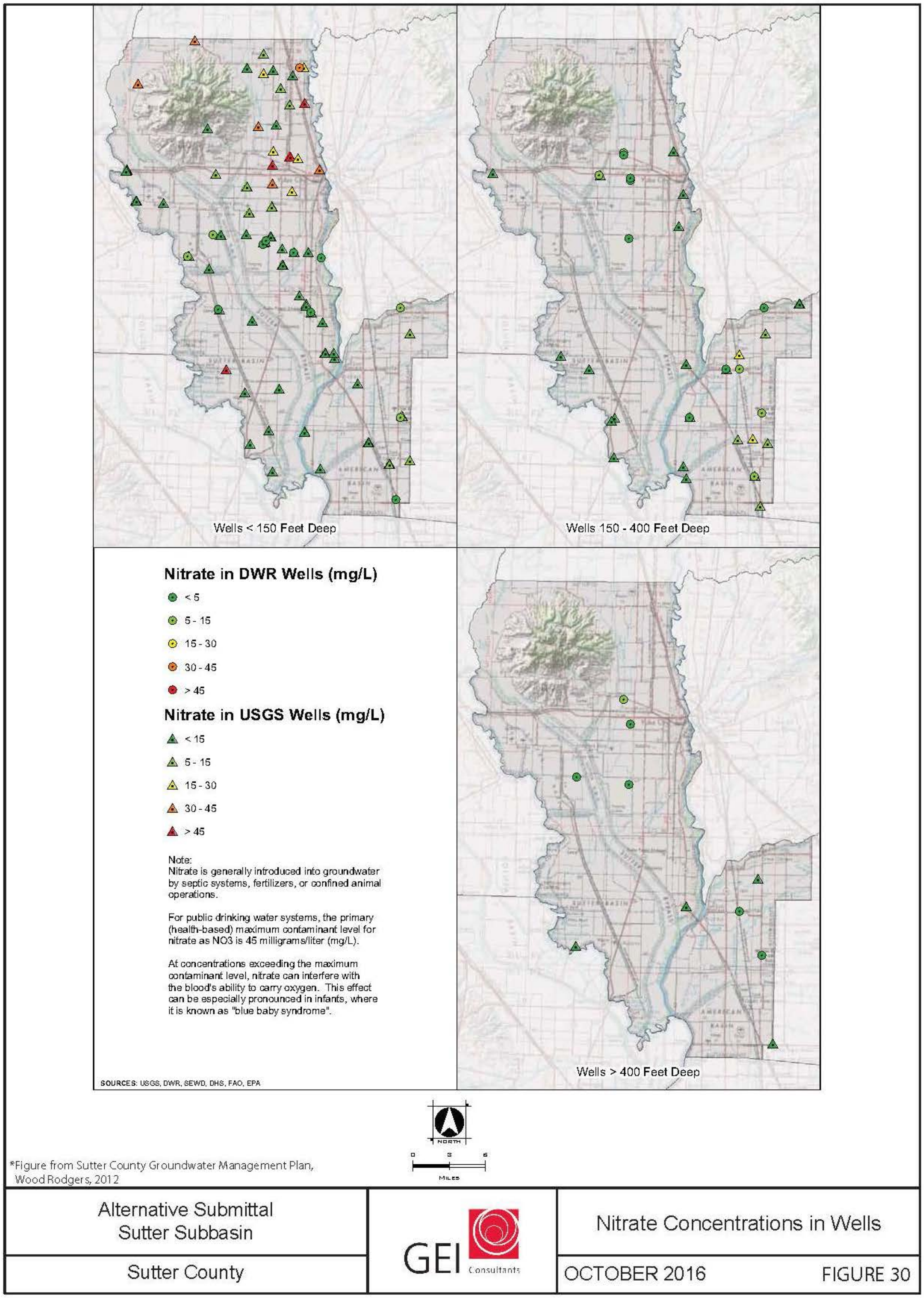


Figure 30. Nitrate Concentrations in Wells

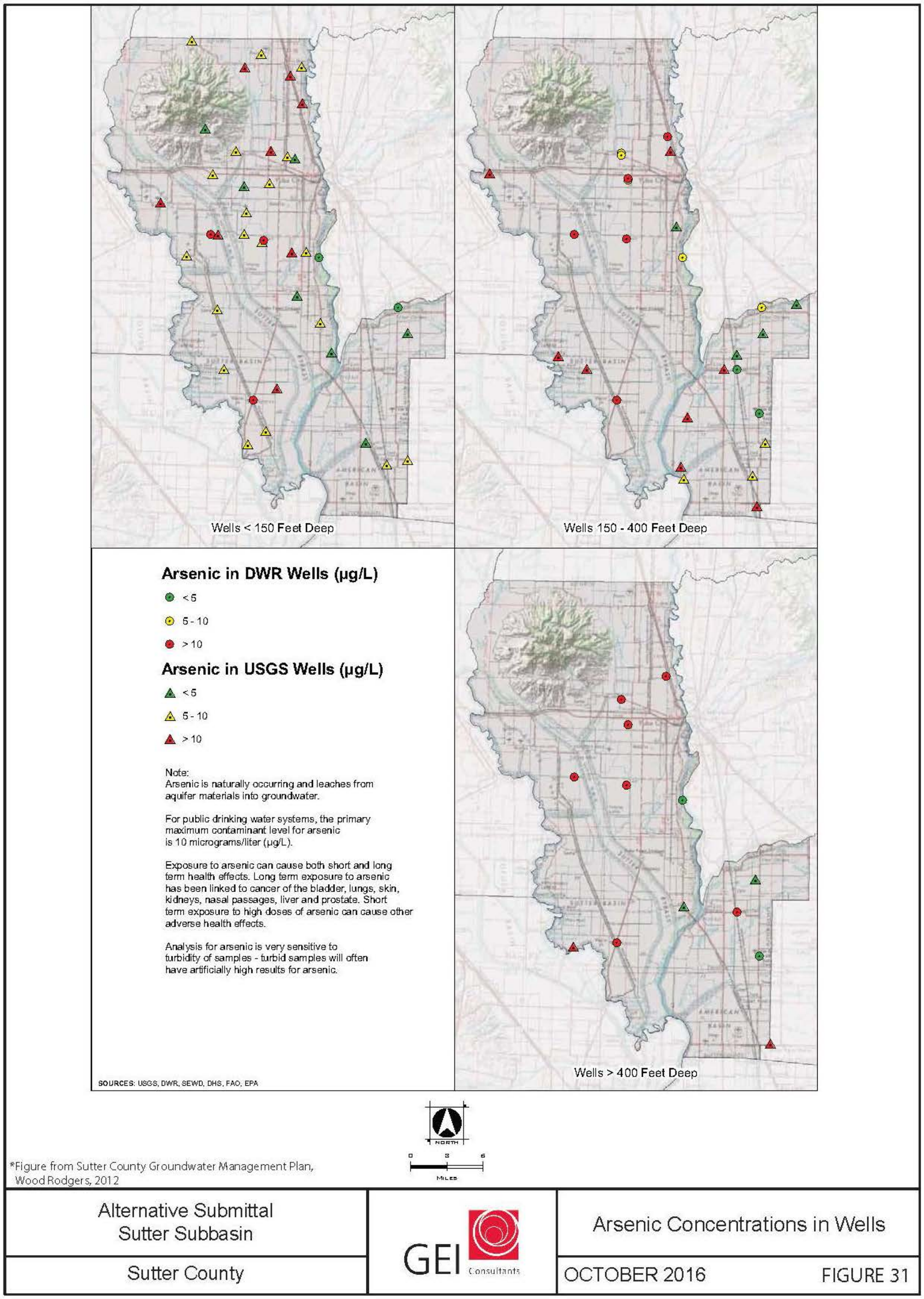


Figure 31. Arsenic Concentrations in Wells

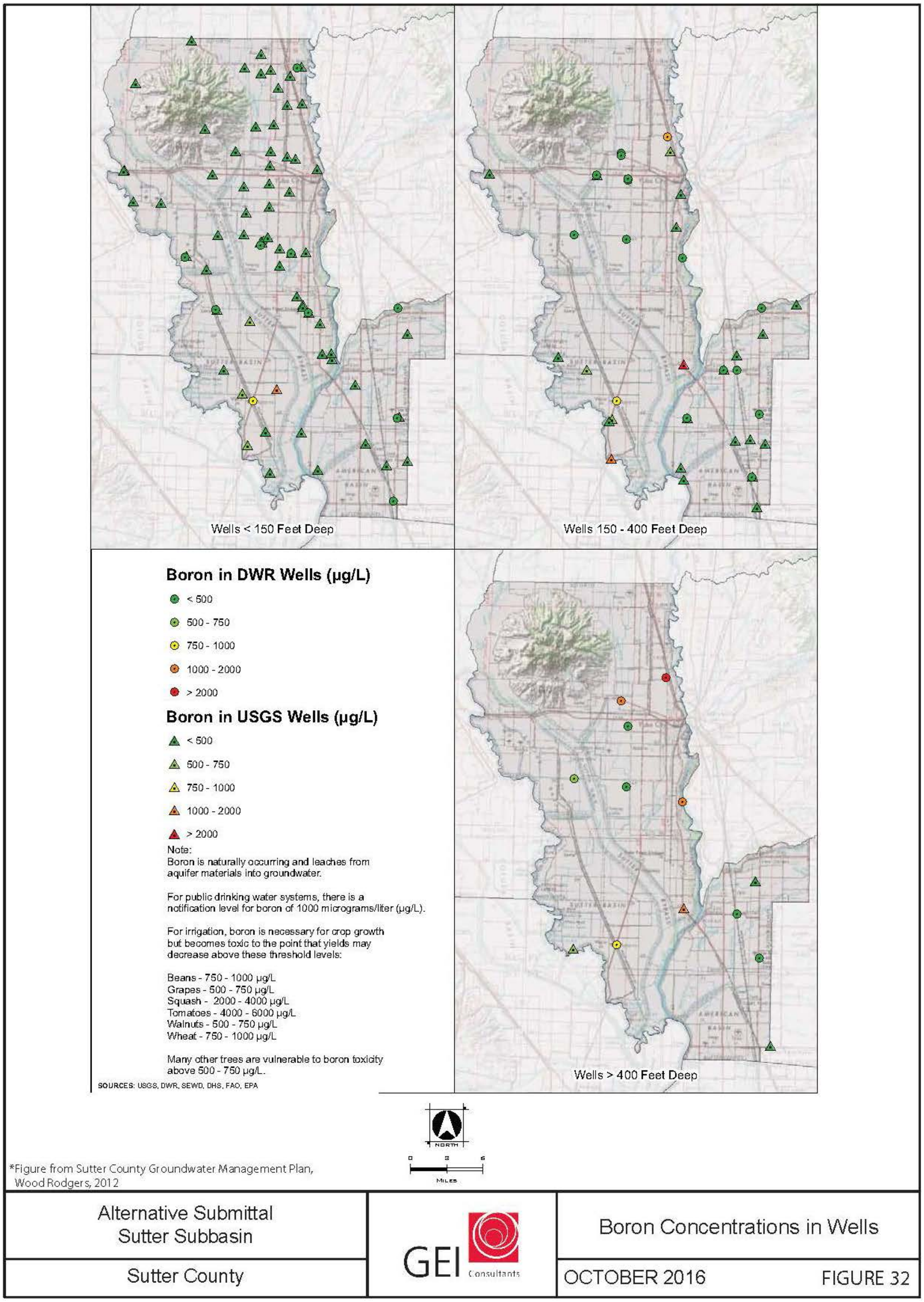


Figure 32. Boron Concentrations in Wells

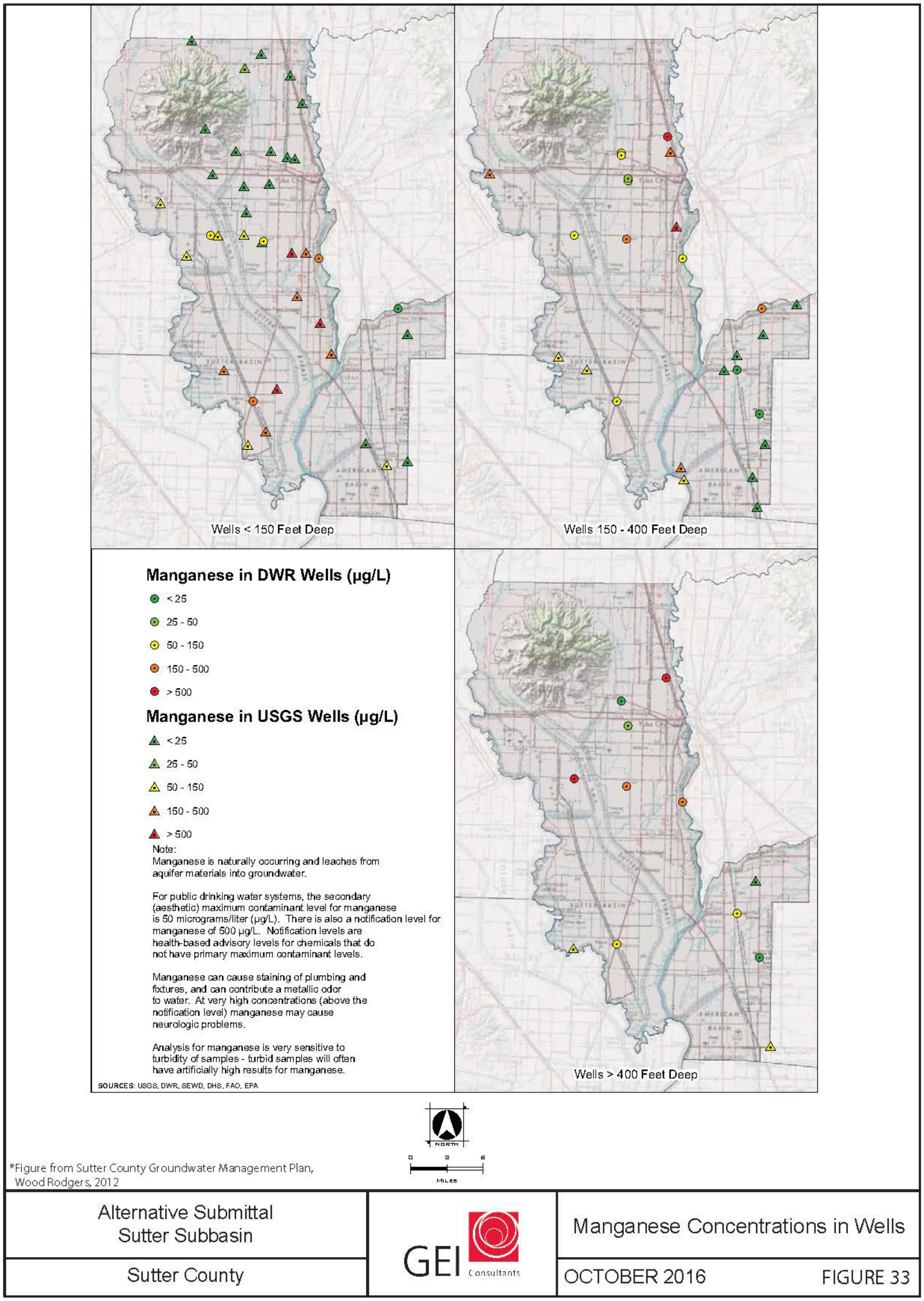


Figure 33. Manganese Concentrations in Wells

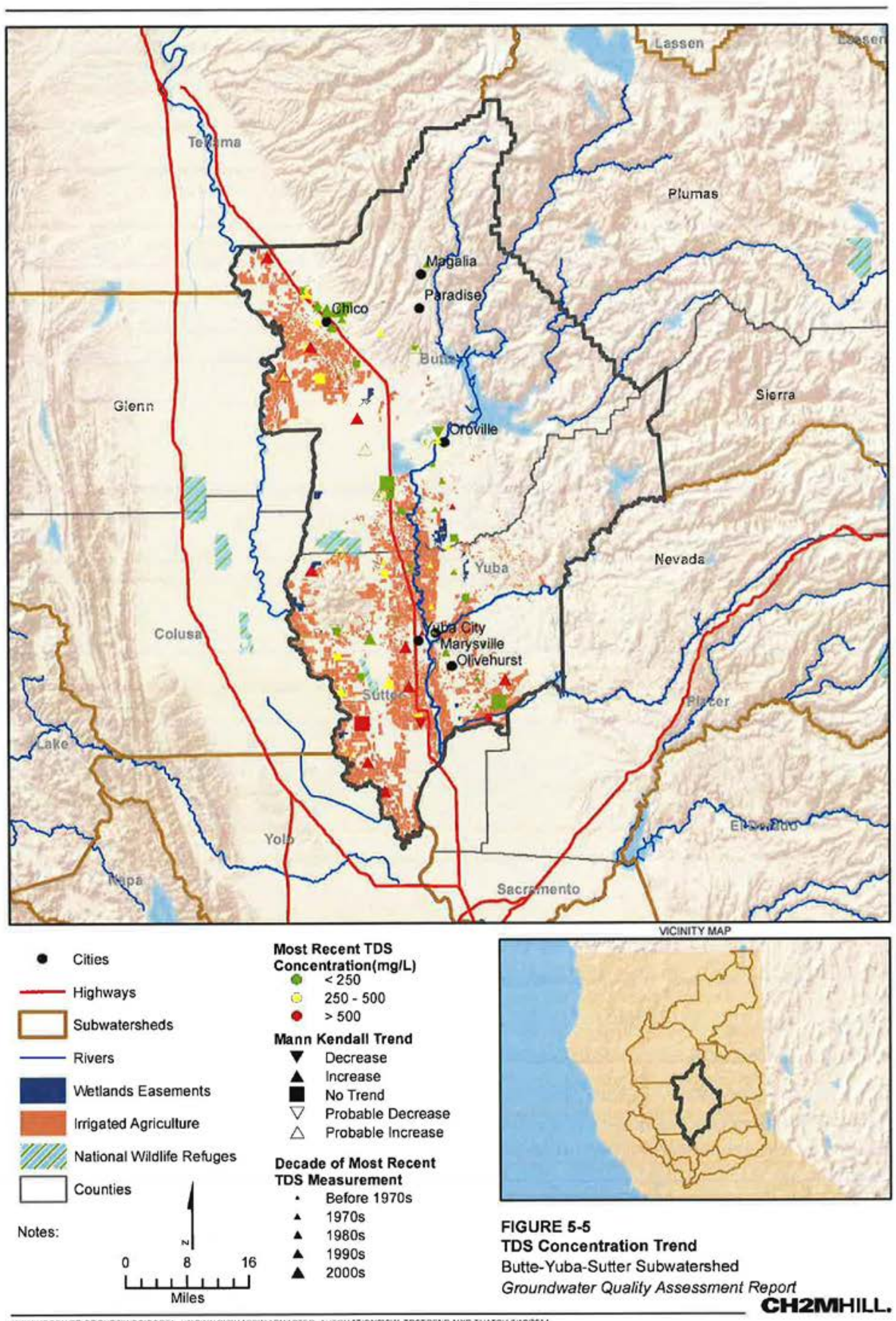


Figure 34. TDS Concentration Trend

Subbasin. Concentrations trends in total dissolved solids (similar to specific conductance) and nitrate are shown for various well locations on **Figures 34** and **35** (CH2MHILL, 2015). **Appendix H** contains groundwater quality trends in some wells in the area which were developed from the Geotracker water quality database.

4.8.1 Specific Conductance

Specific conductance or electrical conductivity is a measure of how effectively water will conduct electricity. When soluble salts dissolve in water, the resulting ions behave as conductors. Therefore, specific conductance provides an indirect measurement of the amount of dissolved solids (salts). This parameter is reported in micro Siemens per centimeter (μS/cm) with lower specific conductance generally indicating better water quality (fresh water) while higher specific conductance generally indicating poorer water quality (brackish to saline water). Chloride is often used to identify saline water and can be representative of where high specific conductance water is present. **Figure 28** shows the extent of high chloride water.

Salinity in groundwater is often caused by the dissolution of soluble mineral, the presence of seawater deposited with marine sediments in particular geologic formations and/or the presence of mineral springs. In the Sacramento Valley, these processes are responsible for elevated salinity levels in the vicinity of the Sutter Buttes, where there are documented saline water intrusions from marine sediments (USGS, 1984).

Specific conductance is monitored as a secondary water standard with the following recommended ranges:

- Recommended threshold: 900 μS/cm (TDS - 500 mg/L)
- Upper limit threshold: 1,600 μS/cm (TDS - 1,000 mg/L)
- Short-term threshold: 2,200 μS/cm (TDS - 1,500 mg//L)

The recommended concentration for drinking water is less than 900 μS/cm while the California Rice Coalition GAR used the upper limit threshold of 1,600 μS/cm as the basis for their analysis.

Specific conductance values in the shallow aquifers in the northern half of the Sutter Subbasin and the County are mostly below the MCL. Elevated values of specific conductance are near to and/or exceed the recommended MCL in the shallow aquifer between the Feather and Sacramento rivers and in the intermediate aquifer at one location and at two locations in the deep aquifer, as shown on **Figure 29**. It is unclear why elevated specific conductance occur in the shallow aquifers, which suggests an agricultural source, but because nitrate concentrations do not correlate with areas of elevated specific conductance the salinity does not appear to be related to agriculture. It is possible the salinity is related to the residual effects of gas oil exploration wells, some of which are located upgraditent of the area of high salinity. Their locations are shown on **Figure 20**. Additional studies are needed.

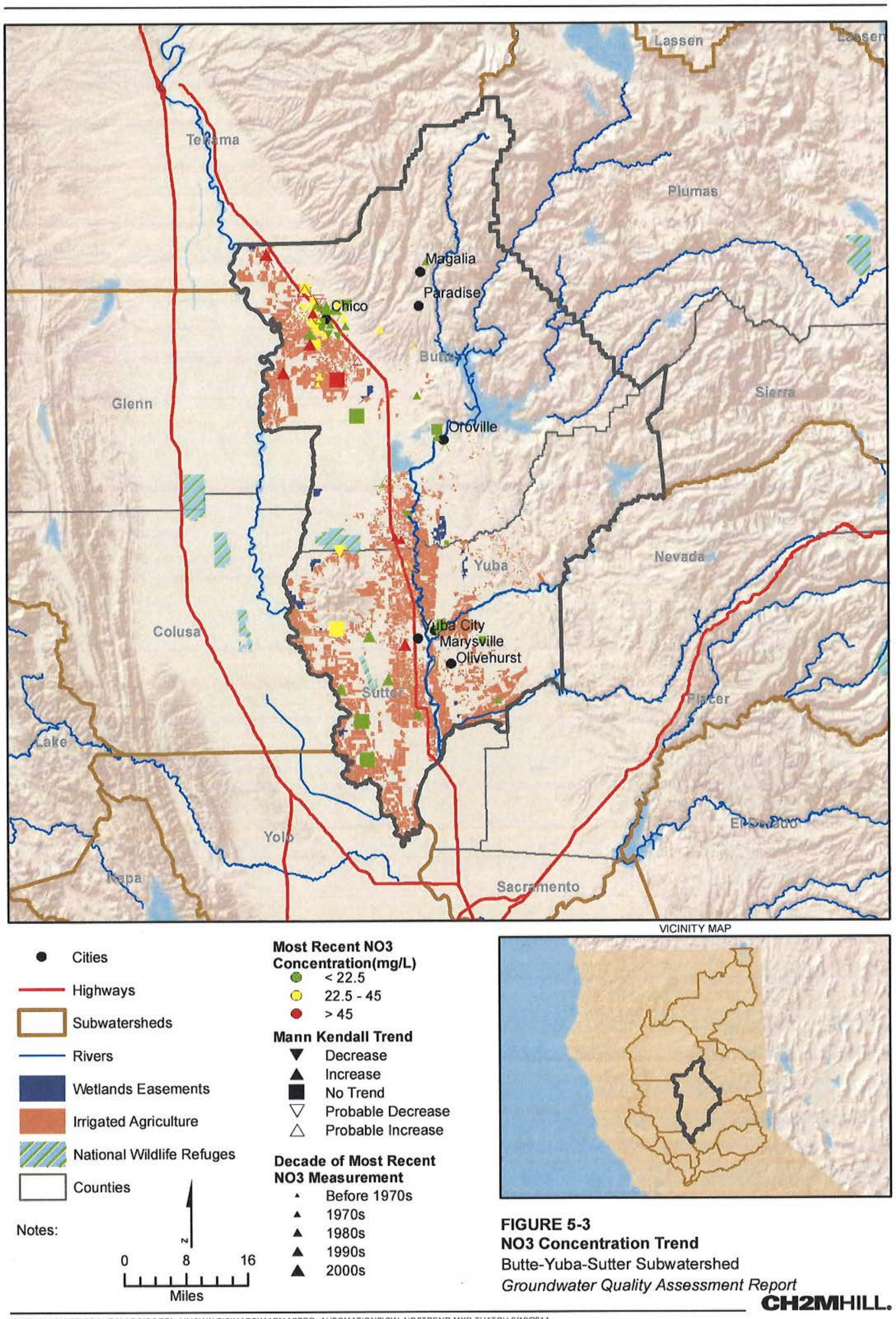


Figure 35. NO3 Concentration Trend

In groundwater below 900 feet, the poor quality water is likely due to the underlying marine sediments being in direct contact with the deeper aquifers and potentially due to faults that have created pathways that allow water from the older marine sediment to migrate upward. Monitoring wells are not available to prove the hydraulic gradients between the underlying marine and fresh water aquifers.

Data on specific conductance from three sources, the USGS Rice Well program, Shallow Domestic Wells and the GAMA program are presented below:

USGS Rice Wells

- Specific conductance values in 21 of the 28 USGS rice wells were below the upper limit secondary maximum contaminant level (SMCL) of 1,600 µmhos/cm.

- A maximum observed specific conductance of 13,800 µmhos/cm was observed in Well 2, located in the Sutter Subbasin south of the Sutter Buttes. The TDS concentration from this well was 7,510 mg/L (brackish water) which exceeds all SMCL for drinking water. High TDS levels have also been recorded at deeper wells in the vicinity of Rice Well 2 (USGS 2001a). The source of high TDS levels in Wells 2 is not known, but is unlikely to be the result of rice irrigation.

- Nine samples from Well 3, also in the Sutter Subbasin, show a slight increase in specific conductance over time. However, all readings remained below the SMCL.

Shallow Domestic Wells

- Of the 31 shallow domestic wells surveyed as part of the California Rice Coalition GAR, 29 wells had specific conductance levels below the upper limit SMCL of 1,600 µmhos/cm

- The more recent of two readings from Well 19 in the Sutter Subbasin was above the SMCL.

USGS GAMA Wells

- In 80 of the 84 wells monitored by the GAMA program in the area covered by the California Rice Coalition GAR, observed specific conductance levels were below the upper limit SMCL.

Figure 34 shows the locations of wells with trends for total dissolved solids which is similar to specific conductance.

4.8.2 Nitrate

Nitrogen is present in water bodies in the following forms that are measured to characterize water quality: nitrate (NO_3), ammonia (NH_3), and organic (TKN minus NH_3). The sum of the concentration of these compounds is referred to total nitrogen. The primary drinking water maximum contaminant level (MCL) for nitrate (as nitrate) is 45 mg/L.

Nitrogen is of particular concern when assessing water quality impacts from agriculture as it, along with phosphorus, is frequently applied as fertilizer. As set forth in the National Primary Drinking Water Standards (NPDWS), the federal MCL for nitrogen compounds are as follows:

- Nitrate + nitrite as N: 10 mg/L (the applicable MCL for this analysis)
- Nitrate as NO_3: 45 mg/L
- Nitrite as N: 1 mg/L

Nitrate concentrations at or exceeding 3 mg/L are generally thought to be caused by anthropogenic sources. Nitrate can occurs naturally in groundwater from leaching of soils or bedrock. Nitrate does not generally react with soil particles or sediment and tends to move with groundwater due to its high solubility in water and its generally stable condition. Ammonia is less mobile and is subject to sorption and conversion to nitrate under oxidized conditions (USGS 1996). Anthropogenic groundwater nitrate sources include synthetic fertilizer, animal manure (including poultry facilities), wastewater treatment plant effluent and biosolids, and septic systems (Esser et al. 2002).

Figure 27 shows the distribution of nitrate. **Figures 21 and 22** show the regional distribution of salinity in the geologic sections. **Figure 30** displays the nitrate concentrations by principal aquifer in the Subbasin and County. Near the Sutter Buttes and Yuba City, nitrate concentrations in several wells in the shallow aquifer or (less than 150 feet) exceed the MCL. Some of these populated areas have septic systems that might be the source of the nitrate. Concentrations in the shallow aquifer in the southern portion of the Subbasin are below the MCL. Concentrations in the intermediate and deep aquifers are also below the MCL.

Multiple samples have been taken from the USGS Rice Wells, Shallow Domestic Wells, and GAMA Well networks and are presented in the Rice Coalition Groundwater Assessment Report. These data allow for trending of nitrogen concentrations in the Sutter Subbasin for the shallow aquifer.

USGS Rice Wells

- For the entire period of record, total nitrogen (NO_2+NO_3-N) level did not exceed the 10 mg/L MCL.
- One USGS Rice Well in the Sutter Basin (Well No. 3) had a single nitrate reading above 5 mg/L but below the MCL. Nine readings from this well ranged from 2.17 to 2.82 mg/L through January 2004. From 2006 to 2008, concentrations increased from 3.77 mg/l to 5.79 mg/L, reaching a peak concentration slightly above the half MCL value of 5 mg/L. The 2011 concentration was 0.65 mg/L, which is a significant decrease from the 2008 level (California Rice Coalition GAR 2013, Table 3, Appendix E, Page 9).
- Eight-four percent of the USGS Rice Wells' samples had nitrate concentrations below 3 mg/L, which is the level generally considered to be indicative of potential impacts by human activities. Therefore, nitrate levels in these wells are likely to be naturally occurring (USGS 2001a).

Shallow Domestic Wells

- Of the 31 shallow domestic wells surveyed as part of the California Rice Coalition GAR, 29 had nitrate results below the MCL. Wells 23 and 25, located in the Sutter Subbasin in northeastern Sutter County, show an increase in nitrate concentrations of approximately 6 mg/L in 2008 relative to the 1996 sampling event. These wells are downgradient of Yuba City and directly upgradient of Sutter County rice fields.

- Well 27 located in northern Sutter County had a nitrate concentration of 8.1 mg/L above half the MCL. This well is located adjacent to a rice field, but is also adjacent to field crops and deciduous fruit and nut trees.

USGS GAMA Wells

- One GAMA well in the Subbasin had a nitrate concentration measured between half the MCL and the MCL.

Locations of nitrate trends are displayed on **Figure 35**. Thirteen municipal water supply wells have increasing nitrate trends (with data between 2010 and 2015).

4.8.3 Arsenic

Arsenic is a naturally occurring element commonly found in alluvial sediments derived from volcanic sources such as the Sutter Buttes Rampart, Mehrten and Tuscan formations that make up the intermediate and deep aquifers. Its presence in groundwater is a result of the dissolution of the element in sediments containing arsenic minerals. Because of the origin of the sediments, arsenic at elevated concentrations is detected throughout the Subbasin and much of the northern Central Valley. Arsenic is not a component of materials applied to farmland. The primary MCL for arsenic is 10 µg/L.

Figure 24 displays the arsenic distribution in the Subbasin and County. **Figure 31** shows the distribution by principal aquifer. Arsenic concentrations vary in the shallow aquifer. Most (50 percent) of the locations show arsenic between half the MCL and the MCL and several locations (29 percent) exceed the MCL. Typically, arsenic concentration increase with depth, in the intermediate and deep aquifers, with concentrations exceeding the MCL. Several locations show concentrations are below the MCL along the eastern side of the County. **Figures 21** and **22** show the regional correlation of arsenic concentrations typically increase with depth.

Arsenic concentrations for the USGS Rice Wells, Shallow Domestic Wells, and GAMA Wells networks, as presented in the Rice Coalition Groundwater Assessment Report, provided the following data for the Sutter Subbasin:

USGS Rice Wells

- Arsenic concentrations above the drinking water MCL of 10 µg/L were recorded in 3 of the 28 Rice Wells.

- The maximum arsenic detection of 15 µg/L was recorded in Well 2 in 1997. A subsequent measurement at Well 2 in August 2006 showed a concentration of 4.9 µg/L.

- Rice Well 6, located in the Sutter Subbasin, showed an arsenic concentration exceeding the MCL in November 1997 and in August 2006.
- Rice Well 3, also located in the Sutter Subbasin, was sampled nine times with readings fluctuating around 8 µg/L but showing a declining trend.

Shallow Domestic Wells

- In 22 of the 31 Shallow Domestic Wells covered in the California Rice Coalition GAR, the maximum arsenic concentration was less than 10 µg/L.
- The following wells in the Sutter Subbasin had maximum arsenic concentrations above 10 µg/L: Well Nos. 11, 16, 21, and 26.
- Concentrations observed in the Shallow Domestic Wells generally exceeded those observed in the Rice Wells.

USGS GAMA Wells

- Arsenic concentration were was less than 10 µg/L in 35 of 43 grid wells and in 13 of 15 flow path wells.

4.8.4 Boron

Boron is a naturally occurring element and similar to arsenic is commonly found in alluvial sediments derived from volcanic sources such as the Sutter Buttes Rampart, Mehrten and Tuscan formations that make up the intermediate and deep aquifers. An MCL has not been established for drinking water, but a Notification Level of 1 mg/L has been established.

Figure 32 displays the boron concentration distribution by principal aquifer in the Subbasin and County. Boron concentrations in the County are generally acceptable. Some deeper wells, which likely encounter more marine sediments, do contain elevated boron concentrations. Boron concentrations were not monitored as part of the Rice Coalition Groundwater Assessment Report.

4.8.5 Manganese

Manganese is a naturally occurring element in rocks and minerals and the dissolution of these materials can mobilize manganese into groundwater. These minerals are commonly associated with volcanic derived sediments that form the Sutter Buttes Rampart, Mehrten and Tuscan formations. The secondary MCL for manganese is 50 µg/L.

Figure 26 displays the manganese distribution in the Subbasin and County. **Figure 33** shows the concentration by principal aquifer. Manganese concentrations in the shallow aquifer are typically below the MCL in the northern portion of the County, but in the southern half typically exceed the MCL. Manganese concentrations in the deeper aquifers typically exceed the MCL, but there are some occurrences where their concentrations are below the MCL. Manganese is sensitive to the redox state of the groundwater and is oxidized from soluble Mn^{2+} to insoluble Mn^{+}. High concentrations of manganese are indicative of reducing conditions.

USGS Rice Wells

- Maximum manganese exceeded the SMCL in 21 of 28 wells. Some wells consistently show negligible concentration, but concentrations in other wells can fluctuate by an order of magnitude. These highly variable results are consistent with the known behavior of manganese.

- Rice Well 2 has the highest manganese concentrations of any well in the program with a concentration of 3,010 µg/L recorded in 1997 and 3,420 µg/L recorded in 2006.

Shallow Domestic Wells

- In 23 of the 31 Shallow Domestic Wells covered in the California Rice Coalition GAR, the maximum manganese concentration was less than 50 µg/L.

- Well 16 in the Sutter Subbasin had a manganese concentration of 1,090 µg/L in 1996 and 1 µg/L in 2008.

- Concentrations in the Shallow Domestic Wells generally exceeded those observed in the Rice Wells.

USGS GAMA Wells

- Arsenic was less than 10 µg/L in 35 of 43 grid wells and in 13 of 15 flow path wells.

4.8.6 Iron

Iron is also a naturally occurring element in minerals contained in igneous rocks and the dissolution of these rocks can mobilize iron into groundwater. These minerals are commonly associated with volcanic derived sediments that form the Sutter Buttes Rampart, Mehrten and Tuscan Formations. The secondary MCL for iron is 300 µg/L.

Figure 25 shows the iron distribution in the Subbasin and County. Iron concentrations were not monitored as part of the Rice Coalition Groundwater Assessment Report.

Pesticides – Pesticides are man-made compounds, which protect crops from insects and come in various forms and with various constituents. Figure 28 shows some of the locations of detected pesticides in the Subbasin. Many of the compounds are regulated and have primary drinking water standards. Over 500 analyses for pesticides were performed on water quality samples collected from the 28 Rice monitoring wells between 1997 and 2010 (CH2MHill, 2013).

The following summarizes the results of pesticides sampling in groundwater:

- Pesticides of interest were not detected at levels within the order of magnitude of drinking water standards. Further, trace detections were not confirmed in follow-up sampling by DPR.

- Thiobencarb was detected three times out of 83 samples. Thiobencarb was detected in 1997 USGS Rice Well sampling. The highest detection was 0.0254 µg/L (Well 10), and the most recent detection was 0.006 µg/L (Well 12). These detections were reported in DPR's 2003

Cumulative Report (DPR, 2003). The detections are considered unconfirmed because the detection limit was less than 80 percent of DPR's approved detection limit. These analyses did not exceed drinking water standards.

- Propanil was detected in USGS GAMA Well ESAC-09, according to the USGS report on its GAMA Program sampling (USGS 2008); however, this result was not included in the results reported to DPR.

- 2,4-D was detected in five wells. These samples were taken in 1985, 1989, and 2006. Subsequent sampling in all five wells showed non-detections of 2,4-D. The most recent 2,4-D sampling included in the DPR Well Inventory Database was conducted in 2008. Use of 2,4-D on rice has been almost eliminated.

- Malathion was detected in one well in 1984. A subsequent sample, taken 2 months later, resulted in non-detection of malathion. The most recent malathion sampling included in the DPR Well Inventory Database was conducted in 2002. Use of malathion on rice has been almost eliminated and is restricted to crack and crevice control in storage silos.

- Paraquat dichloride was detected in five wells. These samples were taken in 1990, 1993, and 1997. Subsequent sampling in all five wells showed non-detections of paraquat. DPR reports that follow-up sampling was performed, and the pesticide was not detected (DPR 1994). Paraquat is a very minor use material on rice.

- DBCP has been sampled in multiple water supply wells since 1987 through 2015, including a few wells repeat samples. The primary MCL is 0.20 ug/L. Detectable concentrations have ranged from 0.012 to 0.065 ug/L. In only one well (511001-002) have concentrations appear to have risen but only by 0.021 ug/L over a 16-year period.

- Bentazone has been sampled in multiple water supply wells since 1987 through 2015, including a few wells repeat samples. The primary MCL is 18 ug/L.

4.9 Groundwater Recharge Areas

Groundwater recharge to the Subbasin occurs from various areas within and outside of the subbasin. The location of groundwater recharge areas were based on groundwater flow contours and geologic profiles. Groundwater contours and flow directions are discussed in detail in **Section 5.0**. For those areas outside of the subbasin, the recharge areas are discussed in the narrative but not shown on the maps. As GSPs are developed for the adjacent subbasins, recharge areas will become better refined.

4.9.1 Recharge Areas Outside of the Subbasin

Groundwater contours show recharge to the subbasin occurs from the north and east of the Subbasin. The recharge areas present in the Yuba North and South and East Butte subbasins would contribute groundwater to the principle aquifers of the Sutter Subbasin.

Significant areas likely to contribute groundwater to the shallow aquifer include creeks, river, and applied water where the water can move vertically through the sediments.

Recharge areas to the deeper aquifers is in part from movement of water vertically from the shallow aquifer and from areas where the principal aquifers "daylight" either at ground surface or beneath the saturated coarse- grained shallow aquifer where recharge water can migrate horizontally along the sedimentary beds. Generally, the rate of movement is ten times higher when water moves horizontally along beds than vertically.

The amount of subsurface inflow to the Subbasin from these recharge areas outside of the Subbasin averages about 30,000 AFY, based on the C2VSim model, and represents about 7 percent of inflow to the Subbasin, based on the water budget.

4.9.2 Recharge Areas Inside of the Subbasin

The entire area of the Subbasin provides recharge to the groundwater system to some extent and at variable rates depending upon soil types and availability of water. Some of the major sources of groundwater recharge in the area are discussed below:

Agricultural Lands - Much of the water applied for irrigation in the Subbasin is surface water diverted from the Feather and Sacramento Rivers with applied water being supplemented by precipitation. The average annual recharge of applied water in the area covered by the Feather River Regional Agricultural Water Management Plan is 1.25 AF/ac while comparable recharge of precipitation is 0.35 AF/ac (Davids Engineering 2014).

The most prominent agricultural land use in the Subbasin is rice production, followed by fruit and nut orchards and a variety of other crops. Rice production is characterized by flooding of relatively impermeable soils, while irrigation of other crops is performed either by traditional surface irrigation techniques or by newer low-volume methods including drip and micro-jet systems.

In recent years, growers have been changing orchards from fruits to nuts (almonds). Fruit and nut orchards have an average crop evapotranspiration (ETc) of about 36.3 inches per year which converts to 3.0 AF/acre. Therefore, shifts between fruit and nut crops have little impact on water use; however, changes in irrigation practices have been accompanying these chances shifts in cropping. For example, new orchards being irrigated almost exclusively with drip and micro-jet systems. This shift away from surface irrigation practices applies less water to fields so while crop consumption may actually increase due to better timing of applications, deep percolation will diminish. In addition, the low-volume systems are often supplied by wells, which can be turned on and off, rather than from canal deliveries. Both the reduction in deep percolation from newly established orchards and the increased reliance on groundwater to irrigate these lands have implications on the water budget – less recharge.

Sutter Buttes Area – The Sutter Buttes Rampart Formation is exposed in an apron surrounding Sutter Buttes that can allow precipitation and agricultural applied water to migrate horizontally along the principal aquifer beds. The amount of recharge, based on surface exposure of the Sutter Buttes Rampart Formation, and an average precipitation of 18 inches per year (about 10 percent recharged) is about 220 AFY, or less than 1 percent of the total inflow to the basin based on the water budget.

Rivers and Bypasses - Detailed geotechnical investigations along the rivers and bypasses as discussed in the **Section 3**, showed multiple sand and gravel layers are present adjacent to the rivers and bypass, which could allow surface water to recharge the shallow aquifer at a relatively high rate. Water can still recharge through silt and clayey layers but at a much slower rate. The amount of water recharge, based on the C2VSim model, averages about 321,000 AFY and represents about 70 percent of inflow to the Subbasin based on the water budget.

Historically, a few pre-2013 areas, on the order of 10 percent or less, have had low permeability slurry walls installed to stabilize the levees, which could have reduced some of these areas of recharge. Starting in 2013 and continuing through 2016, slurry walls have been installed just north of the confluence of the Feather and Bear rivers as shown on the profiles contained in **Appendices C** through **E.** This ongoing work has extended the slurry wall coverage to about 50 percent of the river. The depths of the slurry walls have/will ranged between 21 and 105 feet and will greatly reduce the areas where high permeability sediments were in contact with the surface water but will not entirely stop the recharge or portions of the subsurface inflow from the Yuba Subbasins to the east. Estimates on the of reduction of groundwater recharge were not described in the California Environmental Quality Act documentation for the slurry wall installations (ICF International, 2013).

General Estimate - A comprehensive estimate of recharge through deep percolation of applied water and precipitation within the Subbasin can be derived, based upon the water budget for the Feather River Regional Agricultural Water Management Plan (FRRAWMP [Davids Engineering 2014]). The 740-square mile area covered by this plan includes Yuba City, Live Oak, the Sutter Buttes, the Sutter National Wildlife Refuge, Gray Lodge Wildlife Area, Sutter Extension Water District, Feather Water District, Garden Highway Mutual Water Company, Tudor Mutual Water Company, and the Sutter Bypass-Butte Slough Water Users Association. Although this study area is approximately twice the area of the Subbasin, the similarities in land uses and water management practices within the Subbasin and the area covered by this plan suggest that values presented in the FRRAWMP can be scaled to produce a reasonable estimate of recharge from applied water and precipitation within the Subbasin.

The FFRAWMP estimates average annual deep percolation of applied water at 590,292 AF (1.25 AF/ac) and average annual deep percolation of precipitation at 164,877 AF (0.35 AF/ac). When scaled from the 740-square mile area of the FFRAMMP to the 366-square mile area of the Subbasin, these values result in an estimated average annual volume of deep percolation of applied water of 292,000 AFY and an average annual volume of deep percolation of precipitation of 81,500 AFY. Combining these FRAWMP values produces a total average recharge from percolation of 373,500 AFY, which contrasts with the volume of 94,000 AFY from C2VSim modeling. The C2VSim model includes 64,000 AFY from percolation recharge and 30,000 AFY from canal losses.

Over the period between 1999 and 2012, deep percolation of applied water was relatively stable, ranging from a high of 622,010 AFY in 2004 to a low of 543,525 AFY in 1990 with a difference between the high and low value of 78,485 AFY or 13 percent of the average value (FRRAWMP [Davids Engineering, 2014]). Deep percolation of precipitation fluctuates more widely, as would be expected, given the variability in precipitation. This value ranges from a high of 257,717 AFY in 2011 to a low of 75,386 AFY in 2007. The difference between the high and low precipitation years is 182,331 AFY, or 111 percent of the average value. The combined deep percolation numbers range from a high of 849,920 AFY in 2011 to a low of 664,614 AFY in 2007 representing a range of 185,305 AFY that is 25 percent of the average value. The range in total deep percolation is only slightly higher than the range in deep percolation of precipitation, reflecting how irrigation deliveries were reduced in response to the high precipitation received in 2011.

4.10 Groundwater Discharge Areas

Groundwater discharge occurs along some of the creeks, sloughs and rivers. Some of the more significant areas of discharge are discussed below:

Rivers and Bypasses – The Sacramento River is topographically at the bottom of the basin and therefore would act under predevelopment conditions as a drain for groundwater within the shallow aquifers. Groundwater also may discharge to the Feather River along the southern portion where slurry walls and levee improvements are not planned.

Detailed geotechnical investigations along the Sacramento River and bypasses (Sutter and Tisdale), as discussed in the **Section 3**, showed multiple sand and gravel layers are present adjacent to the rivers and bypass. These permeable layers could allow groundwater to discharge to surface water from the shallow aquifer at a relatively high rate. Water can still discharge through silt and clayey layers, but at a much slower rate. **Figures 36** and **37** shows the amount of surface water discharged and recharged from the subbasin to the rivers, based on the C2VSim model for years 1998 (a high groundwater level year) and 2009 (a low groundwater year). The average discharge from the basins is about 248,000 AFY and represents about 55 percent of outflow from the Subbasin based on the water budget.

4.11 Surface Water Bodies

There are no reservoirs within the subbasins. The Feather and Sacramento rivers due to their lengths do, on a dynamic basis, contain surface water in excess of 100 AF. **Figure 1** shows these surface water bodies.

4.12 Imported Water Supplies

Surface water from Butte Creek and the Feather River are diverted upstream and conveyed by unlined canals into the Sutter Subbasin and the county portion of the East Butte Subbasin. Water use during the 2009 growing season was calculated to be 1,122,018 AF for irrigated agriculture, based on the Sutter County 2009 Crop Report.

4.13 Groundwater Storage

DWR's 1994 California Water Plan estimated a useable storage potential of 5 million AF for the entire Sutter County, but did not define the depth of this resource. In 1978, DWR estimated the storage capacity for the Sacramento Valley but did not provide estimates for each subbasin. The report indicates the storage estimate was made for the upper 600 feet of sediments (DWR, 1978). A weighted specific yield for these estimates was not provided. There are no published reports, which specifically discuss the amount of groundwater in storage for the Subbasin (DWR, 2006).

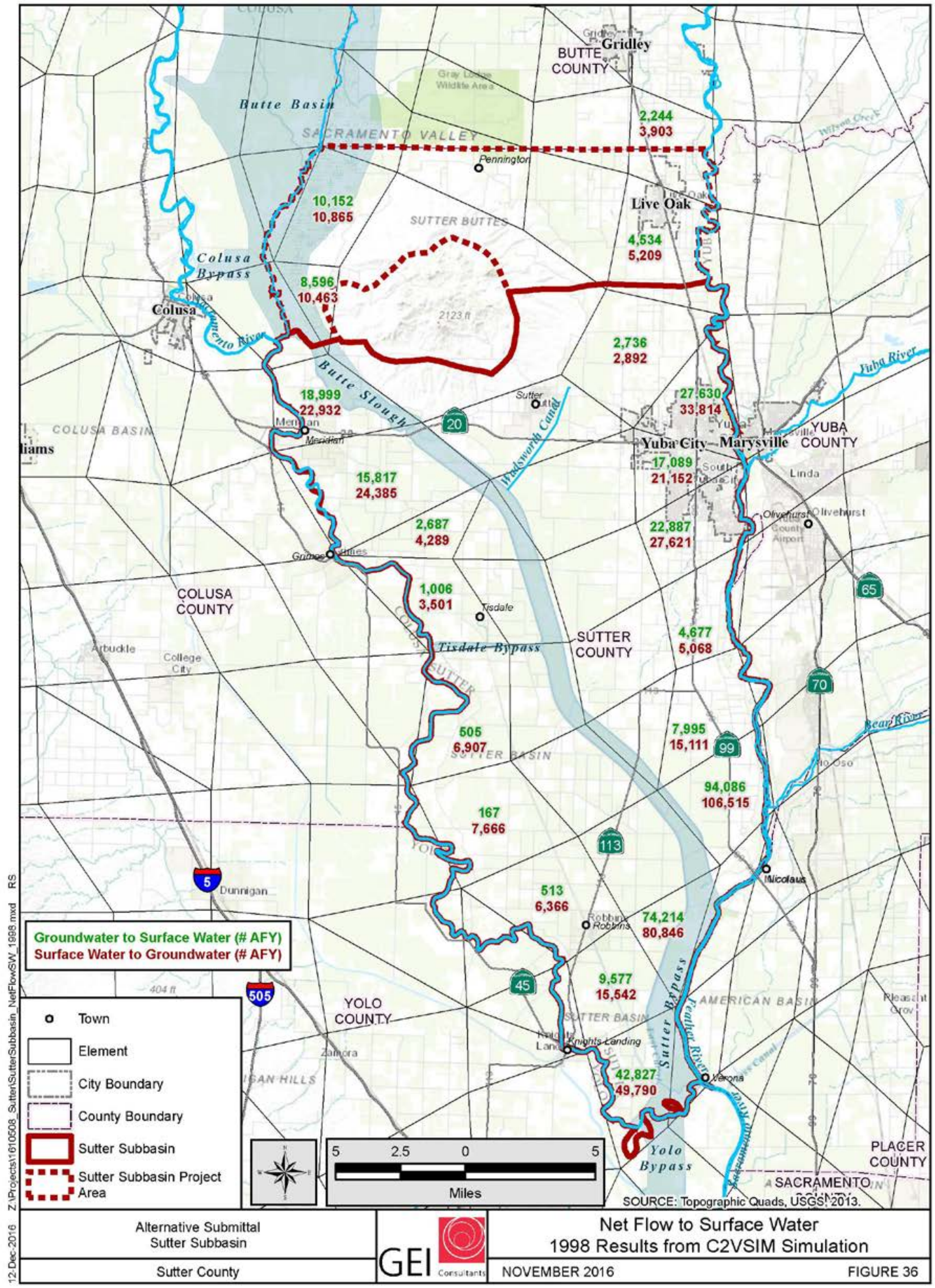


Figure 36. Net Flow to Surface Water 1998 Results from C2VSIM Simulation

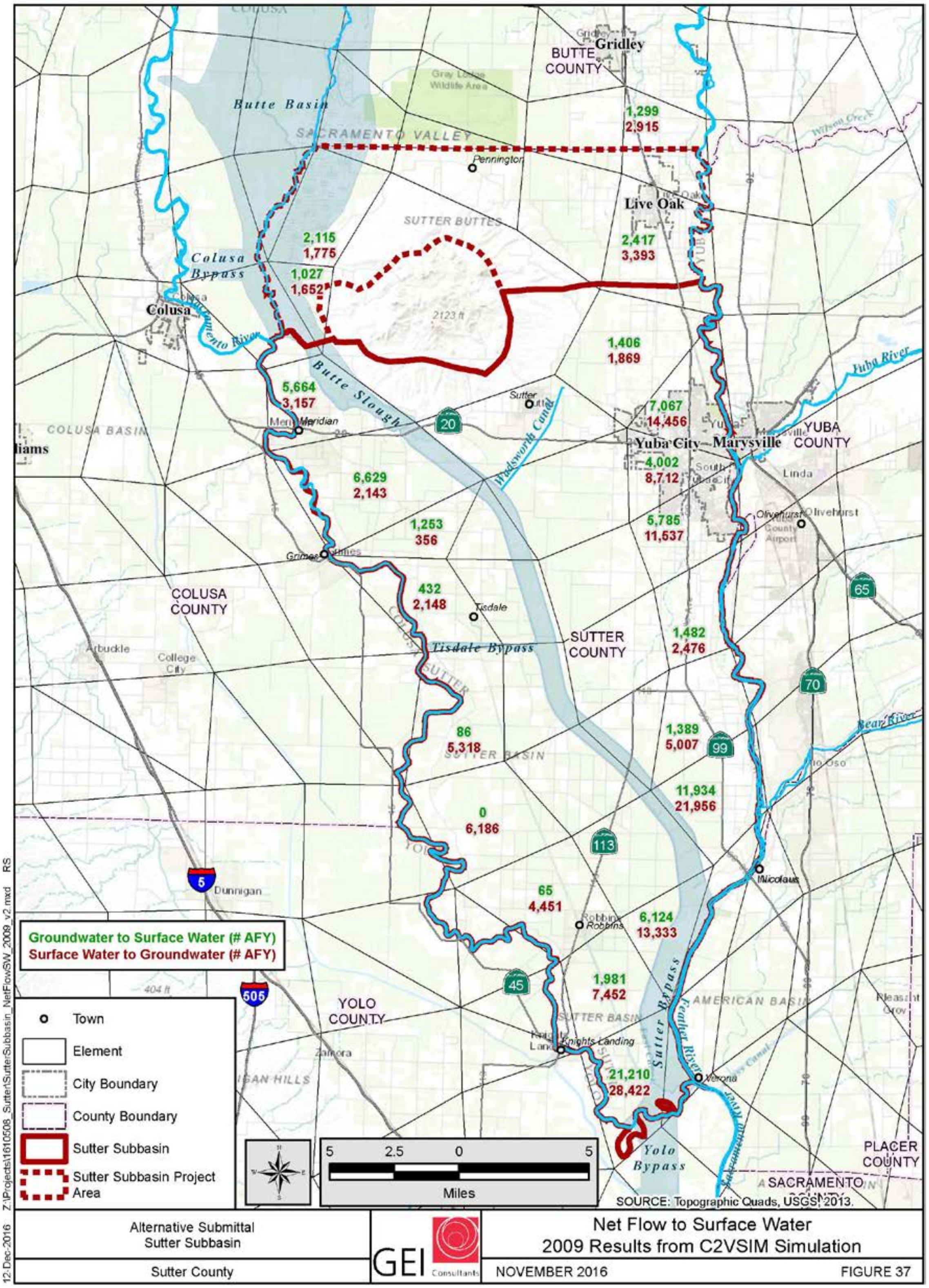


Figure 37. Net Flow to Surface Water 2009 Results from C2VSIM Simulation

The useable storage was proportioned from the entire Sutter County (385,300 acres) to the Subbasin (235,400 acres) and County portion of the East Butte Subbasin (96,500 acres) based on total surface area. The useable storage for the Subbasin is 3.1 million AF and about 1.3 million AF in the East Butte portion.

Assuming 600 feet of saturated sediments in the basin, the average storage per foot in the Subbasin would be about 5,000 AF/foot of area and 2,200 AF/foot of area in the Sutter County portion of the East Butte Subbasin; however, the unit storage rate (13 AF/acre) is not uniform as the types of sediments range from clays to gravels that have large differences in storage capacity and their ability to transmit water.

4.14 Data Gaps in the Hydrogeologic Conceptual Model

A few data gaps were identified during preparation of the conceptual model, but none that would affect our conclusions that the subbasins are sustainable. Data gaps identified are:

- A precise identification of the amount of water in storage in the Sutter Subbasin and in the County portion of the East Butte Subbasin.
- Quantification of the amount of annual water imports of surface water from the Sacramento, Feather, and Butte Creek. These amounts are available from water district files, but have not yet been compiled.
- Wells with unknown well construction details should be investigated to identify which principal aquifer they monitor, which would improve the monitoring network.
- Routine water quality sampling would help to further the understanding of trends of salinity and nitrate.
- Revision of the C2VSim model to incorporate new FFRAWMP estimates of average annual deep percolation of applied water.
- The source of the elevated salinity in the shallow aquifer is unknown at this time. GSP develop in the Yuba Subbasin will assist to quantify if the source is potentially on the east side of the Feather River, outside of the subbasin.
- Water quality samples have not been regionally collected to be able to develop isoconcentration contours to better quantify the extent of salinity and nitrates.

5 Groundwater Conditions

This chapter provides a description of current and historical groundwater conditions in the basin, including data through spring of 2016.

5.1 Groundwater Elevations and Interpretation

Groundwater levels are recorded at over 180 wells in the subbasins. **Figure 38** shows the well locations; however, not all of the wells have similar periods of measurements that can limit the ability to make interpretations. Groundwater levels are also recorded in a number of voluntary wells where well construction details are not available to define the aquifer being monitored. **Appendices G** and **H** provide the well construction details for these wells, sorted by the aquifer that they monitor. Groundwater levels, trends, contours, and an estimate of the volumetric amount of groundwater in storage is estimated by aquifer are discussed in the following sections.

5.1.1 Groundwater Levels

Groundwater levels (water table and peizometric heads) in the Subbasin change seasonally but have been relatively stable for more than 70 years. Groundwater levels typically range from 0 to 50 feet below ground surface. **Appendix I** provides hydrographs for wells sorted by principal aquifer that have a period of record that extends through the base period (1998 to 2009) or short-term hydrographs from currently monitored CASGEM wells. The hydrographs were created with uniform y-axis of 60 feet unless near known pumping wells. Due to the number of monitoring wells present and the long CASGEM identification numbers, each well was provided with a unique number for displaying on a well location map. A table correlating the unique numbers to CASGEM identification numbers is provided. The CASGEM monitoring was started in 2011 so many of the wells only have records through the recent drought.

5.1.2 Groundwater Level Trends

Historically groundwater levels have remained stable in the Subbasin. **Appendix J** provides long-term hydrographs in the basin for each of the aquifers, including those wells that monitor unknown aquifers, where groundwater levels extended through most or all of the base period (1998 to 2009). Shown on each hydrograph is a linear trend line (Fall 1988 through Fall 2009) and slope of the trend line for the base period. Included in the appendix is a summary table of the trends and an interpretation. Some of the trends are so slightly positive or negative that the water levels would considered to be stable. **Figure 39** shows the trends of wells with long-term hydrographs.

A total of 12 long-term hydrographs were available for the shallow aquifer, 10 hydrographs for the intermediate aquifer, 2 hydrographs for the deep aquifer, plus 12 hydrographs that could not be sorted by aquifer due to the lack of construction details.

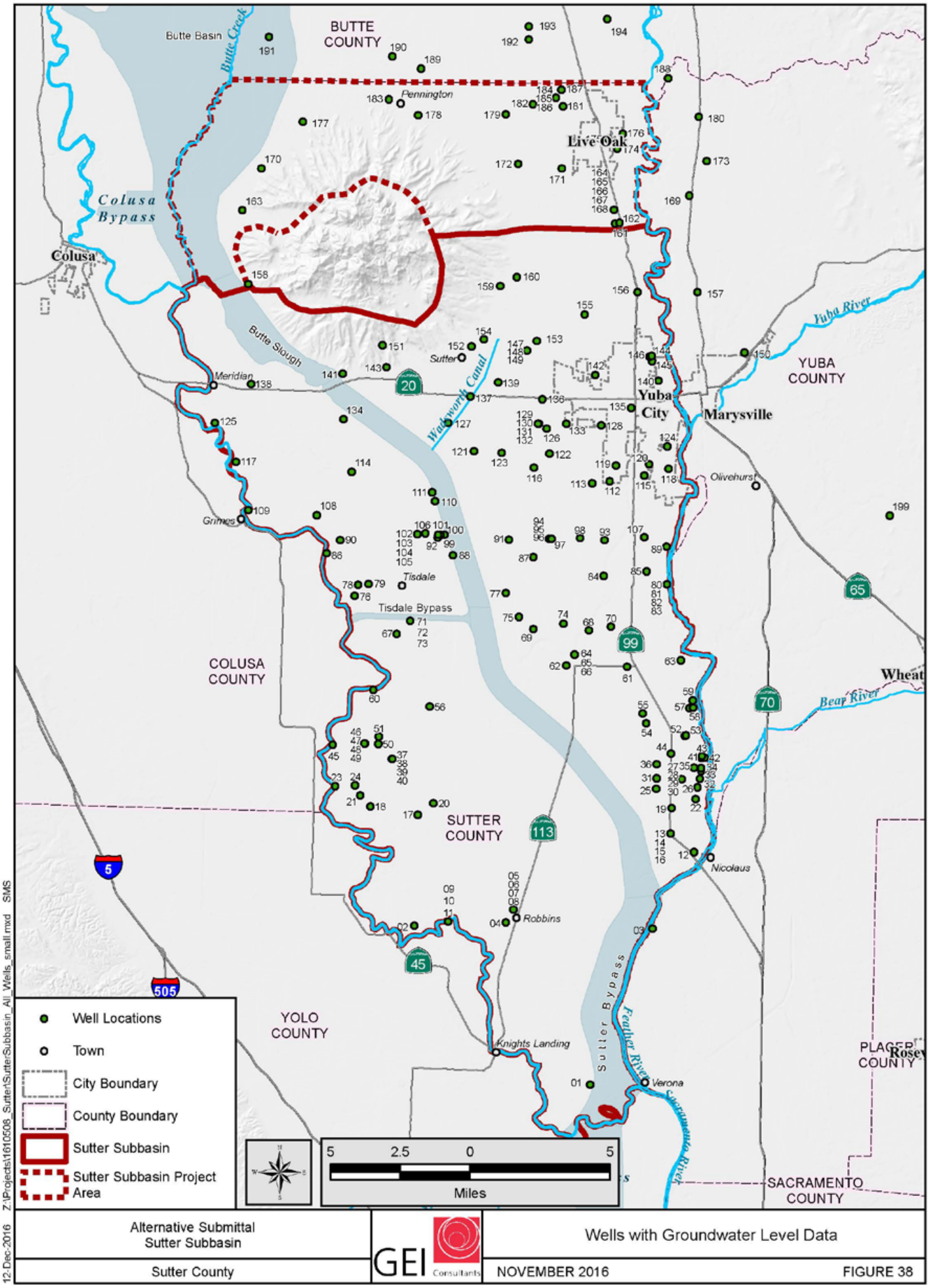


Figure 38. Wells with Groundwater Level Data

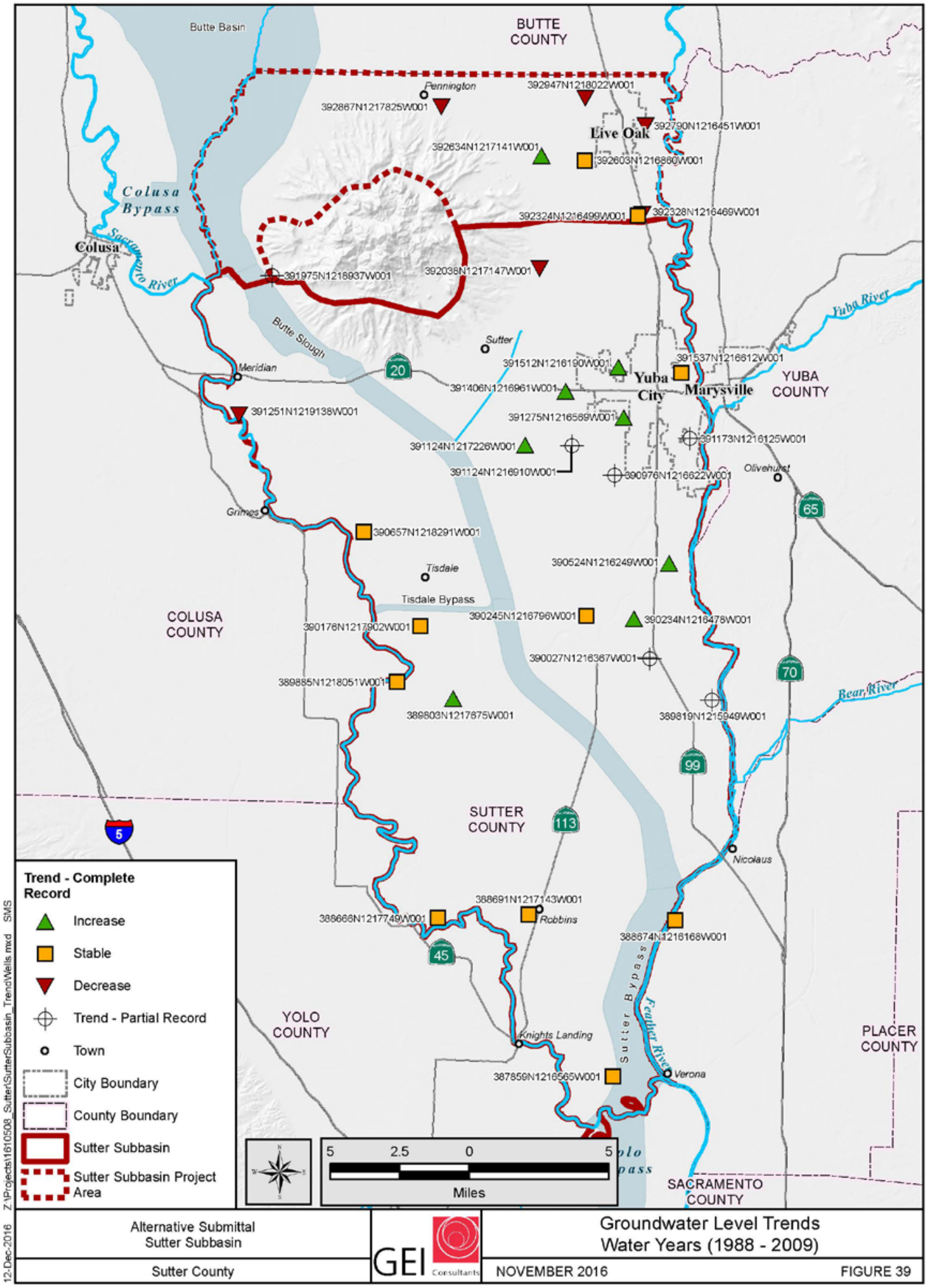


Figure 39. Groundwater Level Trends Water Years (1988 – 2009)

The differences in the groundwater levels from the start of the base period (October 1988) to the end (October 2009) are summarized on **Table 10**. It shows that the basin had both positive and negative difference in groundwater levels, but the magnitude overall are small.

Figure 40 shows the distribution of these changes when the measurements are contoured as one aquifer. It shows the change in groundwater levels for the Subbasin are mostly positive with only a few small areas where groundwater levels declined. On average the change in groundwater levels was positive by about 0.5 feet. In the Sutter County portion of the East Butte Subbasin, the average change in groundwater levels was also slightly positive.

5.1.3 Vertical Groundwater Gradients

Vertical groundwater gradients between aquifers are provided from thirteen nested or clustered wells in the Sutter Subbasin, two nested monitoring wells in the Sutter County portion of the East Butte Subbasin. Nested monitoring well data typically starts in about 2011, but in some cases is available back to 2007. **Figure 41** shows the location of the wells. **Appendix K** contains the hydrographs.

The hydrographs show two distinct patterns, one where groundwater levels in the shallow aquifer are constantly higher (downward gradient) than groundwater levels in the intermediate and deeper aquifers and second where groundwater levels in the deeper aquifer is higher than groundwater levels in the intermediate and shallow aquifers (upward gradient). **Figure 41** shows where the upward and downward gradients occur. There is no distinct pattern. The head differences are typically on the order of a few feet, but may be up to 10 to 20 feet during the summer months. The levels indicate that groundwater between 400 to 785 feet have similar levels, suggesting a single aquifer, except near Sutter County MW-4 where the levels appear to distinct and indicating separate aquifers. Near Sutter County MW-6, the shallow and intermediate aquifers may be interconnected.

The aquifers with upward gradients in the deeper aquifer exist in the southern half of the Sutter Subbasin. In these areas, the base of fresh water is relatively shallow. Pumping in the deeper aquifer could reduce heads and allow migration of brackish water into the fresh water aquifers. The hydrographs show that pumping is occurring in the deep aquifers (425 to 705 feet bgs) and/or in wells that are screened opposite all aquifers as seasonal reversals of gradients are observed and groundwater levels decline in all of the aquifers

5.1.4 Groundwater Contours

One of the earliest groundwater contour maps for the area was prepared in 1912, as shown on **Figure 42,** prior to the development of the deep well turbine pump. The contours likely represents the shallow aquifer and show groundwater entering the subbasin from the north and east. Groundwater appears to have flowed through and beneath the Feather River. The groundwater contours show groundwater discharged to the Sacramento River and to the south.

DWR developed an interactive website that allows users to easily generate contours for depth to groundwater, groundwater elevation and change in groundwater levels (GIC, 2016); however, the earliest groundwater contouring available is for 2011 so groundwater contours were

Table 10. Difference in Groundwater Level Measurements – Base Period

CASGEM ID	October 1988 WSE (in feet)	September 2009 WSE (in feet)	Difference WSE (in feet)
Sutter Subbasin			
Shallow Aquifer			
391406N1216961W001	41.11	45.31	4.2
391512N1216190W001	36.98	38.58	1.6
392038N1217147W001	53.72	52.32	-1.4
390176N1217902W001	25.67	26.17	0.5
389885N1218051W001	25.59	26.19	0.6
389803N1217675W001	17.5	21.3	3.8
391251N1219138W001	36.5	31.7	-4.8
393337N1217097W001	78.29	78.89	0.6
393457N1218375W001	55.94	54.44	-1.5
Intermediate Aquifer			
387859N1216565W001	16.23	15.93	-0.3
391124N1217226W001	40.13	40.33	0.2
388691N1217143W001	15.5	13.8	-1.7
388691N1217143W001	15.5	13.8	-1.7
Deep Aquifer			
388666N1217749W001	16.43	13.93	-2.5
Unkown Aquifer			
388674N1216168W001	16.17	21.07	4.9
390245N1216796W001	30.03	27.43	-2.6
390524N1216249W001	14.6	19.4	4.8
391275N1216569W001	27.3	29.7	2.4
391537N1216612W001	31.09	35.99	4.9
390234N1216478W001	27.52	26.32	-1.2
390657N1218291W001	32.88	31.58	-1.3
East Butte Subbasin Portion			
Shallow Aquifer			
392324N1216499W001	59.88	58.58	-1.3
392328N1216469W001	59.38	58.48	-0.9
Intermediate Aquifer			
392603N1216860W001	63.69	63.89	0.2
Deep Aquifer			
392867N1217825W001	40.15	44.95	4.8
Unkown Aquifer			
392634N1217141W001	66.91	69.11	2.2
392790N1216451W001	66.07	62.57	-3.5
392947N1218022W001	36.6	47	10.4

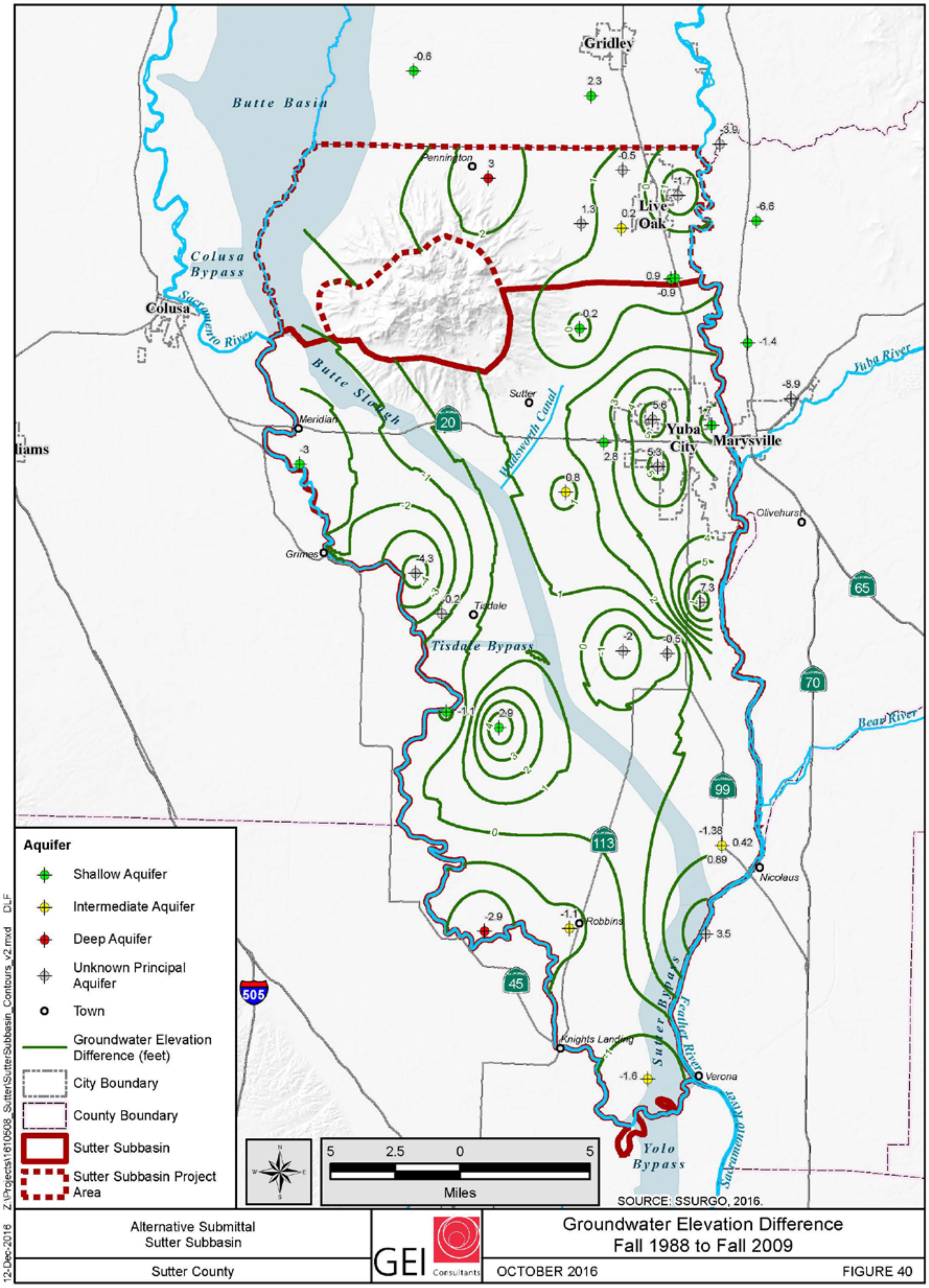


Figure 40. Groundwater Elevation Difference Fall 1988 to Fall 2009

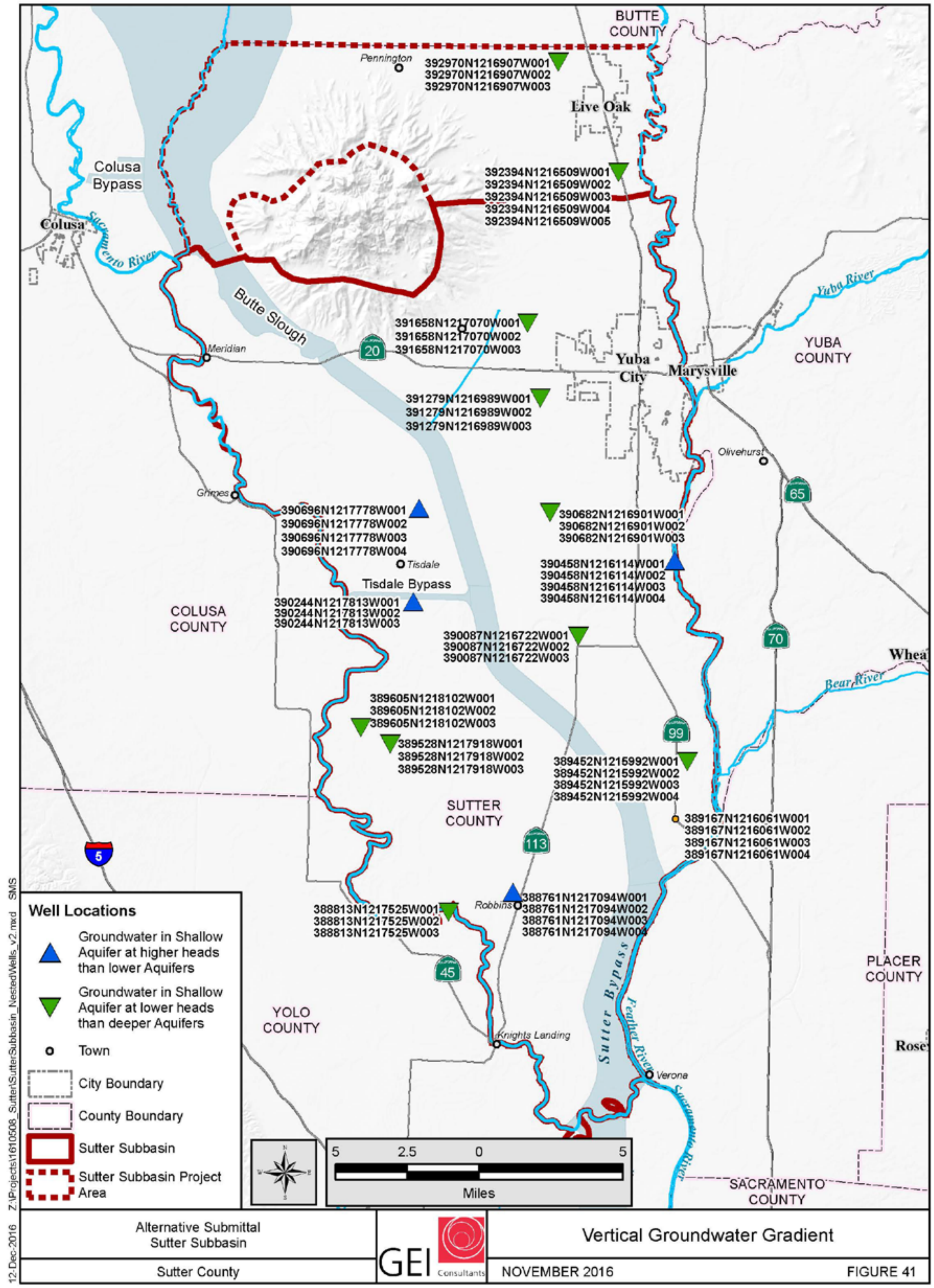


Figure 41. Vertical Groundwater Gradient

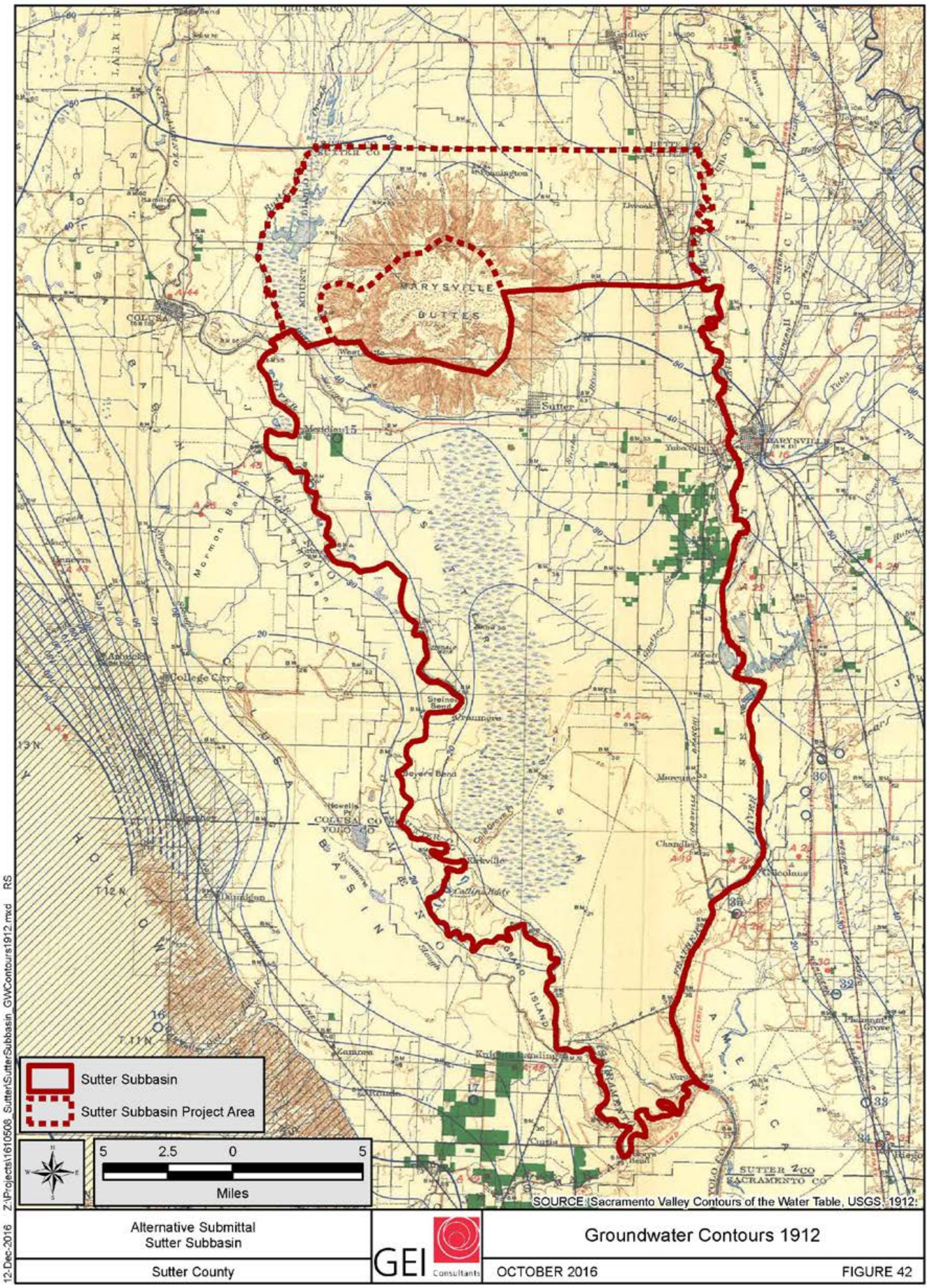


Figure 42. Groundwater Contours 1912

developed using CASGEM and voluntary wells for selected years along with GIS and Surfer contouring programs. The contours were developed using the Kriging function to provide uniform interpretations. To the extent possible, wells in adjacent subbasins (north and east) were also used to provide control near the fringes of the Subbasin. Wells were not selected west of the Sacramento River due to the river being a hydraulic divide. The contouring packages did not easily allow for removal of the Sutter Buttes from the contouring.

To demonstrate the highest and lowest groundwater level conditions, the SRI index along with precipitation were evaluated for the base period. Minimum or maximum groundwater levels were then summarized by year to select a year when the highest and lowest elevations were present. Minimum and maximum water levels at individual wells were present in any year. Therefore, the minimum and maximum groundwater level years were selected based on the SRI and precipitation. Selection of the year when high groundwater levels may have occurred was at the end of multiple SRI index wet years and above average precipitation years. The high groundwater level year selected for contouring was Spring 1998. The lowest groundwater level year was selected in a similar fashion but using sequential dry or critical dry years and precipitation. Fall 2009 was selected to represent groundwater level minimum conditions. Current groundwater level conditions representing the lowest groundwater conditions were developed for fall of 2015, after four years of drought conditions. **Figures 43 through 51** show groundwater contours and groundwater flow directions for each of these years by principal aquifer. The contours show there are multiple small pumping depressions that are not present in all years; however, part of this interpretation is due to the number of wells varying from year to year.

Groundwater contours for all years show groundwater enters the Subbasin from the north and east and leaves to the south. Due to the small scale of the maps and the lack of near river monitoring wells the recharge and discharging conditions are not contoured using the standard programs.

The difference of groundwater level elevations from the highest groundwater level Spring 1998 to the lowest groundwater level, Fall 2009, by each aquifer are shown on **Figure 43** through **51**. The changes by aquifer are provided below:

- **Shallow Aquifer –** At the northern Subbasin boundary, east of Sutter Buttes, the groundwater level difference is about 6 feet. Along the eastern side of the Subbasin, along the Feather River, the difference varies between 6 and 20 feet. Along the western edge of the Subbasin, the groundwater level difference is about 10 feet.

- **Intermediate Aquifer** - At the northern Subbasin boundary, east of Sutter Buttes, the groundwater level difference is about 10 feet. Along the eastern side of the Subbasin, along the Feather River, the difference varies between 12 and 22 feet. Along the western edge of the Subbasin, the groundwater level difference varies from 6 to 18 feet. At the southern boundary of the Subbasin, the difference is 0.5 feet.

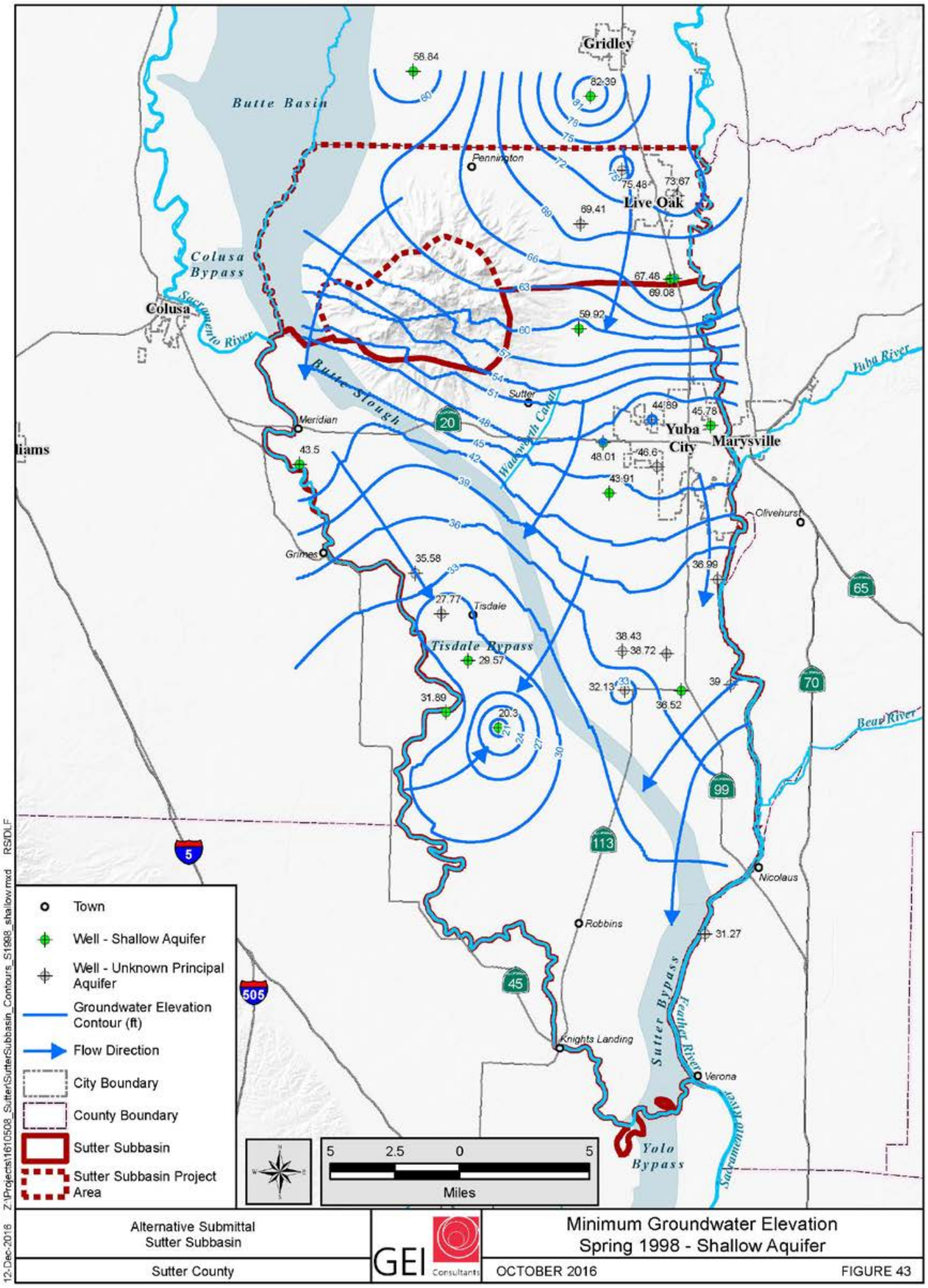


Figure 43. Groundwater Elevation Spring 1998 – Shallow Aquifer

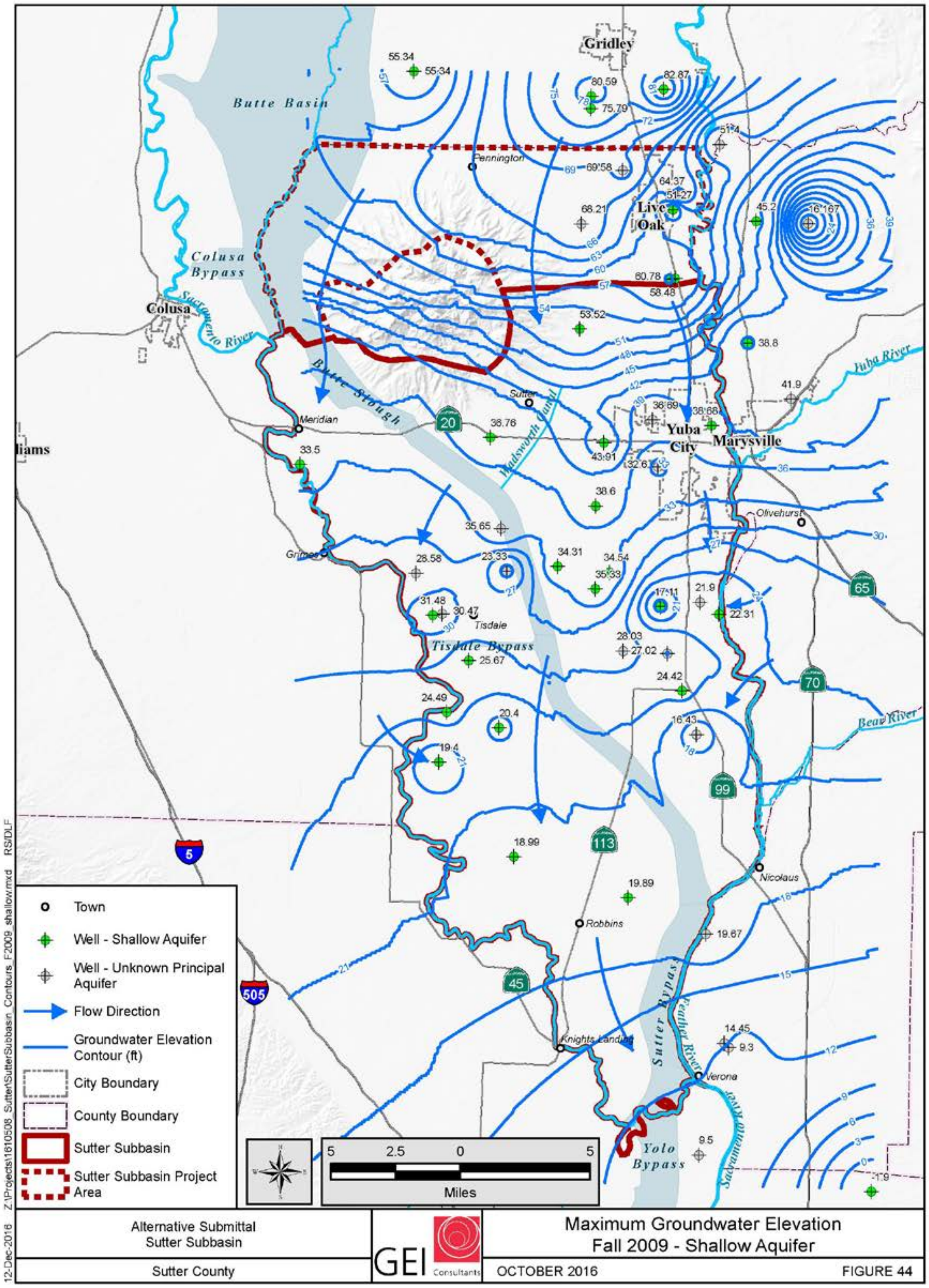


Figure 44. Groundwater Elevation Fall 2009 – Shallow Aquifer

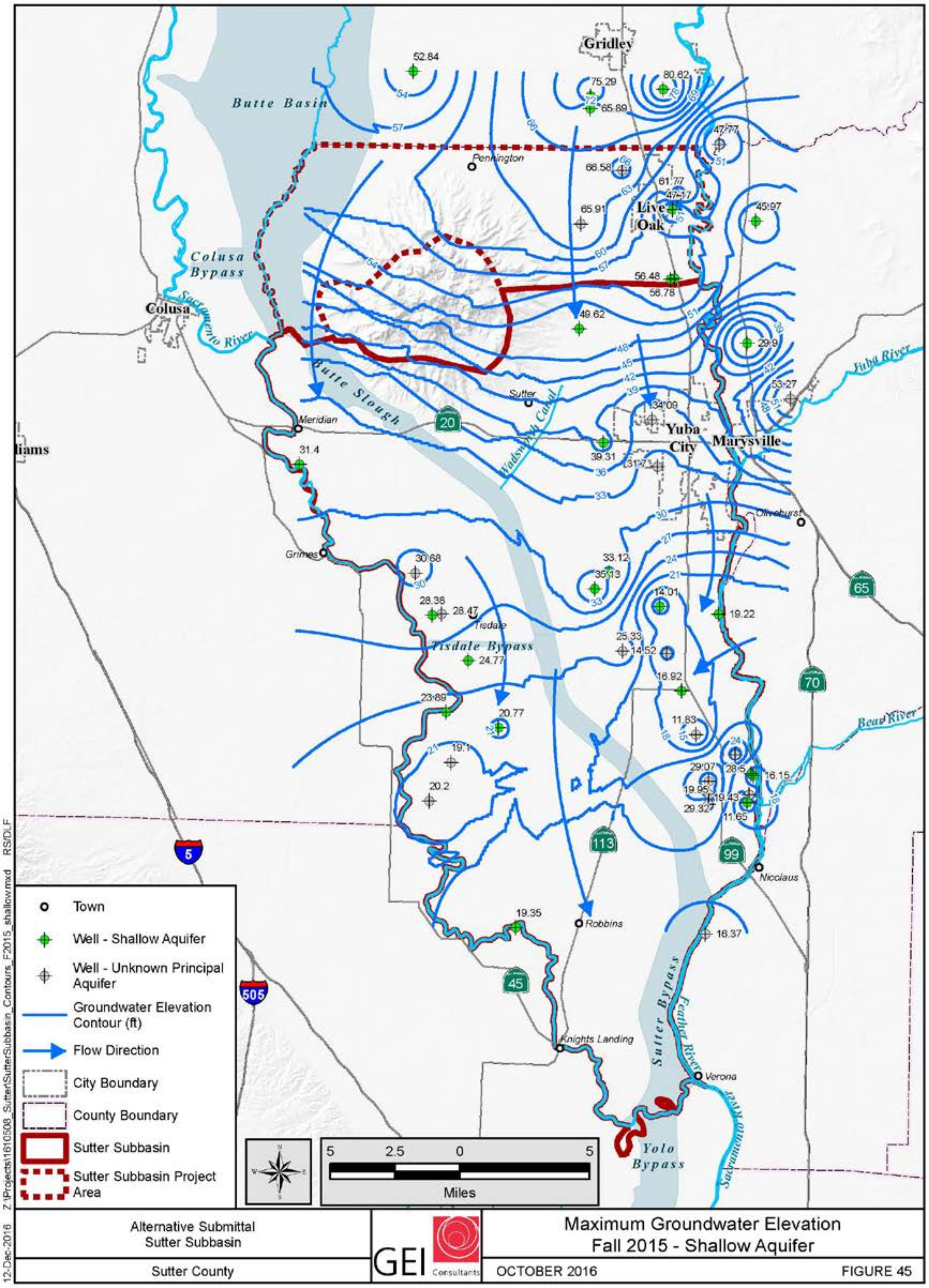


Figure 45. Groundwater Elevation Fall 2015 – Shallow Aquifer

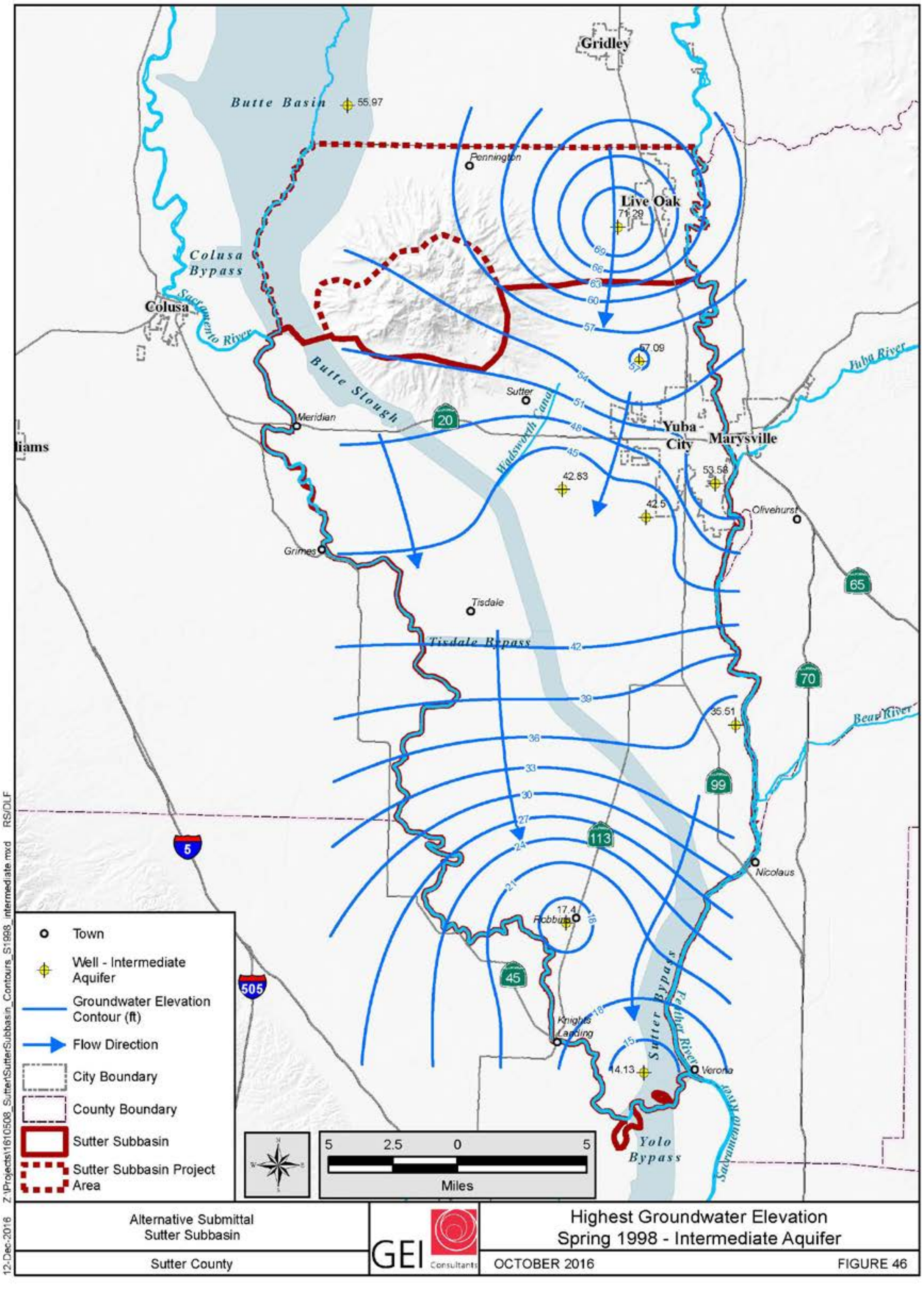


Figure 46. Groundwater Elevation Spring 1998 – Intermediate Aquifer

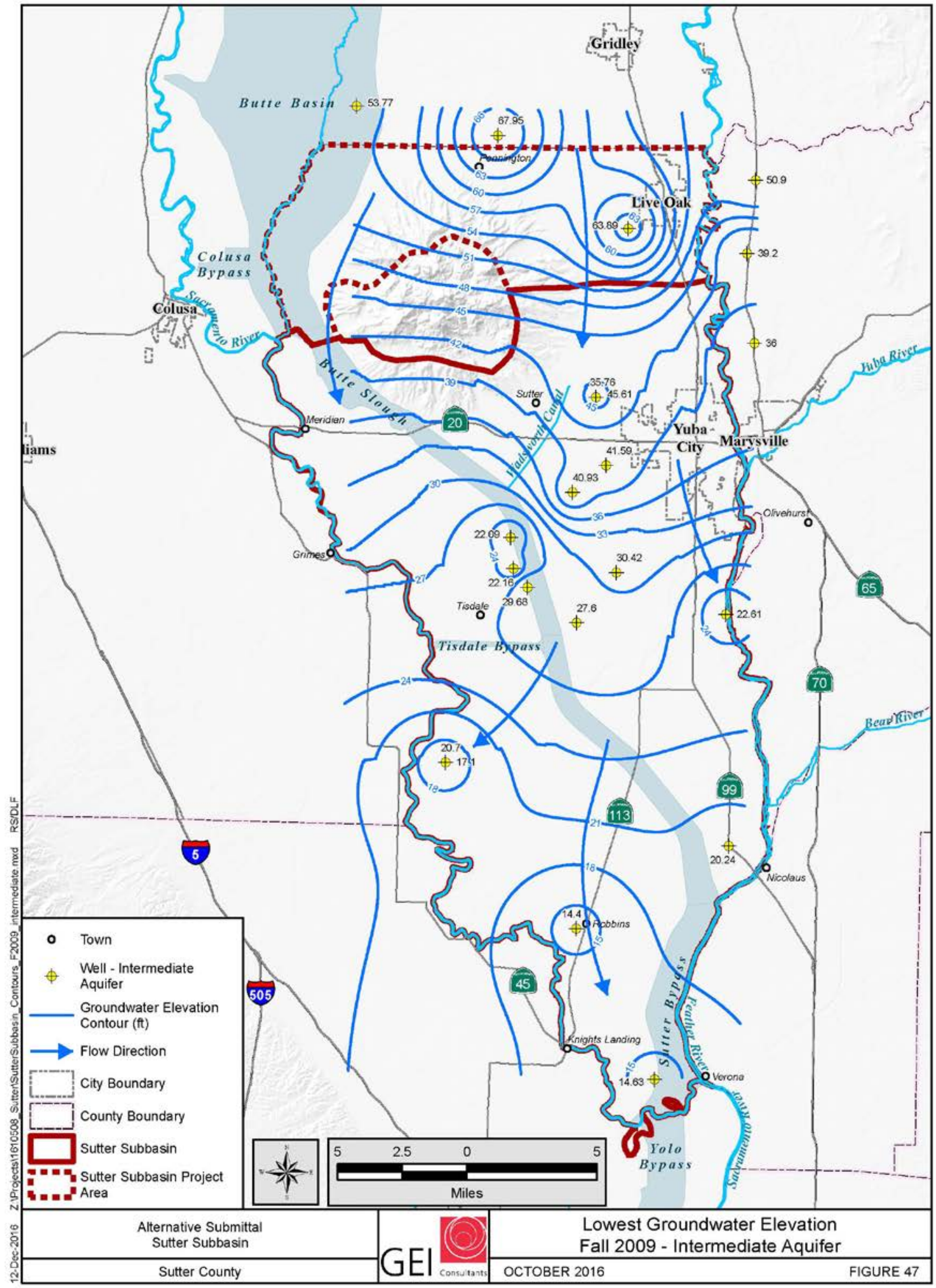


Figure 47. Groundwater Elevation Fall 2009 – Intermediate Aquifer

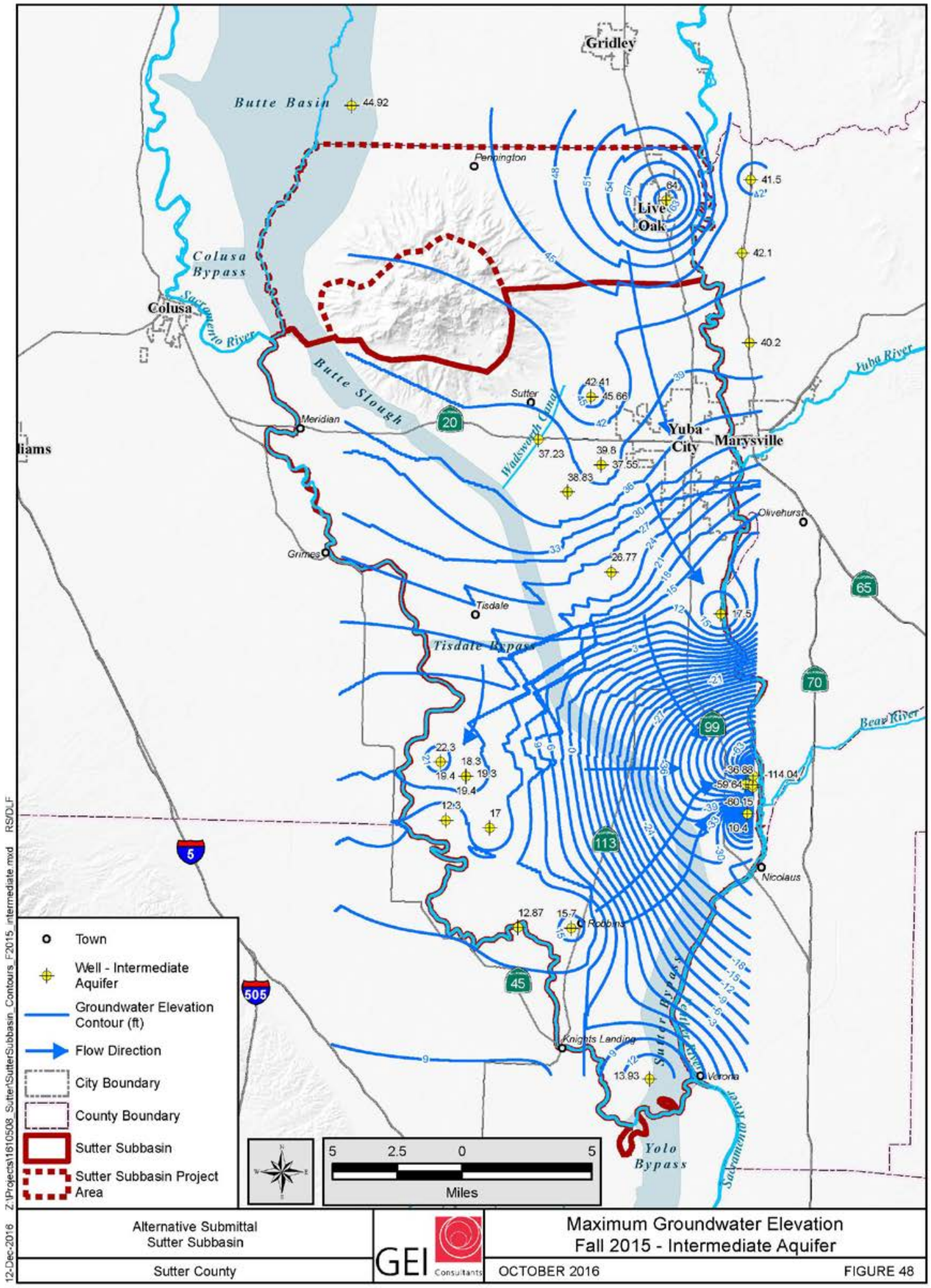


Figure 48. Groundwater Elevation Fall 2015 – Intermediate Aquifer

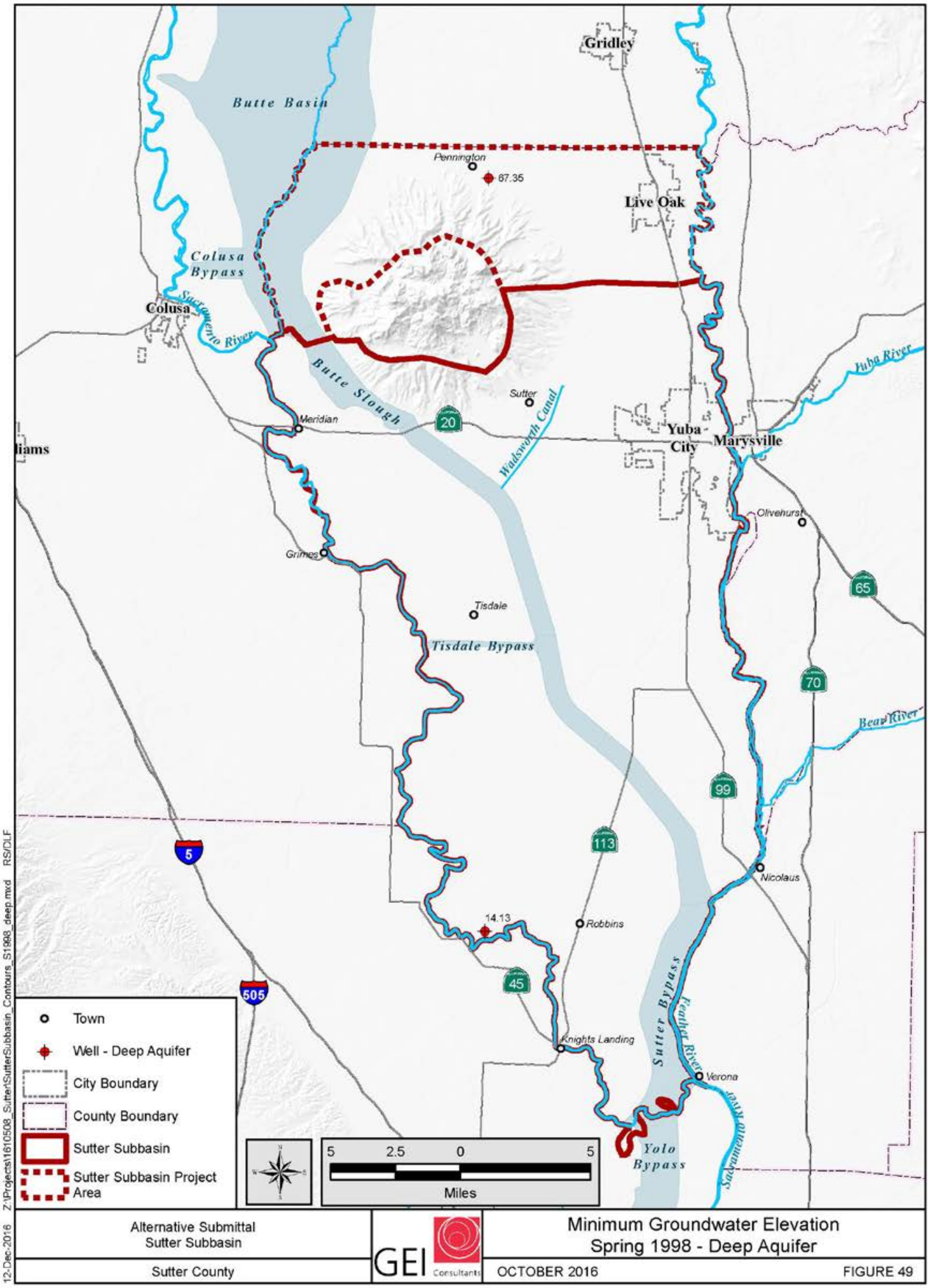


Figure 49. Groundwater Elevation Spring 1998 – Deep Aquifer

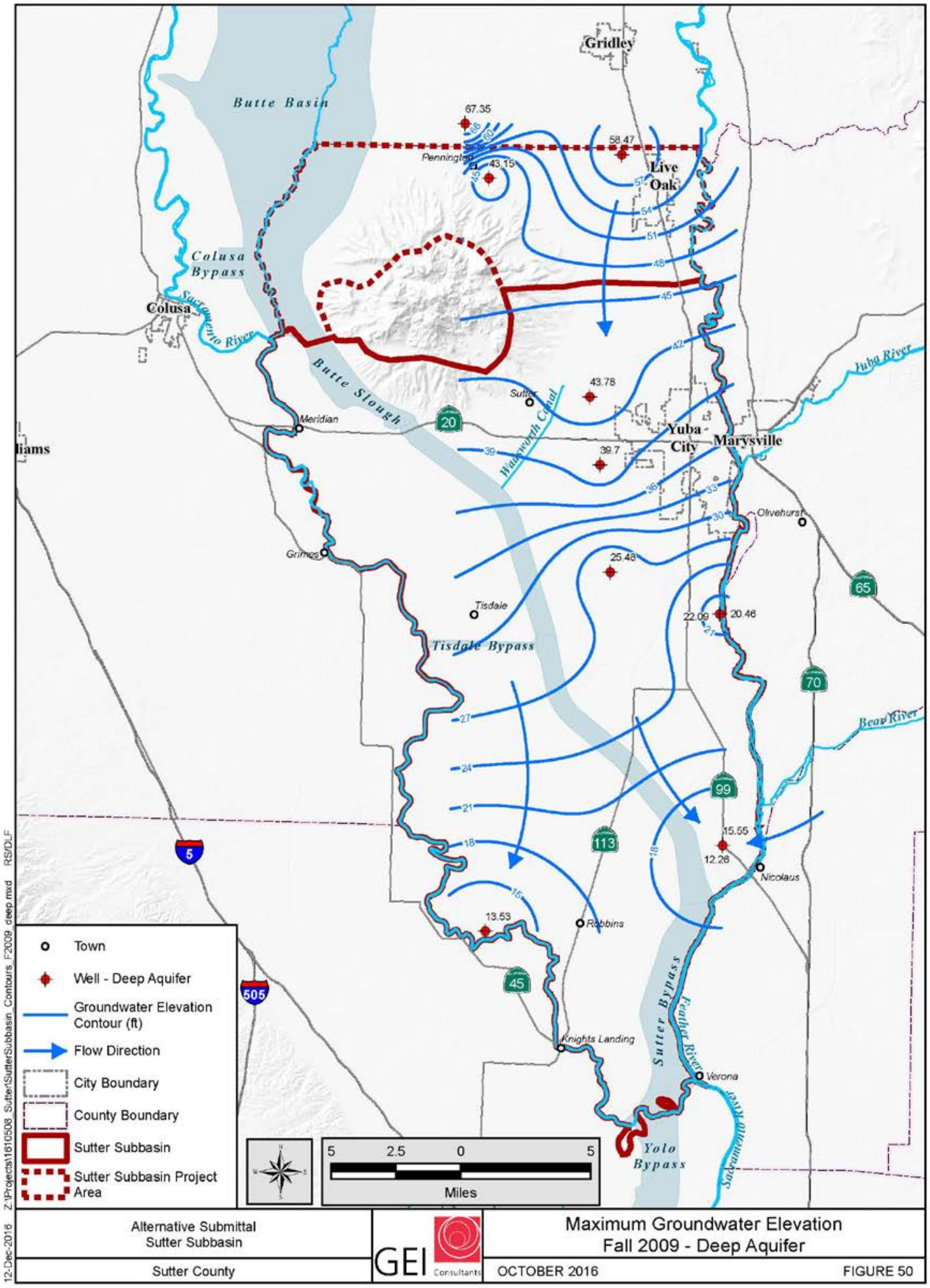


Figure 50. Groundwater Elevation Fall 2009 – Deep Aquifer

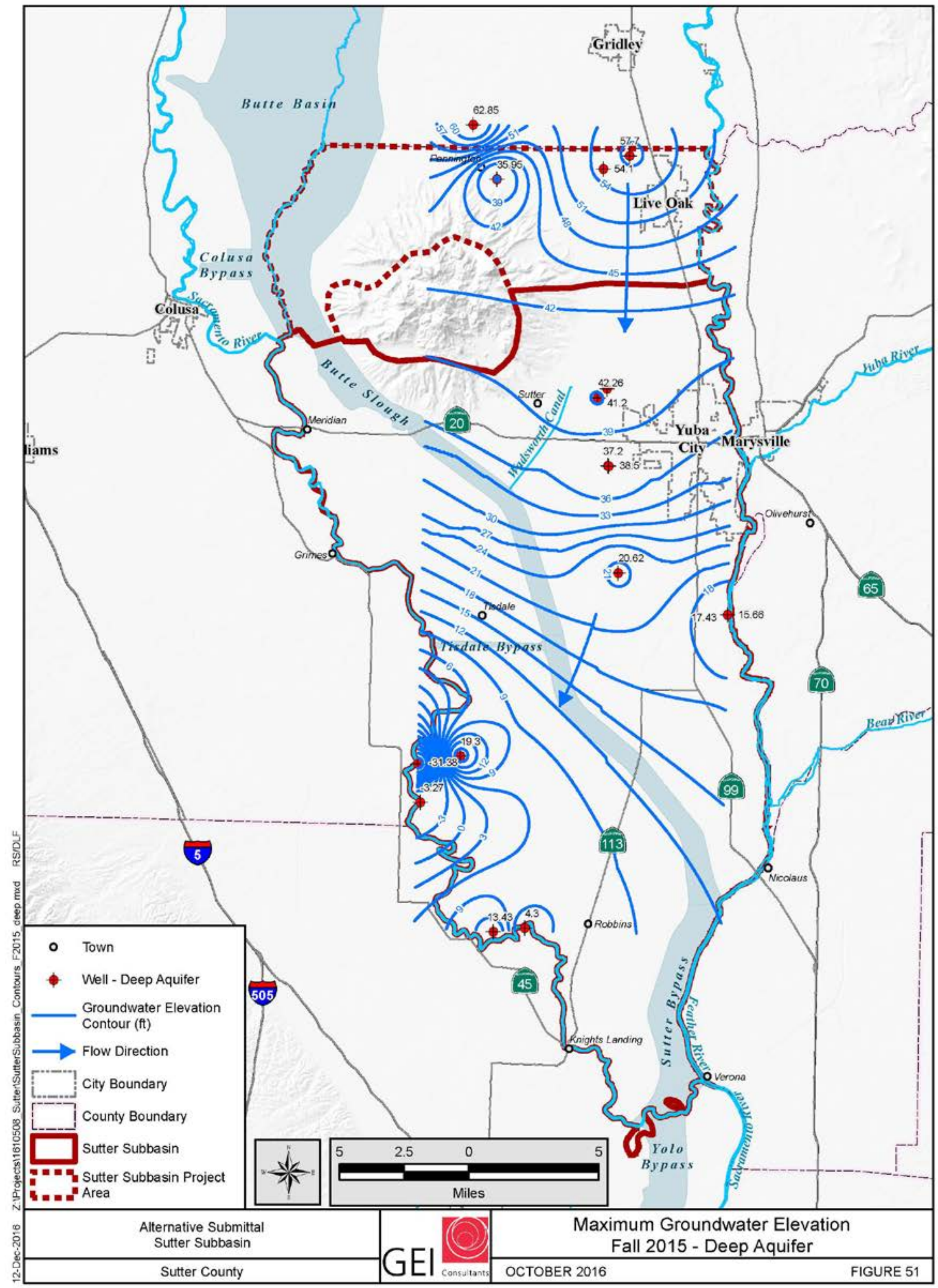


Figure 51. Groundwater Elevation Fall 2015 – Deep Aquifer

- **Deep Aquifer –** Only two measurement points were available in Spring 1998 while in Fall 2009, 8 wells had measurements. The northern well is in the East Butte Subbasin and in fall 2009 it appears to have been pumping, which results in almost a 20 foot decline in groundwater levels. Comparison of the southern well shows a rise in groundwater level of about 0.6 feet in the southern portion of the Subbasin.

Current conditions were assessed using groundwater levels for Fall 2009 and Fall 2015:

- **Shallow Aquifer -** Groundwater levels in the shallow aquifer were about 1 to 3 feet deeper during 2015.

- **Intermediate Aquifer –** Groundwater levels were about 1 to 6 feet deeper during 2015, with the exception of a pumping depression near the confluence of the Bear and Feather Rivers.

- **Deep Aquifer –** groundwater levels were about 1 to 3 feet deeper during 2015.

Groundwater levels after the drought in most wells rose up to the spring 2015 groundwater level depth but did not entirely refill the basin. Although not quantified at the time of this report, the Sacramento River Index maybe an above normal water year 2016.

5.2 Change in Storage

The difference in groundwater elevations from spring 1998 to fall 2009 was used to estimate the change in groundwater storage for the shallow and intermediate aquifers. The average specific yield of 0.07 was used to convert the change in groundwater levels to a volume. This approach does not take into account semi-confined or confined conditions which would increase the amount of groundwater in storage.

Figure 52 shows the change in groundwater levels for the shallow aquifer. On average, groundwater level difference in the shallow aquifer between these years was about 8 feet lower over the total acres in the Subbasin of 234,400 acres. The change in storage is about -131,000 AF or conservatively about 17,000 AF/foot of storage.

Figure 53 shows the change in groundwater levels for the intermediate aquifer. On average groundwater level difference in the shallow aquifer between these years was about 10 feet lower over the total acres of 234,000 acres. The change in storage was about -163,000 AF or conservatively about 17,000 AF/foot of storage.

Based on the C2VSim model, a change in storage of about 138,000 AF was observed with an average change in groundwater levels of about 5 feet or about 28,000 AF per foot of change in water levels reasonably similar to the per foot of storage estimated above.

5.3 Seawater Intrusion

Seawater intrusion does not occur in the vicinity of the Subbasin.

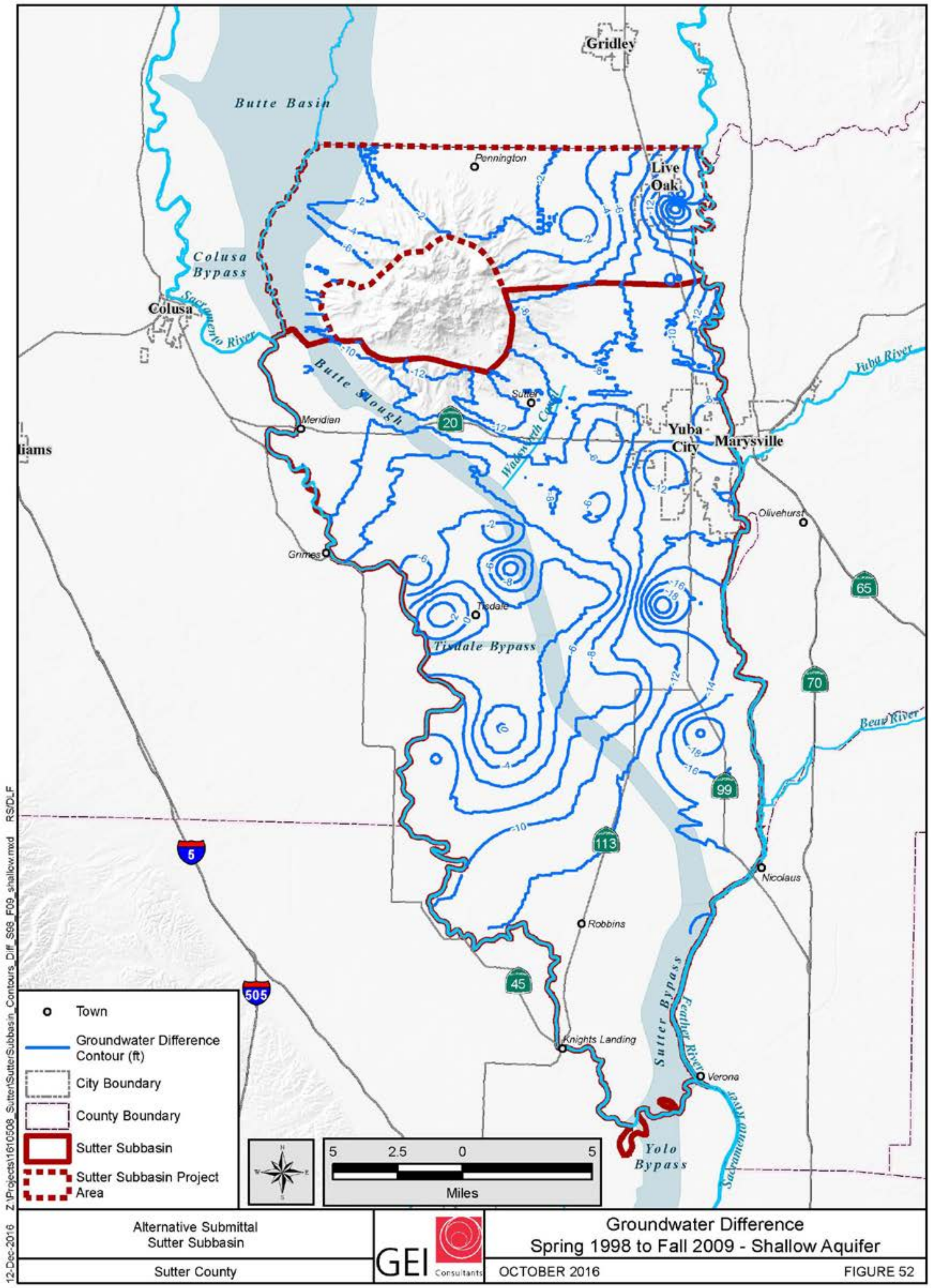


Figure 52. Groundwater Difference Spring 1998 to Fall 2009 – Shallow Aquifer

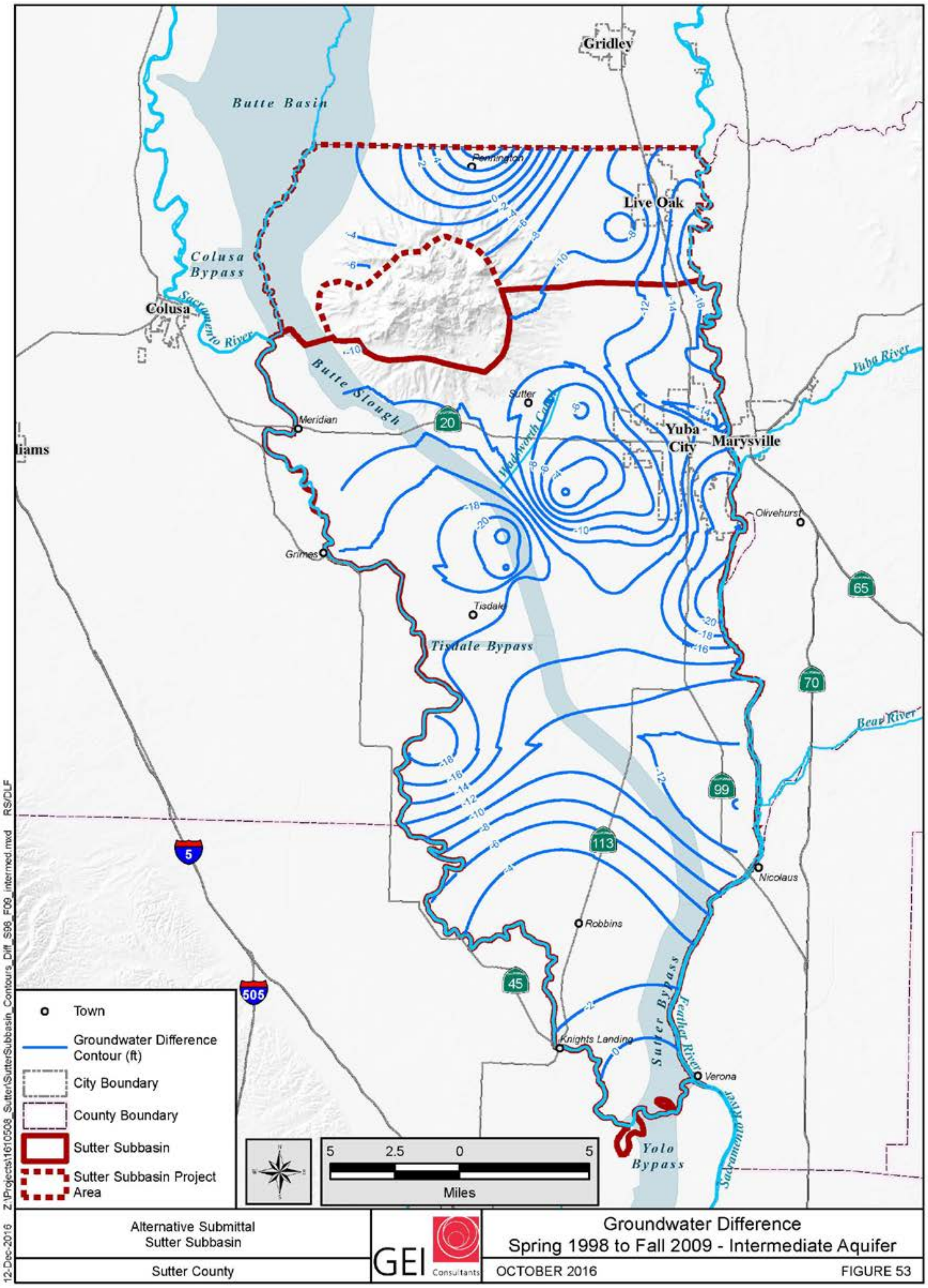


Figure 53. Groundwater Difference Spring 1998 to Fall 2009 – Intermediate Aquifer

5.4 Groundwater Quality Issues

A review of sites with releases of contaminants to the environment was performed (Geotracker website, 2016). **Table 11** lists the open sites in the Subbasin and the type of programs. **Table 12** lists those open sites in the Sutter County portion of the East Butte Subbasin. **Figure 54** shows their locations. Typically, the Clean-up Program Sites and LUST Clean-up Sites are associated with leaky underground fuel tanks (LUFTs) and underground storage tanks (USTs). Their typical constituents of concern are fuel hydrocarbons and the contaminant extent is small. A case file review of the status of these sites, contaminants of concern and clean-up activities was not performed for this Alternative.

5.5 Subsidence

Subsidence monitoring stations have not been installed within the Subbasin or in the Sutter County portion of the East Butte Subbasin to provide a long-term history. Subsidence estimates for the period 2006 to 2010 have been developed from satellites (NASA, 2015) for portions of the state. As shown on **Figure 55**, the portions of Subbasin which were surveyed are not experiencing significant subsidence. Subsidence estimates ranged from +2 to -2 inches in the Subbasin. The variation suggests the subsidence may be naturally occurring due to a variety of factors including but limited to barometric pressure, forces exerted by the moon and the sun, and surface water loading. Overall, the Subbasin has been ranked as having a low potential for subsidence (DWR, GIC website).

Two active extensometers (subsidence stations) are present outside of the Subbasin and the Sutter County portion of the East Butte Subbasin. Their locations are shown on **Figure 9**. Extensometer 18N01E35L001M within the East Butte Subbasin has only experienced elastic subsidence (+0.015 to -0.01 feet) in an area where there has only been 0 to -10 feet of change of groundwater levels. **Figure 56** shows the mostly positive values between 2005 and 2014 and then several negative values, including the lowest, during 2015. Extensometer 11N04E04N005M within the North American Subbasin has experienced both elastic and potentially inelastic subsidence (+0.02 to -0.07 feet or up to 8 inches) in an area where one nearby well has had about -50 feet of change in groundwater levels. **Figure 57** shows annual cycles of increasing and decreasing ground surface displacement, typically 0.02 feet per year between 1994 and 2015. The displacement was fairly stable at zero value until 1999, when the base line shift downward by 0.02 feet. Thereafter, the displacement was stable to trending upward and approaching zero until 2008 when the displacement shifted to a downward trend and the amplitude increased to nearly 0.03 feet after 2013. Due to the close proximity of the well to the extensometer, the information suggests that local subsidence may occur near pumping wells when the drawdown below historic water levels approaches 50 feet.

5.6 Degraded Water Quality

The County GMP identified several constituents within the Basin that are at levels that exceed the maximum contaminant level for drinking water, the highest beneficial use categories. The constituents include arsenic, boron, total dissolved solids, and nitrate. All of the constituents were detected in historic studies but later found to be naturally occurring, other than for nitrate. Nitrate detections are few and scattered. Large groundwater contamination plumes are not present in the Basin.

Table 11. Sutter Subbasin Open Contamination Sites

SITE ID	GLOBAL ID	SITE / FACILITY NAME	SITE / FACILITY TYPE	STATUS
1	SL0610191701	CALPINE RECLAMATION ROAD SITE	CLEANUP PROGRAM SITE	OPEN - ASSESSMENT & INTERIM REMEDIAL ACTION
2	T0610100010	PUREGRO	CLEANUP PROGRAM SITE	OPEN - ASSESSMENT & INTERIM REMEDIAL ACTION
3	SL0600791668	COSTA PROPERTY	CLEANUP PROGRAM SITE	OPEN - ELIGIBLE FOR CLOSURE
4	SLT5S0273068	AAA SALVAGE YARD	CLEANUP PROGRAM SITE	OPEN - INACTIVE
5	SL185132897	BENETO TANK LINES - YUBA CITY SPILL	CLEANUP PROGRAM SITE	OPEN - INACTIVE
6	SLT5S4503712	BOB'S FLYING SERVICE	CLEANUP PROGRAM SITE	OPEN - INACTIVE
7	SL0610116611	BONANZA SEED CO.	CLEANUP PROGRAM SITE	OPEN - INACTIVE
8	SLT5S4523714	CALIFORNIA SEED & FERTILIZER	CLEANUP PROGRAM SITE	OPEN - INACTIVE
9	SLT5S5673500	CROP PRODUCTION SERVICES, YUBA CITY	CLEANUP PROGRAM SITE	OPEN - INACTIVE
10	SLT5S1123152	CUSTOM CHROME & BUMPER COMPANY	CLEANUP PROGRAM SITE	OPEN - INACTIVE
11	T10000000139	DBA MATSUMURA CORPORATION	CLEANUP PROGRAM SITE	OPEN - INACTIVE
12	SL0610185949	DIESEL REPAIR FACILITY	CLEANUP PROGRAM SITE	OPEN - INACTIVE
13	SLT5S4573717	GIUSTI STRIP	CLEANUP PROGRAM SITE	OPEN - INACTIVE
14	SLT5S5643497	MID VALLEY CHEMICAL COMPANY	CLEANUP PROGRAM SITE	OPEN - INACTIVE
15	SLT5S3413660	MORF CONTAMINATED SITE (M.A.D.) SUTTER CO.	CLEANUP PROGRAM SITE	OPEN - INACTIVE
16	SLT5S5503486	ONSTOTT DUSTERS, INC.	CLEANUP PROGRAM SITE	OPEN - INACTIVE
17	T10000004283	PHASE II SUBSURFACE INVESTIGATION; SOUTHWEST CORNER SAWTELLE AVENUE AND EVERGLADE ROAD	CLEANUP PROGRAM SITE	OPEN - INACTIVE
18	SLT5S3323656	SUMITOMO PROPERTY (UNTEMOTO RANCH)	CLEANUP PROGRAM SITE	OPEN - INACTIVE
19	SLT5S5593493	SUNRISE DUSTERS	CLEANUP PROGRAM SITE	OPEN - INACTIVE
20	SL0610154084	SUTTER CO AGRI DEPT	CLEANUP PROGRAM SITE	OPEN - INACTIVE
21	SLT5S5613494	SUTTER FARM CHEMICALS INC.	CLEANUP PROGRAM SITE	OPEN - INACTIVE
22	SL0610138604	UNKNOWN	CLEANUP PROGRAM SITE	OPEN - INACTIVE
23	SLT5S5483485	WAGNER AVIATION	CLEANUP PROGRAM SITE	OPEN - INACTIVE
24	SL185532921	WAGNER ESTATE PROPERTY - YUBA CITY	CLEANUP PROGRAM SITE	OPEN - INACTIVE
25	SLT5S3143350	WELLHEAD ELECTRIC CO. (KARNAK FACILITY)	CLEANUP PROGRAM SITE	OPEN - INACTIVE
26	T10000001874	ZELIE'S CLEANERS	CLEANUP PROGRAM SITE	OPEN - REMEDIATION
27	T10000003059	FEATHER RIVER MILLS	CLEANUP PROGRAM SITE	OPEN - SITE ASSESSMENT
28	SLT5S3363658	SUTTER COUNTY AIRPORT	CLEANUP PROGRAM SITE	OPEN - SITE ASSESSMENT
29	SL185842946	JOHN TAYLOR FERTILIZERS - YUBA CITY	CLEANUP PROGRAM SITE	OPEN - VERIFICATION MONITORING
30	L10009648307	GROUND TECH	LAND DISPOSAL SITE	OPEN
31	L10004041804	GROWER'S AG SERVICE	LAND DISPOSAL SITE	OPEN
32	SLT5SB123551	C.T. JOSEPH DISPOSAL SITE	LAND DISPOSAL SITE	OPEN - REFERRED
33	T0610100058	EXXON (A&R)	LUST CLEANUP SITE	OPEN - REMEDIATION
34	T0610100086	QUESTION MARKET	LUST CLEANUP SITE	OPEN - REMEDIATION
35	T0610100078	QUICK-N-SHOP	LUST CLEANUP SITE	OPEN - REMEDIATION
36	T0610193669	ROBBINS MERCANTILE	LUST CLEANUP SITE	OPEN - REMEDIATION
37	T0610154002	1ST STOP	LUST CLEANUP SITE	OPEN - VERIFICATION MONITORING

Table 12. Sutter County Portion of East Butte Subbasin

SITE ID	GLOBAL ID	SITE / FACILITY NAME	SITE / FACILITY TYPE	STATUS
38	SLT5S0563097	BOWLES FLYING SERVICE	CLEANUP PROGRAM SITE	OPEN - INACTIVE
39	SL0610100858	MORRIS FARMING AND TRUCKING	CLEANUP PROGRAM SITE	OPEN - INACTIVE
40	SLT5S5513487	SUTTER BUTTE DUSTERS INC.	CLEANUP PROGRAM SITE	OPEN - INACTIVE
41	SLT5S5663499	SUTTER BUTTES AG CHEMICAL/OXY CHEMICAL	CLEANUP PROGRAM SITE	OPEN - INACTIVE
42	T0610100075	BOONE'S MINI MART	LUST CLEANUP SITE	OPEN - REMEDIATION
43	T0610178435	BEALE AIR FORCE BASE - TITAN 1B, SUTTER CO. - BEAL	MILITARY CLEANUP SITE	OPEN - INACTIVE

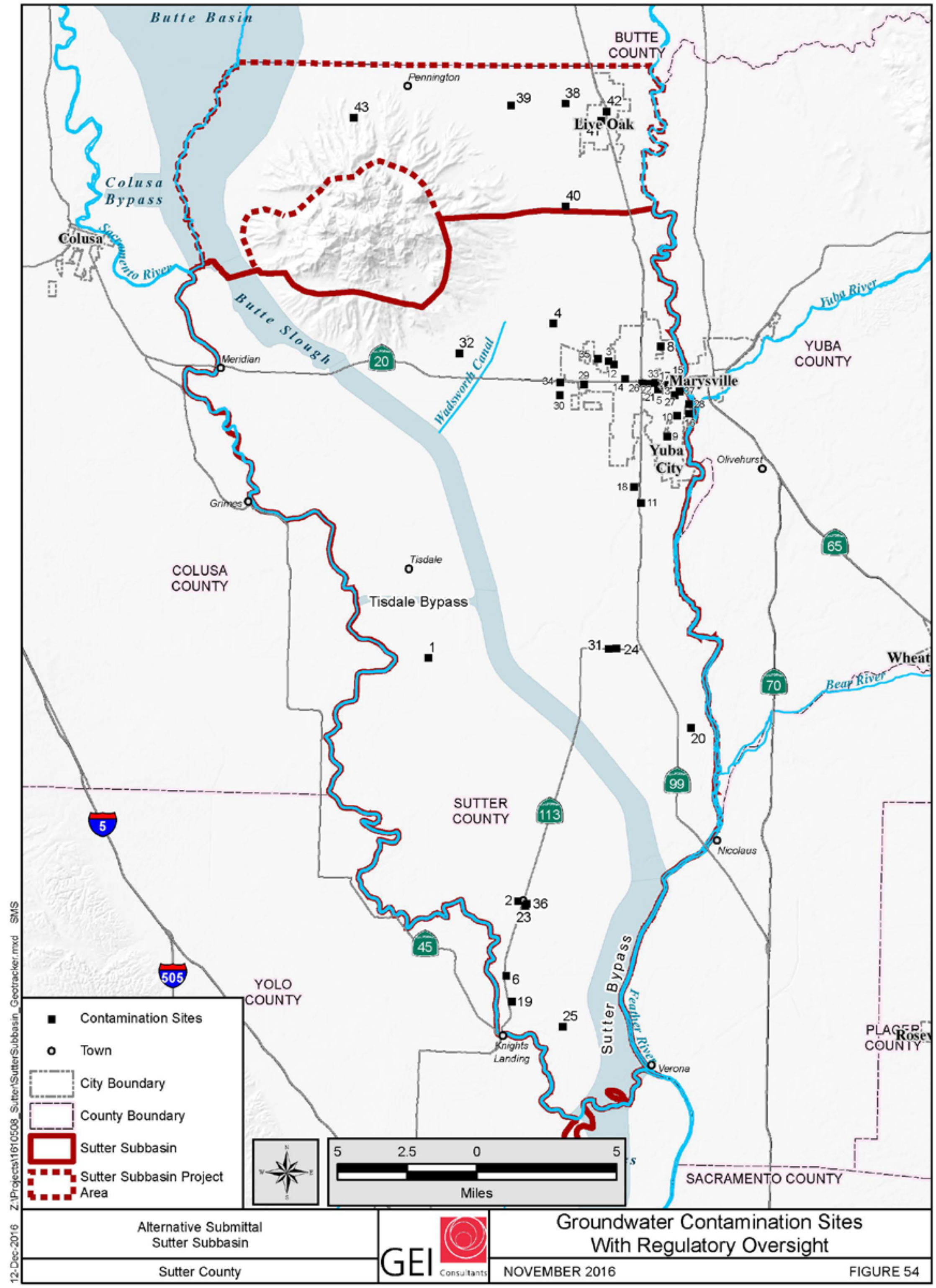


Figure 54. Groundwater Contamination Sites with Regulatory Oversight

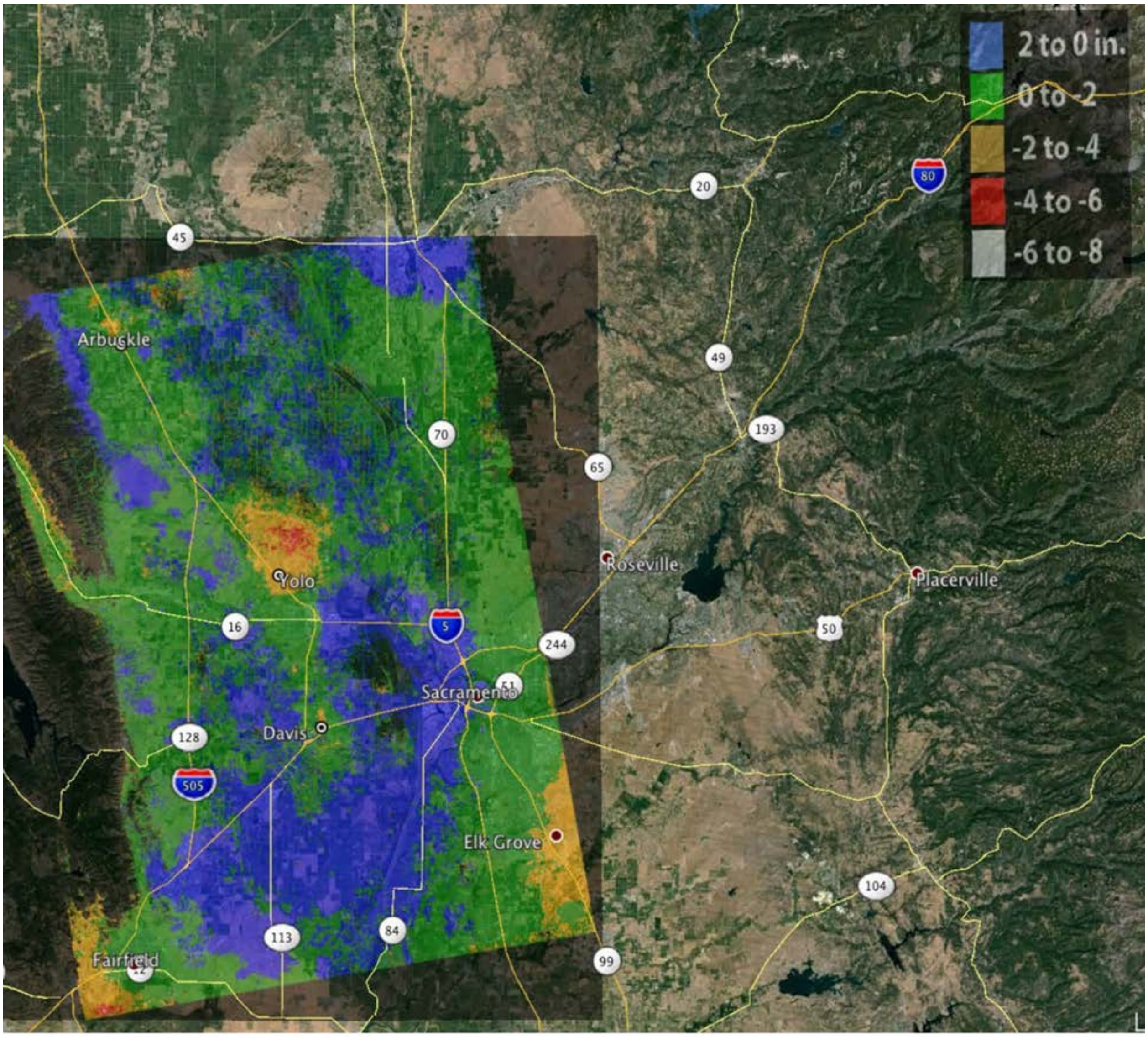


Figure 55. Subsidence

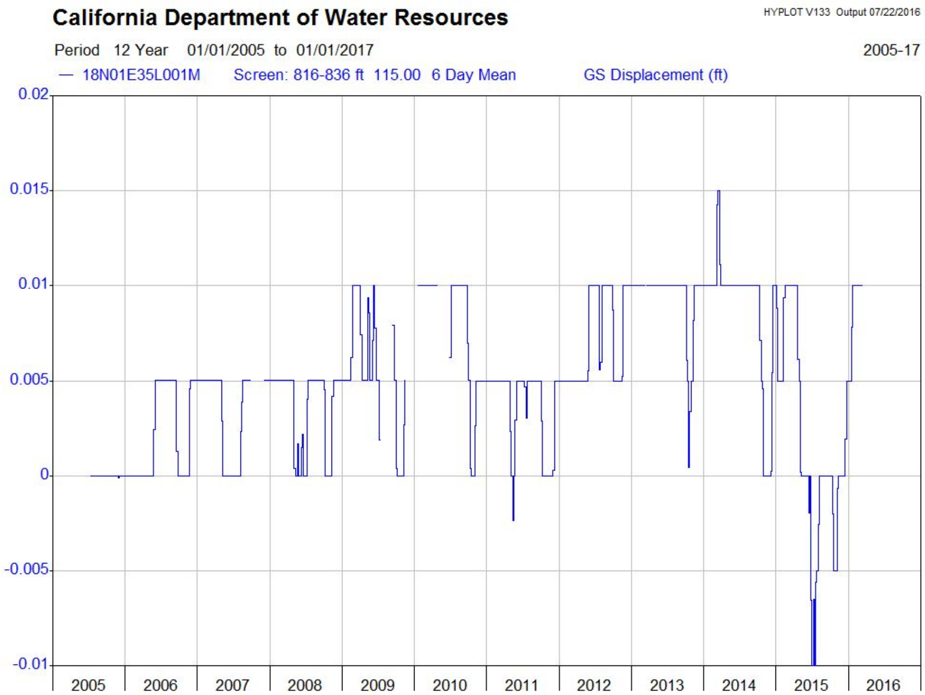


Figure 56. Subsidence at Station 18N01E35L001M

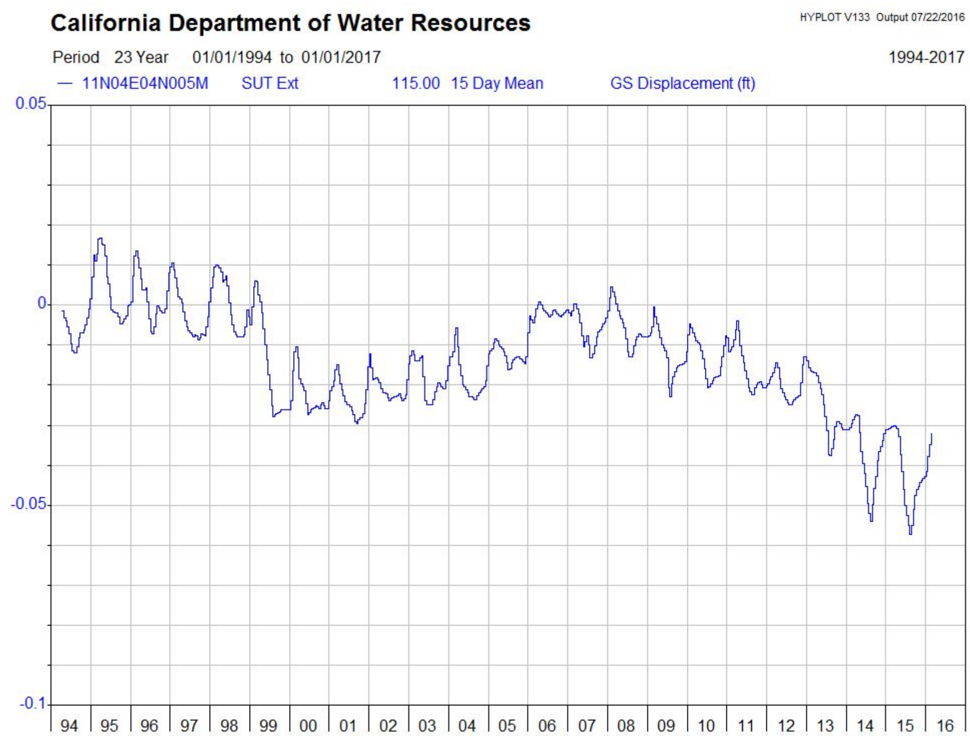


Figure 57. Subsidence at Station 11N04E04N005M

Most of the area east of the Feather River and between the Yuba and Bear Rivers is farmland Potential sources of groundwater contamination may occur from use of pesticides, fungicides, and herbicides. Bentazon and dichlorobromochlorpropane (DBCP) have been detected in the Basin (Sutter County, 1996). The concentrations detected and depths sampled are unknown.

Shallow groundwater, 8 to 17 feet bgs, was sampled from eight wells within the Basin for arsenic, pesticides, and volatile organic compounds (USGS, 2001). Pesticides were detected in only one well in the north portion of the Basin. Volatile organic compounds were detected in only one well on the southwestern portion of the Basin.

Historically, there have been a number of LUFTs and USTs in the Basin (Geotracker, 2003). A recent evaluation of the status of these tanks and the clean-up activities has not been performed.

5.7 Interconnected Surface Water

As shown by the levee stability investigations, coarse-grained sediments are present along the Feather and Sacramento rivers and connect the rivers to the shallow aquifers. The geologic evidence shows that the coarse grained sediments are relatively thin bedded and are interbedded with fine grained sediments that have relatively low permeabilities, but can convey water away from and to the rivers.

Several of the network wells are located along the banks of the Sacramento, Feather, and Bear rivers, as shown in **Figure 38**. The relationship between the volume of water flowing in the major rivers/streams and the influence the surface water imparts on groundwater elevation are being monitored with a combination of nested monitoring wells and river stage gages. Four gaging stations exist in the County for observing this interaction: on the Sacramento River below Wilkins Slough (WLK), on the Bear River at Pleasant Grove Road (BPG), on the Sutter Bypass at RD 1500 pump (SBP), and along the Feather River above Star Bend (FSB). Sutter County also monitors a river stage gage at Boyd's Landing (FBL). At stations BPG and FBL, observations of water surface/groundwater elevations trend closely during high flow/stage events in the rivers, suggesting a significant hydrologic connection between the groundwater in the shallow aquifers and the surface water (Wood Rodgers, 2012).

C2VSim groundwater flow modeling was used to help quantify the amount of water gaining and loosing from the streams for the base period. According to previous studies, groundwater pumping increased during the 1987 to 1992 drought and has increased since this time (RMC, 2016). Therefore, the base period of 1989 through 2009 represents this increased use and the effects on both storage losses and impacts on surface water; however, as shown on Figure 58, the Sutter Subbasin has not increased its losses from streams since the 1987 to 1992 drought and losses and gains remain within the historic range.

Table 13 summarizes the annual gains and losses to rivers while **Figures 58 through 61** shows the model gains and losses to the rivers in the Subbasin. Overall the model predicts that surface water losses are typically greater than gains to the rivers except during wet years. The long-term average over the base period indicates the rivers can change from gaining to losing from year to year and on average through the base period lose about 383,000 AFY and gain about 253,000 AFY.

Table 13. Summary Annual Changes in Gains and Losses from Rivers - Sutter Subbasin

Water Year	Water Year SRI Classification	Gains to Groundwater from Losing Rivers AFY	Losses from Groundwater to Rivers AFY	Difference AFY
1989	D	184,429	150,748	(33,681)
1990	C	113,231	110,295	(2,936)
1991	C	150,777	97,709	(53,068)
1992	C	151,571	88,828	(62,743)
1993	AN	392,246	267,969	(124,277)
1994	C	146,853	91,484	(55,369)
1995	W	784,425	517,327	(267,098)
1996	W	415,633	368,229	(47,404)
1997	W	533,152	432,618	(100,534)
1998	W	760,654	554,569	(206,085)
1999	W	300,165	324,028	23,863
2000	AN	379,966	316,428	(63,538)
2001	D	129,198	135,412	6,214
2002	D	209,473	166,326	(43,148)
2003	AN	344,952	253,107	(91,845)
2004	BN	362,185	274,218	(87,967)
2005	AN	215,925	177,782	(38,142)
2006	W	663,009	495,299	(167,710)
2007	D	151,007	161,758	10,751
2008	C	168,306	118,650	(49,656)
2009	D	189,711	108,018	(81,693)
Minimum		113,231	88,828	(267,098)
Average		321,279	248,133	(73,146)
Maximum		784,425	554,569	23,863

Notes: Positive difference = gains to rivers greater than losses from rivers
Negative difference = losses from river greater than gains to rivers

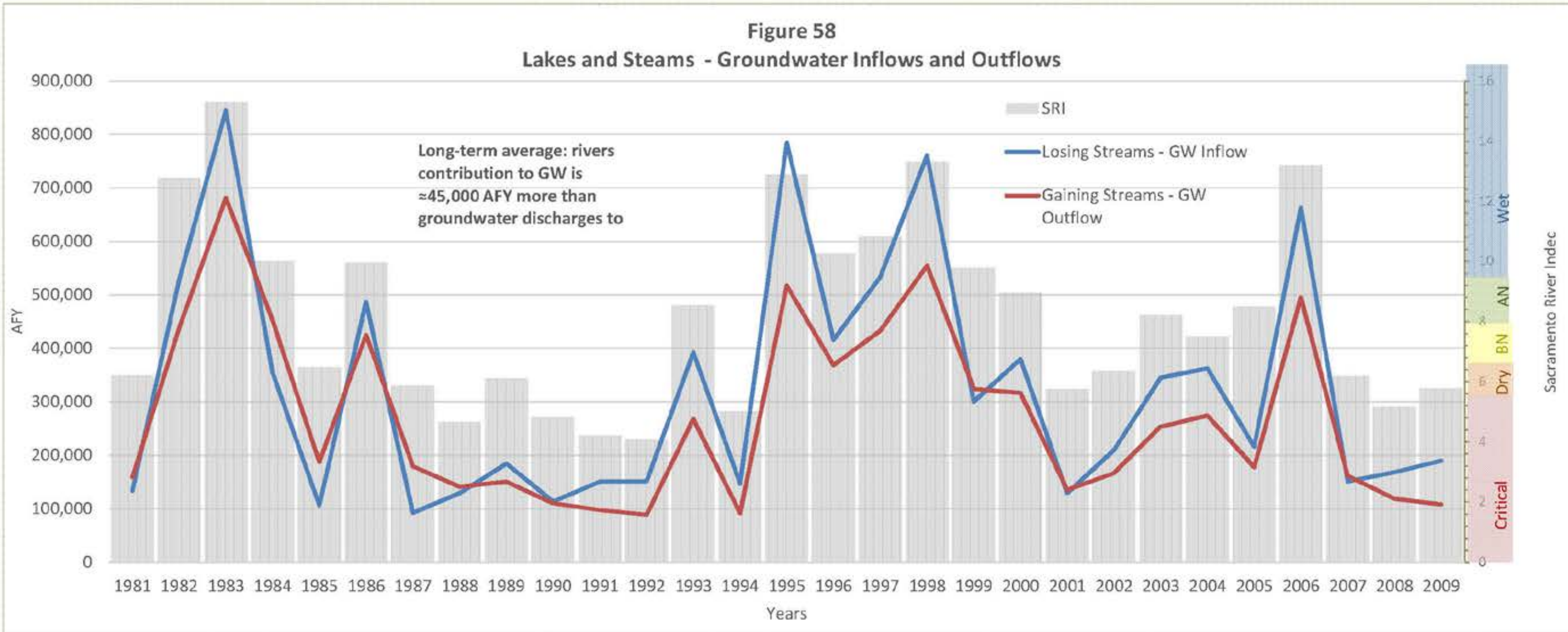


Figure 58. Lakes and Streams – Groundwater Inflows and Outflows

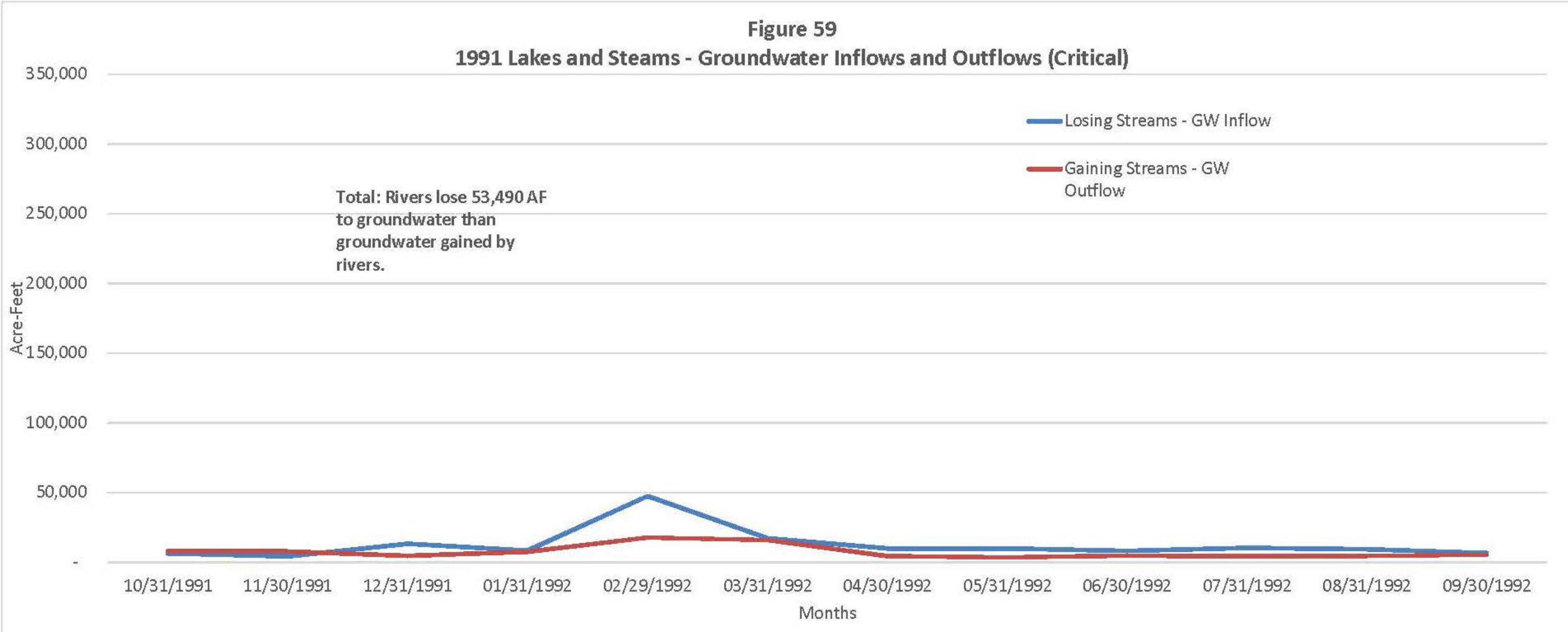


Figure 59. 1991 Lakes and Streams – Groundwater Inflows and Outflows (Critical)

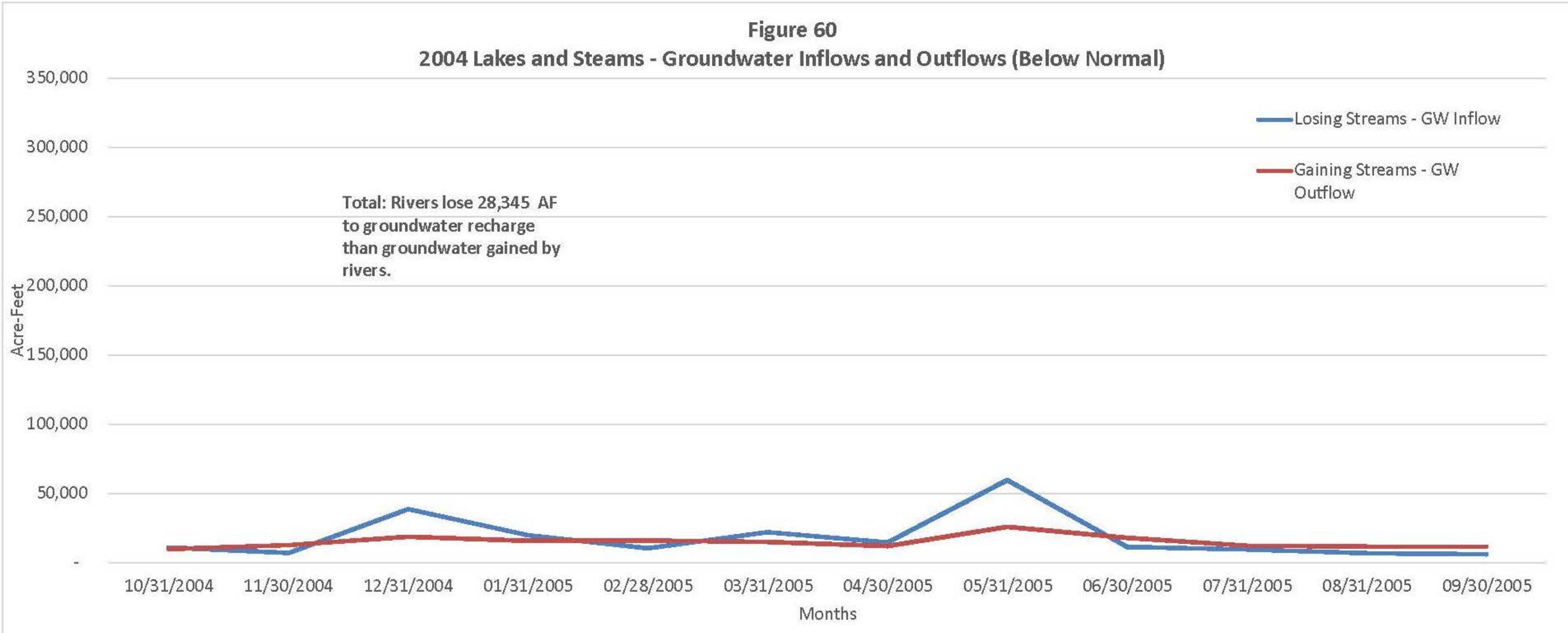


Figure 60. 2004 Lakes and Streams – Groundwater Inflows and Outflows (Below Normal)

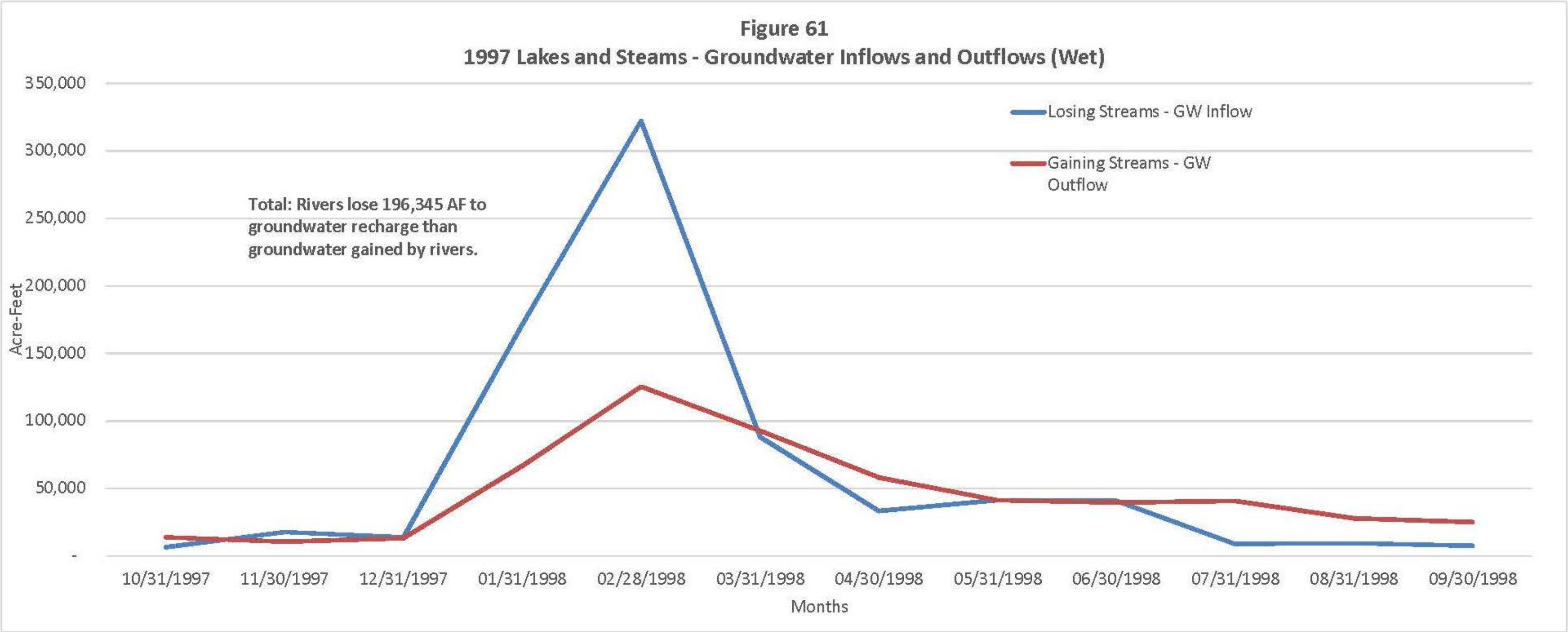


Figure 61. 1997 Lakes and Streams – Groundwater Inflows and Outflows (Wet)

Figure 58 shows the long-term projection of groundwater gains and loss to surface water. It shows that in most years (about 70 percent) groundwater gains more surface water than groundwater contributes back to the rivers.

Although the long-term projections shows, in most years, groundwater gains more surface water than groundwater lost to the rivers, the seasonal distribution shows that these depletions of surface water are typically occurring during the winter months which refills depleted groundwater storage. **Figures 59** through **61** show surface water gains and losses for critical, below normal and wet years, all of the plots maintain the same scale to illustrate the magnitude of water losses or gains. As shown river losses and gains in wet years are about three times higher than in below normal or critical dry years. Even during wet years, surface water loses water to replenish groundwater storage but this occurs between December and March when there is abundant water in the rivers due to rains. High flows in the rivers during these periods are not necessarily put to beneficial use and would be lost to the oceans. During the remaining portions of the wet year the rivers gain more or an equal amount to the amount that is lost.

A similar pattern is present in below normal and critical years, that most of the surface water is lost during the winter months, again to refill groundwater storage. Even in below normal years, at times, the rivers gain more than is lost; however, as seen in the below normal years and in critical years, surface flow is depleted during the summer months when surface flow is needed to support habitat.

Historically, a few levee slurry walls have been constructed along the Feather River. Starting in 2013 and continuing through 2016, additional slurry walls were installed along the Feather River, which may physically reduce the amount of surface water depletions. The amount cannot be quantified at this time. The following information was extracted from a groundwater monitoring program for groundwater-level changes associated with levee stabilization using existing CASGEM wells:

5.7.1 Shallow Aquifer Feather River with Slurry Walls Installed

Four groundwater monitoring wells were selected to track groundwater levels during and after the installation of the slurry walls from the north of the Sutter and Butte County line to just south of Yuba City. All of the wells are generally along a parallel line to the Feather River so no groundwater gradients can be developed. The following general observations have been made as of July 2016 (Wood Rodgers, 2016):

Agricultural Well 16N 03E-04E1

The overall trend indicates that groundwater levels at this site are relatively stable with overall slight groundwater decline since 2013, likely due to current drought conditions.

Observation Well 16N 03E-17J2

The overall trend at this site indicates that groundwater levels have declined by approximately 5 feet since 2011 at this location, likely attributed to current drought conditions, but the water level has nearly rebounded to water levels recorded in spring 2013.

Domestic Well 15N 03E-15H4

The overall trend at this site indicates that groundwater levels have declined by approximately 3 feet since early 2013 at this location, likely attributed to current drought conditions, but are likely beginning to recover.

Observation Well 14N 03E-23D4

This observation well experiences substantial seasonal fluctuations of groundwater levels and is likely influenced by pumping of nearby wells. The overall trend indicates that groundwater levels have declined by approximately three feet since early 2013 at this location, likely attributed to current drought conditions; however, the current (summer) levels are similar to previous summer levels recorded since 2007.

5.7.2 Laurel Avenue FSRP Area – No Slurry Walls

The Laurel Avenue FSRP area, is monitored by six wells that do not have published State Well numbers, so they were labeled Wells A through F, and one observation well with a state well number. Well construction details are not available to confirm which aquifer is monitored by each well. Also, Wells B, C, D, and F are active irrigation wells, and most of the water level measurements recorded during spring and summer months were actually pumping water levels during operations. Pumping water levels appear much deeper than true static water levels. Well F is located adjacent to a portion of the river where a slurry wall is proposed to be installed.

Agricultural Well A

The overall trend at this site indicates that groundwater levels have declined by approximately four feet since spring 2014 at this location, likely attributed to current drought conditions.

Agricultural Well B

The overall trend indicates that groundwater levels are relatively stable at this location, and the latest measurement is higher by approximately two feet in comparison to the level recorded in spring 2015.

Agricultural Well C

The overall trend indicates that groundwater levels have declined by approximately one foot since mid-2013 at this location, likely attributed to current drought conditions.

Agricultural Well D

The latest groundwater level measurement, recorded on March 3, 2016, indicated that groundwater was 16.5 feet bgs. The overall trend at this site indicates that groundwater levels are relatively stable, and groundwater levels have increased by approximately three feet since spring 2015.

Agricultural Well E

The latest groundwater level measurement, recorded on March 3, 2016, indicated that groundwater was 13 feet bgs. The groundwater level has declined by approximately one foot since spring 2014, likely attributed to current drought; however, the overall trend indicates that groundwater levels are relatively stable at this location.

Agricultural Well F

The latest groundwater level measurement, recorded on March 3, 2016, indicated that groundwater was 18.1 feet bgs. The overall trend indicates that groundwater levels have been relatively stable at this location since spring 2014.

5.8 Groundwater Dependent Ecosystems

A wetland is an area of land that is saturated with water (NOAA, website) and are often found alongside waterways and in floodplains. Wetlands vary widely due to differences in soil, topography, climate, water chemistry, and vegetation.

Wetland habitats serve essential functions in an ecosystem, including acting as water filters, providing flood and erosion control, and furnishing food and homes for fish and wildlife. They do more than sustain plants and animals in the watershed, however. Many wetlands are not wet year-round because water levels change with the seasons. During periods of excessive rain wetlands absorb and slow floodwaters, which helps to alleviate property damage and may even save lives.

In general, where groundwater intersects the ground surface, plants and animals that are supported by access to that groundwater will occur, hence the term “groundwater-dependent ecosystems.” In some cases, groundwater emerges at a point location, usually called a spring or seep, depending on the quantity of water available. Herein the term “spring” will be used to include both springs and seeps. Springs are always GDEs. In the case of wetlands supported by groundwater, often there is not a single point where the groundwater flows or emerges at the surface; rather, it usually emerges in a more diffuse manner across a large area. In some wetlands, however, springs emerge within the wetland, or a complex of wetlands and springs is present across an area. In many cases, groundwater-dependent wetlands, such as fens, are simply springs covered by unconsolidated material (such as glacial deposits, pumice, and colluvium) that become saturated to the surface. (Howard 2010).

Groundwater emerging at the ground surface is the common thread that links these features and their associated ecosystems. It is important to recognize that some wetlands are not supported by groundwater, but are formed from water that originates exclusively from precipitation and associated surface runoff. Such wetlands are called “ombrogenous” hydrological systems (National Wetlands Working Group 1997). The meaning of the term ombrogenous is “rain fed” according to Mitsch and Gosselink (2007).

Wetlands can also be associated with rivers whose source is surface water but some groundwater may be contributing to the rivers. **Figure 62** shows the location of wetlands in the subbasins.

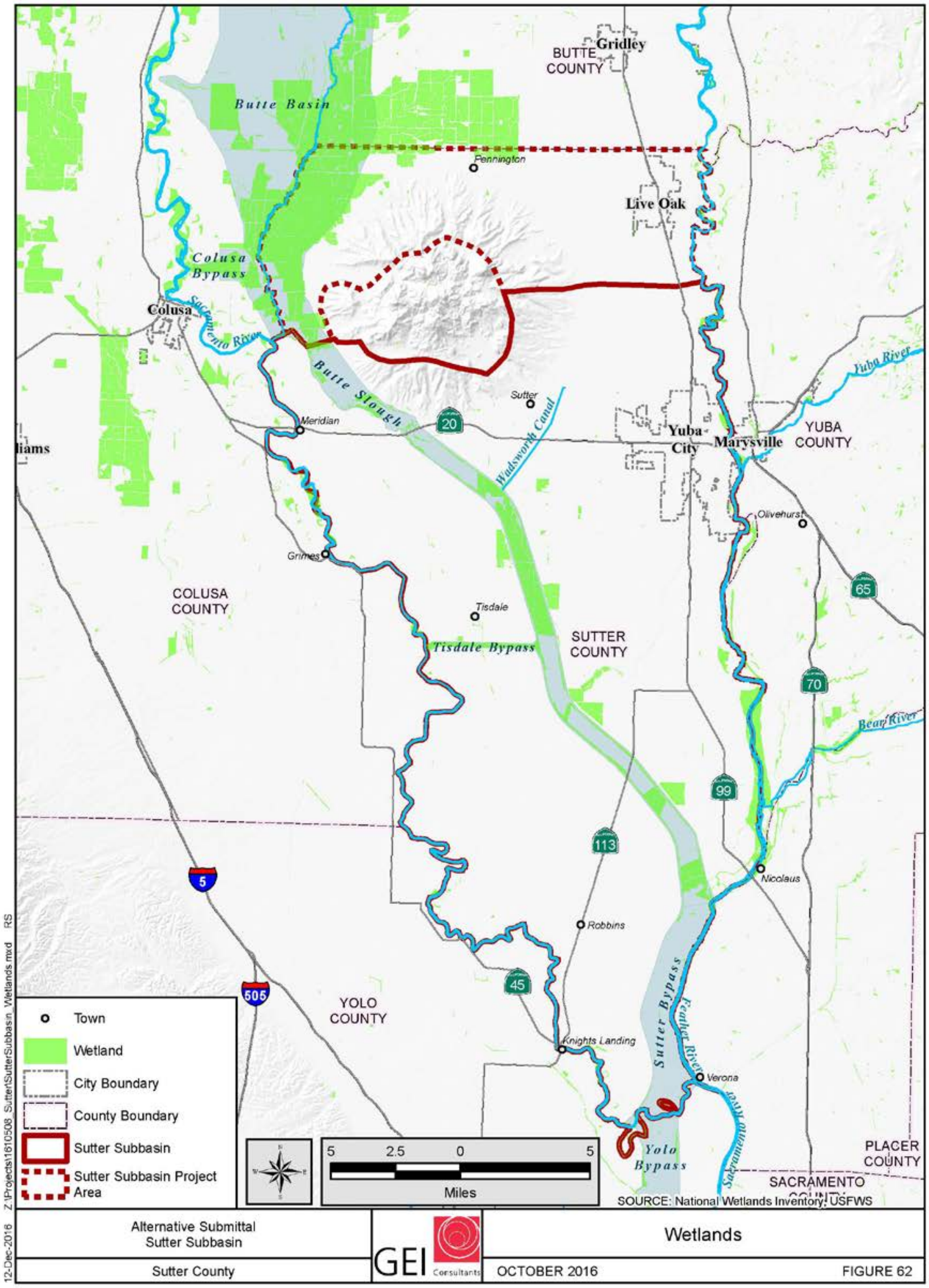


Figure 62. Wetlands

6 Water Budget

The C2VSim groundwater model was been developed by the DWR and was used to extract a water budget for the Sutter Subbasin and the Sutter County portion of the East Butte Subbasin. A base period was selected so the water budget would be representative of long-term average climatic conditions. Water budgets were developed for the historic (water year 1989 to 2009) and current periods (water year 2010 to 2015).

6.1 Climate

The State Climatologist, for purposes of identifying critically over-drafted basins in California as part of SGMA, identified the period of water years 1989 through 2009 as a base period for their evaluation. This same base period was used to provide a 20-year period to evaluate sustainability in the Subbasin. During this base period, groundwater management began in 1995 by a few of the local water agencies. The C2VSim groundwater model also extends over this entire period so a water budget is available.

To develop current periods (2010 through 2015), the Sacramento River Index was used to identify similar water type years to populate those years where model coverage is not yet available.

6.2 Groundwater Model

In 1990, DWR, U.S. Bureau of Reclamation and the California State Water Recourses Control Board joined together to develop the Central Valley Groundwater Surface Water Model (CVGSM). In 2005, the CVGSM model was upgraded to the newly developed Integrated Water Flow Model platform and was renamed the C2VSim model. The C2VSim model was adopted by DWR and many other regional and state-wide agencies, as well as non-governmental organizations, to evaluate various water management scenarios throughout the Central Valley.

The model dynamically calculates crop water demands; allocates contributions from precipitation, soil moisture, and surface water diversions; and calculates the groundwater pumpage required to meet the remaining demand. Agricultural groundwater pumping is not metered in the Central Valley, and the C2VSim model provides some of the best estimates of this pumping because they are constrained spatially and temporally by estimated demand and by surface water supplies. The model can also be used to calculate the changes in aquifer storage and can be used to estimate the water flows between rivers and groundwater aquifers.

DWR currently maintains two versions of C2VSim model (R379), C2VSim Coarse Grid (C2VSim-CG) and C2VSim Fine Grid (C2VSim-FG).

- The latest version of the C2VSim-CG was released by DWR in June 2013 and was used to develop the water budget for the Subbasin. The C2VSim-CG consist of a finite element grid that uses 1,393 nodes to form 1,392 irregular elements over an area of 19,710 square miles, and 449 river nodes to delineate 75 river reaches. The C2VSim model simulates the aquifer system of the Central Valley using three model layers. Model layer one represents the unconfined portion of the aquifer, and model layers two and three represent the confined portions. Layer three generally represent the portion of the aquifer that is not pumped. It is a three-layer model that was generally configured to represent the unconfined aquifer, a confined aquifer where pumping occurs and a deeper aquifer where pumping does not occur. The vertical distribution of groundwater pumping in the Central Valley varies spatially, but on average 30 percent of the total groundwater pumping is from layer one and the remaining 70 percent is from layer two.

- C2VSim-FG has a finer resolution along the major streams and canals to simulate stream-aquifer interaction and assessment of impacts of groundwater pumping on steam flows. The C2VSim-FG also provides more detailed water budget information for some surface processes including land and water use system, stream and canal systems, groundwater system and soil system that are useful for illustrating some of the issues of interest. The C2VSim-FG has yet to be released by DWR.

Peer review of the C2VSim model concluded calibration can be improved in certain areas by including data and information from local data sources and/or local models. In addition, calibration of stream water budgets and seepage loses model calibration of stream flow simulations can be improved.

Groundwater budgets and change in storage are produced by C2VSim. A brief discussion of the modeling findings for the Sacramento Valley are provided for a general perspective and for relation to the water budgets developed for the subbasins covered by this Alternative Submittal. The model found:

- The contribution of surface water to the total water supply has declined from 80 percent in the 1920s to 65 percent in the 2000s with less contribution in dry years such as 60 percent during the 1987 to 1992 drought. The contribution of groundwater pumping for the water supply has increased steadily from 18 percent in the 1920s to 35 percent in the 2000s with higher percentages (40 percent) during the 1987 to 1992 drought.

- Streams in the Sacramento Valley gained water from the aquifer system over most of the historic period. The aquifer beneath the Sacramento Valley discharged, on average, about 0.75 million acre-feet per year (MAFY) to streams in the 1920 and continued to increase (about 1.4 MAFY) until the mid-1940s, coinciding with the construction of Shasta Dam. Around the 1940s, groundwater pumping in the Sacramento Valley increased and groundwater levels experienced a declining trend. As a result, stream depletion due to groundwater pumping began sometime around the end of the 1987 to 1992 drought and streams appear to have become net losers of water for the first time.

- The amount of groundwater in storage has fluctuated significantly from year to year with groundwater levels declining in dry years and recovering in wet years. Since the 1940s, with increasing groundwater pumping, the aquifers apparently could not be replenished completely between droughts and the cumulative storage change had a declining trend.

- The 1987 drought caused another significant increase in the fraction of pumped water supplied from reductions in groundwater storage (and a corresponding drop in water levels), and toward the end of that drought, more than 20 percent of the groundwater withdrawn is estimated to have come from reductions in aquifer storage. After the 1987 to 1992 drought the rate of groundwater level declines slowed, but by this point, somewhere in the vicinity of the early 1990, some of the pumping supply began coming from seepage from streams. This change signals the point at which the rivers and streams of the Sacramento Valley switched from net gaining to net loosing streams, giving up more flow to the Valley groundwater basins than they receive.

- Groundwater levels in the Sacramento Valley did not change significantly from 1925 to 2009 due to its greater surface water supply.

- Many tributaries in the Sacramento Valley were net losers by the 1920s. On the other hand, major streams like the Feather and Sacramento rivers were net gaining streams. Since that time, agricultural development occurred and resulted in some changes. By the 1960s, the Yuba River and Butte Creek became net losers. By the 2000s, portions of the Sacramento River between the Sutter Buttes and Feather River became net losers. This reach is one of the most sensitive reach to changes in the hydrology.

DWR is in progress of updating the C2VSim model and the C2VSim-FG may be released in 2017. Five-year updates to this Alternative Submittal will incorporate the new model results.

6.3 Historic Water Budget

The historic period selected to demonstrate sustainability is from 1989 to 2009, a period of 21 years, during which time in the Sutter County agricultural land use increased by about 37,500 acres but mostly within the last three years of the base period. The average SRI for the base period was 7.88 slightly below the long-term average of 8.19 (1907 through 2015). As shown in Table 5, the average annual precipitation during this period was 18.08 inches, about 1 inch greater than the historic average. The average annual temperatures for the Sacramento Drainage Unit during the base period ranged from 54 to 56 degrees Fahrenheit, which is above the long-term (1901 to 2000) average of 53.9 degrees Fahrenheit (NOAA, 2016).

The water budget for the historic period was obtained from C2VSim groundwater model. The water budget for the historic period is shown on **Table 14**. **Table 15** contains the water budget by water year. The annual cumulative change in storage is shown on **Figure 63**. **Figures 64** and **65** show the annual inflows and outflows, respectively. **Figure 66** shows the groundwater model projections of change in storage versus groundwater pumping. **Figure 67** shows the modeled change in groundwater storage. **Figure 68** shows the differences of groundwater levels for the modeling period from wells with groundwater levels at the start and finish of the base period (October 1988 to October 2009) which show a different pattern and depths of the change in groundwater levels from the modeling.

Over 90 percent of the total inflow to the Subbasin is from four sources of water; recharge from rivers, net deep percolation, subsurface inflow, and diversion recoverable gains (losses from canals). The water budget shows the largest inflow component is recharge from lakes and streams which for the Subbasin is from the upper reaches of Feather and Sacramento Rivers. It constituents about 70 percent of total inflow and ranges from 109,000 AFY to 774,000 AFY.

Table 14. Water Budget Summaries

Water Balance Summary
Sutter B-118 Subbasin

Historical Results from C2VSIM Simulation

Inflow	1989-2009	Outflow	1989-2009
Component	**Average Annual (AFY)**	**Component**	**Average Annual (AFY)**
Total Percolation	64,497	Total Pumping	170,127
Lakes and Streams Inflow	328,122	Lakes and Streams	253,003
Boundary Recharge Inflow	0	Boundary Recharge Outflow	0
SubSurface Inflow	29,561	SubSurface Outflow	35,078
Diversion Recoverable Gains	30,637	Tile Drain Outflow	0
Gain from Subsidence	369	Loss from Subsidence	302
Total Average Inflow	**453,186**	**Total Average Outflow**	**458,509**

Current Estimates based on SRI

Inflow	2010-2015	Outflow	2010-2015
Component	**Average Annual (AFY)**	**Component**	**Average Annual (AFY)**
Total Percolation	64,893	Total Pumping	175,671
Lakes and Streams Inflow	322,726	Lakes and Streams	238,842
Boundary Recharge Inflow	0	Boundary Recharge Outflow	0
SubSurface Inflow	30,101	SubSurface Outflow	34,666
Diversion Recoverable Gains	30,865	Tile Drain Outflow	0
Gain from Subsidence	421	Loss from Subsidence	296
Total Average Inflow	**449,007**	**Total Average Outflow**	**449,475**

Water Balance Summary
East Butte B-118 Subbasin within Sutter County

Historical Results from C2VSIM Simulation

Inflow	1989-2009	Outflow	1989-2009
Component	**Average Annual (AFY)**	**Component**	**Average Annual (AFY)**
Total Percolation	12,384	Total Pumping	38,167
Lakes and Streams Inflow	17,532	Lakes and Streams	13,972
Boundary Recharge Inflow	14	Boundary Recharge Outflow	0
SubSurface Inflow	20,483	SubSurface Outflow	19,338
Diversion Recoverable Gains	17,990	Tile Drain Outflow	0
Gain from Subsidence	74	Loss from Subsidence	60
Total Average Inflow	**68,476**	**Total Average Outflow**	**71,538**

Current Estimates based on SRI

Inflow	2010-2015	Outflow	2010-2015
Component	**Average Annual (AFY)**	**Component**	**Average Annual (AFY)**
Total Percolation	11,973	Total Pumping	41,643
Lakes and Streams Inflow	18,765	Lakes and Streams	14,914
Boundary Recharge Inflow	11	Boundary Recharge Outflow	0
SubSurface Inflow	20,816	SubSurface Outflow	20,280
Diversion Recoverable Gains	17,520	Tile Drain Outflow	0
Gain from Subsidence	70	Loss from Subsidence	57
Total Average Inflow	**69,154**	**Total Average Outflow**	**76,895**

Table 15. Water Budget by Water Year – Sutter Subbasin

Water Year	Water Year Classification SRI	Total Percolation	Lakes and Streams Inflow	Boundary Recharge Inflow	SubSurface Inflow	Diversion Recoverable Gains	Gain from Subsidence	Total Inflow	Total Pumping	Lakes and Streams	Boundary Recharge Outflow	SubSurface Outflow	Tile Drain Outflow	Loss from Subsidence	Total Outflow	Annual Change in Stoarge
1989	D	50,670	184,429	0	33,498	29,891	640	299,128	152,794	150,748	0	26,929	0	232	330,704	-31,576
1990	C	45,057	113,231	0	32,544	29,828	411	221,071	121,890	110,295	0	26,824	0	248	259,257	-38,186
1991	C	42,399	150,777	0	34,193	26,650	685	254,703	191,241	97,709	0	26,789	0	191	315,930	-61,226
1992	C	40,065	151,571	0	32,372	26,623	462	251,094	155,940	88,828	0	27,112	0	206	272,086	-20,993
1993	AN	53,082	392,246	0	31,670	28,749	256	506,004	134,673	267,969	0	29,172	0	325	432,139	73,865
1994	C	58,040	146,853	0	35,353	29,172	721	270,139	235,335	91,484	0	31,737	0	232	358,788	-88,649
1995	W	60,016	784,425	0	30,363	28,033	315	903,152	156,365	517,327	0	36,184	0	524	710,401	192,752
1996	W	46,547	415,633	0	29,111	28,440	365	520,096	168,267	368,229	0	34,514	0	313	571,323	-51,227
1997	W	64,776	533,152	0	29,060	31,325	429	658,742	184,442	432,618	0	36,573	0	429	654,063	4,680
1998	W	69,707	760,654	0	24,707	27,029	331	882,429	149,301	554,569	0	39,443	0	469	743,783	138,646
1999	W	70,933	300,165	0	25,378	32,621	337	429,434	158,087	324,028	0	37,308	0	264	519,686	-90,252
2000	AN	74,014	379,966	0	26,377	33,567	312	514,235	158,397	316,428	0	37,159	0	301	512,285	1,950
2001	D	65,585	129,198	0	27,929	30,697	252	253,661	162,091	135,412	0	33,842	0	185	331,529	-77,868
2002	D	69,147	209,473	0	27,325	31,942	239	338,127	133,950	166,326	0	32,799	0	257	333,331	4,796
2003	AN	65,536	344,952	0	29,911	29,934	299	470,632	185,397	253,107	0	34,569	0	283	473,357	-2,724
2004	BN	82,515	362,185	0	28,988	34,662	317	508,667	185,866	274,218	0	38,151	0	313	498,548	10,119
2005	AN	74,388	215,925	0	28,278	31,298	260	350,149	144,508	177,782	0	36,159	0	266	358,716	-8,567
2006	W	69,901	663,009	0	25,916	31,736	247	790,809	133,761	495,299	0	40,249	0	367	669,675	121,134
2007	D	73,115	151,007	0	29,743	33,686	406	287,957	212,768	161,758	0	40,520	0	247	415,292	-127,335
2008	C	82,009	168,306	0	30,966	33,662	389	315,331	221,057	118,650	0	41,145	0	291	381,142	-65,811
2009	D	83,113	189,711	0	31,035	33,090	344	337,294	209,199	108,018	0	41,313	0	320	358,850	-21,556
Average		63,839	321,279	0	29,748	30,602	382	445,850	169,301	248,133	0	34,690	0	298	452,423	-6,573

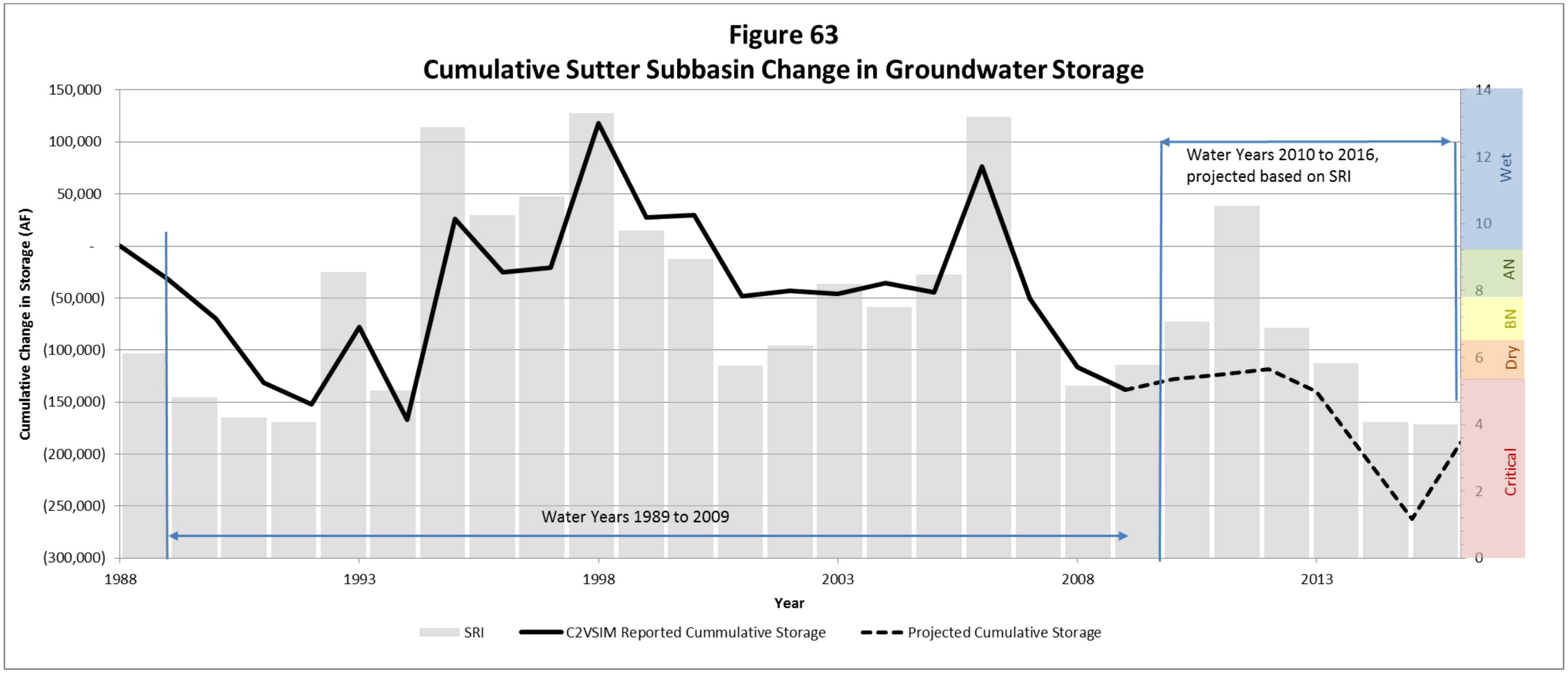


Figure 63. Sutter Subbasin Change in Groundwater Storage

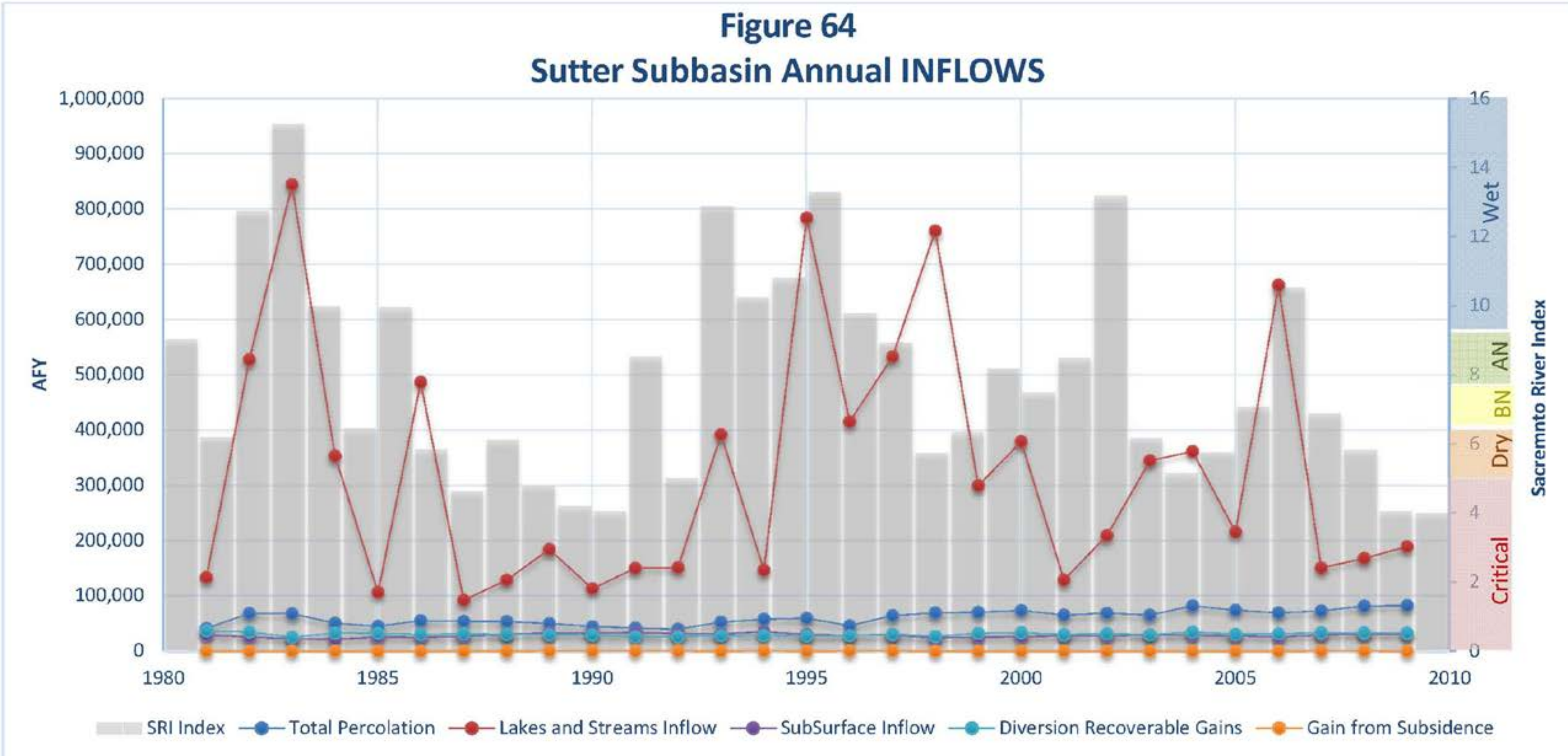


Figure 64. Sutter Subbasin Annual Inflows

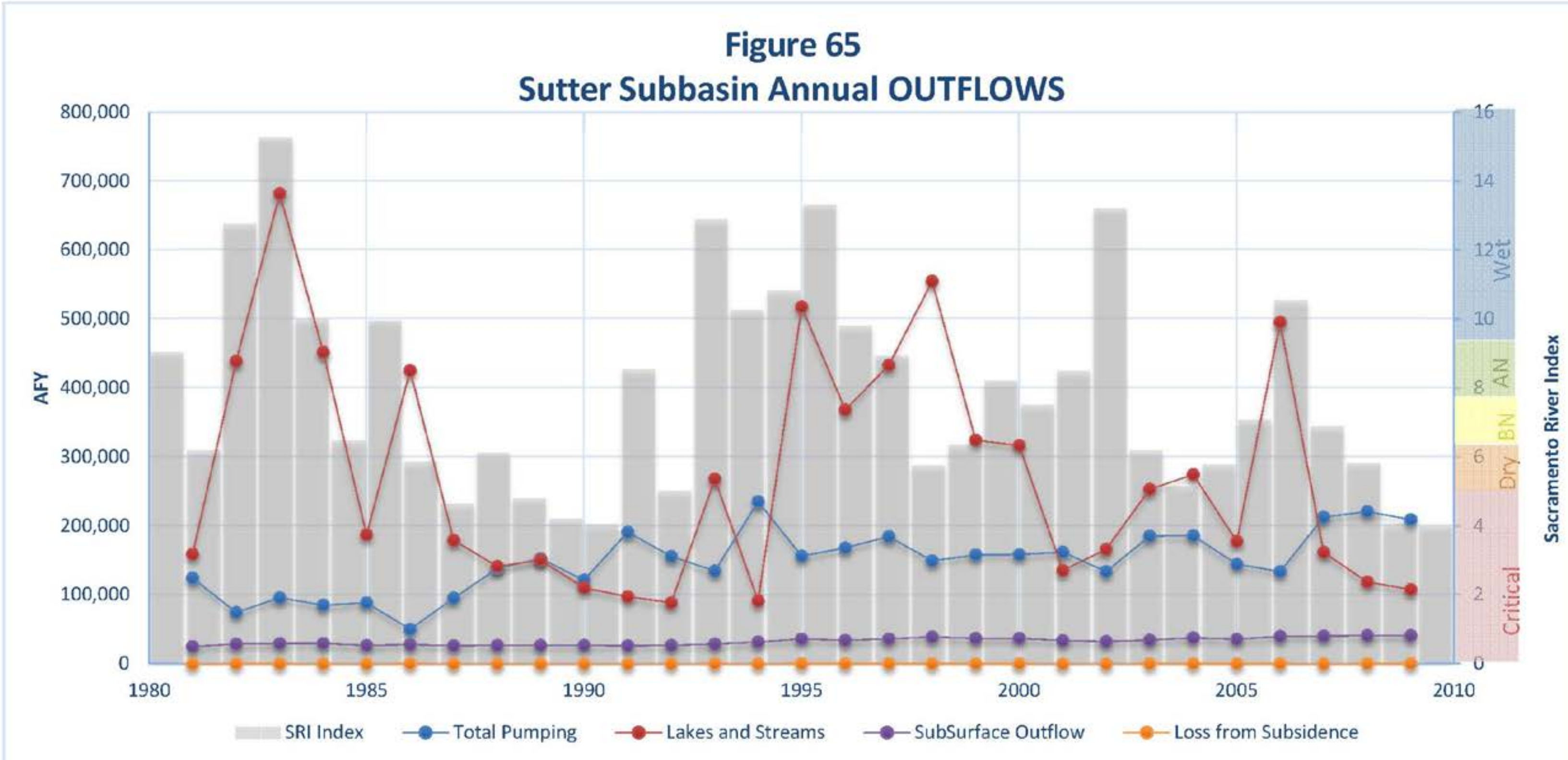


Figure 65. Sutter Subbasin Annual Outflows

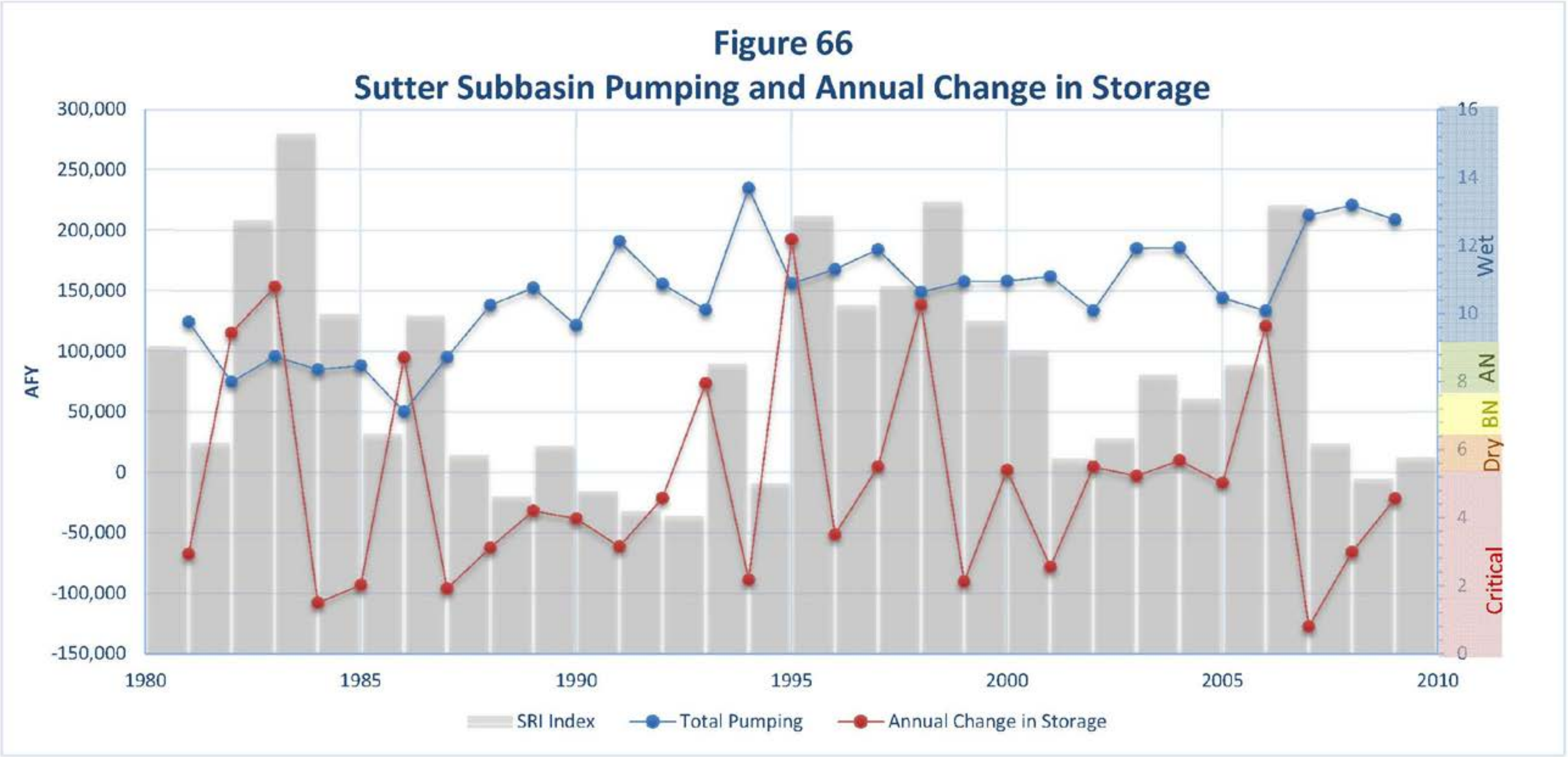


Figure 66. Sutter Subbasin Pumping and Annual Change in Storage

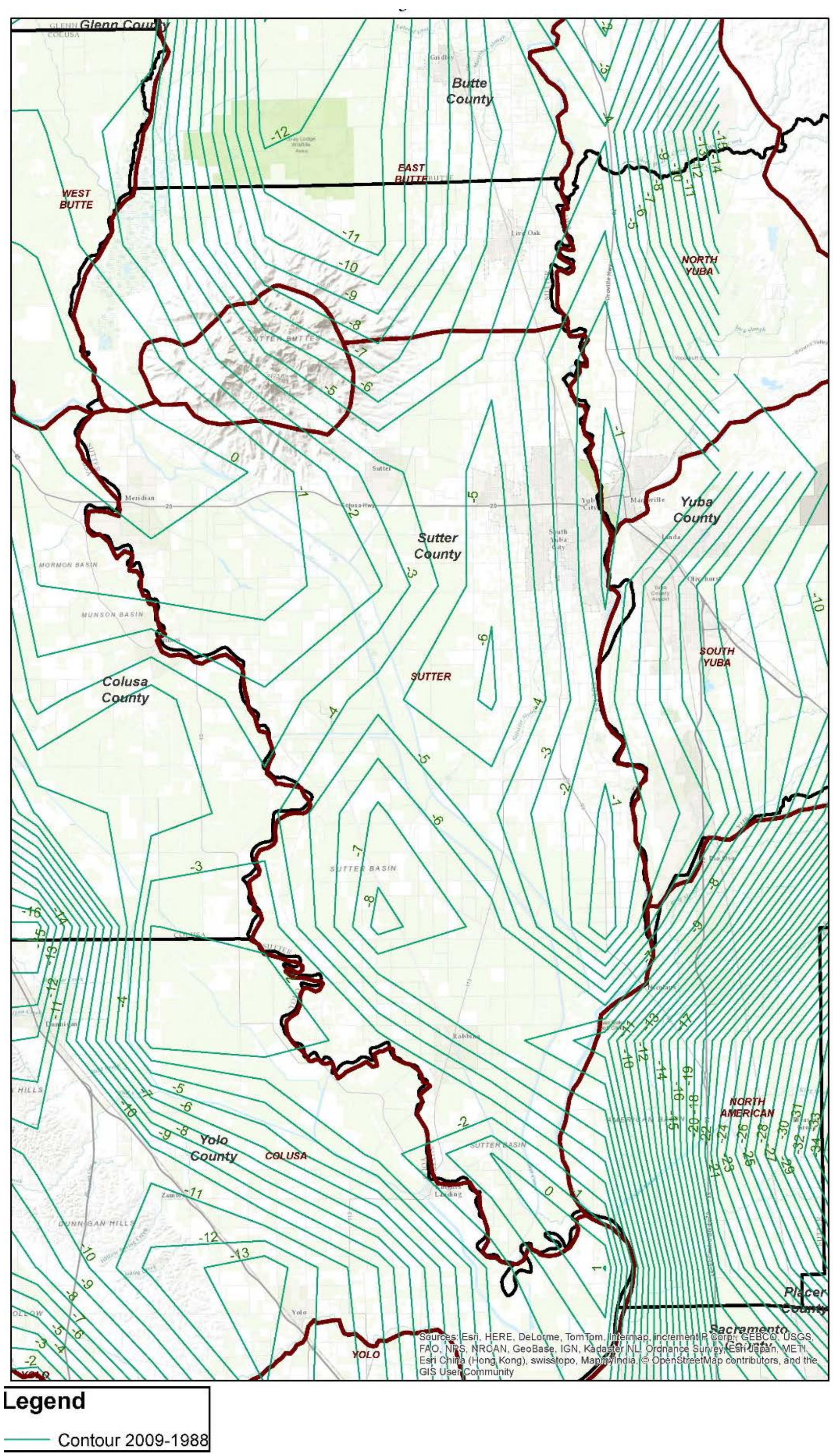


Figure 67. C2VSim Change in Water Levels Fall 1988 to Fall 2009

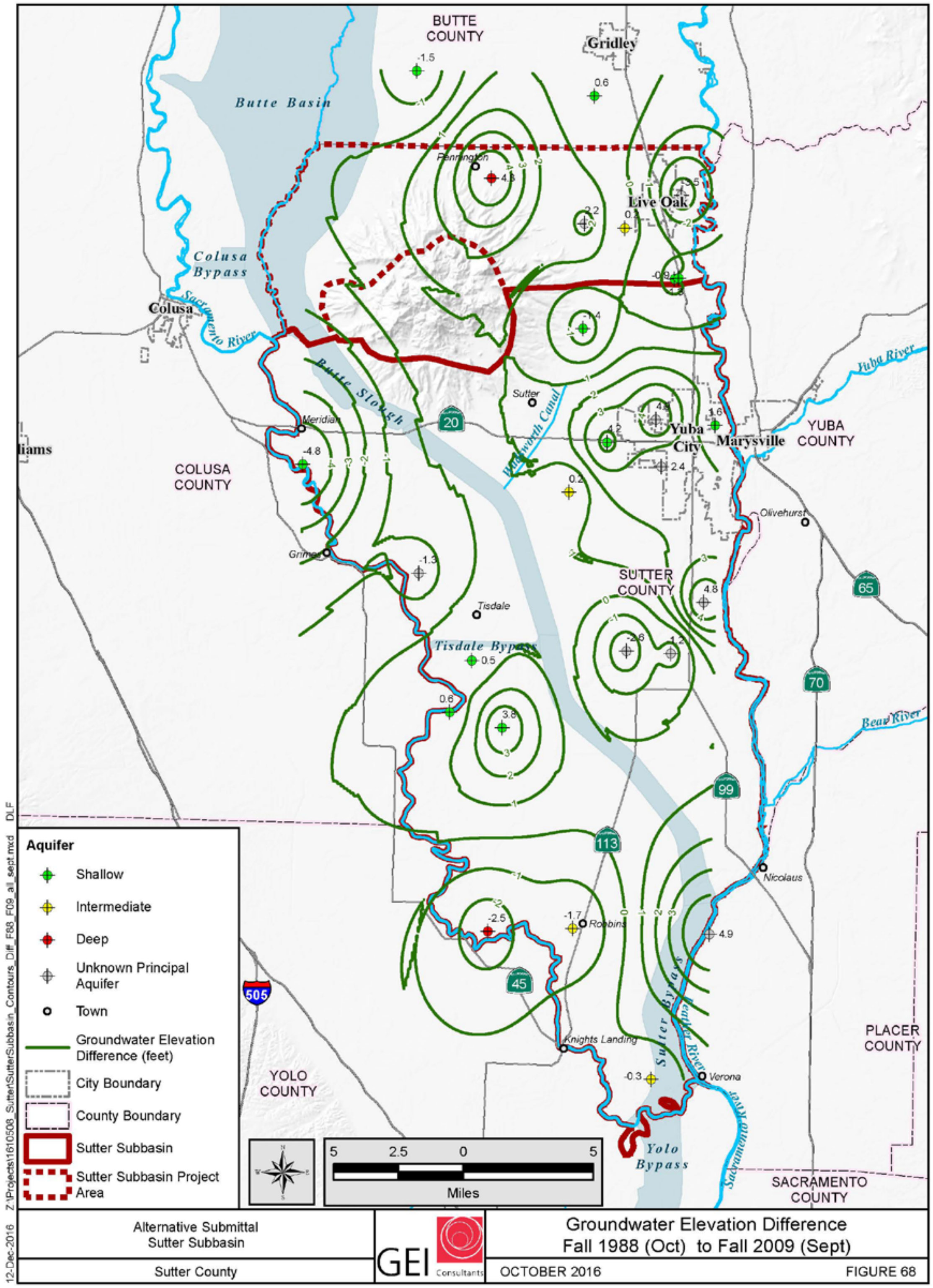


Figure 68. Groundwater Elevation Difference Fall 1988 (Oct) to Fall 2009 (Sep)

The next largest component of inflow to the basin is from net deep percolation and is about 14 percent of the total inflow. It ranges from about 40,000 AFY to 80,000 AFY. Subsurface inflow and diversion recoverable gains (from canal seepage) are both about 7 percent of the total inflow.

Over 90 percent of the total outflow from the basin is from groundwater discharge to river and groundwater pumping. The largest component of outflow (55 percent) is discharge of groundwater to rivers (lakes and streams), which for the Subbasin is to the lower reaches of the Feather and Sacramento Rivers. The outflow ranges from about 91,000 to 558,000 AFY. The next largest component is pumping, which constitutes about 37 percent of the total outflow, and ranges from 122,000 AFY to 235,000 AFY. Subsurface outflow is about 7 percent of the total outflow and ranges from about 27,000 to 40,000 AFY.

The basin on average has inflow of about 448,000 AFY and 454,000 AFY outflow. For the base period, the water budget shows the Subbasin to be in deficit by about 138,000 AF or about 3 percent of the useable groundwater in storage. The deficit has not occurred in a linear fashion (6,600 AFY), which would have resulted in continuous groundwater declines. The deficit appears to be related to the last three years of the base period, which were dry to critically dry years, when pumping increased from about 160,000 AFY (16 year period) to above 200,000 AFY in apparent response to an increase in rice acres; however, this was prior to implementation of the groundwater management plan and, as shown during the 2014 and 2015 drought, growers voluntarily reduced the acres of rice to match water supply.

The water budget changed just after the base period when Yuba City completed conversion of the Hillcrest Water Company from groundwater to surface water. In 2009, groundwater use was about 1,300 AF. Although limited information is available the conversion reduced groundwater pumping by about 1,300 AFY. In addition, with the surface water supply and some of the residents still using private septic systems, groundwater recharge to the basin increased. The City uses an average of 300 gallons per day per resident for determining sewer discharges. About 3,800 properties still use septic systems.

The projected annual increase in recharge to the Subbasin from septic systems is about 1,300 AFY. The total changes to the water budget is 2,600 AFY, leaving an annual deficit of about 4,100 AF. The deficit is based on a 450,000 AFY inflow to the basin or about 0.001 percent of the total inflows, well within the accuracy of the model. These changes bring the Subbasin very close to being in balance.

As shown on **Figure 66,** annual changes in groundwater storage, the operational range of current pumping range, from about plus 200,000 AFY to negative 130,000 AFY (from starting groundwater levels of zero assigned for Fall 1988). During this same period, the trend in pumping increased, from 50,000 AFY in 1984 to as much as 240,000 AFY in 1994. All of this change in storage occurring within a 30 foot range of groundwater levels or less than 5 percent of the saturated sediment thickness.

Uncertainties exist in the water budget:

- The groundwater model projected groundwater levels for each year and a change-in-storage over the base period. The modeled deficit is based on actual groundwater-level measurements, but as shown in **Table 10,** very few measurements were available which increases the uncertainty in the calibration of the model to physical data. **Appendix L** contains both modeled and groundwater contours developed for this submittal to assess the accuracy of the modeled calibration data. Use of automated contouring packages can allow for large depressions, where as shown in previous figures, the pumping depressions are fairly localized. By not having a greater number of wells for calibration, uncertainty increases in the amount of change-in-storage and therefore model calibration.

- The groundwater budget shows recharge from lakes and streams averages about 315,000 AFY, and represents about 70 percent of total inflow to the Sutter Subbasin. Net deep percolation averages about 64,000 AFY. Diversion recoverable gains averages about 31,000 AFY. These three sources comprise about 410,000 AFY. More recent estimates of deep percolation from precipitation and applied water by agriculture are about 292,000 AFY (Davids Engineering, 2014). It appears the estimated sources of inflow in the groundwater flow model were not correctly proportioned and that less water is being recharged by the rivers. **Table 16** shows a potential reapportionment of the inflow.

Table 16. Re-apportioned Inflows

Inflow Component	Historic Water Budget (average AFY)	Water Budget Inflow Revisions (average AFY)
Rivers	315,000	118,000
Net percolation	64,000	292,000
Diversion Recoverable	31,000	
Total	**410,000**	**410,000**

- The base period used for this analysis was selected by DWR using precipitation. As discussed above, recharge from applied water is significant and therefore the base period for the subbasins may need to be selected using SRI index years.

- The calibration of the model is based on groundwater levels. As seen in groundwater contours, when data are abundant, no large pumping depressions exist but there are many small ones. The amount of change in storage is affected in how much data is available for calibration and the method used to develop groundwater contour calibration data. Use of automatic groundwater contouring software, due to the lack of measurements, will create large cones of depressions which are not necessarily present.

6.4 Sustainable Yield

The Sustainable Groundwater Management Act of 2014 defined sustainable yield as “the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result.” Undesirable result means one or more of the following effects caused by groundwater conditions occurring throughout the basin:

chronic lowering of groundwater levels, depletion of interconnected surface water, significant and unreasonable loss of storage, subsidence, saltwater intrusion, and degradation of water quality. None of these undesirable results are present in both the subbasins although the base period has had a less than significant loss of groundwater storage.

The average quantity of groundwater extracted during the base period was 169,000 AF. Due to the projected deficit by C2VSim the sustainable yield would be 162,000 AFY. However, based on the comparison of groundwater levels at wells present at the start and end of the base period and that the groundwater levels have risen basin wide by about 0.5 feet, the sustainable yield would be slightly greater than 169,000 AFY.

The sustainable yield can be increased if conjunctive use projects are implemented to increase recharge to the subbasin. The annual reports and five-year update will document any conjunctive use changes or revisions to this Alternative Submittal.

6.5 Current Water Budget Forecast

A current water budget was developed for the period of water year 2010 through 2016, during the period after the groundwater C2VSim modeling period. The water budget was created by selecting similar historic SRI years to those present during the current period and using those representative years from the groundwater model.

The current period provides estimates for those hydrologic conditions for the period of water year 2010 through 2015. The average SRI was 6.41 less than the long-term average of 8.06 (1906 through 2015). As shown in Table 5, the average annual precipitation during this period was 13.73 inches, about 4 inches less than the historic average. The average annual temperatures for the Sacramento Drainage Unit during the base period ranged from 53.8 to 57.6 degrees Fahrenheit, which is above the long-term (1901 to 2000) average of 53.9 degrees Fahrenheit (NOAA, 2016)

During this period, irrigated agricultural land, based on the entire Sutter County, was relatively constant at about 307,000 acres from 2010 through 2013, but due to the drought the acres decreased to about 271,000 to 275,000 acres, during 2014 and 2015. Most of the decrease was rice. Orchard areas were relatively stable with only a slight increase in 2014. The projections do not include:

- Water supplies for Yuba City also shifted in 2010 from groundwater to surface water, reducing the draw from the basin by about 1,300 AFY. In 2010, surface water was supplied to residents, some of which have septic systems so water is (about 1,300 AFY) additional recharge to the subbasin. This totals about 2,600 AFY of reduced pumping and recharge.

- In 2010, 2013, 2014, and 2015, water transfers occurred but only ranged from about 2,300 AFY to 6,900 AFY in the Subbasin.

- Beginning in 2012, the entire County was managed in accordance to the GMP. Water transfers by BWD, SEWD, and Garden Highway also occurred during this period.

6.6 Projected Water Budget Forecast

This section provides a non-qualitative evaluation to assess, based on forecasted changes, whether groundwater conditions in the Subbasin will change significantly and change its sustainability.

Total agricultural water use in the subbasins is not anticipated to increase as the land use and crop types are anticipated to remain essentially the same other than for future decreases due to urban sprawl, which will further reduce demand. There may be some conversion of crop irrigation practices from flood irrigation to drip irrigation which can reduce groundwater use, but also reduce applied water recharge. Overall, these changes will likely result in a net zero effect.

Future urban water use for Yuba City will be supplied by surface water and will not affect the groundwater resources in the Sutter Subbasin. The City has one backup water supply well that it maintains for use in case of surface water supply shortages and is planning construction of one new well that may increase its occasional use from 1,300 AF up to 3,200 AF. The town of Sutter has adequate water supply but disposal of wastewater will limit growth. Growth in the town of Robbins is expected to be small and is constrained by the ability to pay for and treat its groundwater supply which contains arsenic over the MCL.

Future groundwater pumping projections for the Sutter County portion of the East Butte Subbasin indicate the town of Live Oak may increase groundwater pumping by up to 2,200 AFY through 2025, which will mostly be compensated for by reduction of groundwater pumping. Thereafter, pumping is projected to increase by up to 4,300 AFY, but the projections have a high degree of uncertainty.

Overall, agriculture and urban growth on groundwater are not expected to significantly increase in the future.

7 Sustainable Management Criteria

This chapter describes the criteria and the approach by which the stakeholders established sustainability goals and development of measureable objectives and minimum thresholds. A section for each of the sustainability indicators is provided that presents locally defined undesirable results, measureable objectives and minimum thresholds that will remain until additional information such as an updated CV2Sim-FG model is available at which time the results will be included in the five-year update of this Submittal.

The measurable objectives and the minimum thresholds were established for each sustainability indicator, using the same metrics and monitoring sites and conservatively applying the C2VSim modeling results even though the change in storage may not be entirely correct. The measurable objectives were established to provide a reasonable margin of operational flexibility under adverse conditions. The development of the measureable objectives took into consideration various components such as historical water budgets, seasonal and long-term trends, and periods of drought, while being commensurate with levels of uncertainty. This Submittal used representative monitoring sites rather than the entire 168 sites in the monitoring well network.

7.1 Sustainability Goal

The goal of the stakeholders is to maintain groundwater sustainability within the Subbasin, allow some reduction in groundwater levels in the shallow aquifer for agriculture, and maintain groundwater flows to the rivers. Based on the historic and current water budget the Subbasin is being sustainably managed.

Groundwater levels in the Sutter Subbasin have been relatively stable in the shallow, intermediate and deep aquifers. The overall change in storage during the baseline conditions from 1989 through 2009, during the modeling period was -138,000 AF based on an average decline of groundwater levels in the subbasin of about 5 feet. However, as shown on **Figure 68**, when using data from the monitoring network that has been established for this Submittal, the actual change in groundwater levels during the base period may be plus 0.5 feet basin-wide. In either case the Subbasin is essentially in balance. Since 2009 any deficit evident in the base period has been reduced further by about 2,700 AFY due to conversion of urban groundwater use to surface water. The deficit has also been lowered by a reduction in rice acreage during the last three years. The baseline conditions that are presented precede SGMA and therefore terms from SGMA have been retroactively attached to historical groundwater hydrographs from the monitoring network.

The selected representative wells for which hydrographs are presented are being used as proxies for the following sustainability indicators: Chronic Lowering of Groundwater Levels, Change-in-Storage, Subsidence, and Depletion of Surface Water. For each of the sustainability indicators a measureable objective and minimum threshold have been developed. The management strategies of the stakeholders will continue the sustainable management of the Sutter Subbasin into the future by continuing to meet established measureable objectives and minimum thresholds.

7.2 Processes to Establish Sustainable Management Criteria

The stakeholders developing this Alternative Submittal participated in a forum to review the hydrogeologic conceptual model, groundwater conditions, and water budget estimates to determine whether there were significant and unreasonable effects for any of the sustainability indicators which would cause undesirable results.

The stakeholders have presented the information to their Board of Supervisors or Board of Directors in public meetings. The public comments were documented in their meeting minutes, and pertinent comments were included in this Submittal. Section 9 provides additional documentation of the process and meetings during the development of this Alternative Submittal.

7.3 Relationships between Sustainability Indicators

The following description of beneficial uses is from the Sacramento and San Joaquin Basin Plan (SWRCB, 2016) to provide a relationship between sustainability indicators and beneficial uses. State law defines beneficial uses of California's waters that may be protected against quality degradation to include (and not be limited to) "...domestic; municipal; agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves".

Surface water beneficial uses have been designated for the following portions of the surface water adjacent to the Sutter Subbasin and the Sutter County portion of the East Butte Subbasin as:

- Sacramento River – Colusa Drain to the "I" Street Bridge as municipal and domestic supply, irrigation, recreational, warm water habitat including habitat and spawning, and wildlife habitat.

- Feather River - The fish barrier dam to the Sacramento River as municipal and domestic supply, irrigation, recreational, warm water habitat including habitat and spawning, and wildlife habitat.

- Sutter Bypass – From the Colusa Drain on the Sacramento River to the Feather River are irrigation, recreational, both cold and warm water habitat, and navigation.

- Butte Creek including Butte Slough - as irrigation, stock watering, recreational, both cold and warm water habitat including habitat and spawning, and wildlife habitat.

All groundwater in the region is to be considered as suitable or potentially suitable, at a minimum, for municipal and domestic water supply, agricultural supply, industrial service supply, and industrial process supply.
Within both the Sutter Subbasin and the Sutter County portion of the East Butte Subbasin land use is farmland and agricultural open space, preserves, and rural communities as shown on Figures 3 through 6.

Water quality objectives were designated at the drinking water maximum contaminant levels for arsenic, iron, and manganese. Specific to surface water in the Sacramento River the electrical conductivity ranges from 230 µS/cm above Knights Landing and 340 µS/cm below Knights Landing. The changes in the electrical conductivity generally coincide with locations where elevated salinity in the shallow aquifer may discharge to the Sacramento River. Groundwater quality objectives are intended to meet designated beneficial uses. At a minimum, groundwater designated for use as domestic or municipal supply shall not contain concentrations of chemical constituents in excess of the MCLs. These objectives do not require improvement over naturally occurring background concentrations.

The sustainability indicators were developed based on these beneficial uses and land uses. The relationships for the sustainability indicators, the monitoring networks and their metrics to protect those beneficial uses are provided in Table 17.

7.4 Change-in-Storage Sustainability Indicator

Change-in-storage is a sustainability indicator used to compare the groundwater in storage at two points in time. Groundwater levels have remained stable within the Subbasin during the base period so there has been little to no reduction in storage, as shown in **Table 10**. Groundwater levels declined through the 2010 drought, but in most wells groundwater levels recovered to at least spring 2015 levels, and in some cases, to their pre-drought levels as shown on the hydrographs contained in **Appendices M** through **O**. All of the groundwater levels are expected to recover to their pre-2010 drought levels, as demonstrated by recovery after historic droughts such as after the 1987-1992 drought.

The coarse-grid C2VSim groundwater model was used to estimate the groundwater in storage for each year over the base period. Using the Fall 1988 groundwater levels as the zero change-in-storage starting point, the model results indicate the annual fluctuation in the change-in-storage (operating range) has fluctuated from a deficit of (-) 127,000 AFY to a surplus (+) 193,000 AFY. The deficit projected by CV2Sim model of 127,000 AF represents a change of about 4 percent of the total 3,100,000 AF of useable groundwater in storage.

According to Uncodified Finding (a) (11) from the SGMA legislation, “sustainable groundwater management in California depends upon creating more opportunities for robust conjunctive management of surface water and groundwater resources.” The Subbasin has groundwater levels that are relatively close to ground surface allowing the flexibility in storage that is needed for the Subbasin to be exercised conjunctively for local and state benefit.

There are 25 wells with long-term hydrographs within the monitoring network that are used as representative wells for determining change-in-storage. These wells are presented in **Appendix N**. These monitoring wells were used to establish minimum thresholds which define the lowest level to which the groundwater levels can drop before significant and unreasonable Subbasin-wide undesirable results will occur. If groundwater levels drop in all representative monitoring wells below the minimum threshold, a significant and undesirable result for the entire Subbasin has occurred. The measureable objective has been established at the lower operating range of the Subbasin during the base period. Measureable objectives and minimum threshold levels have been established using monitoring wells that monitor each principal aquifer.

Table 17. List of Sustainability Indicators

Sustainability Indicator	Monitoring Locations			Beneficial Uses and Concerns		Metrics		
	Monitoring Wells	Aquifer Monitored	Representative Monitoring Points	Beneficial Uses	Potential Impacts/Concerns to Beneficial Uses	Minimum Threshold (ft msl)	Measureable Objective (ft msl)	Number of Wells that can fall below MT without basin wide undesireable results
Chronic lowering of groundwater levels , Change-in-storage and Subsidence	389803N1217675W001	Shallow		Agricultural/Domestic	Groundwater Levels/ Nitrate	-1	17	5
	389885N1218051W001	Shallow		Agricultural/Domestic	Groundwater Levels/ Nitrate	8	30	
	390027N1216367W001	Shallow		Agricultural/Domestic	Groundwater Levels/ Nitrate	12	30	
	390176N1217902W001	Shallow		Agricultural/Domestic	Groundwater Levels/ Nitrate	8	21	
	391251N1219138W001	Shallow		Agricultural/Domestic	Groundwater Levels/ Nitrate	19	42	
	391406N1216961W001	Shallow		Agricultural/Domestic	Groundwater Levels/ Nitrate	23	43	
	391512N1216190W001	Shallow		Agricultural/Domestic	Groundwater Levels/ Nitrate	19	51	
	392038N1217147W001	Shallow		Agricultural/Domestic	Groundwater Levels/ Nitrate	36	59	
	387859N1216565W001	Intermediate		Agricultural/Domestic	Groundwater Levels/ Nitrate/ Arsenic	-2	19	
	388691N1217143W001	Intermediate		Agricultural/Domestic	Groundwater Levels/ Nitrate/ Arsenic	-3	12	
	391124N1217226W001	Intermediate		Agricultural/Domestic	Groundwater Levels/ Nitrate/ Arsenic	22	35	
	392603N1216860W001	Intermediate		Agricultural/Domestic	Groundwater Levels/ Nitrate/ Arsenic	47	65	
	393257N1218830W001	Intermediate		Agricultural/Domestic	Groundwater Levels/ Nitrate/ Arsenic	34	49	
	392867N1217825W001	Deep		Agricultural/Domestic	Groundwater Levels/ Nitrate/ Arsenic	22	78	
	388666N1217749W001	Deep		Agricultural/Domestic	Groundwater Levels/ Nitrate/ Arsenic	-1	17	
	388674N1216168W001	Unknown		Agricultural/Domestic	Groundwater Levels	-2	22	
	390234N1216478W001	Unknown		Agricultural/Domestic	Groundwater Levels	10	31	
	390245N1216796W001	Unknown		Agricultural/Domestic	Groundwater Levels	12	30	
	390657N1218291W001	Unknown		Agricultural/Domestic	Groundwater Levels	15	29	
	391275N1216569W001	Unknown		Agricultural/Domestic	Groundwater Levels	9	45	
	391537N1216612W001	Unknown		Agricultural/Domestic	Groundwater Levels	13	48	
	392634N1217141W001	Unknown		Agricultural/Domestic	Groundwater Levels	49	63	
	392790N1216451W001	Unknown		Agricultural/Domestic	Groundwater Levels	48	69	
	392947N1218022W001	Unknown		Agricultural/Domestic	Groundwater Levels	52	70	
	390524N1216249W001	Unknown		Agricultural/Domestic	Groundwater Levels	3	39	
	391975N1218937W001	Shallow - East Butte		Agricultural/Domestic	Groundwater Levels/ Nitrate	28	63	
	392324N1216499W001	Shallow - East Butte		Agricultural/Domestic	Groundwater Levels/ Nitrate	43	61	
	392328N1216469W001	Shallow - East Butte		Agricultural/Domestic	Groundwater Levels/ Nitrate	43	61	
Depletions of Interconnected Surface Water	390426N1218166W001	Shallow	Sacramento River	Surface Water Supply/Groundwater Dependent Ecosystem	Reduction in suface water deliveries, impacts to GDE's	14	27	2
	391251N1219138W001	Shallow	Sacramento River	Surface Water Supply/Groundwater Dependent Ecosystem	Reduction in suface water deliveries, impacts to GDE's	26	37	
	389410N1215884W001	Shallow	Feather River	Surface Water Supply/Groundwater Dependent Ecosystem	Reduction in suface water deliveries, impacts to GDE's	-35	13	
	389571N1215858W001	Shallow	Feather River	Surface Water Supply/Groundwater Dependent Ecosystem	Reduction in suface water deliveries, impacts to GDE's	11	16	
	389820N1215923W001	Shallow	Feather River	Surface Water Supply/Groundwater Dependent Ecosystem	Reduction in suface water deliveries, impacts to GDE's	3	19	
	390458N1216114W001	Shallow	Feather River	Surface Water Supply/Groundwater Dependent Ecosystem	Reduction in suface water deliveries, impacts to GDE's	11	21	
	390657N1218291W001 [1]	Shallow	Feather River	Surface Water Supply/Groundwater Dependent Ecosystem	Reduction in suface water deliveries, impacts to GDE's	20	31	
	391512N1216190W001	Shallow	Feather River	Surface Water Supply/Groundwater Dependent Ecosystem	Reduction in suface water deliveries, impacts to GDE's	32	40	
	390176N1217902W001	Shallow	Bypass/Wetlands	Groundwater Dependent Ecosystem	Impacts to GDE's	20	25	
	392712N1216493W001	Shallow	Feather River	Surface Water Supply/Groundwater Dependent Ecosystem	Reduction in suface water deliveries, impacts to GDE's	44	49	
	391975N1218937W001	Shallow	Bypass/Wetlands	Groundwater Dependent Ecosystem	Reduction in suface water deliveries, impacts to GDE's	24	37	
Water Quality	**Monitoring Wells**	**Aquifer Monitored**	**Representative Monitoring Points**	**Beneficial Uses**	**Potential Impacts/Concerns to Beneficial Uses**	**Minimum Threshold (mg/l) / (µS/cm)**	**Measureable Objective (mg/l) / (µS/cm)**	6
	5110001-002	Municipal		Municipal Water Supply	Nitrate	110	45	
	5110001-011	Municipal		Municipal Water Supply	Nitrate	45	30	
	5110001-013	Municipal		Municipal Water Supply	Nitrate	110	45	
	5110001-005	Municipal		Municipal Water Supply	Nitrate	110	45	
	5100172-001	Municipal		Municipal Water Supply	Nitrate	45	30	
	5100112-002	Municipal		Municipal Water Supply	Nitrate	110	45	
	5100134-001	Municipal		Municipal Water Supply	Nitrate	45	30	
	5103326-001	Municipal		Municipal Water Supply	Nitrate	110	45	
	5103303-001	Municipal		Municipal Water Supply	Nitrate	110	45	
	5100109-002	Municipal		Municipal Water Supply	Nitrate	110	45	
	5101007-001	Municipal		Municipal Water Supply	Nitrate	110	45	
	5101009-001	Municipal		Municipal Water Supply	Nitrate	110	45	
	5101013-001	Municipal		Municipal Water Supply	Nitrate	110	45	
	RICE-01	Shallow		Agricultural	Elevated TDS			
	RICE-02	Shallow		Agricultural	Nitrate	45	30	
	RICE-03	Shallow		Agricultural	Nitrate	45	30	
	RICE-20	Shallow		Agricultural	Elevated TDS			
	390696N1217778W003	Deep		Agricultural/Domestic	Nitrate / Elevated TDS	45 / *2200*	30 / *900*	
	390696N1217778W004	Deep		Agricultural/Domestic	Nitrate / Elevated TDS	45 / *3750*	30 / *1600*	
	390588N1217004W001	Shallow		Agricultural/Domestic	Nitrate / Elevated TDS	45 / *2200*	30 / *900*	
	390497N1216535W001	Shallow		Agricultural/Domestic	Nitrate / Elevated TDS	45 / *3750*	30 / *1600*	
	390458N1216114W003	Deep		Agricultural/Domestic	Nitrate / Elevated TDS	45 / *2200*	30 / *900*	
	389803N1217675W001	Shallow		Agricultural/Domestic	Nitrate / Elevated TDS	45 / *2200*	30 / *900*	
	389605N1218102W002	Intermediate		Agricultural/Domestic	Nitrate / Elevated TDS	45 / *2200*	30 / *900*	
	389605N1218102W003	Shallow		Agricultural/Domestic	Nitrate / Elevated TDS	45 / *2200*	30 / *900*	
	389167N1216061W003	Deep		Agricultural/Domestic	Nitrate	45	30	
	389167N1216061W004	Deep		Agricultural/Domestic	Nitrate	45	30	
	388666N1217749W001	Deep		Agricultural/Domestic	Elevated TDS	2200	900	
	388761N1217094W001	Deep		Agricultural/Domestic	Elevated TDS	3750	1600	
	388761N1217094W002	Deep		Agricultural/Domestic	Nitrate / Elevated TDS	45 / *3750*	30 / *1600*	
	388761N1217094W003	Deep		Agricultural/Domestic	Nitrate / Elevated TDS	45 / *2200*	30 / *900*	
	388761N1217094W004	Deep		Agricultural/Domestic	Nitrate / Elevated TDS	45 / *2200*	30 / *900*	

7.4.1 Subbasin Minimum Threshold Levels:

The goal of the stakeholders is to increase the degree to which the Subbasin is exercised while maintaining the average sustainable yield of the Subbasin which is set at about 162,000 AFY and will be assessed in the future using a moving average of the last 21 water years.

During the base period, the CV2Sim model showed the maximum annual deficit was approximately 127,000 AF or 4 percent of the total groundwater in storage. To expand conjunctive use to benefit the environment and the State, it is reasonable to exercise the Subbasin to use up to 10 percent of the groundwater in storage, 310,000 AF. Exercising the Subbasin in this manner could result in groundwater levels being lowered from 11 to 18 feet below the historic low level as observed in Fall 1988. The range of 11 to 18 feet depends upon which storage coefficient for the aquifers is used. Reasonable storage coefficients range from 17,000 to 28,000 AF/foot of saturated sediments. Therefore, removal of 10 percent of the groundwater stored in the Subbasin would equate to a reduction in storage of approximately 310,000 AF. Allowing for use of up to 310,000 AF of groundwater in storage allows for increased annual pumping, especially during drought years, but overall the basin will have to remain within its long-term sustainable yield. Some short-term impacts may occur, but because the basin will remain within its long-term sustainable yield there should be no long-term undesirable results. Division of this volume by the low range storage coefficient of 17,000 AF/foot results in an estimated Subbasin-wide change in groundwater level of about 18 feet. **Figures 69 and 70** show the historic change-in-storage along with the minimum thresholds.

7.4.2 Undesirable Results of Change-in-Storage:

- depletion of the aquifer to the extent that other components of the water budget are unreasonably affected which could affect adjacent subbasins and rivers;
- any of the issues presented for chronic lowering of water levels as stated in **Section 7.5.1** Chronic Lowering of Groundwater Levels;

7.4.3 Subbasin Measurable Objective:

The measureable objective was set using water budget estimates from the C2VSim model of the historic maximum cumulative change-in-storage during the base period of 138,000 AF, as shown on **Figure 69.** The maximum annual (water year) change in storage during the base period was 127,000 AF as shown on **Figure 70**. Setting the measureable objective at the maximum cumulative change-in-storage from the base period will maintain groundwater elevations at a sufficient level to avoid creation of undesirable results. Meeting the measureable objective will also allow recharge from rivers and subsurface inflow from adjacent subbasins to be maintained within the range observed during the base period to continue to support designated water quality standards and beneficial uses.

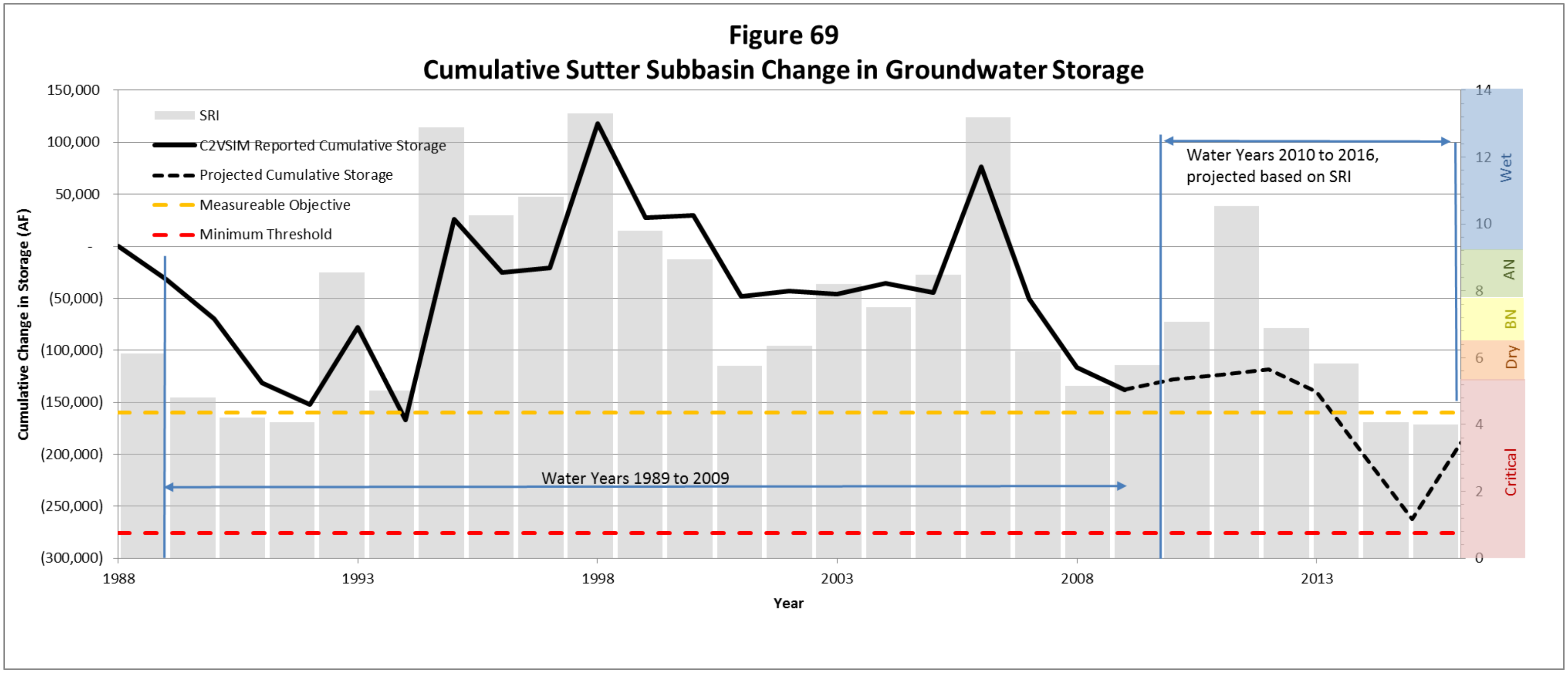


Figure 69. Sutter Subbasin Operation Range: Change in Groundwater Storage

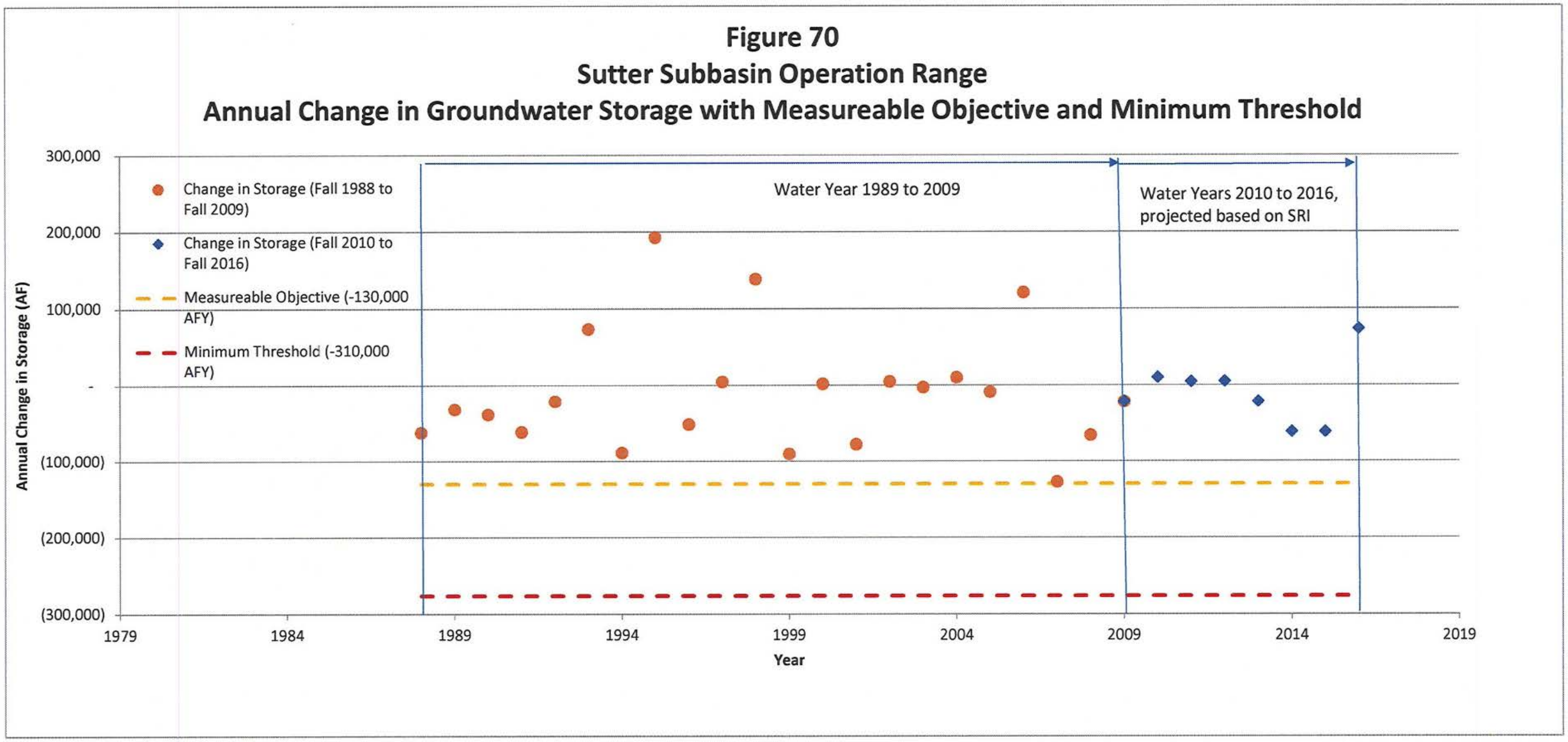


Figure 70. Sutter Subbasin Operation Range Annual Change in Groundwater Storage with Measurable Objective and Minimum Threshold

7.5 Chronic Lowering of Groundwater Levels Sustainability Indicator

The chronic lowering of groundwater levels sustainability indicator is used to compare the groundwater levels in monitoring wells throughout the Subbasin. There are 25 wells in the Subbasin with long-term hydrographs that monitor groundwater levels for this sustainability indicator. **Figure 71** shows their locations, and hydrographs from these wells are presented in **Appendix N**. The Subbasin has 168 active monitoring wells (monitored in 2016) that will continue to be used to track groundwater levels, though not all are designated for monitoring of minimum thresholds or measureable objectives.

The selection of the monitoring network was based upon wells with records that extend at least from Fall of 1988 through the present. In addition, to the extent possible wells were chosen that had construction details. Using the Fall of 1988 as a starting point allows for the incorporation of the operating range observed through the base period. Chronic lowering of groundwater levels in the Subbasin has not been observed in the monitoring network. Annually the groundwater levels range from 0 to 50 feet below ground surface.

The Subbasin contains about 600 feet of fresh-water saturated sediments. There are annual groundwater level fluctuations of up to 30 feet which represent a decline of about 5 percent of the total thickness of saturated sediments. The stakeholders want the ability to exercise the Subbasin to respond to future effects of slurry wall installations and climatic changes both of which could cause the Subbasin's groundwater levels to decline.

Groundwater levels in the Subbasin may decline to as much as 18 feet below the Fall 1988 groundwater levels. Allowing for greater fluctuations in groundwater levels could increase the sustainable yield of the Subbasin by allowing precipitation and applied water to infiltrate rather than being rejected due to the lack of storage. Lowering of the groundwater levels would benefit agriculture by allowing the crop root zones to remain unsaturated and urban areas by allowing infrastructure to remain dry.

Groundwater production in the Sutter Subbasin is not expected to increase in the future as the largest groundwater users, agricultural groundwater suppliers, have shown a stable land and water use pattern over the last 21 years. There have been no occurrences reported to DWR of wells going dry within the Sutter Subbasin during the recent drought (DWR, 2015).

7.5.1 Groundwater Level Minimum Threshold – All Aquifers

Minimum thresholds were established using selected wells with long-term records by subtracting 18 feet from the observed Fall 1988 groundwater measurement elevation. The minimum threshold levels identified in this Alternative Submittal may be exceeded for short periods during dry and critically dry years. Potential affects would be to surface water discharges and on adjacent subbasins by increasing subsurface inflows but these would be short-term and should not affect beneficial uses of surface water or groundwater or land use.

- For the portion of the monitoring network not adjacent to surface water bodies, the minimum thresholds were established 18 feet below the Fall 1988 historic groundwater levels at each of the monitoring wells.

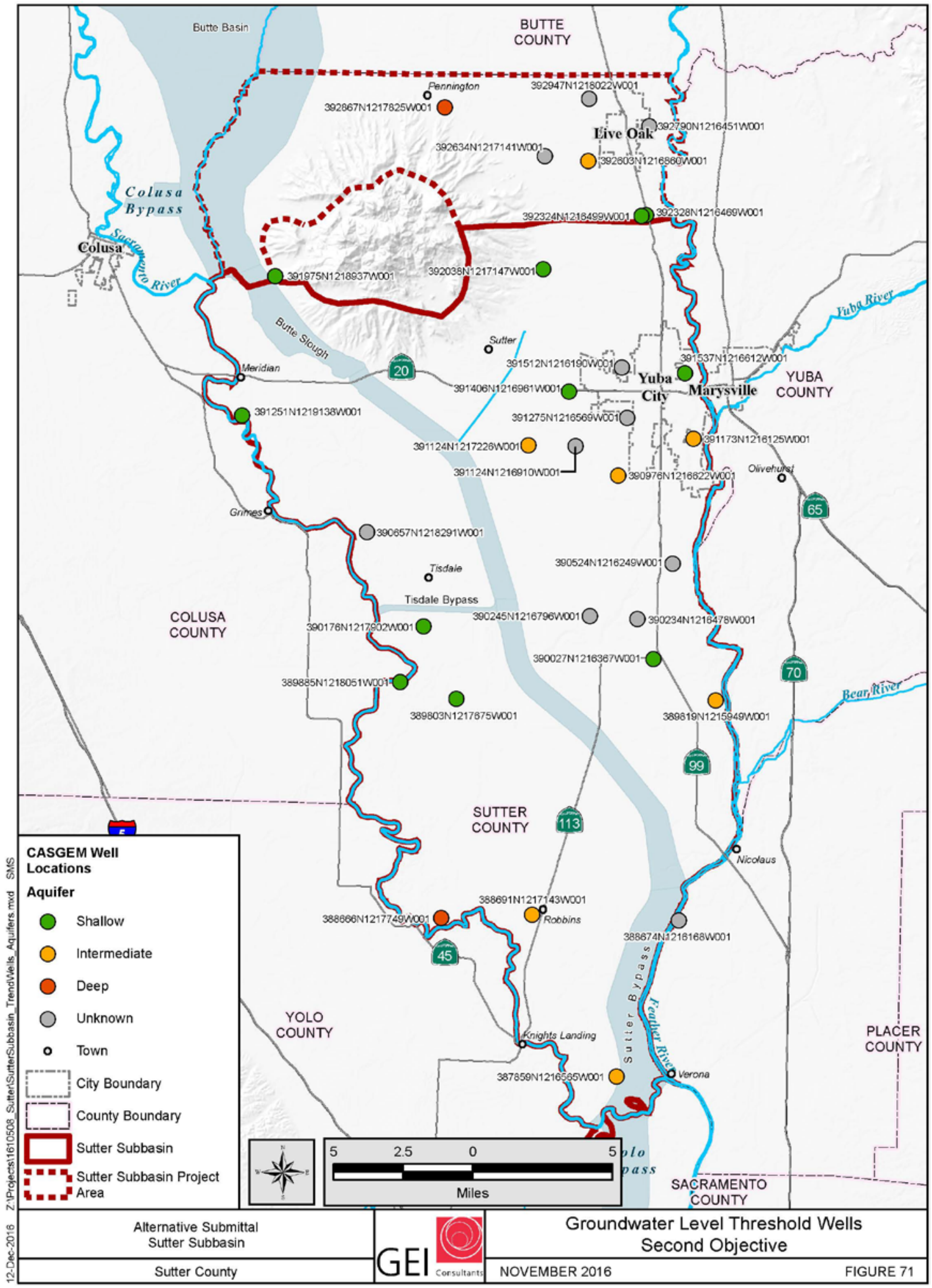


Figure 71. Groundwater Level Threshold Wells

No more than five (20 percent) of the selected 25 wells included in the Sutter Subbasin monitoring well network for the groundwater levels sustainability indicator may drop below the minimum threshold during a given year. The reasons listed below may be a cause for wells to breach the minimum thresholds and will require the wells and data to be evaluated:

- Temporary pumping impacts that locally influence water levels at specific monitoring wells but may not be causing significant and unreasonable impacts on the entire Subbasin.
- Erroneous groundwater level measurements.
- Modifications to the well structure.

Evaluations will be performed to assess and address the cause of any declines on a per case basis.

Planned conjunctive use projects may also locally affect groundwater levels. For example, pumping to create capacity to capture recharge for conjunctive use may be desirable and could lead to some minimum thresholds being temporarily exceeded in some wells. The annual reports and five-year update will document any conjunctive use changes to this Alternative Submittal.

7.5.2 Locally Defined Undesirable Results

The following undesirable results were locally defined and may occur when groundwater levels drop below the minimum thresholds described above.

- Groundwater levels dropping to a level at which domestic or irrigation wells go dry or lose functional pumping capacity.
- Significant and unreasonable effort to maintain or deepen production wells.

7.5.3 Groundwater Level Measurable Objectives – All Aquifers

The measurable objectives were established for groundwater levels to be 10-feet below ground surface, in accordance with the GMP to prevent impacts to agriculture. According to the long-term hydrographs provided in **Appendix N**, this objective has been achieved in most wells. However, in some wells groundwater levels remain within 10 feet of ground surface even after the last 21 years of pumping.

Appendix N shows the measureable objectives at selected wells in the Subbasin. This information is also presented in **Table 17** which summarizes the measureable objective levels along with other sustainability indicators.

7.6 Seawater Intrusion Sustainability Indicator

The Sutter Subbasin does not have a connection to the Delta or Pacific Ocean. Therefore, seawater intrusion has not occurred and is not expected to occur. Minimum thresholds and measureable objectives have not been established.

7.7 Degraded Water Quality Sustainability Indicator

The degraded water quality sustainability indicator consists of monitoring groundwater in the Subbasin which has several constituents that exceed the MCL for drinking water and may limit the ability of the water for use by agriculture. Drinking water is the highest beneficial use for groundwater in the Subbasin. The constituents of concern (COC) include arsenic, boron, total dissolved solids, and nitrate. Naturally occurring background levels for each of the COCs has been detected except for nitrates.

Arsenic, manganese, iron, nitrates and salts [measured as total dissolved solids (TDS) or electrical conductivity (EC)/specific conductance (SC)] have exceeded primary and recommended secondary drinking water standards at various locations over different periods. Bentazon and dibromochloropropane (DBCP) have also been detected but are below the primary drinking water levels. The Northern California Water Association's (NCWA) Sacramento Valley Water Quality Coalition Groundwater Quality Assessment Report (GAR) and the California Rice Commission's Rice-Specific GAR are part of the Central Valley Regional Water Quality Control Board's Irrigated Lands Program. The two coalitions active in the Subbasin have established monitoring networks and conduct sampling to prevent future degradation of groundwater quality for nitrates, salts, Bentazon and DBCP. These GARs do not address contaminants from non-agricultural sources such as septic systems. The Water Board also has regulatory oversight on industrial and commercial sites where release of contaminants to the environment have occurred that have degraded groundwater quality.

To develop measureable objectives and minimum thresholds for water quality, the COCs were analyzed and naturally occurring COCs (boron, manganese, iron and arsenic) were not included. Arsenic is occurring at levels exceeding the maximum contaminant level (MCL) in all aquifers. In shallow aquifers, where recent recharge occurs, the arsenic concentrations may be below the MCL, but in the intermediate and deep aquifers the concentrations typically increase with depth.

High salinity is present in the shallow aquifer in the southern half of the Subbasin and may discharge to the Sacramento River or wetlands in the Sutter Bypass. The source and cause of the elevated salinity is not likely to be related to irrigation as the groundwater in the area with elevated salinity also has low nitrate concentrations. Elevated salinity is also present in the deeper aquifer and may be due to water from old marine sediments deep in the subbasin.

The groundwater quality that is within the potential control of the stakeholders is limited to salinity and nitrates. Nitrate concentrations are typically low in all aquifers within the Subbasin except for the area adjacent to the western edge of Yuba City and in scattered occurrences in the Sutter County portion of the East Butte Subbasin. Elevated levels of nitrate in the Subbasin may be related to septic systems.

7.7.1 Water Quality Minimum Thresholds

There are 20 wells in the monitoring network, some of which are municipal, that have been sampled for nitrate and salinity throughout the base period and can be used for water quality sustainability indicators. The location of the wells, and their relationship to the known water quality concerns are shown on **Figure 72** and trend graphs of the water quality with minimum thresholds are provided in **Appendix O**.

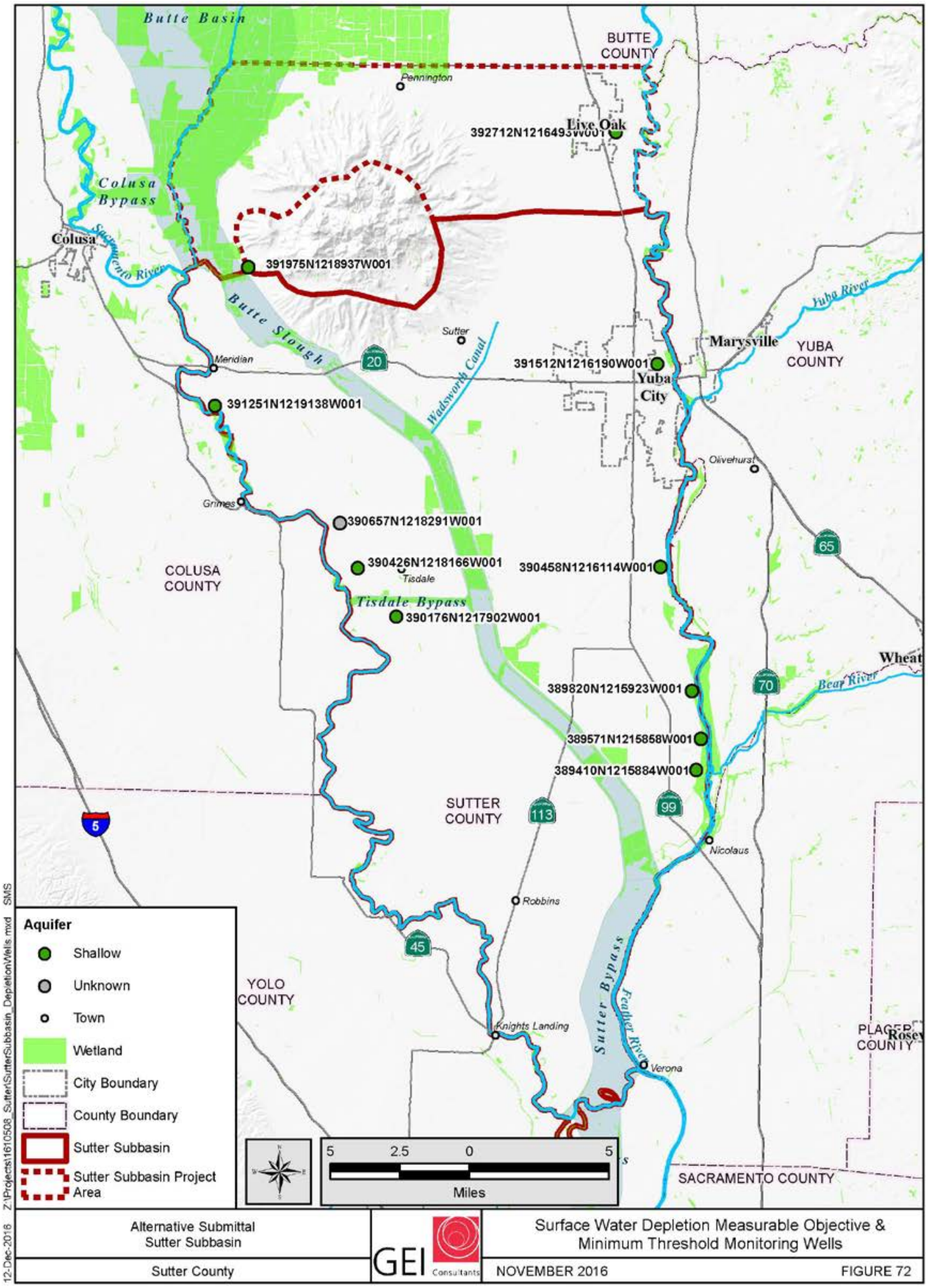


Figure 72. Groundwater Quality Wells for Objectives and Thresholds

The minimum thresholds for water quality were established to maintain or improve the water quality within the Subbasin. These thresholds were not established to improve water quality over naturally occurring background concentrations, similar to the basin plan water quality objectives. The minimum thresholds were developed for two COCs, nitrate and salinity. The goal is to maintain the nitrate level below state primary drinking water standard except where they currently are exceeding those standards.

For salinity, the minimum threshold for water quality was set to improve or maintain the salinity below the Upper Secondary Standard (consistent with the Irrigated Lands Regulatory Program) except where the groundwater currently exceeds those standards. The monitoring wells shown on **Figure 72** were chosen to monitor nitrate and salinity concentrations for compliance with the water quality sustainability indicator.

Water quality minimum thresholds for nitrate and salinity were established depending upon the existing concentrations in the wells. The minimum threshold levels for salinity and nitrate are:

- The minimum threshold for salinity (EC) is the secondary MCL (1,600 µS/cm) or, at wells that have maximum historic concentrations exceeding the MCL, the concentrations were increased by about 10 percent or conservatively 100 µS/cm.

- The minimum threshold for nitrate is 45 mg/L, the drinking water MCL, or at wells that have maximum historic concentration exceeding the MCL the concentrations were increased by 10 mg/L.

7.7.2 Locally Defined Undesirable Results

- If the groundwater quality monitoring indicates that the minimum threshold has been exceeded for salinity or nitrate, the beneficial use for drinking water could be impacted.

7.7.3 Water Quality Measureable Objectives

The Irrigated Lands Regulatory Program has primary responsibility and regulatory authority over irrigated lands and measurable objectives for these areas are not proposed.

The Water Board also has regulatory oversight over contaminant sources such as leaky underground storage tanks. Measurable objectives are not included for these sites. Release of contaminants to the environment from industrial sites is being and will continue to be regulated by the Water Board.

Water quality measureable objectives for nitrate and salinity were established based upon the existing concentrations in the wells. For concentrations below the MCL, the measureable objective was set at two-thirds the MCL for drinking water, a point at which agencies typically must increase monitoring. For wells with water quality currently exceeding the MCL, the measureable objectives were also set at two-thirds the MCL.

7.8 Subsidence Sustainability Indicator

The subsidence sustainability indicator consists of monitoring subsidence at extensometers that are located near, but outside of the Subbasin. Subsidence estimates for the period 2006 to 2010 have been developed from satellites (NASA, 2015) for portions of the State. Subsidence estimates range from about plus or minus 0.05 feet which appears to be elastic subsidence due to the annual fluctuation and the lack of a downward trend of subsidence, according to regional DWR extensometers. The variation suggests the subsidence may be naturally occurring due to a variety of factors, including, but limited to, barometric pressure and surface water loading.

Subsidence can be created by chronic lowering of groundwater levels and dewatering of fine grained sediments. Chronic depletion of groundwater levels has not occurred in the Subbasin so significant or unreasonable subsidence impacts are not occurring in the Subbasin.

One undesirable result of subsidence is that major infrastructure could be affected, including Highways 113, 70 and 99; canals; sewers within Yuba City, and levees. The NASA study showed plus or minus 2 inches of subsidence should not impact these facilities.

7.8.1 Subsidence Minimum Threshold Levels

Significant land subsidence has not been observed over the historic period of monitoring.

The goal of the minimum threshold is to keep inelastic subsidence due to groundwater extraction from exceeding six inches based on satellite imagery as provided in the future by DWR.

The minimum thresholds for subsidence are:

- Water levels in monitoring wells will not be allowed to drop more than 18 feet below Fall 1988 levels.

7.8.2 Locally Defined Undesirable Result

The undesirable results of exceeding the minimum threshold is damage to local infrastructure creating the need for costly repairs.

7.8.3 Subsidence Measurable Objectives

The measurable objective for the network that monitors subsidence is to remain within plus or minus 2 inches of subsidence as observed in the background data.

7.9 Depletion of Interconnected Surface Water Sustainability Indicator

The depletion of interconnected surface water sustainability indicator consists of monitoring groundwater levels in the shallow aquifer at 12 wells as shown on **Figure 73**. **Appendix M** contains their hydrographs with the minimum thresholds and measureable objectives provided. The monitoring wells are located near the Feather and Sacramento rivers. The shallow aquifer is interconnected with the Feather and Sacramento rivers.

Recharge from the river to groundwater and vice-versa were both present historically as shown on **Figure 42**. The C2VSim model indicates surface water losses to groundwater during the base period ranging from 89,000 AFY to 555,000 AFY. Surface water losses to groundwater in most years exceeded gains. Depending on the type of water year the magnitude of gains and losses to the Feather and Sacramento rivers vary. An increase in surface water infiltrating to the subsurface during winter months has been observed frequently in the historical data. Dependent on type of water year, below normal to critical, depletions during summer months may be present.

Local levee districts and stakeholders have supported the slurry walls recently constructed to stabilize the levees by minimizing underflow for certain reaches of the Feather River. These slurry walls may reduce both losses and gains of groundwater to and from the rivers but the volume has not been quantified. The slurry walls were not intended to shut off flow between the river and the shallow aquifers but to stabilize the levees

Installation of the slurry walls creates a new equilibrium for surface water and groundwater interaction that has the potential to decrease the volume of groundwater discharged to surface water. Groundwater levels in monitoring wells adjacent to the rivers will be used as a proxy for measuring losses from the rivers. The actual volumes of the water lost and gained by the rivers will be estimated when the C2VSim model is updated.

7.9.1 Minimum Threshold Levels

The Subbasin has 168 monitoring wells. Thresholds were established at selected CASGEM monitoring wells based upon the following criteria: 1) wells that have well construction details 2) wells that are adjacent to a river or wetland 3) wells within the same aquifer that allow for development of gradients to assess whether the river is gaining or losing. A total of 11 wells were selected for surface water depletion monitoring and establishing thresholds. Their locations are shown on **Figure 73** and their hydrographs are presented in **Appendix M**.

Minimum thresholds were established, at a level of 1 foot above the invert, for those wells where the river invert is below the groundwater level, to maintain outflow to the rivers. This allows operational capacity for periods of droughts or the reduction of flow by the slurry walls. Where groundwater levels have historically been below the invert of the river the minimum thresholds were set about 5 feet below the historic range of the measurements.

The historic range of losses from rivers has been from 89,000 AFY to 555,000 AFY. The historic gains of groundwater discharges to rivers has been 113,000 to 785,000 AFY. With the minimal allowable change, these threshold values should continue to maintain this range of inflows and outflows from the rivers but the range may increase by about 12,000 AF. These minimum thresholds may be revised based upon the future revisions to C2VSim model.

Threshold levels were established based on criteria developed for the shallow aquifer as follows:

- For those wells where the groundwater levels are greater than the invert of the river, the minimum threshold was established above the river invert to continue groundwater discharge to the rivers, even during droughts.

- For some wells where the historic groundwater elevations are below the invert of the rivers, the minimum thresholds were established at 5 feet greater than their historic lows to limit recharge of surface water to groundwater.

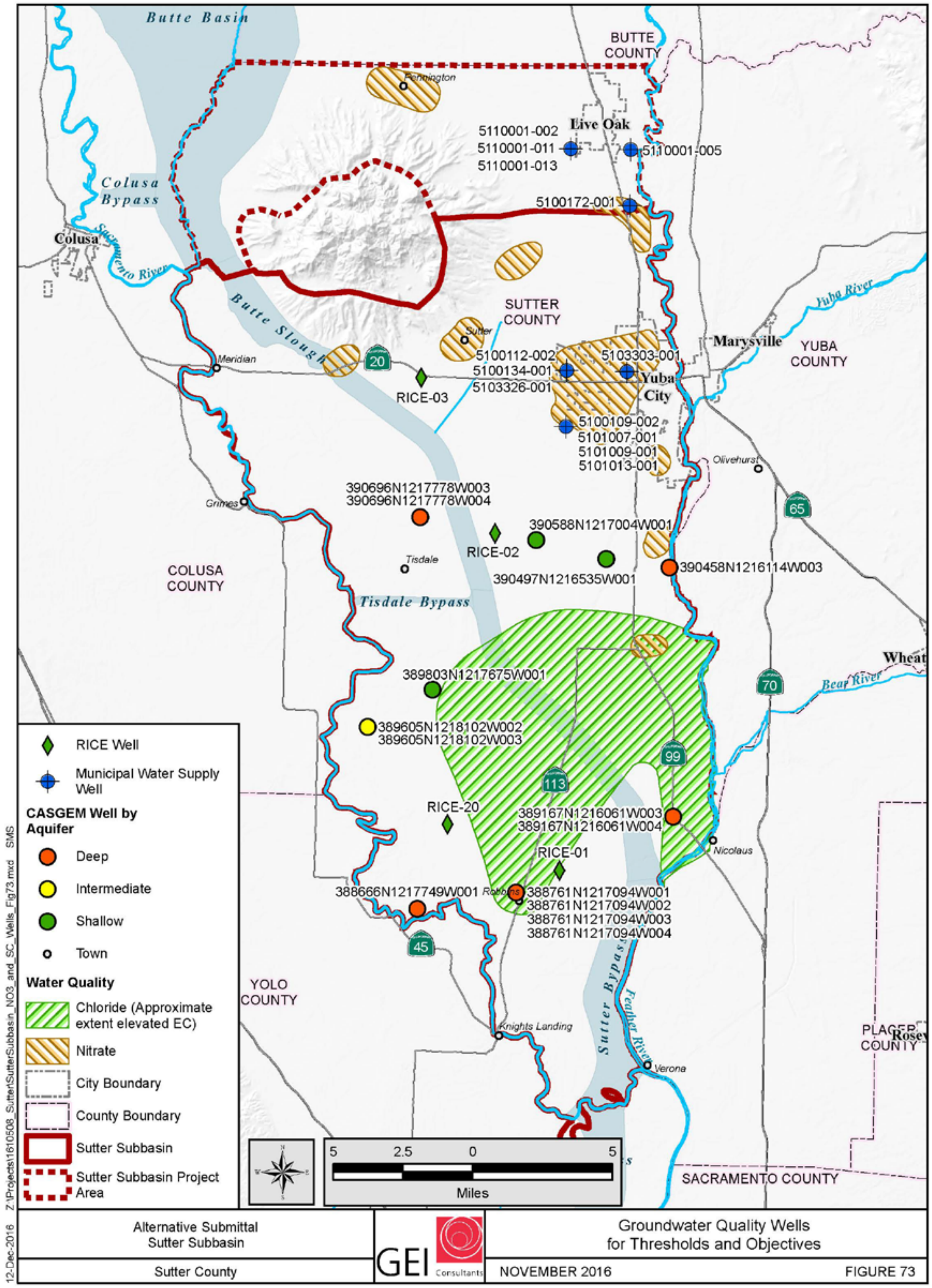


Figure 73. Surface Water Depletion Objective and Threshold Monitoring Wells

7.9.2 Locally Defined Undesirable Result

a. Increased depletion of interconnected surface water exceeding the historic annual volume of 555,000 AFY.

b. Degradation of groundwater dependent ecosystems.

7.9.3 Measurable Objectives

Measureable objectives were established to maintain surface water and groundwater interactions at levels that are consistent with those observed during the base period. The measureable objectives were set based on available data.

8 Monitoring Networks

The subbasins have a well-established groundwater-level monitoring program. Wells in the monitoring network include DWR CASGEM wells, wells constructed by the USGS, and local landowner wells. The monitoring network has been developed to assess groundwater levels related to the sustainability indicators. Not all wells are used to monitor for each sustainability indicator and within the monitoring network certain wells will be used to assess short-term and long-term trends for chronic lowering of groundwater levels, change in storage, depletion of surface water, subsidence and, water quality.

8.1 Monitoring Objectives

The objectives of the monitoring are to characterize the groundwater levels in each principal aquifer, flow into and out of each of the three principal aquifers, and whether groundwater quality is changing.

8.2 Monitoring Network

Sutter County established a groundwater monitoring network and is a DWR designated monitoring entity for the CASEM program. Groundwater levels are measured in 168 active monitoring wells in the Subbasin. Of the 168 wells, 38 are designated as CASGEM wells, and the remaining 126 are voluntary wells. In addition, four other monitoring wells are measured by the USGS. Of 168 well in the monitoring network, 138 wells have logs and construction details.

In the County portion of the East Butte Subbasin, 23 wells are active for water level monitoring. Of the 23 wells, 2 sets of nested wells provide water level measurements for discrete depth intervals and can be used to assess vertical flow gradients. Of the 23 wells 18 wells have logs and construction details. The location of these monitoring wells are presented on Figure 74.

Additional information will be obtained and used to identify which principal aquifers are monitored by wells without construction details.

Key representative wells have been selected with which to track the measureable objectives and minimum thresholds.

The following sections provide a description of each monitoring network, its justification, and frequency of measurement.

8.2.1 Chronic Lowering of Groundwater Levels

The monitoring network selected for evaluating chronic lowering of groundwater levels includes all of the CASGEM monitoring wells within the Subbasin, including wells with unknown construction details, until further details about these wells can be obtained. **Figures 74** through **76** show the wells by aquifer (note old wells with unknown construction details are included on

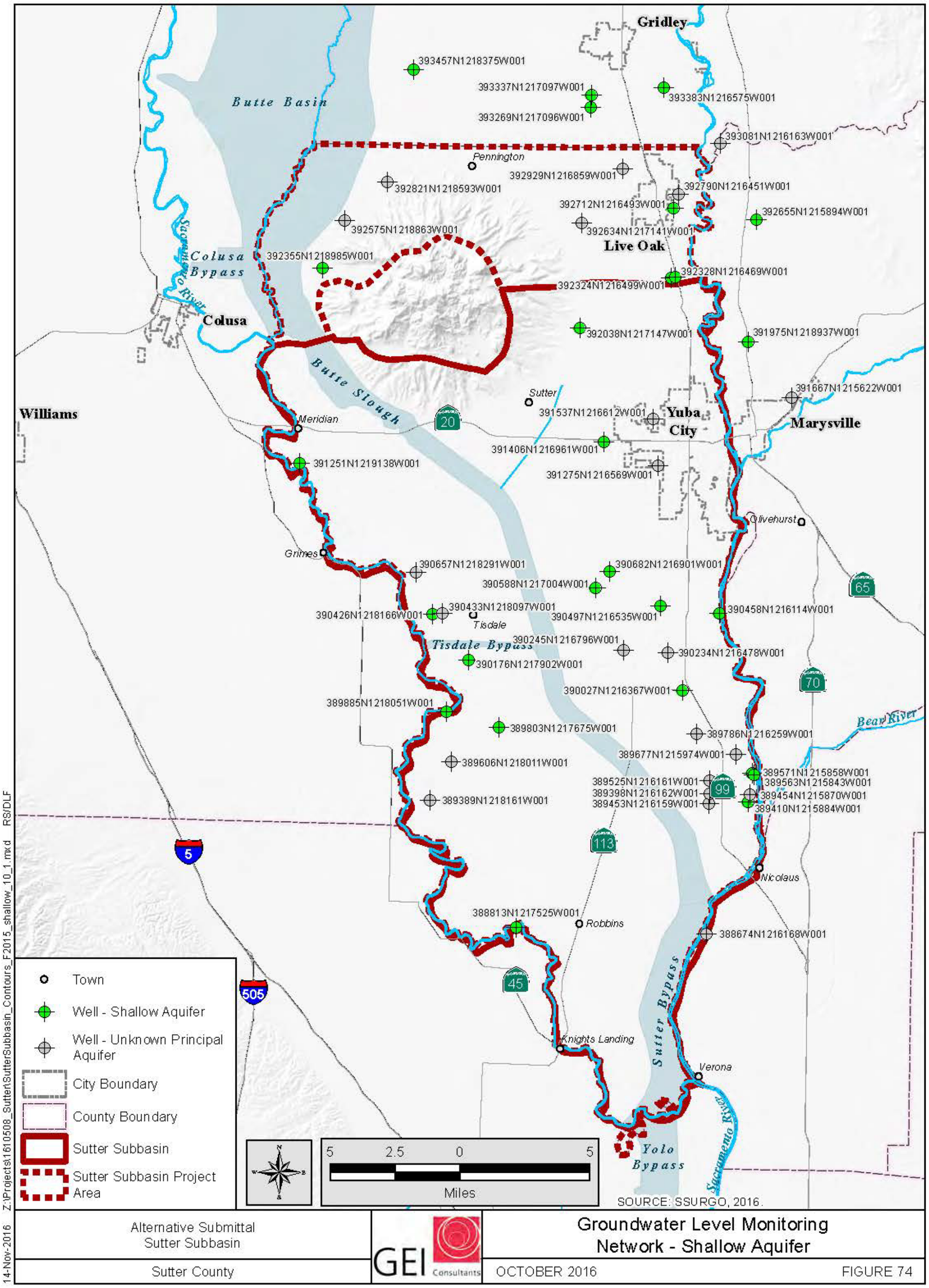


Figure 74. Groundwater Level Monitoring Network – Shallow Aquifer

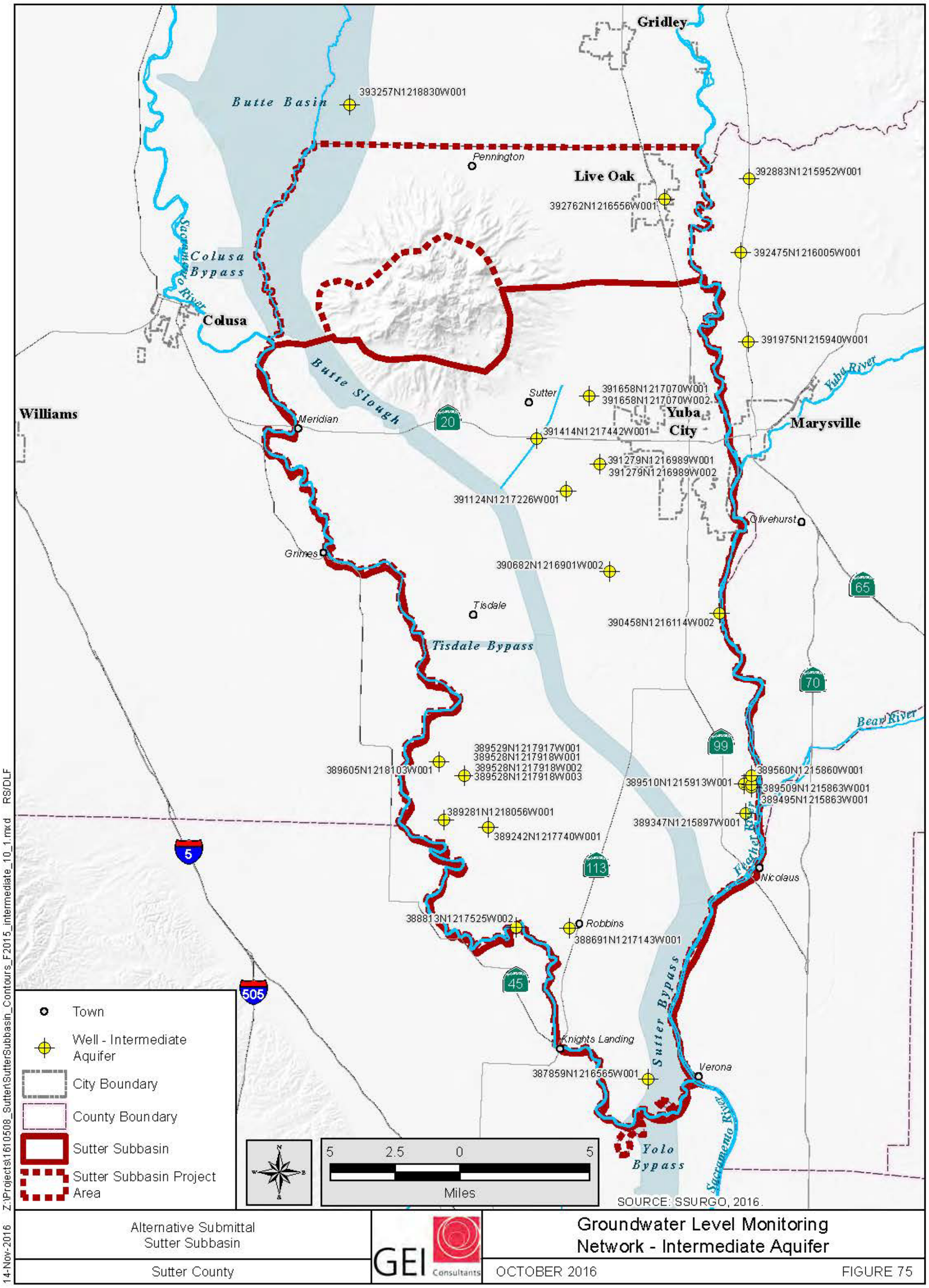


Figure 75. Groundwater Vertical Gradient Monitoring Network – Intermediate Aquifer

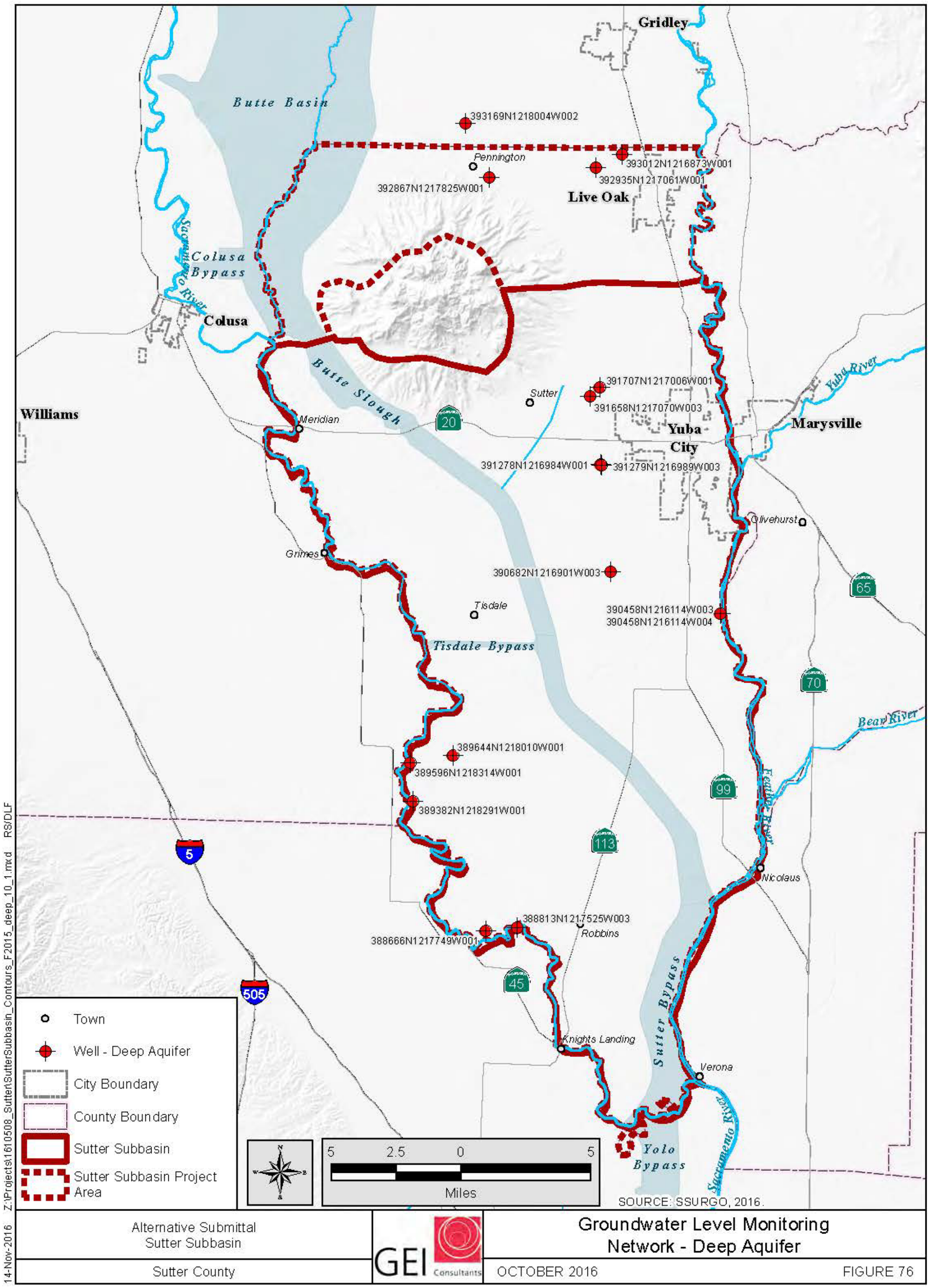


Figure 76. Groundwater Quality Monitoring Network – Deep Aquifer

the shallow aquifer figure due to the likelihood, because of their age, that they are shallow wells). **Appendix P** contains a groundwater monitoring summary table listing the monitoring wells by aquifer, the frequency of measurement, and whether they are being used as threshold wells. Groundwater levels from all wells will be measured and used to develop groundwater level contours for each principal aquifer and will show where groundwater is present and flow directions. Groundwater monitoring wells from adjacent subbasins will also be used to augment groundwater contouring.

A total of 15 nested monitoring wells are present in the Sutter and East Butte Subbasins that can provide vertical gradients between aquifers to limit the movement of degraded water and better quantify the amount of recharge to each aquifer. The location of the nested monitoring wells are shown on **Figure 77**.

Groundwater levels will be measured twice per year, in the spring (April) to represent seasonal highs and fall (October) of each year to represent seasonal lows. Historically, groundwater levels have been measured in similar months so the data will be comparable. Groundwater level measurements will be obtained from the USGS but some of their wells are only monitored once every two years. In some monitoring wells transducers obtain more frequent measurements.

Selected representative monitoring wells will be used to confirm the managing Agency is meeting measureable objectives and minimum thresholds for groundwater levels.

8.2.2 Reduction of Groundwater Storage

The groundwater levels measured in the wells utilized for chronic lowering of groundwater levels will be used to develop groundwater contours by principal aquifer and provide an estimate of the change in groundwater storage by principal aquifer.

8.2.3 Seawater Intrusion

The Agency has demonstrated that seawater intrusion is not present in the basin. Therefore a monitoring network has not been established for this sustainability indicator.

8.2.4 Groundwater Quality

Over the base period, only a few wells have been sampled for groundwater quality. The groundwater quality monitoring network, as shown on **Figure 78**, has been has been developed using existing wells, some of which have historical groundwater quality data. The wells were selected to monitor areas of elevated nitrate and elevated specific conductance and to provide up-gradient and cross-gradient data points. Most of the water quality elevated detections are in the shallow aquifer. Monitoring wells were also selected in the underlying aquifer to confirm the water quality is not being degraded from the shallow aquifer. Monitoring wells were also selected to monitor groundwater in the deeper aquifer to confirm that upwelling of saline water from the underlying marine sediments is not degrading the water quality. **Table 18** provides a summary of the purpose of each well and its relationship to the water quality contaminant.

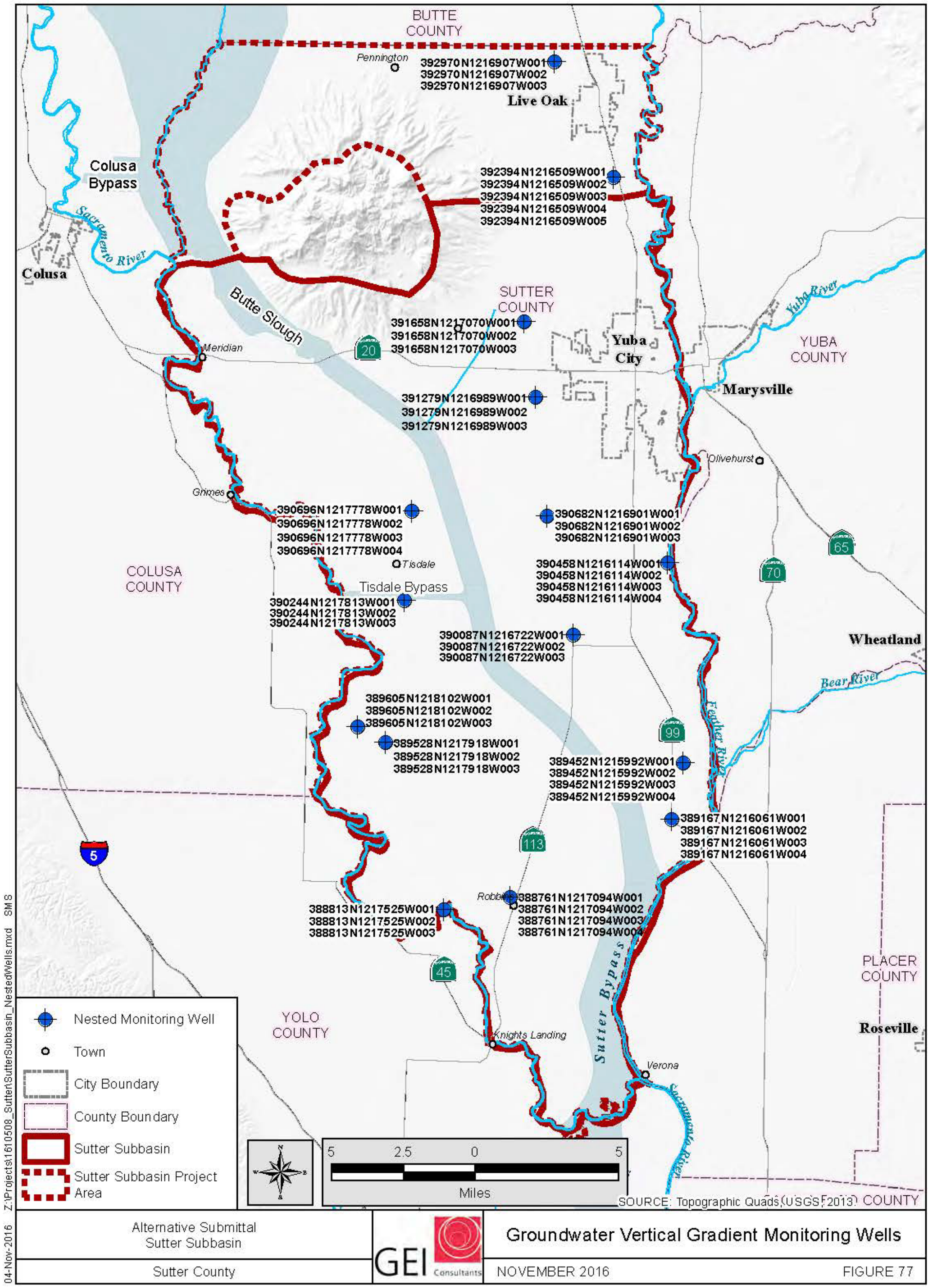


Figure 77. Groundwater Vertical Gradient Monitoring Wells

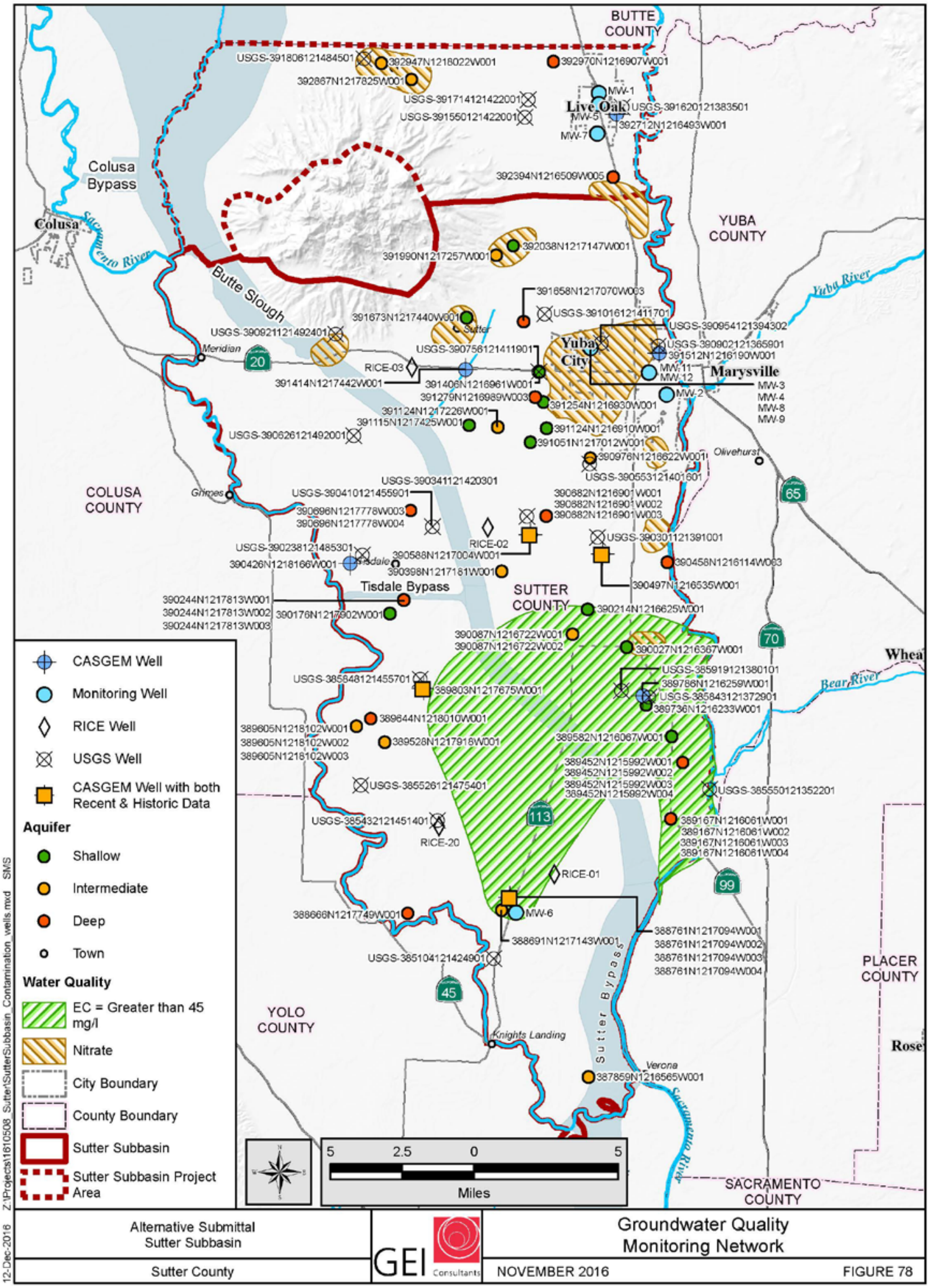


Figure 78. Groundwater Quality Monitoring Network

Table 18. Groundwater Quality Monitoring Network Selection

Sutter Subbasin											
Wells					Water Quality Purpose		Relationship of Wells Within Contaminant Area		Relationship of Wells Outside of Contaminant Area		
CASGEM ID	State ID	Local ID	Lat	Long	TDS/EC	Nitrate	Within Detection Area	Below Aquifer with Detections	Up-gradient	Down-gradient	Upwelling Bracksish Water
Shallow Aquifer											
388761N1217094W001	12N02E23H001M	Sutter County MW-2A	38.8761	-121.709	X		X				
389167N1216061W001	12N03E02G004M		38.9167	-121.606	X		X				
389605N1218102W003	13N01E24G004M	Flood MW-1C (shall)	38.9605	-121.81	X		X				
390087N1216722W001	13N03E06A001M	Sutter County MW-6A	39.008641	-121.672	X		X				
389803N1217675W001	13N02E17A001M	13N02E17A001M	38.9803	-121.768	X		X				
390214N1216625W001		Feather WD-4	39.02141	-121.662	X		X				
390497N1216535W001	14N03E20H003M	14N03E20H003M	39.0497	-121.654	X		X				
390027N1216367W001	13N03E04J001M	13N03E04J001M	39.0027	-121.637	X		X				
389736N1216233W001		Feather WD-3	38.973607	-121.623	X		X				
389582N1216067W001	13N03E23K001M		38.9582	-121.607	X		X				
390176N1217902W001	14N02E31K001M	14N02E31K001M	39.0176	-121.79	X				X		
390588N1217004W001	14N02E13L001M	14N02E13L001M	39.0588	-121.7	X				X		
390682N1216901W001	14N02E13A003M	SEWD MW-3A	39.068233	-121.69	X				X		
390244N1217813W001	14N02E32D001M	SMWC MW-1A	39.024429	-121.781	X				X		
391406N1216961W001	15N02E24B001M	15N02E24B001M	39.1406	-121.696		X				X	
391115N1217425W001	15N02E34D002M	15N02E34D002M	39.112953	-121.741		X				X	
391254N1216930W001	15N02E25A001M		39.1254	-121.693		X				X	
391124N1216910W001	15N02E36A001M		39.1124	-121.691		X				X	
391051N1217012W001	15N02E36L001M	15N02E36L001M	39.105113	-121.701		X				X	
Intermediate Aquifer											
388761N1217094W002	12N02E23H002M	Sutter County MW-2B	38.8761	-121.709	X			X			
389452N1215992W001	13N03E26J002M	Sutter County MW-4A	38.945159	-121.599	X			X			
389167N1216061W004	12N03E02G003M	12N03E02G003M	38.9167	-121.606	X			X			
389605N1218102W002	13N01E24G003M	Flood MW-1B (int)	38.9605	-121.81	X			X			
389528N1217918W001		Pelger #1 - Shallow	38.95277	-121.792	X			X			
390087N1216722W002	13N03E06A002M	Sutter County MW-6B	39.008641	-121.672	X			X			
388691N1217143W001	12N02E23K001M	12N02E23K001M	38.8691	-121.714	X			X			
390398N1217181W001	14N02E26C001M	14N02E26C001M	39.039832	-121.718	X				X		
390682N1216901W002	14N02E13A004M	SEWD MW-3B	39.068233	-121.69	X				X		
390244N1217813W002	14N02E32D002M	SMWC MW-1B	39.024428	-121.781	X				X		
387859N1216565W001	11N03E20H003M	RD 1500 Karnak	38.7859	-121.657	X					X	
390976N1216622W001	14N03E05C001M		39.0976	-121.662		X		X		X	
391124N1217226W001	15N02E35D001M	15N02E35D001M	39.1124	-121.723		X		X		X	
Deep Aquifer											
388761N1217094W004	12N02E23H004M	Sutter County MW-2D	38.8761	-121.709	X						X
389452N1215992W004	13N03E26J005M	Sutter County MW-4D	38.945159	-121.599	X						X
389167N1216061W003	12N03E02G002M	12N03E02G002M	38.9167	-121.606	X						X
389644N1218010W001	13N02E19D001M	Well 1 (Tucker)	38.96443	-121.801	X						X
388666N1217749W001	12N02E20P001M	12N02E20P001M	38.8666	-121.775	X						X
390682N1216901W003	14N02E13A005M	SEWD MW-3C	39.068233	-121.69	X				X		X
390244N1217813W003	14N02E32D003M	SMWC MW-1C	39.024429	-121.781	X				X		X
390458N1216114W003	14N03E23D005M	Feather River MW-1C	39.0458	-121.611	X				X		X
391658N1217070W003	15N02E12E003M	SEWD MW-1C	39.165846	-121.707	X				X		X
391279N1216989W003	15N02E24P003M	SEWD MW-2C	39.127861	-121.699	X				X		X
390682N1216901W003	14N02E13A005M	SEWD MW-3C	39.068233	-121.69	X				X		X
390244N1217813W003	14N02E32D003M	SMWC MW-1C	39.024429	-121.781	X				X		X
390696N1217778W004	14N02E17C004M	Sutter County MW-1D	39.0696	-121.778	X				X		X
390696N1217778W003	14N02E17C003M	Sutter County MW-1C	39.0696	-121.778	X				X		X
388761N1217094W003	12N02E23H003M	Sutter County MW-2C	38.8761	-121.709	X				X		X
389452N1215992W004	13N03E26J005M	Sutter County MW-4D	38.945159	-121.599	X				X		X
389452N1215992W002	13N03E26J003M	Sutter County MW-4B	38.945159	-121.599	X				X		X
Sutter County Portion of East Butte Subbasin											
Shallow Aquifer											
392355N1218985W001	16N01E18K001M		39.2355	-121.899							
392878N1217240W001	17N02E34A001M		39.2878	-121.724							
392970N1216907W003	17N02E25J003M	BWD MW-1C	39.297051	-121.691							
392712N1216493W001	16N03E04E001M	16N03E04E001M	39.2712	-121.649							
392394N1216509W001	16N03E17J001M	Sutter County MW-3A	39.2394	-121.651		X					
392328N1216469W001	16N03E21D002M	16N03E21D002M	39.2328	-121.647		X					
392324N1216499W001	16N03E21D001M	16N03E21D001M	39.2324	-121.65		X					
Intermediate Aquifer											
392970N1216907W002	17N02E25J002M	BWD MW-1B	39.297051	-121.691							
392603N1216860W001	16N03E07D002M	16N03E07D002M	39.2603	-121.686							
392394N1216509W002	16N03E17J002M	Sutter County MW-3B	39.2394	-121.651		X					
Deep Aquifer											
392970N1216907W001	17N02E25J001M	BWD MW-1A	39.297051	-121.691	X						X
392394N1216509W005	16N03E17J005M	Sutter County MW-3E	39.2394	-121.651		X					X
392867N1217825W001	17N02E31A001M	17N02E31A001M	39.2867	-121.783		X					
392935N1217061W001	17N02E26R001M	17N02E26R001M	39.2935	-121.706							
392970N1216907W001	17N02E25J001M	BWD MW-1A	39.297051	-121.691							
393012N1216873W001	17N03E30E001M	17N03E30E001M	39.3012	-121.687							
392394N1216509W003	16N03E17J003M	Sutter County MW-3C	39.2394	-121.651		X					
392394N1216509W004	16N03E17J004M	Sutter County MW-3D	39.2394	-121.651		X					
Unknown Aquifer											
392575N1218863W001	16N01E08C001M	16N01E08C001M	39.2575	-121.886							
392821N1218593W001	17N01E33G001M		39.2821	-121.859							
392947N1218022W001	17N01E25J001M	17N01E25J001M	39.2947	-121.802							
392634N1217141W001	16N02E02Q001M	16N02E02Q001M	39.262386	-121.715							
392929N1216859W001	17N03E30N001M	17N03E30N001M	39.292644	-121.686							
392762N1216556W001		Live Oak Well 5	39.276234	-121.656							
392790N1216451W001	17N03E33P001M	17N03E33P001M	39.27901	-121.646							

The selected monitoring wells will be sampled once per year, in October at the end of the summer pumping period, for the first five years to develop trends in concentrations and isoconcentration maps. Thereafter the frequency may be increased and the number of wells used will be evaluated. The USGS monitoring wells are only sampled once every two years. **Appendix P** contains a groundwater monitoring summary table listing the monitoring wells by aquifer, the frequency of measurement, and whether they are being used to monitor minimum thresholds.

The samples will be analyzed for specific conductance and nitrates depending upon their relation to the nearest defined area of poor quality water. All deep monitoring wells will be analyzed for specific conductance.

The groundwater quality monitoring network may be revised after at least four measurements have been obtained and trends in concentrations and the extent have been developed.

8.2.5 Land Subsidence

The Agency has demonstrated that land subsidence has not occurred in the subbasins but because groundwater is pumped from the basin a potential exists. Groundwater levels will be used as a surrogate to evaluate land subsidence. Twenty-five (25) groundwater level monitoring wells will be used to assess the potential for subsidence.

The Agency will also track and use any regional subsidence studies pertinent to the basin to further the assessment.

8.2.6 Depletion of Interconnected Surface Water

Eleven monitoring wells have been selected near the Feather and Sacramento Rivers to track surface water/groundwater interaction in the Sutter and East Butte Subbasins. All wells have construction details and are in the shallow principal aquifer except for one, but it is likely to be within the shallow aquifer and its depth will be confirmed prior to continued monitoring. **Figure 79** shows the surface water interaction monitoring wells. These wells will be used in conjunction with other shallow aquifer monitoring wells to develop historic groundwater gradients and flow directions. **Table 19** lists the purpose for selection of the monitoring wells.

The monitoring wells shall be measured twice per year, in the spring (April) to represent seasonal highs and fall (October) of each year to represent seasonal lows. The measurements can be correlated back to specific years from the C2VSim modeling to estimate the amount of base flow contribution.

Temporal changes in river flows volumes from gaging stations cannot be used due to the relatively small volumes of groundwater gains and losses in comparison to the volume of water in the rivers. The uncertainty in the accuracy of the volume increases due to the complex nature of merging rivers, ungagged small tributaries, wastewater discharges, and tail water return.

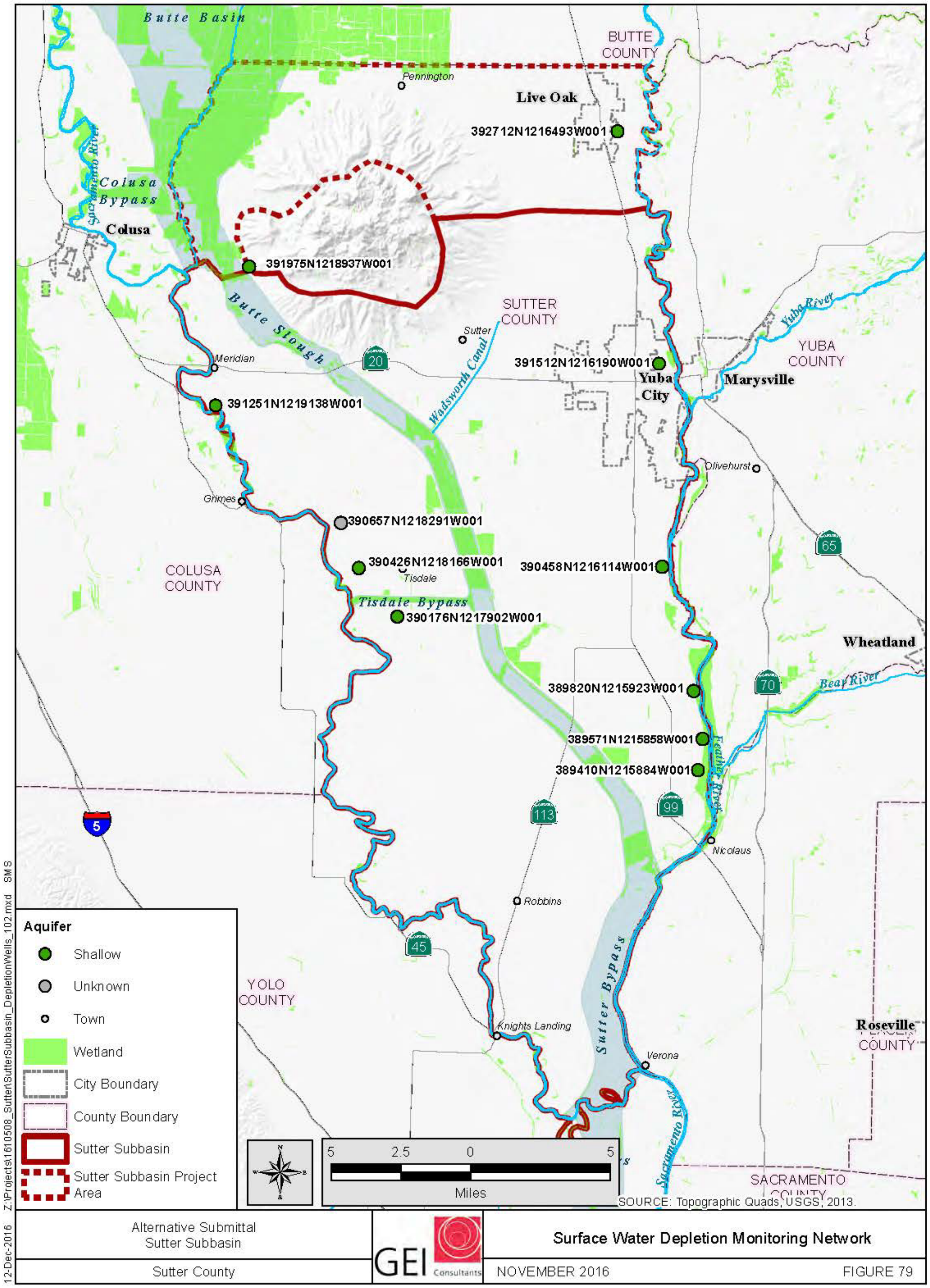


Figure 79. Surface Water Depletion Monitoring Network

Table 19. Surface Water Depletion Monitoring Network Selection

Wells					Selection Criteria		
CASGEM ID	**State ID**	**Local ID**	**Lat**	**Long**	**Adjacent to River**	**Adjacent to Wetland**	**Gradient Control Well**
Sacramento River Monitoring Wells or Gradient Clusters							
391251N1219138W001	15N01W25A001M	15N01W25A001M	39.1251	-121.914	X		
390426N1218166W001	14N01E24N001M	14N01E24N001M	39.0426	-121.817	X		
389605N1218102W003	13N01E24G004M	Flood MW-1C (shall)	38.9605	-121.81	X		
390176N1217902W001	14N02E31K001M	14N02E31K001M	39.0176	-121.79			X
389803N1217675W001	13N02E17A001M	13N02E17A001M	38.9803	-121.768			X
Feather River Monitoring Wells or Gradient Clusters							
389410N1215884W001		GH Well 18	38.941048	-121.588	X		
389563N1215843W001		GH East MW Site	38.956263	-121.584	X		
389571N1215858W001		GH North MW Site	38.957096	-121.586	X		
389736N1216233W001		Feather WD-3	38.973607	-121.623			X
389820N1215923W001		Feather WD-2	38.982025	-121.592	X	X	
390027N1216367W001	13N03E04J001M	13N03E04J001M	39.0027	-121.637			X
390497N1216535W001	14N03E20H003M	14N03E20H003M	39.0497	-121.654			X
390458N1216114W001	14N03E23D001M	Feather River MW-1A	39.0458	-121.611	X		
390027N1216367W001	13N03E04J001M	13N03E04J001M	39.0027	-121.637			X
391512N1216190W001	15N03E15H004M	15N03E15H004M	39.1512	-121.619	X		
392712N1216493W001	16N03E04E001M	16N03E04E001M	39.2712	-121.649	X		
392762N1216556W001		Live Oak Well 5	39.276234	-121.656	X		
By Pass/Wetlands areas							
391975N1218937W001	16N01E31H001M	16N01E31H001M	39.1975	-121.894		X	

8.3 Groundwater Monitoring Protocol

The existing monitoring protocol developed for the CASGEM program will be used to measure groundwater levels in the monitoring wells. A copy of the protocol is provided in **Appendix P**.

Groundwater quality monitoring protocol are provided in **Appendix P**.

8.4 Assessment and Improvements of Monitoring Network

An assessment of the existing monitoring network shows the following improvements will need to be made to improve the accuracy and extent of the monitoring network. The following items will be accomplished within the next five years:

- Well construction details are unknown for 53 monitoring wells. The total depths of wells without pumps or with large diameter casings and access ports will be measured to provide a preliminary assessment based on depth (less than 150 feet deep) as to whether they are in the shallow principal aquifer. Identify wells that may need subsequent and more in-depth study along with an evaluation of whether the wells are needed to support the evaluation of the subbasins.

- No monitoring wells in the Sutter Subbasin are located near wetlands near the Sutter Bypass. Construct a shallow aquifer monitoring well. Depends upon whether a willing land-owner is willing to provide property.

8.5 Annual Reports

The Agency will submit an annual report to DWR April 1 of each year following the approval and adoption of this Alternative Submittal. 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.

(b) Groundwater elevation contour maps for each principal aquifer in the basin illustrating, at a minimum, the seasonal high and seasonal low groundwater conditions.

(c) Hydrographs of groundwater elevations and water year type using historical data to the greatest extent available, including from January 1, 2015, to current reporting year.

(d) Groundwater extraction for the preceding water year will be provided using water budgets to estimate crop consumption minus surface deliveries to obtain an estimate of groundwater pumping. The most accurate of these estimates of groundwater pumping will be through updates of the C2VSim groundwater flow model. Groundwater extractions may be revised at five-years when the model is run and calibrated to groundwater levels. The data will 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), accuracy of measurements, and a map that illustrates the general location and volume of groundwater extractions.

(e) 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.

(f) 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.

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

(h) 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.

(i) A description of implementation of projects or management actions since the previous annual report.

8.6 Periodic Evaluation by Agency

The Agency will evaluate this Alternative Submittal at least every five years and whenever the Submittal is amended, and provide a written assessment to DWR. The assessment will describe whether the basin is still sustainable, implementation of projects and management actions, and will include the following:

(a) A description of current groundwater conditions for each applicable sustainability indicator relative to measurable objectives, interim milestones, and minimum thresholds.

(b) A description of the implementation of any projects or management actions, and the effect on groundwater conditions resulting from those projects or management actions.

(c) Elements of this Alternative Submittal, including the basin setting, management areas, or the identification of undesirable results and the setting of minimum thresholds and measurable objectives, and whether any of these should be reconsidered and any proposed revisions, if necessary.

(d) An evaluation of the basin setting in light of significant new information or changes in water use, and an explanation of any significant changes. If the Agency's evaluation shows that the basin is experiencing overdraft conditions, the Agency shall include an assessment of measures to mitigate that overdraft.

(e) An assessment of monitoring network function with an analysis of data collected to date, identification of data gaps, and the actions necessary to improve the monitoring network, consistent with the requirements of Section 354.38.

(f) If the Agency identifies data gaps, the Alternative Submittal will describe a program for the acquisition of additional data sources, including an estimate of the timing of that acquisition, and for incorporation of newly obtained information into the Submittal.

(g) The Plan shall prioritize the installation of new data collection facilities and analysis of new data based on the needs of the basin.

(h) A description of significant new information that has been made available since Submittal adoption or amendment, or the last five-year assessment. The description shall also include whether new information warrants changes to any aspect of the Submittal, including the evaluation of the basin setting, measurable objectives, minimum thresholds, or the criteria defining undesirable results.

(i) A description of relevant actions taken by the Agency, including a summary of regulations or ordinances related to the Submittal.

(j) Information describing any enforcement or legal actions taken by the Agency in furtherance of the sustainability goal for the basin.

(k) A description of completed or proposed Submittal amendments.

(l) Where appropriate, a summary of coordination that occurred between multiple Agencies in a single basin, Agencies in hydrologically connected basins, and land use agencies.

(m) Other information the Agency deems appropriate, along with any information required by the Department to conduct a periodic review as required by Water Code Section 10733.

9 Notice and Communications

This Alternative Submittal was circulated and coordinated by the Agency with its stakeholders and other interested parties. A summary of the communications is provided in the following sections.

9.1 Nature of Consultations

Surface water adjacent to the subbasin has been designated for domestic; municipal; agricultural and industrial supply; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves. Groundwater beneficial uses have been designated for domestic, municipal, agricultural, and industrial uses. Land uses are agricultural and to a limited extent rural communities and habitat preserves. Sutter County has met with agricultural and rural communities and preserve managers in public meetings along with specific phone disucssions with individual representatives as illustrated in the following sections.

Sutter County being agricutually based provided consultations with land owners on a face-to-face basis. Sutter County did not use DWR funded facilitation services due to the conservative nature of county constituents and wanting to deal with parties that they know.

9.2 Public Meetings

A list of public meetings at which the Plan was discussed or considered by the Agency is provided below. In addition to these meetings Sutter County provided general SGMA information, along with notification that the County was preparing an Alternative Submittal to the monthly Crop Talk magazine, distributed by the Yuba-Sutter Farm Bureau, in December's edition., Appendix Q provides a compilation of meeting agendas, meeting minutes, and a list of participants for the meetings where the Alternative Submittal discussions with the public were held and relevant portions of the Crop Talk magazine.

Outreach Meetings with White Space Property Owners

- Feb. 23, 2016 – East Butte Subbasin
- Mar. 8, 2016 – Sutter Subbasin
- Aug 2, 2016 – East Butte Subbasin
- Aug. 3, 2016 – Sutter Subbasin – Alt. GSP discussed; those present agreed to proceed

Meetings with Stakeholders

- July 28, 2016 – Sutter Subbasin: Alt. GSP discussed

- Aug. 5, 2016 – Sutter Subbasin: Will move forward with Alt. GSP
- Aug. 31, 2016 – Sutter Subbasin
- Oct. 18, 2016 – Sutter Subbasin
- Oct. 31, 2016 – Sutter Subbasin
- Dec. 5, 2016 – Conference call to discuss progress of Alt. GSP
- Dec. 9, 2016 – Sutter Subbasin

Board of Supervisors Meetings

- Aug. 23, 2016 – Staff discussed moving forward with the preparation of the Alternative Plan
- Sept. 27, 2016 – Sutter County Water Resource Update, discussed the Alternative Plan in the Sutter Subbasin
- Dec. 20, 2016 – Board approved the Alternative Plan via Resolution, and authorized the Director of Development Services to submit the plan.

9.3 Comments Received

Comments were received by Sutter County from stakeholders and those property owners in white spaces that they will represent. Comments were either incorporated directly into the text or responses to comments were prepared to provide additional details to respond to the clarifications.

10 Reference List

California Department of Water Resources, "GSP Regulations", May 18, 2016. http://www.water.ca.gov/groundwater/sgm/pdfs/GSP_Final_Regs_Guidebook.pdf

Berkstresser, 1973. Base of Fresh Ground Water – Approximately 3,000 mMicromohs – in the Sacramento Valley and Sacramento-San Joaquin Delta, California. WRI, 4073.California Department of Water Resources, "Evaluation of Ground Water Resources: Sacramento Valley," Bulletin 118 – 6, August 1978.

California Department of Water Resources, "California Water Plan Update" Bulletin 160-94, 1994. http://www.water.ca.gov/waterdatalibrary/docs/historic/Bulletins/Bulletin_160/Bulletin_160-93-ES__1994.pdf

California Department of Water Resources, "California's Groundwater," Bulletin 118 – Update 2003, East Butte Subbasin, last update February 27, 2004. http://www.water.ca.gov/pubs/groundwater/bulletin_118/california's_groundwater__bulletin_118_-_update_2003_/bulletin118_entire.pdf

California Department of Water Resources, "California's Groundwater," Bulletin 118 – Update 2003, Sutter Subbasin, last update January 20, 2006. http://www.water.ca.gov/pubs/groundwater/bulletin_118/california's_groundwater__bulletin_118_-_update_2003_/bulletin118_entire.pdf

California Department of Water Resources, "Household Water Supply Storage Reporting System, https://mydrywatersupply.water.ca.gov, 2015.

California Department of Water Resources, California Water Data Exchange Library, Department of Water Resources, http://cdec.water.ca.gov/cgi-progs/iodir/WSIHIST

California Department of Water Resources, 2015. DWR Draft – Water Transfer White Paper. http://www.water.ca.gov/watertransfers/docs/2016_Water_Transfer_White_Paper.pdf.

California Department of Water Resources, Groundwater Information Center Interactive Map Application. https://gis.water.ca.gov/app/gicima/

CH2MHill, 2013. Rice-Specific Groundwater Assessment Report. http://www.swrcb.ca.gov/centralvalley/water_issues/irrigated_lands/regulatory_information/rice_growers_sacvalley_wdrs/2013july_crc_gar_final.pdf

CH2MHill, 2014. Sacramento Valley Water Quality Coalition Groundwater Quality Assessment Report. http://www.svwqc.org/wp-content/themes/svwqc-2015/docs/groundwater-quality-assessment-report.pdf

City of Live Oak, 2030 General Plan.

Davids Engineering, Inc., 2014. Feather River Regional Agricutural Water Management Plan, Volume 1: Regional Plan Components. http://www.water.ca.gov/wateruseefficiency/sb7/docs/2014/SBX%207-7%20Plans/Feather_River/FRRAWMP_Volume_I_August_2014.pdf

EcoLogic, 2009. City of Live Oak Water Master Plan.

Johnson, 1967. Specific Yield – Complilatin of Specific Yields for Various Materials. Geologic Survey WaterSupply Paper 1662-D. https://pubs.usgs.gov/wsp/1662d/report.pdf

NOAA National Centers for Environmental information, Climate at a Glance: U.S. Time Series, Average Temperature, published December 2016, retrieved on December 12, 2016 from http://www.ncdc.noaa.gov/cag/

Pavley et al, 2014. Sustainable Groundwater Management Act, September 2014. [And Related Statutory Provisions from SB1168 (Pavley), AB1739 (Dickinson), and SB1319 (Pavley) as Chaptered] https://www.opr.ca.gov/docs/2014_Sustainable_Groundwater_Management_Legislation_092914.pdf

RMC, 2016. Groundwater and Stream Interaction in California's Central Valley: Insights for Sustainable Groundwater Management. http://scienceforconservation.org/dl/GroundwaterStreamInteraction_2016.pdf

Sustainable Groundwater Management Act, September 2014. [And Related Statutory Provisions from SB1168 (Pavley), AB1739 (Dickinson), and SB1319 (Pavley) as Chaptered] https://www.opr.ca.gov/docs/2014_Sustainable_Groundwater_Management_Legislation_092914.pdf

Sutter County, 1996, General Plan. https://www.co.sutter.ca.us/contents/pdf/cs/ps/General_Plan-Policy_Document.pdf

Sutter County, 2016, GIS Compiled Acreage by Agency and White Areas.

Wood Rodgers, March 2012, Sutter County Groundwater Management Plan. https://www.co.sutter.ca.us/contents/pdf/pw/wr/gmp/Sutter_County_Final_GMP_20120319.pdf

Wood Rodgers, August 2016. SBFCA - Quarterly Groundwater Monitoring Report.

URS, 2016. Technical Memorandum, Paired Piezometers. http://sutterbutteflood.org/wp-content/uploads/2013/09/URS_2016c-Paired_Piezometer_032016.pdf

US Geologic Survey, 2001, Shallow Groundwater Quality Beneath Rice Areas in the Sacramento Valley California, 1997, Water Resources Investigations Report 01-4000. http://pubs.usgs.gov/wri/2001/wri014000/pdf/wrir014000.pdf

US Geologic Survey, 2001, Shallow Groundwater Quality Beneath Rice Areas in the Sacramento Valley California, 1996, Water Resources Investigations Report 01-4125. http://pubs.usgs.gov/wri/wri014125/wrir01-4125.pdf

US Geologic Survey, National Water Information System, http://waterdata.usgs.gov/nwis/rt

State of California Department of Justice, Demographics, Data Estimates, Historic Population Estimates for Cities, and Counties E-4 http://www.dof.ca.gov/Forecasting/Demographics/Estimates/

Sutter County, 2011. Sutter County General Plan. Sutter County 2030 General Plan. (March 29, 2011) https://www.co.sutter.ca.us/pdf/cs/ps/General_Plan_Policy_Document.pdf

Sutter County, 2008. Sutter County General Plan Update Technical Background Report. Sutter County General Plan Update. (February, 2008) https://www.co.sutter.ca.us/pdf/cs/ps/gp/tbr/tbr.pdf

Sutter County, 2012. Sutter County Groundwater Management Plan. Sutter County. (March 19, 2012) https://www.co.sutter.ca.us/pdf/pw/wr/gmp/Sutter_County_Final_GMP_20120319.pdf

State Water Resouces Control Board, revised July 2016. Water Quality Control Plan for the Sacramento and San Joaquin River Basins. http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/

Yuba City, 2016. 2015 Urban Water Management Plan Update, Public Review Draft. Yuba City (June, 2016) http://www.yubacity.net/UserFiles/Servers/Server_239174/File/Public%20Works/Utilities/Water/Treatment/Final%202015%20Urban%20Water%20Management%20Plan.pdf

Yuba City, 2004. City of Yuba City - Water System Master Plan Update. City of Yuba City Utilities Department. (May, 2004) http://www.yubacity.net/UserFiles/Servers/Server_239174/File/WaterMasterPlan.pdf

Yuba City, 2006. Wastewater System Master Plan Update – City of Yuba City, Utilities Department. (March, 2006) http://www.yubacity.net//city_hall/departments/public_works/utilities/wastewater/wastewater_planning/

Wikipedia, 2010. Wikipedia, 2016 United States Census (2010. Wikipedia. Wikipedia Foundation, Inc..(2016) https://en.wikipedia.org/wiki/Main_Page

APPENDIX A
SUTTER COUNTY
GROUNDWATER MANAGEMENT PLAN

Sutter County

Groundwater Management Plan

March 2012

WOOD RODGERS

DEVELOPING INNOVATIVE DESIGN SOLUTIONS

Sutter County Groundwater Management Plan

Certificate and Seals

This report and analysis was prepared by Wood Rodgers, Inc. with data and technical assistance provided by the Sutter County Public Works Department - Water Resources Division and the California Department of Water Resources - North Central Region.

Date: March 19, 2012

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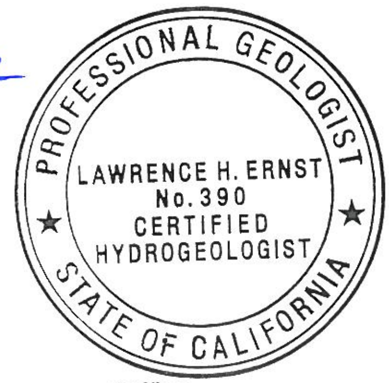

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1. INTRODUCTION

1.1. Purpose of Groundwater Management Plan

Sutter County (County) has prepared this Groundwater Management Plan (GMP) with input and direction from County stakeholders, and with financial and technical assistance from the California Department of Water Resources (DWR). Preparing this GMP is one step Sutter County is taking to promote and encourage groundwater users in the County to be responsible stewards of the water resources.

Sutter County's purposes for preparing this GMP are to:

- Summarize the current understanding of the groundwater underlying Sutter County and its role in the County's overall water supply, and make that information publicly available.
- Formulate goals and objectives that can be used as guidelines to help manage groundwater resources to meet current and future demands in Sutter County.
- Establish a plan for the County's involvement in ongoing monitoring and management of groundwater to promote those goals and objectives.
- Maintain eligibility for grant funding administered by the California Department of Water Resources to increase the understanding of the groundwater basins underlying Sutter County.

1.2. Sutter County's Role in Groundwater Management

Sutter County has the authority to adopt and implement this GMP under California Water Code §10750 et seq., which states that a local agency that overlies part of a groundwater basin can "by ordinance, or by resolution…adopt and implement a groundwater management plan…within all or part of its service area," so long as the area is:

- Not served by another local agency, a water corporation regulated by the Public Utilities Commission, or a mutual water company.
- Served by a local agency, when the majority of the agency's governing body declines to exercise its authority to manage groundwater and enters into an agreement with the local agency developing the GMP.

Sutter County's intended role in groundwater management, as discussed in this GMP, is to help coordinate the various groundwater users in the County, and encourage them to be responsible stewards of the water resources. The County does not have the budget or staff to act as an “enforcer” with regards to groundwater use, and does not intend to do so.

1.3. Plan Area

Sutter County intends this GMP to be relevant for the entire County. Sutter County overlies the south central part of the Sacramento Valley Groundwater Basin, and specifically the Sutter Subbasin and portions of the East Butte and North American Subbasins, as shown in Figure 1. The majority of the County is serviced by water and irrigation districts, reclamation districts, cities, and public utility districts (Figure 2), which have the authority to manage groundwater in their service areas. Unless those entities decline to manage groundwater on their own, and instead enter into agreements with the County, this GMP does not formally apply to those areas. If those entities choose not to adopt their own GMPs, they have the option of taking formal action to adopt the Sutter County GMP for their areas. By doing so, they will fulfill the requirements of the groundwater management provisions of the California Water Code.

Some of the water purveyors in the County have prepared groundwater management plans established under provisions of Sections 10750-10756 of the California Water Code (Assembly Bill 3030). Four of these plans have been submitted to DWR for final adoption.

1.4. Public Involvement in Plan Development

Throughout the development of this GMP, Sutter County solicited public input to help guide the direction and content. Aside from the required public notices and hearings related to the GMP development, Sutter County undertook an extensive public outreach program to encourage public involvement in the GMP development and to solicit public input for the GMP. To help guide the development of the GMP, a Plan Advisory Group (PAG) was formed that included representatives of water purveyors, cities, and the general public (attendance sheets provided in Appendix A)

The Sutter County Water Resource Department and the Board of Supervisors approved a Public Outreach Plan (Appendix B) for the GMP process. The Public Outreach Plan established the following objectives:

- Establish an open process to facilitate stakeholder input.
- Provide information to facilitate stakeholder education on material forming the basis of the GMP.

- Provide a framework by which stakeholders are kept informed of the process, issues, and potential solutions.
- Incorporate public comments throughout the decision-making process.

Various entities – including the Board of Supervisors, Plan Advisory Group, and the general public – were involved in the development, approval, and adoption of the GMP.

While developing the GMP, eleven public meetings were held. The location and time for each of the PAG meetings were advertised in local media. Attendance at each PAG meeting was recorded and a mailing list was created to disseminate meeting times and important information regarding the GMP progress. Participation in the PAG was voluntary and the public was invited to attend and comment at public workshops held in Yuba City. At each of the public workshops, Wood Rodgers, Inc. presented a PowerPoint® presentation of the purpose, scope, and schedule for preparing the GMP, along with educational information related to groundwater, geology, wells, and information about the hydrogeology within the County. The PAG meetings were held in 2008 on June 10, August 14, October 17, and December 9; in 2009 on February 10; in 2010 on June 17, August 19, October 28, and December 15; and in 2011 on April 14[1]and October 20. The Sutter County Water Resources Department hosted a website for the GMP at:

http://www.co.sutter.ca.us/doc/government/depts/pw/wr/gmp/gmphome

All of the presentations and applicable meeting information were posted on the GMP website. Presentations, attendance sheets, and a summary of public comments from the workshops are included in Appendix B.

1.4.1. GMP Survey

The County circulated a voluntary Public Opinion Survey to obtain participation and feedback from stakeholders. The surveys were distributed to interested individuals at the PAG meetings and were also made available for download on the County's website. In order to differentiate between individual well owner concerns and water district concerns, two surveys were distributed. Unfortunately, due to the limited returns, the surveys were not beneficial in identifying countywide concerns related to groundwater.

[1] The reason the meetings extended over four years is that DWR issued a stop work order in 2009 due to uncertainties with the State of California budget. Consequently, the GMP process was temporarily delayed from February 2009 to May 2010. Resumption of the GMP process required approval of a new Notice of Intent and a contract amendment with DWR.

1.5. Issues of Concern

A variety of issues and/or concerns with regard to groundwater and groundwater management have been raised by residents of the County during the development of this GMP. These issues and concerns include the following.

1.5.1. Protect private groundwater rights.

The development of the GMP has raised concerns about how individual groundwater rights will be affected. California State Water Law gives property owners the right to make reasonable and beneficial use of the groundwater resource underlying their property. The GMP does not encroach upon or place any restrictions on groundwater rights. Furthermore, the County does not have the budget or staff to act as an "enforcer" with regards to groundwater use, and does not intend to do so.

1.5.2. Is there enough groundwater to sustain a drought?

Water districts within the County have been able to provide groundwater when surface water supplies were reduced during past droughts. Conversely, the use of groundwater when surface water is in short supply allows the aquifer(s) to recharge when surface water is available and is known as conjunctive use.

Increased use of groundwater in some areas is perceived to be taxing the available supply, and there is concern that wells will go dry during a drought. A related concern is that existing wells may be damaged by increased pumping. This concern is particularly widespread in the southeastern portion of the County, where groundwater is used extensively for irrigation. Additionally, changes in cropping trends to more permanent crops have raised concerns about the ability to reduce groundwater use during drought periods without sustaining substantial economic losses in areas that do not use groundwater conjunctively with surface water.

This concern is understandable given the history of significant groundwater level fluctuations in the southeastern portion of the County during past drought periods. Data also indicate that during wetter periods, or when pumping is reduced, groundwater levels have started to recover. The need for water supply reliability to support water users in the County can be addressed through the conjunctive use/management of available surface water, groundwater, and recycled water supplies. Together, these water sources comprise the irrigation water supply for the County, and can be used in fluctuating proportions to meet demands during different hydrologic (including climatic) and economic conditions. Successful management will also require better coordination among water users, and water users will need to work together to develop strategies for curtailing water use during drought periods. If intra-county water transfers (transfers from one party to another within Sutter County) are possible, they can become an important water management tool and consideration during these periods.

1.5.3. Are there plans to "export" water out of Sutter County?

There is general concern that projects related to groundwater studies and groundwater management (including this GMP) are somehow related to the desire to "export" water from the County. Those who express this concern feel that the State (and other parties within and outside of the County) cannot be trusted to protect the interests of the community within the County. Currently, under state law, groundwater substitution water transfers are allowed. A groundwater substitution water transfers occurs when an entity with surface water rights makes an agreement to transfer some or all of its surface water to downstream users (by not diverting it), and then pumps groundwater to make up for the "lost source supply" that results from the transfer.

This concern can be somewhat allayed by maintaining local water district control of water management decisions. Also, establishing an open process for discussing groundwater conditions and making management decisions will help the stakeholders within the County have a better understanding of the resources and issues and to voice their concerns and have them addressed.

1.5.3.1. Sutter County Conjunctive Water Use Success (Case Study)

The Department of Water Resources provided the following case study for inclusion in this GMP to demonstrate the effectiveness of conjunctive water use.

"An example of a successful conjunctive use program was implemented by the South Sutter Water District (SSWD or District). The SSWD is located in southern Sutter and western Placer counties, with the Bear River as the northern boundary and stretching southwest between Highway 65 and Highway 70 to Pleasant Grove and Curry Creeks. The District was formed in 1954 to develop, store and distribute surface water supplies and to augment and replenish over-drafted groundwater supplies. Figures 3 and 4 are groundwater level hydrographs illustrating the recovery of groundwater levels after the implementation of the

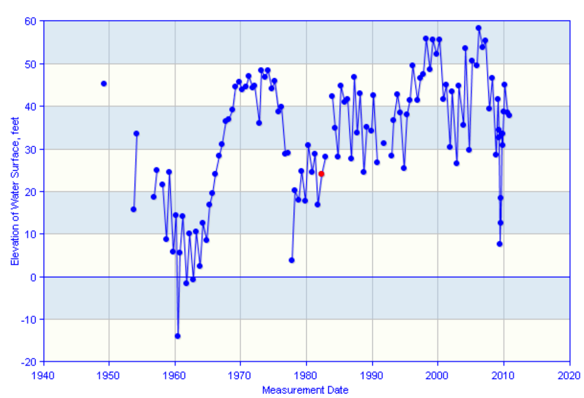

Figure 3 - Hydrograph for Well 13N/5E-30A1M

conjunctive use program. Today SSWD encompasses a total gross area of nearly 64,000 acres, including 57,012 acres that are authorized to receive surface water. According to the District,41,946 acres have actually been irrigated in recent years using a combination of surface and groundwater supplies. By far the majority of those acres grow rice (roughly 34,834 acres, or 83%), while the balance is apportioned between orchards (2,881 acres, or 5%), irrigated pasture (2,088 acres, or 5%), row and field crops (1,742 acres, or 4%) and the remaining 3%, which is fallowed in certain years.

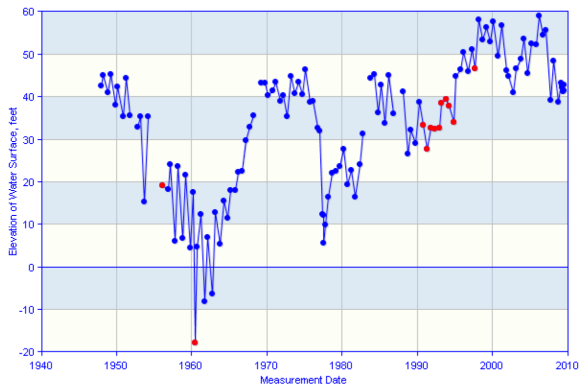

Figure 4 - Hydrograph for Well 13N/4E-13R1M

The enlarged New Camp Far West (NCFW) Reservoir was completed in 1964 with a storage capacity of 104,400 acre-feet (AF). SSWD and Camp Far West Irrigation District (CFWID), formed in 1924, holds the water rights for operating the reservoir. Surface supplies are managed conjunctively with groundwater supplies. The seven (7) megawatts of power generated by the NCFW powerhouse is wholesaled to Sacramento Municipal Utility District. The Federal Energy Commission (FERC) license for NCFW was issued on July 2, 1981.

One and a quarter miles downstream of NCFW Dam (and about 15 miles above the confluence with the Feather River), water is diverted by a diversion dam designed to move 30 cubic feet per second (cfs) north into the CFWID and 380 cfs south into the SSWD. In 1994, SSWD, CFWID, and the Department of Water Resources entered into a settlement agreement to meet the District's obligations under the State Water Resources Control Board's (SWRCB) Water Quality Control Plan for the Bay-Delta. Under the agreement, SSWD agreed to release up to 4,400 AF of water from NCFW, when requested by DWR, in all dry and critical year types. The present water rights require minimum in stream flows below the diversion works of 25 cfs from April 1 through June 30 and 10 cfs from July 1 through March 30. Under the new agreement, SSWD would increase the flow releases to the lower Bear up to 37 cfs in dry and critical years for up to sixty days in July through September.

SSWD receives anywhere from 5,000-20,000 AF of surplus water from Nevada Irrigation District (NID) annually. That water is currently conveyed to SSWD from Rollins Reservoir via the Bear River/Wise Canal system. When completed, SSWD's Canal Expansion project, including related conveyance system improvements, could *well provide previously-unforeseen opportunities for delivering a portion of surplus NID supplies to SSWD directly via the Bear River and NCFW Reservoir."*

1.5.4. Will there be taxes or fees for groundwater use?

Concerns have been expressed about the sources of funding for the GMP and other groundwater programs in the County. Funding would be necessary should staff be required to perform new monitoring and evaluation activities or to undertake groundwater investigations. Funding for the latter may be available from DWR and other grant programs, under which this GMP maintains eligibility for the County. Currently, the County assesses fees only for exploratory drilling, well construction, and well destructions, as shown in the following table (Table 1).

Table 1
***Current* Sutter County Fee Assessments (as of January 1, 2012)**

Well Permit	***Fee***
Well Construction	$470.00
Well Destruction	$376.00
Water Exploration and Test Holes	$376.00
Permit Extension (1 year)	$47.00

There is concern about the potential for taxes and fees on groundwater use, and metering of pumps. This GMP does not contain any recommendation to meter groundwater pumping or to enact use-based fees or taxes, although they are considerations and are used in other areas. State law affords property owners the right to make beneficial use of groundwater on their land.

1.5.5. How can we obtain good quality water?

Water quality problems are significant within the County and concerns have been expressed about water quality with regard to salinity, arsenic, and manganese. The hydrogeology of the County as it relates to water quality is not well-understood, and further study will be necessary to develop guidelines for how to obtain good-quality water in different areas of the County, and to determine how to manage groundwater without causing water quality deterioration in areas with otherwise good quality water. As discussed in Section 4.4, this GMP illustrates water quality in different areas of the

County, and shows the geographic areas (and depths) where poorer quality groundwater can be anticipated. As more data becomes available, the County will be able to incorporate it into the existing understanding of the groundwater subbasins.

1.5.6. Is this going to generate new regulations on groundwater?

Concern has been expressed about the potential for additional layers of bureaucracy and regulations on groundwater use. In general, stakeholders recognize a need to better understand and manage groundwater in the County, but have expressed a desire for a "balance" between achieving this objective and minimizing bureaucracy and regulations.

To implement the GMP, an institutional framework (not yet determined) will be needed; however, the intent of this GMP is to minimize the bureaucracy and regulations needed to achieve the goals and objectives of the GMP. The GMP provides a framework and a forum for studying, discussing, and managing groundwater within the County. Ideally, management will be accomplished cooperatively amongst the groundwater users in the County.

2. THE COUNTY

2.1. Physical Setting

Sutter County encompasses approximately 607 square miles (389,443 acres) in the central portion of the Sacramento Valley. As shown in Figure 5, Sutter County is bound by Butte County to the north, Colusa and Yolo Counties to the west, Yuba and Placer Counties to the east, and Sacramento County to the south. The County seat, Yuba City, is located approximately 50 miles north of Sacramento. The 2010 U.S. Census reported that the population of the County in 2010 was 94,737, with the majority of the population residing in Yuba City and Live Oak, and about 25 percent of the population in the rural communities. Land use within the County is principally agricultural, with approximately 318,701 acres in production (Sutter 2010a).

The two main population centers in the County are Yuba City, with 67 percent of the population, and the City of Live Oak, approximately 10 percent of the population (U.S. Census 2010). The remaining County residents live within the small communities of Tierra Buena, Meridian, Rio Oso, Trowbridge, Sutter, Pleasant Grove, Nicolaus, East Nicolaus, Riego, Robbins, or in the vast rural agricultural areas which make up Sutter County. Future major growth areas planned for Sutter County include Sutter Pointe (Measure M). The Sutter Pointe Specific Plan details a large-scale development project that is currently on file with and being processed by Sutter County. This plan area is located in the southern most portion of the County adjacent to the Sacramento County border and a portion of the Placer County border. The plan area includes the development of approximately 7,500 acres into mixed use and residential properties and has been structured to facilitate future incorporation as an independent city (Sutter 2010).

The main transportation routes connecting the County with the region are Highway 99, which runs north-south through the County, California State Route 20, which runs east-west through the County and Highway 113, which runs from the south-west portion of the County and terminates at Highway 99 (connecting Woodland with the County).

Land elevations range between 80 and 20 feet above sea level throughout the County with the exception of the Sutter Buttes, where elevations are more than 2,100 feet above sea level. The lowest land elevations are located towards the southern portion of the County.

Sutter County has abundant surface water, including the Sacramento, Feather, and Bear Rivers, as shown in Figure 5. A number of the water districts in the County (Figure 2) divert and transfer surface water.

2.2. Water Purveyors and Users

Water resources in the County are managed by water purveyors and individual water users who have "hands on" control of both surface water and groundwater for agricultural, urban, environmental, and domestic uses. These water managers represent a complex mix of organized water purveyors, non-organized areas, and areas within National Wildlife Refuges. A brief discussion of each category is presented below.

2.2.1. Water Purveyors

There are 48 water purveyors in Sutter County which provide water service to their customers (Figure 2). These water purveyors include water districts, irrigation districts, reclamation districts, mutual water companies, public utilities districts, and incorporated cities. Additionally, there are many private water users including community service districts (CSD's) and farming interests.

Six water purveyors provide water service not only in Sutter County, but in the counties that share borders with Sutter. They are:

- Reclamation District No. 1004 (Colusa County)
- Biggs-West Gridley Water District (Butte County)
- Butte Water District (Butte County)
- Dry Creek Mutual Water Company (Yuba County)
- South Sutter Water District (Placer County)
- Natomas Central Mutual Water Company (Sacramento County)

2.2.2. Non-Organized Areas

The non-organized areas within the County are not within the boundaries or service area of established water purveyors.

2.2.3. National Wildlife Refuges

The Sacramento National Wildlife Refuge Complex consists of five national wildlife refuges and three wildlife management areas. Portions of Sutter County have been dedicated, both through public and private efforts, as wildlife refuges. Exclusively in Sutter County, the Sutter National Wildlife Refuge has 2,591 total acres, with the majority (83%) located inside the Sutter Bypass. According to U.S. Fish and Wildlife

Service, the refuge “consists of approximately 1,881 acres of seasonal and summer wetlands and approximately 674 acres of unmanaged wetlands, grasslands, and riparian habitats” (USFW 2009).

The Natomas Basin Conservancy also owns nearly 1,000 acres of wildlife habitat/mitigation lands within the southern portion of the County.

2.3. Land Use

The predominant land use within the County is agriculture. The 2008 Sutter County General Plan Technical Background Report estimates that 322,240 acres (83%) of Sutter County is agricultural land. An estimated 44,581 acres (11%) is designated as open space. The remaining 6% of the County is designated as residential, public and vacant, commercial, industrial, and transportation and utilities. As stated above, agriculture dominates land uses within Sutter County. Figure 6 shows the distribution of land uses, with regard to crop type and water source, for the entire County. It is apparent that permanent crops dominate the eastern portion of the County, along the Feather River, while rice and other non-permanent crops dominate the central and western portion of the County.

2.4. Water Use

The amount of water applied for agricultural production and urban or community use has been estimated using information from DWR with respect to unit crop, consumptive use, and applied water, with corresponding losses included and accounted for. Water use within cities and communities was estimated using limited production data from some water purveyors from 2008 to 2010.

2.4.1. Agricultural Water Use

Water use during the 2009 growing season was calculated based on the Sutter County 2009 Crop Report. Estimates of applied water for irrigated agriculture are 1,122,018 AF.

Sutter County’s agricultural water usage is approximately 60 percent surface water, 20 percent groundwater, and 20 percent that is irrigated by both surface water and groundwater. Figure 6 illustrates the source of water for crops grown in the County. The predominant source of water for permanent crops is groundwater.

2.4.2. Urban/Community Water Use

Water for urban and community use is from groundwater and surface water. From available DWR records, the minimum urban water use was 1,770 AF in 2010 (records for all urban water suppliers was not available). Yuba City provides mostly surface water (15,682 AF in 2008) while smaller communities rely exclusively on groundwater.

3. HYDROLOGY AND SURFACE WATER

3.1. Seasonal and Long-Term Hydrology

Annual fluctuations in northern California precipitation directly influence the volume of water flowing in the Sacramento River. Precipitation and climate data from the Western Regional Climate Center (WRCC) suggest the average annual precipitation for the west side of the County (Colusa Station) is 16.40 inches per year and on the east side of the County (Marysville Station), it is 20.96 inches per year. In Nicolaus, the average annual precipitation is 18.27 inches per year. Collectively, average annual precipitation is 18.54 inches per year. Snow-fall within Sutter County is rare, measuring on average 0.01 inches per year. Precipitation is highly variable throughout the State, from year to year. Precipitation usually takes place from October to May and on average no precipitation occurs from June to September. The water year, defined as starting on October 1 and ending September 30, is classified as one of five water year types: critical, dry, below normal, above normal, or wet[2]. Within the past ten years, only two water years were classified as wet and one year was classified above normal. The remaining years were either dry, critical, or below normal. The average annual temperature is approximately 62° F, with an average high of 95.7° F in July and an average low of 37.4° F in January.

Precipitation in the Sierra Nevada, Coast Range, Klamath, and Cascade Mountains contribute to surface water flow and groundwater recharge in the Sacramento River Basin. The general direction of surface water flow is toward the center of the valley, flowing south. Water diversions, evaporation, and groundwater recharge reduce flows as the Sacramento River approaches the Delta.

3.2. Surface Water

Sutter County is located in the Sacramento River Basin, with the Sacramento River on the west and the Feather River on the east. The Sacramento River is the largest river in northern California and drains the northern central part of California. The watershed for the Sacramento River includes tributaries originating in the Sierra Nevada, the Coast Range, and the Cascade Mountains. The main tributaries in Sutter County include the Feather River, Bear River, Dry Creek, Pleasant Grove Creek, Auburn Ravine, and Coon Creek.

During periods of heavy precipitation and runoff, a portion of the flow within the Sacramento River is diverted through the Sutter Bypass. The Sutter Bypass is a man-made feature in Sutter County and was designed to alleviate the flood control system along the Sacramento

[2] http://cdec.water.ca.gov/cgi-progs/iodir/wsihist

River. Aside from the major rivers and tributaries within Sutter County, there are no significant surface water storage reservoirs within Sutter County.

It is important to note that flows in all the major rivers in northern California are managed by dams, e.g. the Feather River by Lake Oroville and the Sacramento River by Lake Shasta. The reservoirs are managed to provide flood protection while collecting runoff from the watershed. Releases from the reservoirs occur from spring through summer to provide irrigation water for agriculture as well as to provide drinking water downstream.

The following discussion provides information on the location, ownership, infrastructure, and an overview of the operational practices of the major water bodies that relate to or are within Sutter County.

3.2.1. The Sacramento River

The Sacramento River is the major surface water feature in Sutter County. Running north-south along the western part of the County, the Sacramento River is the main drainage for the Sacramento Valley Basin on its way to the Delta and the San Francisco Bay. The Sacramento River supports many beneficial uses including recreational, agricultural, and wildlife. The river is currently not used for municipal or domestic water supplies in the County. There are, however, future plans to utilize the Sacramento River, in conjunction with groundwater, to provide municipal water supply to the Measure M Sutter Pointe development (Sutter 2011).

Many tributary streams flow from the mountains on both sides of the valley into the Sacramento River. According to a 2005 report by the Glenn County Department of Agriculture (GCDA), flows in the Sacramento River near Grimes in Southern Colusa County range from 6,500 cfs to 16,900 cfs for the period of record of 1946-2003 (GCDA 2005).

3.2.2. The Feather River

The Feather River is a major tributary of the Sacramento River and outlines a major portion of Sutter County's eastern boundary. The river trends north-south along the northern and central portions of the County to the convergence with the Bear River, where it changes course and flows southwest through the south-central portion of the County until it intersects the Sutter Bypass and the Sacramento River. Like the Sacramento River, the Feather River provides beneficial uses including recreation, agricultural, and wildlife. Yuba City obtains a large portion of its annual water supplies for municipal and domestic use from the Feather River.

3.2.3. The Bear River

The Bear River is a tributary of the Feather River and enters Sutter County from Placer County near the City of Wheatland in Yuba County. It forms the boundary between Sutter and Yuba Counties up to the convergence with the Feather River. The Bear River generally flows west until it converges with the Feather River, approximately one mile upstream from the rural community of Nicolaus. Although smaller than the Sacramento and Feather Rivers, the Bear River also provides beneficial uses that include recreation, agricultural, and wildlife. Discharges within the river are partially controlled by several upstream reservoirs. The Camp Far West Reservoir (located in the counties of Yuba, Placer and Nevada) is the last downstream reservoir on the river and subsequently regulates surface water discharges to downstream users, which has been the source of surface water for a very successful conjunctive water use program for the South Sutter Water District.

3.2.4. The Sutter Bypass

The Sutter Bypass (Bypass) is an artificial flood corridor constructed in the 1930's. As described by the Army Corp of Engineers, "the Sutter Bypass, which began operation in the 1930's, is a leveed portion of the natural floodway in the Sutter Basin. The bypass is south of the Sutter Buttes from Colusa to Verona between the Sacramento and Feather rivers. Flows enter the Sutter Bypass from the Butte Basin at its upper end near Colusa at the Butte Slough. Other flows enter from Wadsworth Canal, interior drainage from pumping plants, and the Sacramento River by way of the Tisdale Weir and Bypass. Flows exit the Sutter Bypass and combine with the Sacramento River, Feather River, Natomas Cross Canal, and Yolo Bypass upstream from the Fremont Weir near the town of Verona"(USACE).

3.3. Seasonal and Long-Term Water Quality

Under the USGS National Water Quality Assessment (NAWQA) Program, the USGS conducted an intensive study of the Sacramento River Basin and collected data between 1995 and 1998. Through the sampling process, the USGS selected indicator streams that were based upon the characterization that "they drain small to intermediate sized watersheds with relatively homogeneous land use and geology" (USGS 1998). The Colusa Basin Drain is located entirely in the Sacramento Valley and was chosen as an indicator stream to determine the impacts of agriculture on stream-water quality (USGS 1998). At the indicator water quality station, Colusa Basin Drain at Road 99E near Knights Landing, it was determined that pH levels were generally on the higher end, with declining suspended sediment concentrations over the two-year sampling period. The higher concentrations of mercury correlate with suspended sediment because much of the load of total mercury is transported with the suspended material.

The findings of the USGS study also indicated that the water of the Sacramento River and its major tributaries is generally of good quality. As stated in the U.S. Geological Survey Circular 1215:

> "the amount of dissolved solids in the Sacramento River and its major tributaries (Yuba, Feather, and American rivers) was low at all of the sampled locations. Higher median concentrations of dissolved solids occurred at agricultural sites such as the Sacramento Slough and Colusa Basin Drain, but those are diluted upon mixing with Sacramento River water. Nutrient concentrations such as nitrate also were low throughout the Sacramento River Basin, and drinking-water standards for nitrate were not exceeded during the course of this study. The concentrations of Molinate and other pesticides (used in rice farming) measured during this study in the Colusa Basin Drain or in the Sacramento River, represent a significant improvement over concentrations measured in previous years".

3.4. Surface Water Supply Contracts

3.4.1. Settlement Contracts

USBR currently contracts with approximately 145 water districts, water purveyors, or private users for water rights to the Sacramento River. The total amount of water under the settlement contracts is approximately 2.2 million acre-feet and cover a total of almost 440,000 acres of land bordering the Sacramento River and its tributaries between Redding and Sacramento. The Settlement Contracts were originally executed in 1964 with a term not to exceed 40 years. New contracts have been executed with approximately 145 existing Sacramento River Settlement Contracts.

The Settlement Contracts include a Base Supply and Project Water. The Base Supply is the amount that reflects the agreed-upon water right of the respective entity. This is generally regarded as pre-1914 water rights and also water rights perfected after 1914 and reflect water that would be available to the respective entities under "natural" conditions. Project Water represents the amount of water the Bureau of Reclamation agrees to provide from its Central Valley Project (CVP) yield. Under the provisions of the Settlement Contracts both the Base Supply and Project Supply could be reduced by 25 percent of the total contract amount, but only in certain water year types.

3.4.2. Long-Term Renewal Contracts

In accordance with the CVP Improvement Act (CVPIA), the USBR negotiated long-term water service contracts in 2007. According to Section 3404c of the CVPIA, Renewal of Existing Long-Term Contracts requires the USBR to renew any existing long-term repayment or water service contract for the delivery of water from the CVP for a period of 25 years and may renew such contracts for successive periods of up to 25 years each. The USBR anticipates that, “as many as 113 CVP water service contracts, located within the Central Valley of California, may be renewed during this negotiation process” (USBR 2007a).

The long-term renewal contracts, unlike the Settlement Contracts, have no specified reduction in delivery; during critically dry or water-short years, the water supply available from the Project will be allocated among the contractors.

Also, the long-term renewal contracts contain a tiered pricing provision. The Base Supply is 80 percent of the total contract amount, and Tier 1 and Tier 2 supplies represent 10 percent each of the remaining contract amount. Each tier has an incrementally higher water cost. The Tier 1 and Tier 2 water, which is available in most years, is not used due to the incremental higher cost of water.

4. GROUNDWATER

4.1. Groundwater Basins and Subbasins

Sutter County is underlain by the Sacramento Valley Groundwater Basin. The Sacramento Valley Groundwater Basin covers a vast area and encompasses the alluvial deposits under the valley floor from the Sierra Nevada Mountains to the east, the Coast Range mountains to the west, the Sacramento-San Joaquin Delta to the south, and the Klamath and Cascade Ranges to the north. The Sacramento Valley Groundwater Basin covers over 5,900 square miles and 10 counties, and has been divided into 18 subbasins. The GMP area is underlain by three groundwater subbasins (Figure 1) as defined by the California Department of Water Resources (DWR) in “California’s Groundwater, Bulletin 118 – Update 2003”. These subbasins are: the East Butte Subbasin, the Sutter Subbasin, and the North American Subbasin. According to DWR,

“A groundwater basin is defined as an alluvial aquifer or a stacked series of alluvial aquifers with reasonably well-defined […] features that significantly impede groundwater flow such as rock or sediments with very low permeability or a geologic structure such as a fault. […]

“A subbasin is created by dividing a groundwater basin into smaller units using geologic and hydrologic barriers or, more commonly, institutional boundaries […]. These subbasins are created for the purpose of collecting and analyzing data, managing water resources, and managing adjudicated basins.”

4.2. Hydrogeology

4.2.1. Overview of Groundwater and Geology

Groundwater is water that is underground and below the water table (saturated zone), as opposed to surface water, which flows across the ground surface. There are three main types of subsurface geology where groundwater can exist:

- Hard Rock – Groundwater can be present in cracks or fractures in the rocks.
- Underground Caverns – Groundwater can fill these underground voids.
- Porous Sediments – Groundwater can fill the pore spaces between grains of sand and gravel.

In Sutter County, groundwater exists in porous sediments, alluvial aquifers, or fractured volcanic rock such as in the vicinity of the Sutter Buttes. Figure 7 shows a simplified surface geologic map with the major faults in the County. Sutter County is situated along the axial portion of the Sacramento Valley Groundwater Basin. The subsurface aquifers consist generally of layers of gravel, sand, clay, and in some cases volcanic ash. The characteristics of different aquifers, and zones within each aquifer, are related to the aquifer materials (sands, gravels, clays, etc.). Within a single aquifer zone, nearby wells with similar construction can have very similar well yields and water quality. It should be noted that many of the geologic formations that make up the alluvial aquifers are continuous units that are also present in other counties as discussed.

In the northern portion of Sutter County, the geologic setting changes rapidly from the stratigraphic succession observed in the rest of the County. A thick sequence of volcaniclastic sediments derived from the Sutter Buttes volcanic epoch form a volcanic fan apron of alluvial deposits around its perimeter. These deposits have been characterized recently by DWR as consisting largely of gravel, sand, silt, and clay. These deposits are observed at ground surface around the Buttes, and may extend up to a 15 mile radius in the subsurface (Springhorn 2008). Sediments deposited under marine sedimentary processes are also observed at ground surface and at shallow depths in the subsurface around the Buttes. These deposits were elevated from depth to their current position during the emplacement of the volcanic intrusion which formed the Sutter Buttes. Water quality in these sediments is generally poor and deteriorates with depth.

There is a large amount of hydrogeologic data available in the Sacramento Valley which has been widely studied, and groundwater is continuous within specific aquifer zones (although discontinuous between different aquifer zones) over large areas within the Sacramento Valley.

4.2.2. Status of Understanding of Regional and Local Geology

The geology of the Sacramento Valley has been studied for at least 95 years, and much has been learned over this time. However, there are still many areas of active study and debate. In Sutter County, areas that are not well-understood and/or are actively being studied include:

- The connection between the Coast Range-sourced Tehama Formation and the analogous Sierra Nevada-sourced deposits, and where this interaction occurs.
- The possible existence of subsurface barriers to groundwater flow within the County.
- The source of poor water quality in parts of the County.

4.2.3. Regional Geology and Structure

The Sacramento Valley Groundwater Basin is a north-south trending structural trough which is filled with layers of sediments. The stratigraphic succession of the basin deposits, from oldest to youngest (deep to shallow), depict a regional change in depositional environment from one dominated by marine sedimentary processes to that of continental (alluvial) processes. The deepest portions of the basin generally consist of marine sedimentary rocks, ranging in age from Late Jurassic to early Miocene (160 million years ago to 24 million years ago). These marine deposits are overlain by younger alluvial and locally prominent volcanic rocks of early Miocene to Holocene age (Harwood and Helley 1987). Within the Basin, these deposits are disrupted by deformational stresses derived from east-west compressional forces associated with regional uplift along the western margin of the valley and extensional forces to the east, within the Basin and Range Provenance (Harwood and Helley 1987). Over time, these forces have applied great stresses and strain on valley deposits, creating complex and diversely-oriented fold and fault structures.

The prominent fault system that occurs in Sutter County is the Willows Fault. The Willows Fault is an active northwest-trending fault that dips steeply to the east and shows reverse displacement, meaning the ground east of the fault has moved up relative to the west side. The Willows Fault enters into the County from Colusa County southwest of the Sutter Buttes and extends to the southeast portion of the County towards Sacramento.

The most prominent and recognizable geologic feature in Sutter County are the Sutter Buttes. The Sutter Buttes are composed of late Cenozoic volcanic rocks that rise over 2,000 feet above the Sacramento Valley floor. The Sutter Buttes formed between 2.4 and 1.4 million years ago as magma at depth was injected into the overlying Cretaceous and Tertiary rocks, causing deformation in the form of faulting, folding, and uparching (Harwood and Helley 1987).

4.2.4. Regional Stratigraphy

The prominent non-marine, fresh water-bearing stratigraphic units found within the East Butte, Sutter, and North American Subbasins include (from youngest to oldest):

- Recent Alluvial Deposits (stream channel, basin, and flood plain);
- the Modesto Formation;
- the Riverbank Formation;

- the Sutter Buttes Rampart;
- the Victor Formation;
- the contiguous Laguna, Tuscan, and the Tehama Formations;
- the Mehrten Formation; and
- the informally named Sutter Formation (Springhorn 2008).

Except for the Sutter Formation, the stratigraphic descriptions presented herein are based upon the California Department of Water Resources "Bulletin 118 – California's Groundwater" and are shown in the geologic cross-sections (Figure 8). The location of the cross-section is shown in Figure 7.

Locally, the stratigraphic succession observed in each subbasin differs slightly; therefore, each subbasin and its associated geologic setting are described separately with regard to their relative positions and occurrences in the specific subbasin.

4.2.4.1. East Butte Subbasin (Basin Number 5-21.59)

The northern section of Sutter County is underlain by the East Butte Subbasin. The East Butte Subbasin is bounded by the Sutter Buttes to the south, Butte Creek to the west and northwest, the Cascade Mountain range to the northeast, and the Feather River to the southeast. The East Butte Subbasin aquifer system consists of late Tertiary to Quaternary aged deposits comprised of Sierra and Cascade sourced material, and in the southern portion of the subbasin around the Sutter Buttes, by volcanic and volcaniclastic rocks. The geologic formations that comprise the East Butte Subbasin are (from youngest to oldest):

- Recent Alluvial Deposits;
- the Pleistocene aged Modesto and Riverbank Formations;
- the Sutter Buttes Rampart; and
- the Tertiary aged Laguna and Tuscan Formations.

Recent Alluvial Deposits

Stream channel deposits are Holocene in age and were deposited between 11,000 years ago and present day. The stream channel deposits occur along the current and ancestral paths of streams and rivers in Sutter County. Where present, the stream channel deposits extend from ground surface up to a depth of 80 feet below ground surface (Helley and Harwood 1985). The stream channel deposits consist of unconsolidated gravels, sand, silt, and clay, derived from the erosion and reworking of the Modesto and Riverbank Formations (described below). This unit is moderately to highly permeable, but because of its shallow depth and limited thickness, it possesses limited water-bearing capacity.

Basin deposits are Holocene in age and, like the stream channel deposits, were deposited between 11,000 years ago and present day. Basin deposits occur where sediment-laden floodwaters breached natural stream and river levees and spread across lower-lying topography. Where present, the basin deposits extend from ground surface up to a depth of 150 feet. The basin deposits consist mainly of silt and clay. These units have low permeability and generally yield small quantities of water to wells.

The Modesto Formation

The Modesto Formation is Pleistocene in age and is a stream terrace deposit that was deposited between 12,000 to 50,000 years ago (Helley and Harwood, 1985). Within this subbasin, the Modesto Formation consists of poorly indurated gravel and cobbles, sand, and clay and is derived from the reworking and deposition of the Riverbank Formation, Laguna Formation, and Tuscan Formation (DWR 2004). The Modesto Formation was likely deposited by the same stream and river systems that flow today, because it generally borders existing channels (Blake et. al. 1999). This formation may extend across the entire subbasin and where present, may range in thicknesses from 50 to 150 feet (DWR 2000). The sediments of the Modesto Formation are moderately to highly permeable and can yield moderate quantities of water to wells.

The Riverbank Formation

The Riverbank Formation is Pleistocene in age and was deposited between 120,000 and 500,000 years ago (Helley and Harwood, 1985). The Riverbank Formation consists of gravel and small cobbles, and is interbedded with reddish-clay, sand and silt. Like the Modesto Formation, the Riverbank Formation is a stream terrace deposit. However, the Riverbank Formation is older than the Modesto Formation. The

Riverbank Formation may extend across the entire subbasin, underlying the Modesto Formation, with thicknesses ranging from 50 to 200 feet. The Riverbank Formation is poorly to highly permeable and can yield moderate quantities of water to wells.

Sutter Buttes Rampart

The Sutter Buttes Rampart was deposited during the Middle to Lower Pleistocene period and is encountered in the southern portion of the subbasin. This unit is up to 600 feet thick in the subsurface (DWR 2000). In several studies (William and Curtis 1977, Springhorn 2008) the Sutter Buttes Rampart has been separated into two distinct units: the Rhyolitic Rampart and the Andesitic Rampart. The Andesitic Rampart phase of volcanism was much larger than the Rhyolitic phase. All the large peaks of the Sutter Buttes are andesitic domes and comprise the majority of the Rampart on the surface and the subsurface. The Sutter Buttes Rampart consists largely of gravel, sand, silt, and clay sediments which were deposited circumferentially around the Buttes as a geologic apron. These sediments may extend up to 15 miles north of the Sutter Buttes and west beyond the Sacramento River. Certain zones within these units yield large quantities of water (DWR 2004).

Laguna Formation

The Laguna Formation is Plio-Pleistocene in age and was deposited between 4 million and 2 million years ago. The Laguna Formation is comprised of Sierra Nevada sourced sediments, consisting of consolidated alluvial gravel, sand, and silt, comprised of granitic, metamorphic, and volcanic material. Estimates of the thickness of the Laguna Formation range from 180 feet (Helley and Harwood 1985) to 1,000 feet (Olmstead and Davis 1961). The Laguna Formation is characterized as being moderately consolidated and poorly to moderately cemented. Because of this, the permeability of formation is generally low to moderate. Wells completed in this formation have been observed to yield only moderate quantities of water (DWR 2003).

Tuscan Formation

The Tuscan Formation has been the subject of much interest in recent years. The Tuscan Formation is a regional aquifer system wholly or in parts of Tehama, Butte, Glenn, Colusa, and Sutter County. Within Sutter County, there has been limited analysis done on the subsurface extent of the Tuscan Formation. It is likely that the Tuscan Formation is only present in the northern portion of the County and consequently is not a major water resource for the County.

The Tuscan Formation is Plio-Pleistocene in age and was deposited between 4 million and 2 million years ago. The Tuscan Formation was derived by alluvial deposition associated with the erosion of volcanic material derived from Cascade volcanism. The formation outcrops from Red Bluff, in the northern part of the Sacramento Valley, to Oroville, southeast of Chico, and has been recognized in the subsurface at a distance of about 15 miles west of the Sacramento River (DWR 2003a). The deposits of the Tuscan Formation thin from east to west, from about 1,600 feet thick in the foothills of the Sierra Nevada to about 300 feet thick in the subsurface of the Sacramento Valley (Lydon 1969). In surface outcrops, the exposures of the Tuscan Formation are described as four separate, but lithologically similar units: Units A through D (Helley and Harwood 1985). Units A, B, and C are found within the subsurface in the northern part of the subbasin and units A and B are found in the southern part of the subbasin (DWR 2004). All of the units of the Tuscan Formation contain stratigraphic sequences of volcanic mudflows, volcanic conglomerates, volcanic sandstones, siltstones, and tuff deposits. In the subsurface, the Tuscan Formation consists largely of black volcanic sand and gravel, with interbedded layers of tuff breccias and tuffaceous clays (Ferriz, H. 2001). Unit A is the oldest (deepest) water-bearing unit and is distinguished from Units B and C by the presence of metamorphic clasts. Unit B contains equal distributions of volcanic mudflows, conglomerates, and tuffaceous sandstones. Units A and B are referred to as the “Lower Tuscan Formation”. Unit C is capped by massive volcanic mudflows with some interbedded conglomerates and sandstones. In the subsurface, the volcanic mudflows of Unit C act as a confining layer to groundwater flow, separating the more permeable deposits of the Lower Tuscan Formation (Helley and Harwood 1985).

4.2.4.2. Sutter Subbasin (Basin Number 5-21.62)

The Sutter Subbasin underlies the central portion of Sutter County and is wholly within the boundaries of the County. The subbasin is bound by the confluence of Butte Creek with the Sacramento River and the Sutter Buttes to the north, by the Feather River to the east, by the confluence of the Sutter Bypass and Sacramento River to the south, and by the Sacramento River to the west. The Sutter Subbasin aquifer system consists of late Tertiary to Quaternary aged deposits comprised of Sierra-sourced (Sierra Nevada) detritus and volcanic and clastic rocks in the northern portion of the subbasin around the Sutter Buttes. The identified geologic formations that comprise the Sutter Subbasin are (from youngest to oldest):

- Recent Alluvial Deposits;
- the Pleistocene aged Sutter Buttes Rampart and Victor Formation;
- the Pliocene Laguna Formation; and
- the informally named Sutter Formation.

Recent Alluvial Deposits

The Holocene aged stream channel and flood plain deposits occur along the current and ancestral paths of streams and rivers in Sutter County. The stream channel and flood plain deposits consist of unconsolidated gravel, sand, silt, and clay. Both thickness and grain size decrease as the distance increases from their source. Where present, the stream channel and flood plain deposits extend from ground surface to an estimated depth of 100 feet (Helley and Harwood 1985). These units are highly permeable and provide for large amounts of groundwater recharge within the subbasin. This unit is highly permeable, and yields significant quantities of water to wells (DWR 2000).

Sutter Buttes Rampart

The Sutter Buttes Rampart is Middle to Lower Pleistocene aged alluvial deposit that is encountered in the northern portion of the subbasin. This unit can be up to 600 feet thick in the subsurface (DWR 2000). In several studies (William and Curtis 1977, Springhorn 2008), the Sutter Buttes Rampart has been separated into two distinct units: The Sutter Buttes Rhyolitic Rampart and the Sutter Buttes Andesitic Rampart. The deposition and composition of Rhyolitic Rampart reflects the initial stages of volcanism and deposition around the Sutter Buttes, while the Andesitic Rampart reflects the later stages. These fan deposits form an apron around the Buttes and consist largely of gravel, sand, silt, and clay, and may extend up to 15 miles north of the Sutter Buttes and west beyond the Sacramento River. Certain zones within these units yield large quantities of water (DWR 2004).

Victor Formation

The Pleistocene aged Victor Formation is comprised of alluvial fan deposits composed of Sierra-sourced loosely consolidated gravel, sand, and silt. The Victor Formation has an estimated thickness of 100 feet (DWR 2004). This unit is observed to have an impermeable surface due to the presence of hardpan and clay pan soils (DWR 2003). At its base, the Victor Formation has been observed to have moderate permeability and provides most of the groundwater for domestic and shallow irrigation wells in Sutter County (DWR 2003). Wells completed in this unit have been reported to have yields as high as 1,000 gpm.

Laguna Formation

The Laguna Formation is comprised of Sierra sourced, consolidated alluvial gravel, sand, and silt, which consist of granitic, metamorphic, and volcanic material. Estimates of the formations thickness range from 180 feet (Helley and Harwood 1985) to 1,000 feet (Olmstead and Davis 1961). The Laguna Formation is characterized as being moderately consolidated and being poorly-to-moderately cemented, because of this, the formation generally has a low to moderate permeability. Wells completed in this formation have been observed to yield only moderate quantities of water (DWR 2003).

Sutter Formation

The Mio-Pliocene aged Sutter Formation is an informally named stratigraphic unit that underlies the area around the Sutter Buttes and the central portion of Sutter County. The extent of the deposits have been characterized on a local to sub-regional scale and have been generally classified as volcanic and epiclastic[3] sediments derived from volcanic sources located to the east in the Sierra Nevada, western Nevada, and the southern Cascade Volcanic Province (Springhorn 2008). Due to the complexity of identifying distinguishable characteristics within these deposits, informal and formal stratigraphic units within this region have been grouped together. Some of the major regional stratigraphic units that have been included in the Sutter Formation (from youngest to oldest) are the Tuscan, Mehrten, and Princeton Valley fill deposits.

4.2.4.3. North American Subbasin (Basin Number 5-21.65)

A portion of the North American Subbasin underlies the southeastern section of Sutter County. The North American subbasin is bound by the Bear River to the north, the Feather River to the west, the Sacramento River to the south, and in the east by a north-south trending line that represents the approximate edge of the alluvial basin (DWR 2004). The North American Subbasin is dominated by late Tertiary to Quaternary aged deposits consisting of Sierra-sourced volcanic sediments and alluvial derived sediments. The identified geologic formations that comprise the North American Subbasin are (from youngest to oldest):

[3] Consisting of fragments of preexisting rocks

- Recent Alluvial Deposits;
- Older alluvial deposits (the Pleistocene aged Modesto, Riverbank, Victor, and Laguna Formations); and
- the Mio-Pliocene aged Mehrten Formation.

Recent Alluvial Deposits

Stream channel deposits are Holocene in age and were deposited between 11,000 years ago and present day. The stream channel deposits occur along the current and ancestral paths of streams and rivers in Sutter County. The stream channel deposits consist of unconsolidated gravels, sand, silt, and clay, derived from active stream deposition, overbank sedimentation, and the erosion and deposition of existing Quaternary stream terrace deposits such as the Modesto and Riverbank Formations. Where present, the stream channel deposits extend from ground surface to a depth of 100 feet (Helley and Harwood 1985). This unit is highly permeable, and yields significant quantities of water to wells (DWR 2000).

The flood plain deposits consist primarily of silt and clay size sediments, with intermittent lenses of stream channel deposits. These deposits are generally observed along the flanks of existing and ancestral stream and river systems. These deposits have an estimated thickness up to 100 feet. Being that this unit is primarily comprised of finer-grained material, permeability is generally poor and generally yields low quantities of water. Brackish water is commonly encountered within this unit (DWR 2000).

Older Alluvial Deposits

Within this subbasin, a number of geologic formations have been assigned to the category "older alluvium" including: the Modesto, Riverbank, Victor, and Laguna Formations (DWR 2004). These deposits generally underlie the Recent Alluvial Deposits and consist of loosely to moderately compacted gravel, sand, silt, and clay size sediments that were derived and deposited under alluvial conditions. The thickness of these units ranges from approximately 100 to 650 feet (DWR 2004).

Mehrten Formation

The Mehrten Formation is Mio-Pliocene in age and consists of a sequence of volcaniclastic and volcanic rocks. In the subsurface, the Mehrten Formation ranges in thickness from 200 feet to 1,000 feet along the axis of the Sacramento Valley (DWR

2003). The Mehrten Formation is comprised of two distinct geologic units. The first unit consists of sediments deposited under alluvial and fluvial conditions and are comprised of gravel, sand, silt, and clay size sediments. This unit is highly permeable and wells constructed within this unit have been observed to produce yields exceeding 1,000 gpm (DWR 2003). The second unit consists of dense volcanic flows of tuff breccias with some interbedded conglomerates and sandstones. This unit acts as a confining layer between sand intervals and has a thickness that ranges from 200 to 1,200 feet in the subsurface (DWR 2003).

4.2.5. Areas Outside a Designated Groundwater Basin

The only part of the County that is not within a designated groundwater basin is the area consisting of the Sutter Buttes. Groundwater is likely found in the subsurface in fractures of the volcanic rock; however, historic groundwater levels and water quality were not reviewed in the preparation of this GMP. There are no local entities, aside from private domestic water users, that utilize groundwater resources in this area.

4.3. Groundwater Levels

DWR does not currently consider any of the groundwater subbasins underlying the County to be in overdraft. Overdraft is characterized by a declining trend in groundwater levels over multiple years without recovery during recharge events. Historic groundwater level data were reviewed for each of the subbasins within the County. DWR maintains a publicly available on-line database, which includes groundwater level data for the County. The DWR Water Data Library (WDL) website can be found at http://www.wdl.water.ca.gov. Wells monitored by DWR and cooperating agencies are identified by the State Well Number (SWN). Data can be obtained for specific wells by means of a map interface, by groundwater basin, or by the assigned SWN.

A 79-year period of record for water level measurements in Sutter County depicts a groundwater system that has experienced changing conditions over time. A number of DWR monitored wells were selected throughout the County to represent these changes. The locations of these wells, along with their associated hydrographs illustrating the historic groundwater levels, are shown in Figure 9. Groundwater level data from well 10N/4E-12A1, a 290-foot-deep well located in the southeast portion of Sutter County, and well 13N/3E-32N1, a shallow (less than 100 feet deep) well located in the southern portion of the County show the groundwater levels typical of different areas of the County. Groundwater levels in well 10N/4E-12A1 are characteristic of areas of high groundwater use and differing water conditions. Water levels fluctuate, sometimes dramatically, in response to changes in groundwater use and hydrologic conditions. This well is located in an area where agricultural demands are supplied entirely with groundwater. The Sacramento County Department of Water Resources website includes published groundwater elevation maps and indicates that this well is in close proximity to a large pumping depression in northern Sacramento County. Groundwater levels in well 13N/3E-32N1 are characteristic of areas with lower groundwater use and more stable water conditions, and as such, water levels have not exhibited significant fluctuations over times. This well is located in an area where agricultural demands have been met almost entirely with surface water and groundwater demands have consequently been small.

Groundwater levels in well 10N/4E-12A1 have varied from 20 to 80 feet below ground surface over time. The combination of high groundwater use, the close proximity to a pumping depression, and changing climatic conditions has led to significant declines in groundwater levels from the early 1950' through the late 1970's. In the middle to late 1970's, drought conditions increased the rate of decline of groundwater levels on an even larger scale. In the mid 1980's and early 1990's, private and municipal water agencies in a collaborative effort started to implement conjunctive water use programs. With the availability of surface water, and the decrease in groundwater pumpage, groundwater levels have been steadily recovering from the early 1980's through present. Groundwater levels in this well are currently about 35 to 40 feet higher than they were in the late 1970's.

Groundwater measurements in well 13N/3E-32N1 shows very stable groundwater levels since measurements began in 1942. Groundwater levels have remained virtually unchanged, with water levels within 5 to 6 feet of ground surface and seasonal fluctuations of less than 10 feet.

The direction of groundwater flow during the fall season within the County has not changed significantly from 1912-1913 (Bryan 1923) to 2007; with the exception of the southeastern portion of the County. Contours of equal groundwater levels from fall 1912-1913 and fall 2007 were compared to identify changes over the 95 year period. Figure 10 depicts changes in groundwater levels over the aforementioned period. In most areas within the County, groundwater levels were not dramatically different in 2007 than they were in 1912-1913. In the central portion of the County, an increase in groundwater levels is observed in the data, which may be likely due to applied surface water for irrigation. In the southeastern portion of the County, a significant decline in groundwater levels is observed, which can be related to the high usage of ground water for irrigation of crops, and the influence of the large pumping depression in the northern portion of Sacramento County.

Fall and spring contour maps of equal groundwater elevation for 2007, 2008, 2009, and spring 2010 were reviewed (Figures 11 through 17) to determine groundwater gradient and flow direction. The fall 2009 and spring 2009 groundwater contours generally follow the topography of the County and indicate that groundwater flows from the Sierra Nevada toward the Sacramento Valley (east to west), and north to south within the Valley. The fall 2007 contour map of equal groundwater elevations indicates a few locations where small pumping depressions are present, but in general, suggests the same direction of groundwater flow as seen in the spring 2007 groundwater contour map. Differences in groundwater levels between fall and spring appear to be a result of normal fluctuations in groundwater conditions from seasonal pumping and from wet and dry climatic cycles.

Data from the nested monitoring well at the extensometer site in the southern portion of the County indicates that, for the 14 years of available data, the spring groundwater levels in the monitored aquifer zones have been very similar, within a few feet of one another; except for the deepest completion where groundwater levels are approximately 10 feet lower than the shallower completions.

4.4. Groundwater Quality

The quality of groundwater is a product of the material through which it flows, or that flows into it. Local variations in the quality of the County's groundwater can limit its use for either potable water supply and/or agricultural applications. Groundwater contamination is a result of naturally occurring, point source contamination, and/or regional contamination. Naturally occurring contaminants of concern include dissolved salts [as measured by the specific conductance or electrical conductance (EC)], boron, nitrate, manganese, arsenic, and mercury. Point source contamination typically involves solvent releases originating mostly from gas stations and dry cleaners. Regional sources of contamination include applied fertilizers, salts, and leaky septic systems (nitrate and salt loading).

Historic and current water quality data (collected by the DWR, USGS, and local water purveyors) for wells located within the County were analyzed to characterize spatial and depth dependent water quality trends within the County's groundwater subbasins. The data was separated by well depth into the following three categories: less than 150 feet deep, 150 to 400 feet deep and more than 400 feet deep, as shown in Figures 18 through 23. The categories were chosen based on the occurrence at which certain stratigraphic units are observed in the subsurface in Sutter County.

4.4.1. Specific Conductance

Specific conductance was selected as an indicator of overall water quality. Specific conductance is a property of groundwater that is relatively simple to collect in the field at the well head and can help identify and characterize the condition of the non-marine fresh water bearing aquifer system. Specific conductance is a measure of how effectively water will conduct electricity and is reported in micro Siemens (µS/cm) per centimeter and provides for the indirect measurement of the amount of dissolved solids (salts) in the groundwater. Lower specific conductance generally indicates better water quality (fresh water) while higher specific conductance generally indicates poorer water quality (brackish to saline water).

Applied irrigation and fertilizers can add salts to the water that percolate into the hydrogeologic system, increasing the specific conductance of the groundwater. Increased specific conductance values of the groundwater can also be attributed to naturally occurring brackish or saline water, such as geologic formations (aquifers) which are, or have been in the past, directly connected to a salt water body or where geologic formations were deposited under marine (salt water) conditions and which have inherently high dissolved salt concentrations. As shown in Figures 18 and 19, specific conductance values within the County are generally acceptable for agricultural and domestic use east of Highway 99 and in the northern half of the County. Elevated values for specific conductance are near to and/or exceed the recommended maximum contaminant level (MCL)[4] for domestic use in the shallow aquifers near the Sacramento River and in the aquifers below 900 feet. The elevated specific conductance could potentially be problematic for agricultural use. It is unclear why there is elevated specific conductance in this area.

4.4.2. Boron

Boron is a naturally occurring element. As shown in Figure 20, boron concentrations in the County are generally acceptable. Some deeper wells, which likely encounter more marine sediments, do contain elevated boron concentrations. Boron is a necessary element for agriculture, but may become toxic to crops above 500 micrograms per liter (µg/L). For public drinking water systems, the California Department of Public Health (CDPH) has established a notification level of 1,000 µg/L for boron. Increased concentrations of boron are observed in wells greater than 400 feet as well as in the southwestern portion of the County.

4.4.3. Nitrate

Nitrate is a contaminant which does not naturally occur in the subsurface. Elevated concentrations of nitrate are widespread in the Sacramento Valley. As shown in Figure 21, concentrations of nitrate in the populated areas of Sutter County are near or above the MCL for nitrate (as NO_3). The CDPH has established a primary MCL of 45 milligrams per liter (mg/L) for nitrate (as NO_3). Near the Sutter Buttes and Yuba City, nitrate concentrations in several wells (less than 150 feet) exceed the MCL. Where present, elevated concentrations of

[4] Recommended CDPH MCL for Specific Conductance is 900 µS/cm; upper limit is 1,600 µS/cm; short term is 2,200 µS/cm

nitrate are likely a result of overlying land uses, such as septic systems, animal enclosures, or applied fertilizers.

4.4.4. Manganese

Manganese is a naturally occurring element found in rocks and minerals. Its presence in groundwater is a result of the dissolution of the naturally occurring element in sediments containing minerals composed of manganese. As illustrated in Figure 22, manganese concentrations are elevated in all portions of the County, at levels that may cause aesthetic problems (odor or staining) for domestic and municipal uses, but generally below levels that could represent a health risk. There are, however, a few locations where manganese concentrations are near or exceed the CDPH established Notification Level of 50 µg/L, and may pose a health risk.

4.4.5. Arsenic

Arsenic is a naturally occurring element commonly found in alluvial sediments. Its presence in groundwater is a result of the dissolution of the element in sediments containing minerals containing arsenic. The CDPH has established a primary MCL of 10 µg/L for arsenic. As illustrated in Figures 19 and 23, arsenic concentrations are near to or above the CDPH MCL throughout the County in each of the aquifer zones assessed; conversely, concentrations of arsenic below the CDPH MCL are also present throughout the County in each of the aquifer zones assessed. Countywide, arsenic concentrations do not appear to be isolated to any one specific aquifer zone in the subsurface. However, recent data analysis suggests a possible correlation between elevated arsenic concentrations and the presence of volcaniclastic material of the Sutter Buttes Rampart formation. Concentrations of arsenic in the stratigraphic units that occur above and below the Rampart are generally less than 10 µg/L, whereas concentrations of arsenic within the Rampart material are between 10 to 370 µg/L (Springhorn, 2008). Concentrations of arsenic tend to be under the CDPH MCL southeast of Highway 99 and in the shallow aquifers.

4.4.6. Mercury

Historic gold mining processes and operations introduced toxic mercury into the surface water system throughout Northern California in the late 1800's. Due to the proximity of these operations to Sutter County, the PAG requested an assessment of the concentrations of mercury in the groundwater. A limited number of wells have been sampled within Sutter County for mercury, and as such, concentrations of mercury in the groundwater within Sutter County can not be well characterized. The few wells that have been sampled for mercury indicate that mercury concentrations were low. In most cases, the concentrations were below the analytical detection limit (not detectable by the laboratory method used at the time).

4.5. Land Subsidence

Land subsidence is the gradual or sudden lowering of the land surface due to compaction of the underlying sediments. Two types of land subsidence are observed within alluvial sediments: inelastic and elastic. Inelastic land subsidence is a result of the compression of geologic formations and is irreversible. Inelastic land subsidence can be caused by excessive extractions of groundwater, oil, or natural gas. In discussing land subsidence, it is important to note that elastic (reversible) land subsidence is a normal occurrence, whereas inelastic land subsidence has associated negative impacts.

Although there are several causes of inelastic land subsidence, the compression of clay as a result of groundwater extraction is considered the most likely cause of subsidence north of the Sacramento-San Joaquin Delta (Page 1998). Once water is removed (mined) from compressible clay, the clay compresses and cannot accept water again, thus resulting in the permanent lowering of the overlying land surface (inelastic land subsidence). Clay compression has occurred in several locations in California, including the San Joaquin Valley. Compressible clay, such as the Corcoran Clay member of the Tulare Lake Formation, has been mapped over much of the western side of the San Joaquin Valley and can be over 130 feet thick. The subsidence documented in the San Joaquin Valley extends over a very large area, with over 30 feet of subsidence recorded in some areas.

North of the Sacramento-San Joaquin Delta in the Sacramento Valley, inelastic land subsidence, which has been directly related to clay compression as a result of groundwater extraction, has occurred in portions of Solano, Yolo, and Colusa Counties (Page 1998). Recorded land subsidence of more than two feet, and possibly as much as five feet, has occurred in this area. Subsidence in the Sacramento Valley appears to extend from Davis to Arbuckle. The area of subsidence appears to follow a local geologic feature known as the Zamora Syncline. A syncline is a structural fold that is formed by compressional forces which cause the sedimentary layers to have a concave, or a bowl-like geometry. Lakebeds are often associated with structural lows such as synclines. Lakebed deposits typically consist of fine-grained, clayey sediments, which settle out to the bottom of standing bodies of water and of which can include large volumes of freshwater diatoms[5]. Along with sediments, the microscopic diatoms settle and collect on the bottom of a lakebed. In Yolo County, diatomaceous (diatom rich) clay sediments have been identified within the geologic formations of Zamora Syncline. These diatomaceous clay sediments were identified to be

[5] Diatoms are unicellular aquatic algae, typically 20 to 200 microns (Prothero, 1998)

highly compressible (Page 1998). Although diatomaceous clay has been identified in numerous boreholes drilled in Sutter County, there have not been any recorded land subsidence issues.

Elastic land subsidence is observed to be cyclical and does not result in permanent compaction of subsurface materials. One example of elastic land subsidence is seasonal fluctuations in ground surface elevations that coincide with fluctuations in groundwater levels (and associated aquifer pressure). In elastic land subsidence, the subsurface pressures acting on the aquifer do not decrease enough so that subsurface materials permanently compact.

The DWR, in cooperation with federal, state and local agencies, installed and surveyed Global Positioning System (GPS) monuments to be able to measure and monitor ground surface elevations over time in the Sacramento Valley. The project, titled “The Sacramento Height-Modernization Project”, consists of 339 monuments, spaced approximately 7 kilometers apart, in 10 counties. There are 32 monuments located in Sutter County. The GPS monuments will augment the existing network of extensometers which DWR currently monitors for land subsidence. In total, there are 13 extensometers located in Glenn, Colusa, Butte, Yolo, and Sutter Counties. The land subsidence monitoring network is shown in Figure 24. Only one of these extensometers, State Well Number 11N/4E-04, is located within Sutter County. It is located in the south-central part of the County along Highway 99, and extends to a depth of 1,003 feet, extending over a large portion of the fresh-water formations. The extensometer is installed in a dedicated monitoring well and is designed to measure any change in distance between the bottom of the well and the ground surface. DWR reports the accuracy of the extensometer to be ±0.001 feet. The extensometer provides for ongoing, real-time data collection, of land surface elevation changes. The Sutter County extensometer has been recording data since early 1994. In the 14 years since it began recording, the extensometer in Sutter County has recorded seasonal (cyclic) elastic land subsidence of approximately 0.03 feet (approximately one-third inch). There has been no indication over the period of record that any inelastic subsidence has occurred.

4.6. Groundwater-Surface Water Interaction

Several clustered monitoring wells located throughout the county adjacent are used to monitor changes in surface flow or quality that directly affect the groundwater system (levels or quality), and/or to monitor changes in surface flow or quality that are caused by groundwater pumping. These monitoring wells are adjacent to surface water bodies, and have a river stage gage located in the immediate vicinity.

Several of the network wells are located along the banks of the Sacramento, Feather, and Bear Rivers, as shown in Figure 25. The relationship between the volume of water flowing in the major rivers/streams and the influence the surface water imparts on groundwater elevation are being monitored with a combination of nested monitoring wells and river stage gages. Four stations exist in the County for observing this interaction: on the Sacramento River below Wilkins Slough (WLK), on the Bear River at Pleasant Grove Road (BPG), on the Sutter Bypass at RD 1500 pump (SBP), and along the Feather River above Star Bend (FSB). Sutter County also monitors a river stage gage at Boyd's Landing (FBL). At stations BPG and FBL, observations of water surface/groundwater elevations trend closely during high flow/stage events in the rivers, suggesting a significant hydrologic connection between the groundwater in the shallow aquifers and the surface water.

4.7. Groundwater Recharge

Groundwater recharge is the process in which groundwater is replenished. The geologic formations that comprise the aquifer system underlying the County extend well beyond the County's jurisdictional boundaries. Several processes are responsible for recharge of the groundwater basin. On a regional scale, surface water flowing over the surface expression of the geologic formations (surface outcrops) allows for direct infiltration into the hydrogeologic system. Figure 26 depicts contours of equal groundwater elevations, superimposed over the surface geology, for the Sacramento Valley Groundwater Basin. Groundwater flow is perpendicular and down gradient to the contour interval. On the east side of the Sacramento Valley Groundwater Basin, the groundwater contours become parallel to and follow the margin of the valley, indicating groundwater is moving through the subsurface from the east to the west. Locally, groundwater recharge occurs where surface water flows over permeable sediments (gravel and sand) in the river channels, allowing for the direct infiltration of surface water. Deep percolation of applied irrigation water also recharges the groundwater basin. Additionally, surface water deliveries have increased the quantity of water flowing down the river, adding available water to recharge the underlying aquifers helping to improve groundwater elevations.

The amount of groundwater recharge is dependent on the available storage space within the aquifer(s). Depending on the degree of separation between the elevation of the bottom of the river or stream and that of the groundwater, streams can either "lose" water into the underlying aquifer(s) or "gain" water. Where groundwater levels are at or above the elevation of surface water, groundwater will discharge into the stream (gaining stream). Where there is a separation between the groundwater and surface water, water flowing downstream will recharge into (losing stream) the groundwater basin (although the contribution has not been studied). Conversely, if groundwater levels are at land surface, there will be refusal of any "new" water into the subsurface.

The State Water Resources Control Board has identified hydrogeological vulnerable areas, meaning vulnerable to groundwater contamination, where geologic conditions allow recharge to the underlying aquifers. Generally, these areas include the coarse deposits associated with the Feather River.

4.8. Groundwater Infrastructure

According to DWR records, 6,742 well completion reports have been filed for wells constructed in Sutter County. Well completion reports are not always filed with DWR, even though they are required by law, so the number of reports likely under-represent the actual total for the County. Of the wells for which well completion reports have been filed:

- 3,344 are domestic wells
- 1,167 are irrigation wells
- 854 have unknown or other uses
- 308 are monitoring wells
- 75 are municipal wells
- 34 are industrial wells
- 13 are test wells
- Seven (7) are stock-watering wells
- 12 are fire or frost protection wells
- Two (2) are cathodic protection wells

Figure 27 shows the number of DWR well completion reports filed for Sutter County from 1928 through 2007. The figure only illustrates wells that were classified as either: domestic, irrigation, or public supply. Domestic wells were constructed at a rate of approximately five per year from 1941 through 1950, but have been constructed at a rate of approximately 59 per year since then. Irrigation wells tend to be constructed more frequently during drought periods, in the mid-1970's and early 1990's. On average, 16 irrigation wells are constructed per year; however, significantly more wells are constructed during droughts. Municipal well construction has averaged two-and-a-half per year. Of the wells for which records exist, approximately 700 wells are classified as either abandoned or destroyed.

Figure 28 shows the average depth of wells constructed from 1950 through 2005. The average depth of domestic wells has fluctuated since the 1930's, but has generally been about 100 feet deep. The average depth of irrigation wells has fluctuated significantly, but has been about 160 feet deeper than the average depth of domestic wells in any give year, or an average of about 260 feet deep. Municipal well depths are inconsistent and vary widely in depth, from about 50 to 700 feet deep. Combined with the small number constructed annually, calculation of an average depth of new municipal wells would not be meaningful.

5. GROUNDWATER MANAGEMENT PLAN REQUIRED, VOLUNTARY, AND RECOMMENDED COMPONENTS

California Water Code §10750 et seq., as amended by Senate Bill (SB) 1938, defines the required and voluntary components of a GMP and establishes procedures by which they must be developed. DWR recommends additional elements to include in a GMP in Bulletin 118 Update 2003, Appendix C. The Sutter County GMP includes the components required in the Water Code and has been developed in accordance with the required procedures. This GMP also includes many of the voluntary and recommended GMP components. This GMP also includes components designed to address the requirements of California Water Code §10920 et seq., which establish requirements for groundwater monitoring that affect eligibility for grant funding.

5.1. California Water Code Requirements

Section 10750 et seq. of the California Water Code, as amended by SB 1938, requires GMPs to include six mandatory components to be eligible for the award of funds administered by DWR for the construction of groundwater projects or groundwater quality projects. These components are listed below.

Description	***GMP Section***
Make available to the public a written statement describing the manner in which interested parties would be allowed to participate in the development of the GMP.	1.4
Include Basin Management Objectives (BMOs), including components relating to the monitoring and management of groundwater levels, groundwater quality degradation, inelastic land subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping.	6.2
Prepare a plan that involves other agencies that enables Sutter County to work cooperatively with other public entities whose service area or boundary overlies the groundwater basin.	7.1.5
Prepare a map that details the area of the groundwater basins, Sutter County's boundaries, and other local agencies within the groundwater basins.	Figure 1

Description	*GMP Section*
Adopt monitoring protocols to detect changes in groundwater levels, groundwater quality, inelastic surface subsidence, and flow and quality of surface water that directly affects groundwater levels or quality or are caused by groundwater pumping.	7.1
For areas outside the groundwater basins, use geologic and hydrologic principles appropriate to those areas.	4.2.5;7.1.4

5.2. DWR Bulletin 118 Recommended Components

DWR's Bulletin 118 recommends other components that may voluntarily be included in a GMP. These are listed below.

Description	*GMP Section*
Establish an advisory committee of stakeholders to help guide the development and implementation of the plan and provide a forum for resolution of controversial issues.	1.4
Describe the area to be managed under the GMP.	1.3
Describe how meeting each BMO will contribute to a more reliable long-term groundwater supply, and describe management actions to achieve each BMO.	6.2
Describe GMP monitoring program.	7.1
Describe integrated water management planning efforts.	7.1.5
Periodically report groundwater basin conditions and management activities.	7.1.6
Evaluate GMP periodically.	7.1.6

5.3. California Water Code Voluntary Requirements

California Water Code §10753.8 lists twelve issues of groundwater management which may voluntarily be included in a groundwater management plan.

Description	***GMP Section***
Control of saline water intrusion.	6.1.3
Identification and management of wellhead protection areas and recharge areas.	4.7; 6.1.3
Regulation of the migration of contaminated groundwater.	N/A
Administration of well abandonment and well destruction program.	6.1.3
Mitigation of conditions of overdraft.	4.3
Replenishment of groundwater extracted by water producers.	N/A
Monitoring of groundwater levels and storage.	4.3; 5.4
Facilitating conjunctive use operations.	6.1.3
Identification of well construction policies.	6.1.3
The construction and operation of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects.	N/A
The development of relationships with state and federal regulatory agencies.	7.1.5
Review of land use plans and coordination with land use planning agencies to assess activities which create a reasonable risk of groundwater contamination.	7.1.6

5.4. California Water Code Groundwater Monitoring Components

On November 4, 2009 the State Legislature amended the Water Code with Senate Bill SBx7-6, which mandates a statewide groundwater elevation monitoring program to track seasonal and long-term trends in groundwater elevations in California's groundwater basins. To achieve that goal, the amendment requires collaboration between local monitoring entities and DWR to collect groundwater elevation data. Collection and evaluation of such data on a statewide scale is an important fundamental step toward improving management of California's groundwater resources.

In accordance with this amendment to the Water Code, DWR developed the California Statewide Groundwater Elevation Monitoring (CASGEM) program. The intent of the CASGEM program is to establish a permanent, locally-managed program of regular and systematic monitoring in all of California's alluvial groundwater basins. The CASGEM program will rely and build on the many, established local long-term groundwater monitoring and management programs. DWR's role is to coordinate the CASGEM program, to work cooperatively with local entities, and to maintain the collected elevation data in a readily and widely available public database. DWR will also continue its current network of groundwater monitoring as funding allows.

The law anticipates that the monitoring of groundwater elevations required by the enacted legislation will be done by local entities. The law requires local entities to notify DWR in writing by January 1, 2011 if the local agency or party seeks to assume groundwater monitoring functions in accordance with the law (Water Code §10928).

Additionally, on or before January 1, 2012, the law requires that Monitoring Entities shall begin reporting seasonal groundwater elevation measurements to DWR (Water Code §10932).

Local entities in Sutter County that have submitted official notifications to DWR to be considered for CASGEM Monitoring Entities include:

- Sutter Extension Water District
- Feather Water District
- Reclamation District 1500 (including RD 1500, Pelger Mutual Water Company and Sutter Mutual Water Company)
- Natomas Central Mutual Water Company
- South Sutter Water District

Garden Highway Mutual Water Company has shown interest in participating in CASGEM but has not yet completed the official notification submittal process include.

Local entities that submit complete Monitoring Entity notifications and adequate groundwater monitoring plans and well networks will be officially designated by DWR to be the Monitoring Entities for their respective subbasin or portion of a subbasin for the purposes of the CASGEM Program. However, if no local monitoring entity volunteers or is identified for a particular area or groundwater basin, DWR may assume the monitoring and reporting duties and certain entities in the basin may not be eligible for water grants or loans administered by the state.

Sutter County is severely limited in its ability to take a lead in groundwater monitoring because of budget and staff shortages. Furthermore, the County does not own any groundwater monitoring wells and does not conduct any groundwater monitoring on its own. For this reason, Sutter County does not seek to assume groundwater monitoring functions under California Water Code §10920 et seq. However, the County does promote the coordinated collection of groundwater elevation data through its Groundwater Monitoring Program, discussed in Section 7.1 of this GMP.

6. GROUNDWATER MANAGEMENT GOALS AND BASIN MANAGEMENT OBJECTIVES

6.1. Groundwater Management Goals

Sutter County's groundwater management goals represent the overarching intent of the County with regard to groundwater management. Basin Management Objectives (BMOs) and Management Actions must be consistent with these Groundwater Management Goals, and must contribute to achieving the goals. Sutter County's goals for groundwater management (as developed with input from the public through PAG meetings and workshops) are:

- To promote responsible groundwater use in Sutter County so groundwater is available to meet present and future demands.
- To provide groundwater users with information and guidance to help them be responsible stewards of the groundwater resources in Sutter County.
- To discourage activities that could reduce the long-term availability of high-quality groundwater in Sutter County.

Each of the Groundwater Management Goals is discussed below.

6.1.1. To Promote Responsible Groundwater Use in Sutter County So Groundwater is Available to Meet Present and Future Demands.

One of Sutter County's main goals for groundwater management is to ensure that a reliable water supply is available so that water users in the County can be confident that water will be available to meet domestic, irrigation, and other demands on an ongoing basis.

The goal to promote responsible groundwater use in Sutter County is intended to provide the County with useable groundwater resources now and in the future. This is important because the socio-economic well being of the County could be adversely affected if the groundwater supply becomes less useable from a supply or quality standpoint. Ensuring responsible groundwater use will help protect groundwater rights and maintain local control because adjudication of the groundwater basin will not be warranted if long-term groundwater sustainability can be achieved.

6.1.2. To Provide Groundwater Users with Information and Guidance to Help Them Be Responsible Stewards of the Groundwater Resources in Sutter County.

It is important to understand that in order to responsibly manage groundwater to ensure long-term groundwater sustainability, it is necessary to thoroughly understand the groundwater system underlying the County, along with its capabilities and limitations. Sutter County's water resources should be viewed as a dynamic system with the amount of available surface water and groundwater varying over time with fluctuations in hydrologic and climatic conditions. The implementation of a surface/groundwater monitoring program to observe and document the County's resources is essential to provide the community with the necessary information to accomplish this management objective.

6.1.3. To Discourage Activities that Could Reduce Long-Term Availability of High-Quality Groundwater in Sutter County.

It is important to recognize that this management objective is not intended to restrict the users within the community from exercising their legal rights to groundwater. Groundwater is a resource that should remain available for the people of the County to use beneficially on their property. The intent of this objective is for groundwater management to be accomplished in a way that minimizes activities that could potentially reduce the long-term availability of high-quality groundwater in Sutter County. There are a number of management practices that can be utilized to accomplish this goal. Two of the main practices that should be considered are conjunctive use programs and improving County well standards.

The goal of optimizing the conjunctive use of surface water and groundwater will enhance the County's water supply reliability and maximize the available water supply. The term "conjunctive use" basically means using surface water and groundwater together to meet water demands, using different proportions of each depending upon availability. For example, in years of reduced surface water availability, more groundwater would be used and groundwater levels might decline. Conversely, in years of full surface water availability, less groundwater would be used and groundwater levels would be allowed to recover. Optimizing conjunctive use generally means that, whenever possible, surface water is used to the fullest extent with groundwater serving as a "back-up" supply. This maximizes the available water supply because unused surface water generally flows downstream and is lost, but unused groundwater remains in the ground and would be available for later use.

On the other hand, the potential may exist in some areas of the County where groundwater levels are (and have historically been) high, to utilize more groundwater and thus induce more recharge (by creating additional storage space within the aquifer) thereby increasing the total water supply available in the County.

A related goal is to "even out" water availability in the County. There are cases when surplus water is available in some areas of the County, but other areas have inadequate supplies. For example, an area with high groundwater levels may have adequate or excess surface water, while another area may have low groundwater levels and inadequate surface water. In this case, groundwater could be pumped in the area with high groundwater levels, and their surface water could be transferred to the area with low groundwater levels so that area does not have to rely as much on groundwater. If possible, undertaking such projects will help improve the overall water supply reliability in the County.

The goal for updating the County's well standards is to add additional levels of protection to ensure that the design of new well structures prohibit the downward migration of surface/shallow contaminants or cross contamination of aquifers. The County has adopted standards as set forth in Chapter II of the State Department of Water Resources Bulletin 74-81, and as supplemented by Bulletin 74-90, entitled "Water Well Standards: State of California", except as otherwise provided in Section 700, Chapter 765 "Water Wells" of the Sutter County Municipal Code[6]. Some amendments that could be made to the existing well standards are: (1) require the use of geophysical surveys for all new well projects, (2) increase the required minimum sanitary seal depths, (3) institute water quality sampling during cable tool well drilling, (4) institute well restriction zones where poor water quality is known, and (5) improve/implement well destruction programs.

Requiring the use of geophysical surveys (spontaneous potential, 16- and 64-inch resistivity) in all new boreholes can help to enhance groundwater protection by identifying the zone(s) of poor water quality, as well as the depths of confining layers, which can be used to design adequate sanitary/annular seals. With this data, future wells can be designed to effectively seal against poor water quality while providing adequate measures for aquifer protection.

Increasing the minimum sanitary seal depth required for new wells is a proactive measure that can effectively increase aquifer protection. Increasing the required sanitary seal to a minimum depth of 50 feet for all new wells can seal off shallower aquifers with poorer water quality from the deeper aquifers with better water quality, as well as impede the

[6] http://www.co.sutter.ca.us/doc/government/bos/ordinance

downward migration of surface contaminants. Currently, the standards in force require a minimum 50-foot sanitary seal for municipal supply wells and 20-foot sanitary seal for all other wells (Bulletin 74-90).

Many wells in Sutter County have been drilled and constructed utilizing the cable tool drilling method. One of the main troubles with cable tool wells is that they usually are constructed across, and connect, multiple aquifer zones. Some of these well structures likely have become conduits for the downward migration and cross contamination of aquifer zones. Water quality sampling during the drilling of these wells (field tests for TDS or specific conductance) would delineate between problematic and non-problematic aquifer zones. If an existing well is deemed problematic (i.e. poor water quality), corrective measures through well modification or even well destruction could help mitigate the movement of poorer water quality between aquifer zones.

Implementing well restriction zones where water quality contamination is known to exist in specific aquifers can aide in protecting aquifers with acceptable water quality. Restricting the construction of wells or requiring specific seal intervals can provide an additional level of aquifer protection. Certain areas within Sutter County have localities of poorer water quality. It may be beneficial to assess the risk of drilling and constructing new wells within these areas. If adequate aquifer protection can not be achieved during construction activities, it may be warranted to designate well exclusion zones.

Unused, unsecured, abandoned, or improperly destroyed wells can act as a direct conduit for surface water infiltration or degradation of one or more aquifers, if they are connected by the well structure. Well destruction requirements adopted by the County currently require abandoned wells to be destroyed. Currently, these requirements require the uppermost 20 feet of the well/borehole be filled with impervious material. Special situations, in the case where vertical movement of poor water quality could contaminate an aquifer with good water quality, require impervious sealing material to be placed adjacent to confining layers. Increasing oversight of the permitting process during the planning and design of well destruction programs can ensure added protection against the vertical migration of poor water quality.

6.2. Basin Management Objectives

Basin Management Objectives (BMOs) are guidelines established to ensure that the County's basin management goals are being fulfilled. BMOs create a systematic method for collecting and monitoring data for specific components of the groundwater system and to provide for the dissemination of such information to the public. The objective of the BMOs is not to assign a fixed value, or level, to each parameter, but to allow for the early identification of potential problems with sufficient time for the County and its groundwater users to formulate an action plan to mitigate adverse effects to its groundwater resource.

Sutter County's BMOs address the following parameters:

- Groundwater levels
- Groundwater quality
- Inelastic land subsidence
- Surface water
- Coordination

6.2.1. Groundwater Levels BMO

There are three BMOs for groundwater levels:

- *Avoid ongoing declines in groundwater levels during water year types identified by DWR to be "above normal" or "wet" for the Sacramento Valley.*
- *Avoid problematically high groundwater levels.*
- *Provide assistance with assessing problems and resolve disputes related to groundwater levels.*

Groundwater levels are to be managed to ensure adequate water supplies while avoiding adverse impacts and mitigating them if and when they do occur. Adverse impacts related to groundwater levels can occur from excessively high or low groundwater levels. What constitutes an excessively high or low groundwater level may change over time, and will also vary by land use and hydrologic and climatic conditions.

Excessively high groundwater levels are problematic in some areas of the County. High groundwater levels in Sutter County are often naturally occurring. However, groundwater levels can be raised by application of water to the ground surface through irrigation, surface storage, or recharge projects. When groundwater levels are high, there is no storage capacity available in the underlying aquifer for groundwater recharge from precipitation, stream flow, or excess applied irrigation water. This represents a lost opportunity to capture recharge and increase the overall water supply for the County. Adverse impacts related to high groundwater levels include:

- Damage to foundations, roads, and other infrastructure.

- Water-logging the root zone of certain crops.

Groundwater levels decline when pumping exceeds recharge and rise when recharge exceeds pumping. It is important to note that periodic short-term declines in groundwater levels (during drought periods and/or increased pumping), which are then followed by recovery to at or near historic highs (during wet periods and/or decreased pumping), are normal and do not represent overdraft. Excessively low groundwater levels that are caused by long-term declines without recovery, thus overdraft, can be avoided by reducing pumpage. This can be accomplished by expanding the conjunctive use with surface water. Adverse impacts related to low groundwater levels include:

- Infrastructure problems when lowered groundwater levels dewater pumps or wells, so groundwater cannot be extracted using existing infrastructure even though it is available at greater depths.
- Depleted available groundwater supply.
- Inelastic land subsidence.
- Riparian and/or native vegetation destroyed.
- Reduced surface water flow due to increases in streambed infiltration, or increases in the capture of groundwater that otherwise would have contributed to increasing the base flow of a surface water system.

6.2.2. Groundwater Quality BMO

The BMO for groundwater quality is to:

- *Improve the understanding of groundwater quality in Sutter County.*
- *Maintain or improve groundwater quality.*

Adverse impacts to groundwater quality most commonly occur when degradation of groundwater renders groundwater unsuitable for intended uses. Accordingly, what constitutes a significant adverse impact to groundwater quality is related to the purposes for which groundwater is used, and may change over time as land uses and water quality regulations change. Groundwater quality degradation can occur when groundwater pumping causes poor quality water (surface water or groundwater) to migrate into areas with good quality groundwater. It can also occur when surface contaminants migrate into groundwater. As a consequence, it is important to coordinate land use planning and resource management activities in order not to create opportunities for water quality deterioration. Adverse impacts related to groundwater quality include:

- Degradation of groundwater quality so that yields are reduced for crops irrigated with groundwater.
- Degradation of groundwater quality so that it does not comply with drinking water quality standards.
- Degradation of groundwater quality so that it is no longer suitable for beneficial uses.

There are some areas in Sutter County that currently have problems with groundwater quality (particularly arsenic and salinity) that appear to be naturally-occurring. The BMO of maintaining or improving groundwater quality reflects the County's desire to improve the quality of naturally-occurring groundwater where possible, so that it is more useful as a water supply.

6.2.3. Inelastic Land Subsidence BMO

The BMO for inelastic land subsidence is to:

- *Avoid inelastic land subsidence that is linked to declines in groundwater levels.*

Inelastic land subsidence is the permanent compaction of the subsurface. In Sutter County, the activities that have the most potential to cause inelastic land subsidence are withdrawals of groundwater or natural gas from the subsurface. Adverse impacts related to inelastic land subsidence include:

- Reduction in the volume of the subsurface that results in a permanent loss in aquifer storage.
- Damage to foundations, roads, bridges, and/or other infrastructure.
- Change in surface topography that reverses the gradients in canals and ditches, and/or changes floodplains.

6.2.4. Surface Water

There are three BMOs for surface water:

- *To improve the understanding of the relationship between surface water and groundwater.*

- *To avoid changes in surface water flow and surface water quality that adversely affect groundwater levels or are caused by groundwater pumping.*

- *Avoid changes in surface water flow and water quality that adversely affect groundwater quality*.

Pumping from very shallow aquifer zones or poorly sealed wells has the potential to affect surface water or wetlands. Adverse impacts related to surface water or wetlands include:

- Depletion of surface flows and/or degradation of water quality.

- Destroying riparian and/or native vegetation and habitat.

6.2.5. Coordination

This BMO for coordination is to:

- *Coordinate County groundwater management efforts with other groundwater management efforts within and surrounding Sutter County*.

This BMO establishes the importance of local coordination of groundwater management and sharing of hydrogeologic data. To make effective and relevant decisions, the County must rely on current data regarding the quality and quantity of the underlying groundwater.

7. PLAN IMPLEMENTATION

Sutter County intends to implement this GMP through a Groundwater Monitoring Program and an Action Plan. In order to recognize and mitigate adverse impacts to the underlying groundwater system, a system is required to collect and disseminate information to the appropriate groundwater users and agencies.

7.1. Groundwater Monitoring Program

The role of monitoring is essential to implementing the BMOs. Monitoring is the process of collecting data that is used to better understand the groundwater basin underlying the County, evaluate groundwater conditions, facilitate groundwater management, and other related activities. In order for the County to promote sustainable groundwater management, as well as for groundwater users to make effective and relevant decisions, the data needs to be made publicly available.

7.1.1. Groundwater Level Monitoring

There is an extensive network of DWR monitored wells, both dedicated monitoring wells and wells with other uses, within Sutter County. Additionally, several water purveyors within the County monitor groundwater levels within their service areas by means of dedicated monitoring wells and production wells. There is an extensive inventory of wells with groundwater measurements within Sutter County. Historically, DWR and its partners have monitored 172 wells in Sutter County, including 15 dedicated monitoring wells. The earliest recorded DWR water level measurement in Sutter County took place in 1929. Wells accessible to DWR are typically agricultural or domestic wells in which the land owners have previous agreements with DWR to allow access for measurements. Overall, the County has adequate spatial distribution of its current network to obtain groundwater level measurements. For this GMP, DWR utilized 122 of the 172 wells to produce groundwater contour maps of equal elevation.

Water level measurements are generally made two times each year, in spring and fall. Measurements have been made at some monitoring wells on an almost-monthly basis. Twice-annual (spring/fall) water level measurements are generally sufficient for the purpose of determining changes in overall groundwater conditions over time. However, these measurements should reflect the annual high (spring) and low (fall) water levels. More frequent (i.e. at most monthly) measurements are necessary to confirm that the months chosen for spring and fall measurements reflect the months with the highest and lowest groundwater elevations, on average. Water level data is currently available from DWR's Water Data Library, at: http://well.water.ca.gov.

7.1.1.1. Vertical Groundwater Gradients – Nested and/or Clustered Monitoring Wells

The vertical gradients between aquifer zones are important because they give an indication of the direction (up or down) that groundwater will migrate if a pathway, such as a well that connects multiple aquifer zones, is present. To evaluate the vertical gradient between aquifer zones, data for the different aquifer zones at a single location is needed. The preferred way to obtain this data is with nested and/or clustered monitoring wells. Nested monitoring wells have multiple wells within a single borehole, with each well isolated from the others by annular seals. Clustered monitoring wells have a single well in each borehole, with the boreholes in close proximity to one another. Figure 19 shows the locations of the 15 nested and/or clustered monitoring wells in Sutter County. Eleven of these wells are in the DWR monitoring network with measurements taken twice a year, in spring and fall. The remaining four nested monitoring wells are pending inclusion into the network because they were constructed by private parties. All of these wells are dedicated monitoring wells.

7.1.1.2. Groundwater Flow Direction – Contour Maps

The direction of groundwater flow is evaluated with groundwater level contour maps. Groundwater contours are created which connect surfaces of equal elevation (or levels). Figure 17 illustrates the contours of equal groundwater elevation for measurements taken in the spring of 2010.

The current water level monitoring network spacing is suitable for contouring groundwater elevations. Additionally, it would be beneficial to include data from nearby monitored wells in Butte, Yolo, Sacramento, and Yuba Counties to better characterize the groundwater flow direction at the County lines.

7.1.2. Water Quality

Water quality samples from wells within the County have, in the past, been obtained either by local water purveyors, the DWR, or the USGS. Currently, the County only samples groundwater in Robbins, its only public water supply system. Groundwater samples have been collected for analysis in a total of 133 wells. The DWR has sampled 34 of these wells in Sutter County, fifteen of which are nested multiple-completion monitoring wells, as shown in Figure 19. The USGS has sampled 94 of these wells, and the remaining wells were sampled by water purveyors which have shared their data. The DWR expects to conduct water quality sampling of these wells every three years, or as funds are available. The water quality data is disseminated on the DWR WDL.

The results for the USGS water quality sampling are available on the National Water Information System (NWIS) website[7]. The USGS sampled these wells as part of a larger investigation to document the condition of the groundwater throughout the valley. It is not expected that the USGS will routinely sample these wells.

The current water quality monitoring network consists of DWR owned multiple-completion monitoring wells with a sparse distribution covering the entire County. Routine sampling of these wells will allow for water quality trends to be identified. As stated within this GMP, the County does not own any dedicated monitoring wells. In conjunction with DWRs efforts to collect and distribute water quality information of the groundwater resource, the County encourages private water purveyors to disseminate their water quality data to aid in documenting depth specific and County-wide water quality trends.

7.1.3. Land Subsidence

Land subsidence has not been historically reported or documented within Sutter County. Nevertheless, DWR installed an extensometer and began monitoring for ground surface displacement in 1994. Measurements are recorded on a daily basis, offering real-time and site specific measurements. On a more regional scale, DWR and its cooperating agencies, have implemented the Sacramento Valley GPS Height Modernization Project which will provide significant enhancements to a Sacramento Valley subsidence monitoring program. It is reported by DWR that the GPS monuments will be re-surveyed approximately every three years. The monitoring of land surface elevations will allow for periodic measurements of permanent land subsidence induced by groundwater pumping and/or natural processes. The surveys will be conducted in accordance with the National Geodetic Survey Standards for two centimeter accuracy.

When used in conjunction with surface subsidence survey data (GPS), the extensometer data could aide in identifying whether subsidence is occurring over the total depth of the monitoring well.

7.1.4. Future Groundwater Monitoring

The County's existing monitoring network is described above. Groundwater monitoring within the County is currently conducted by DWR and local water purveyors. The County will continue to cooperate with DWR and encourage the local water purveyors to continue to monitor groundwater levels. Under the voluntary guidelines of SBx7-6, selected local water purveyors will continue to monitor groundwater elevations for their

[7] http://waterdata.usgs.gov/nwis

respective service area(s), along with the DWR, under protocols established by DWR. The possibility exists that in the future, DWR may cease their monitoring if they lose funding for groundwater level measurements, and the responsibility of groundwater level monitoring will be entirely upon the local water purveyors.

All new wells should be sampled for basic water chemistry (i.e. specific conductance, arsenic, manganese, and nitrate). Although not required, the County may, in the future, consider requesting copies of laboratory reports to be submitted through the permit process. Water quality results from wells sampled by DWR are routinely placed on the WDL, and are often sampled every three years, or as funding allows.

The overall subsidence monitoring program should continue to be monitored by the extensometer and GPS monuments throughout the County. The Sacramento Valley GPS Network incorporates existing GPS networks and monuments to create a regional network that covers part or all of Colusa, Sutter, Glenn, Butte, Yolo, Yuba, Tehama, and Placer Counties.

For the area encompassing the Sutter Buttes, which is outside of a DWR delineated groundwater basin, groundwater is likely contained in the fractures of the volcanic rock as well as in the marine sands that compromise the Sutter Buttes. The area encompassing the Sutter Buttes is primarily privately owned and groundwater use is unknown but is likely limited to domestic wells or stock watering wells. It is suggested that private well owners monitor groundwater levels at least twice a year (fall and spring) in order to realize changing conditions. It is also good practice to test the quality of the groundwater for health based constituents.

7.1.5. Local and Regional Groundwater Management Coordination

Coordinating local and regional groundwater management is important to meeting Sutter County’s Groundwater Management Goals because groundwater, like other resources, does not respect administrative/jurisdictional boundaries, and actions outside the County can affect groundwater in the County. Further, in order to achieve the Groundwater Management Goals, the County needs to be an “effective participant” in local and regional management efforts and work cooperatively with water managers to conduct effective groundwater management. To be an “effective participant”, the County needs to be informed of its groundwater conditions and activities underway or planned, which may affect the resources positively or negatively. With time and appropriate documentation of water management activities and monitoring, an understanding of the resources can be obtained so that groundwater conditions can be the result of deliberate water management choices.

Coordinating groundwater management across local and regional jurisdictions will contribute to ensuring a reliable water supply by working towards management of entire groundwater basins, not just the portions underlying the County. Involvement in regional activities will help ensure that activities outside of Sutter County that affect the reliability of the groundwater supply in the County can be addressed through regional management actions. This involvement will also help protect water rights because the County's involvement with regional groundwater management will allow it to be part of a larger group that can exert more influence in preserving water rights north of the Delta. Finally, regional coordination will help the County maintain local control by ensuring that the County's interests are represented in regional groundwater management activities.

Sutter County recognizes the importance of regional coordination, collaboration, and communication and is signatory to the "Four-County Group," which has evolved into the "Northern Sacramento Valley – Integrated Regional Water Management Group", consisting of Butte, Glenn, Colusa, Tehama, Shasta, and Sutter Counties.

In addition to the water management coordination addressed above, which is more at a technical and operational level, it is important that coordination occur at the policy level as well. This is especially important for effective and consistent operations within water purveyors whose geographic jurisdiction extends beyond Sutter County. The processes to addressing water transfers, in particular, are different in each of the three counties. It would be important, as the GMP is implemented and the institutional structure and management processes become solidified, that a dialogue be established with the neighboring counties to address the need for developing consistency in processes that affect the management and operation of the respective water purveyors.

7.1.6. State of the Basin Report - Groundwater Condition and Groundwater Management Plan Evaluation

In the future, Sutter County and local water purveyors may benefit from preparing an annual report of the conditions of its groundwater basin. However, the present County staffing and funding levels are unable to accommodate this work effort. Groundwater elevation data for the County will be available through the CASGEM program and continued DWR monitoring. Additionally, new and/or current water quality data is periodically submitted and is available through the DWR Water Data Library. The County encourages cooperation among all groundwater users to share data (groundwater level and/or quality) which is not reported or what is readily available through the Water Data Library. Water quality data is also accessible through the Department of Public Health for permitted public water systems. Through this report, the County will encourage its groundwater users to be responsible stewards of the County's resources.

This GMP prepared by the County is not intended to be a static document. As conditions change, such as population, land uses, or climate, it may be warranted to revisit the County's goals and BMOs to ensure that the overall goals of sustaining its groundwater resources to meet current and future demands for the County are being satisfied. The County encourages cooperation among its groundwater users to keep these goals in mind. It is not Sutter County's intent of this GMP to be an enforcer with regards to groundwater use; however, as climatic and groundwater usage change in the future, it may be necessary to "check in" and adjust or expand this GMP.

7.2. Action Plan

7.2.1. Actions for Groundwater Levels BMO

To avoid ongoing declines in groundwater, to avoid abnormally high groundwater levels, the County has taken and will take the following actions:

Action	***Frequency***	***Status***
Participation in the "Northern Sacramento Valley – Integrated Regional Water Management Group"	As needed	2008 - Present
Maintain relationships with state and federal agencies	Annual	1850 - Present
Promote conjunctive use through public outreach	Annual	2008 - Present
Coordination with local and regional jurisdictions on groundwater.	Annual	2008 - Present
Ensure compliance with adopted policies in 2008 General Plan (Goal ER 6)	Annual	2008 - Present
Review groundwater contour maps prepared by DWR	Annual	2008 - Present
Disseminate groundwater level data on County's website	As needed	2010 - Present

7.2.2. Actions for Groundwater Quality BMO

To improve the understanding of groundwater quality, the County has taken and will take the following actions:

Action	***Frequency***	***Status***
Cooperate with DWR in its monitoring efforts	Annual	2010 - Present
Maintain relationships with neighboring counties	Annual	1850 - Present
Ensure compliance with adopted policies in 2008 General Plan (Goal ER 6)	Annual	2008 - Present
Ongoing coordination with local and regional jurisdictions on groundwater	Annual	unknown - Present

7.2.3. Actions for Inelastic Land Subsidence BMO

To avoid inelastic land subsidence that is linked to declines in groundwater levels, the County has taken and will take the following actions:

Action	***Frequency***	***Status***
Cooperate with DWRs monitoring efforts	Annual	2010 - Present
Participate in the “Northern Sacramento Valley – Integrated Regional Water Management Group”	Annual	2008 - Present
Establish and update a groundwater management plan website	Annual	2008 - Present
Review data from the extensometer installed in Sutter County	6 months	2010 - Present
Maintain relationships with state and federal agencies	Annual	1850 - Present

7.2.4. Actions for Surface Water BMO

To improve the understanding of the relationship between surface water and groundwater; to avoid changes in surface water flow and surface water quality that directly affect groundwater levels or are caused by groundwater pumping; and to avoid changes in surface flow and surface water quality that directly affect groundwater quality, the County has taken and will take the following actions:

Action	*Frequency*	*Status*
Engage in the "Northern Sacramento Valley – Integrated Regional Water Management Group"	Annual	2008 - Present
Establish a groundwater management plan website	Annual	2008 - Present
Maintain relationships with state and federal agencies	Annual	1850 - Present
Ensure compliance with adopted policies in 2008 General Plan (Goal ER 5)	Annual	2008 - Present

7.2.5. Actions for Coordination BMO

To coordinate County groundwater management efforts with other groundwater management efforts within and surrounding Sutter County, the County has taken and will take the following actions:

Action	*Frequency*	*Status*
Engage in the "Northern Sacramento Valley – Integrated Regional Water Management Group"	Annual	2008 - Present
Maintain relationships with state and federal agencies	Annual	1850 - Present
Establish and update a groundwater management plan website	As needed	2008 - Present

REFERENCES

Bachman, S. et al., “California Groundwater Management,” 2nd Ed., California Groundwater Resources Association, 2005.

Blake, M.C., Jr., Harwood, D.S., Helley, E.J., Irwin, W.P., Jayko, A.S., and Jones, D.L., 1999, Preliminary geologic map of the Red Bluff 1:100,000 quadrangle, California: U.S. Geological Survey Open-File Report 84–105, scale 1:100,000, 22 p.

Bryan, K. “Geology and ground-water resources of Sacramento Valley, California.” USGS Water-supply paper 495, 1923.

Butte, Colusa, Glenn, and Tehama Counties, “Memorandum of Understanding Four-County Regional Water Resource Coordination, Collaboration, and Communication,” December 2005.

Butte, Colusa, Glenn and Tehama Counties, “Memorandum of Understanding for Integrated Regional Water Management Planning and Regional Water Resources Coordination, Collaboration, and Communications,” 2007.

California State Water Resources Control Board, “Hydrogeologically Vulnerable Areas Map,” 2000.

California Department of Water Resources (DWR), "Groundwater Management in California: A Report to the Legislature Pursuant to Senate Bill 1245," 1997.

California Department of Water Resources, “Geology and Hydrogeology of the Freshwater Bearing Aquifer Systems of the Northern Sacramento Valley, California,” In Progress, 2000.

California Department of Water Resources, “California Well Standards,” Bulletin 74-90 (Supplement to Bulletin 74-81), June 1991.

California Department of Water Resources, “California’s Groundwater,” Bulletin 118 – Update 2003, October 2003.

California Department of Water Resources, Central District, "California 2004 Land Use Shapefile," 2004.

California Department of Water Resources, “Sacramento River Basinwide Water Management Plan,” 1st Ed., California: 2003b.

California Department of Water Resources, "California's Groundwater," Bulletin 118, Sacramento Valley Groundwater Basin, East Butte Subbasin, February 27, 2004.

California Department of Water Resources, "California's Groundwater," Bulletin 118, Sacramento Valley Groundwater Basin, Sutter Subbasin, January 1, 2006.

California Department of Water Resources, "California's Groundwater," Bulletin 118, Sacramento Valley Groundwater Basin, North American Subbasin, January 1, 2006a.

California Department of Water Resources, "California's Groundwater," Bulletin 118-Update 2003, < http://www.water.ca.gov/groundwater/bulletin118/update2003.cfm >

California Department of Water Resources, "California Water Plan Update 2005: A Framework for Action," Department of Water Resources Bulletin 160-05 3 (Dec. 2005).

California Department of Water Resources, Northern District, "Colusa Basin Drain," 2007. 1st Ed., California: October 2007d. <http://www.nd.water.ca.gov/PPAs/WaterQuality/RiversStreams/SacramentoRiver/CB>.

California Department of Water Resources (DWR), Draft "Groundwater Substitution Transfers How to Make Them Work in the Sacramento Valley in 2009," September 2008. This paper contains material from a white paper originally assembled by the DWR in 2002 as well as from the environmental documents supporting the operation of the 2009 Drought Water Bank.

California Department of Water Resources, Division of Planning and Local Assistance, "A Brief Overview of Groundwater Management in California," undated.

Curtin, George (1971), "Hydrogeology of the Sutter Basin, Sacramento Valley, California," M.Sc Thesis, University of Arizona: USA.

Domagalski, J.L., Knifong, D.L., Dileanis, P.D., Brown, L.R., May, J.T., Connor, Valerie, and Alpers, C.N., 2000, Water Quality in the Sacramento River Basin, California,1994–98: U.S. Geological Survey Circular 1215, 36 p., on-line at http://pubs.water.usgs.gov/circ1215/

Ferriz, H., Groundwater Resources of Northern California - An overview: in Ferriz, H., Anderson, R., (eds.), Engineering Geology Practice in Northern California: Association of Engineering Geologists Special Publication 12 and California Division of Mines and Geology Bulletin 210, 2001.

Glenn County Department of Agriculture, Northern Sacramento Valley (Four County) Drinking Water Quality Strategy Document (County of Glenn, County of Butte, County of Colusa, County of Tehama), Final Draft, California: CDM, June 2005.

Harwood, D.S., and Helley, E.J., "Late Cenozoic Tectonism of the Sacramento Valley, California," U.S. Geological Survey Professional Paper 1359, 1987.

Helley, E.J., and Harwood, D.S., "Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California," U.S. Geological Survey Miscellaneous Field Studies Map MF-1790, 1985.

Lydon, P.A., "Geology and Lahars of the Tuscan Formation," Northern California: Geological Society of America Memoir 116, 1969.

Olmsted, F.H., Davis, G.H., "Geologic Features and Ground-Water Storage Capacity of the Sacramento Valley, California," U.S. Geological Survey Water-Supply Paper, W1497, 1961.

Prothero, Donald R., "Bringing Fossils to Life: An Introduction to Paleobiography." Boston, Massachusetts: WCB/McGraw-Hill, 1998.

Page, R. W., 1998**,** A Compressible Diatomaceous Clay, Sacramento Valley, California. (Included in: Land Subsidence, Case Studies and Current Research: Proceedings of the Dr. Joseph F. Poland Symposium on Land Subsidence, 1998.)

Sacramento County Municipal Services Agency, Department of Water Resources website <http://www.msa.saccounty.net/waterresources/files/Files.asp?c=elev>

Springhorn, Steven T. (2008), "Stratigraphic Analysis and Hydrogeologic Characterization of Cenozoic Strata in the Sacramento Valley near the Sutter Buttes," M.Sc. Thesis, California State University, Sacramento: USA.

Sutter County, "Health and Sanitation Ordinance, Chapter 765, Sections 765-010 - 765-130," Sutter County Ordinance Code (2011).

Sutter County, "Sutter County General Plan Update," 2011.

Sutter County, "Sutter County General Plan Technical Background Report," General Plan Update, February 2008.

U.S. Army Corps of Engineers, Sacramento District, Central Valley Flood Management Systems, Post-Flood Assessment for 1983, 1986, 1995, and 1997

U.S. Bureau of Reclamation, Sacramento River Settlement Contractors Contract Renewal Effort. 2007, August 2007a, http://www.reclamation.gov/mp/cvpia/ 3404c/index.html.

U.S. Census Bureau, "Population Estimates, Census of Population and Housing, Small Area Income and Poverty Estimates, State and County Housing Unit Estimates, County Business

Patterns, Non-employer Statistics, Economic Census, Survey of Business Owners, Building Permits, Consolidated Federal Funds Report," State and County Quick Facts, June 2011, U.S. Census Bureau, October 2011 < http://quickfacts.census.gov/qfd/states/06/06101.html >.

U.S. Fish and Wildlife Service, Pacific Southwest Region, "Sacramento, Delevan, Colusa, and Sutter National Wildlife Refuges: Final Comprehensive Conservation Plan," March 2009.

U.S. Geological Survey, "Water Quality Assessment of the Sacramento River Basin, California: Water Quality, Sediment and Tissue Chemistry, and Biological Data 1995-1998," Open-File Report 2000-391(1998).

Western Regional Climate Center, "Climate Station Data," Nicolaus2 Period of Record General Climate Summary 1962-2010 2011, October 2011, < http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca6194>.

Western Regional Climate Center, "Climate Station Data," Marysville Period of Record General Climate Summary 1897-2007 2011, October 2011, < http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca5385>.

Western Regional Climate Center, "Climate Station Data," Colusa 2 SSW Period of Record General Climate Summary 1948-2010 2011, October 2011, < http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca1948>.

Yuba County Water Agency, "Groundwater Management Plan," March 2005

Map Figures

Ludington, S., Moring, B.C., Miller, R.J. , Flynn, K., Hopkins, M. J, Stone, P., Bedford, D. R., and Haxel, G. A., "Preliminary Integrated Geologic Map Databases for the United States Western States: California, Nevada, Arizona, and Washington," Version 1.0, U.S. Geological Survey Open-File Report 2005-1305, scale 1:750,000, 2005.

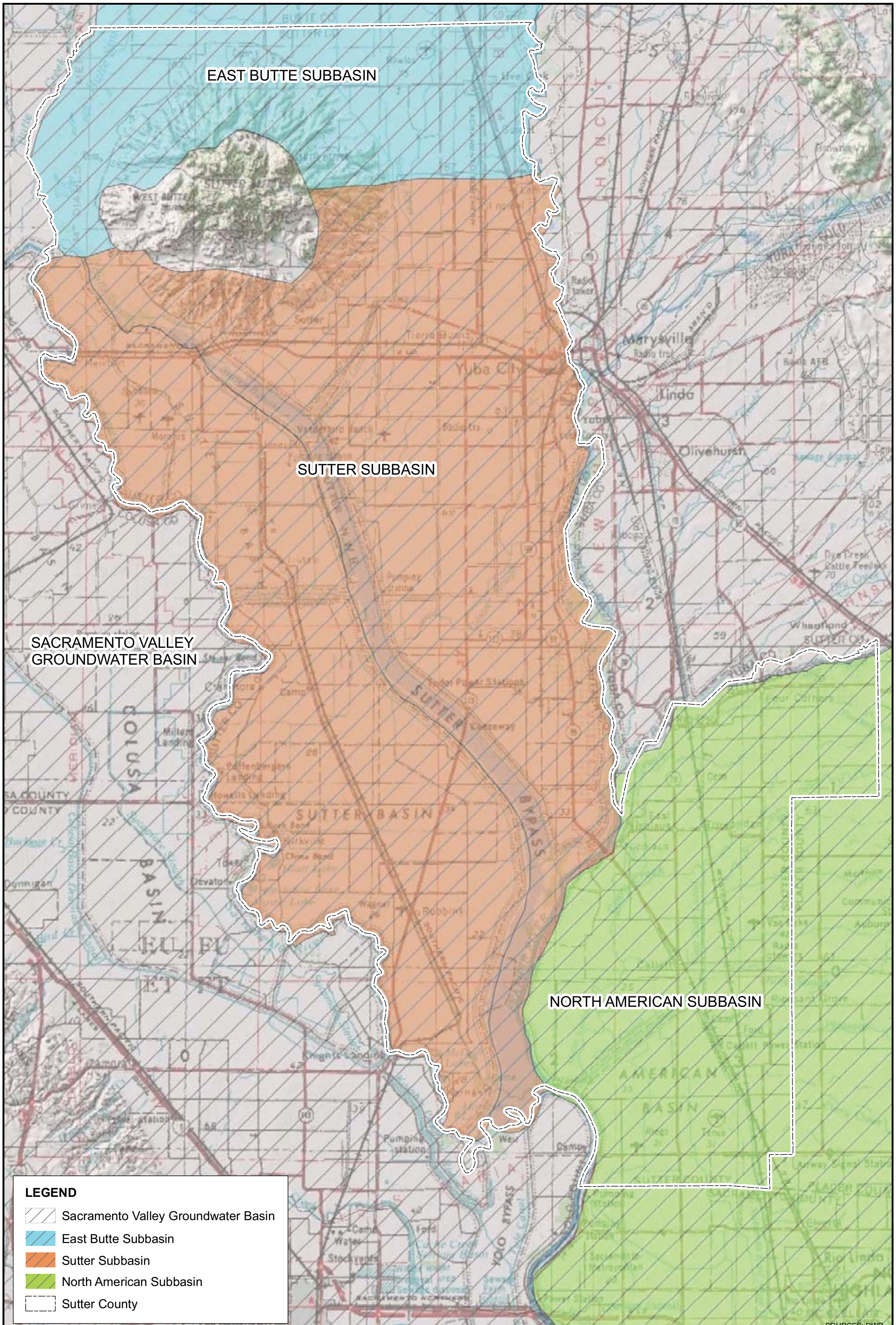

FIGURE 1
GROUNDWATER BASIN AND SUBBASINS
SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012

NORTH

0 1.5 3
MILES

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J:\Jobs\8337_SutterCounty\GIS\Tasks\20120201 Final Draft Figure Comments\Figure 1 Groundwater Subbasins.mxd 2/7/2012 12:50:01 PM bdemucha

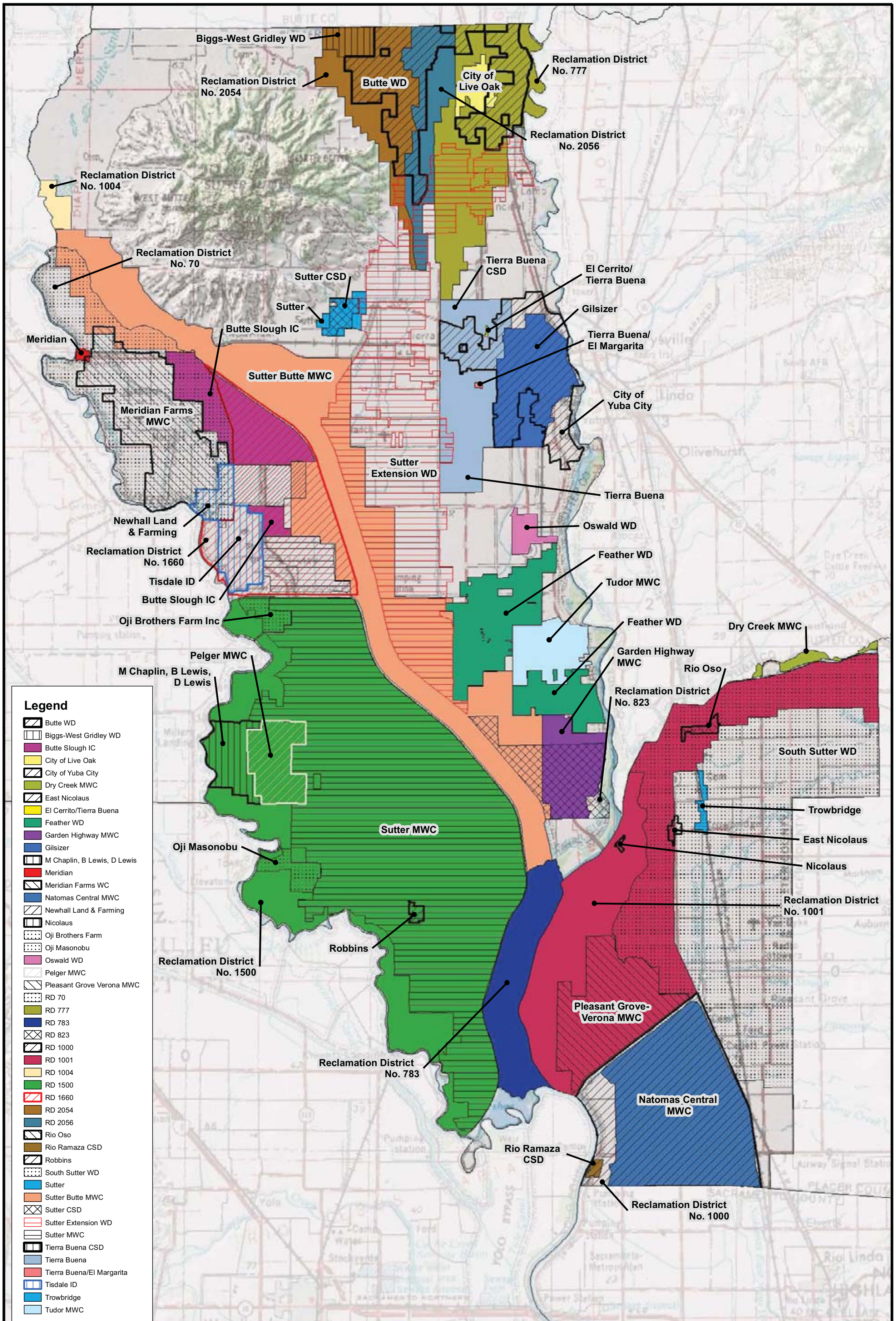

FIGURE 2
WATER DISTRICTS, PURVEYORS, AND WATER COMPANIES

SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012

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J:\Jobs\8337_SutterCounty\GIS\Tasks\20120116 Final Draft\Figure 2 Water_District_Poster.mxd 2/7/2012 12:39:44 PM bdemucha

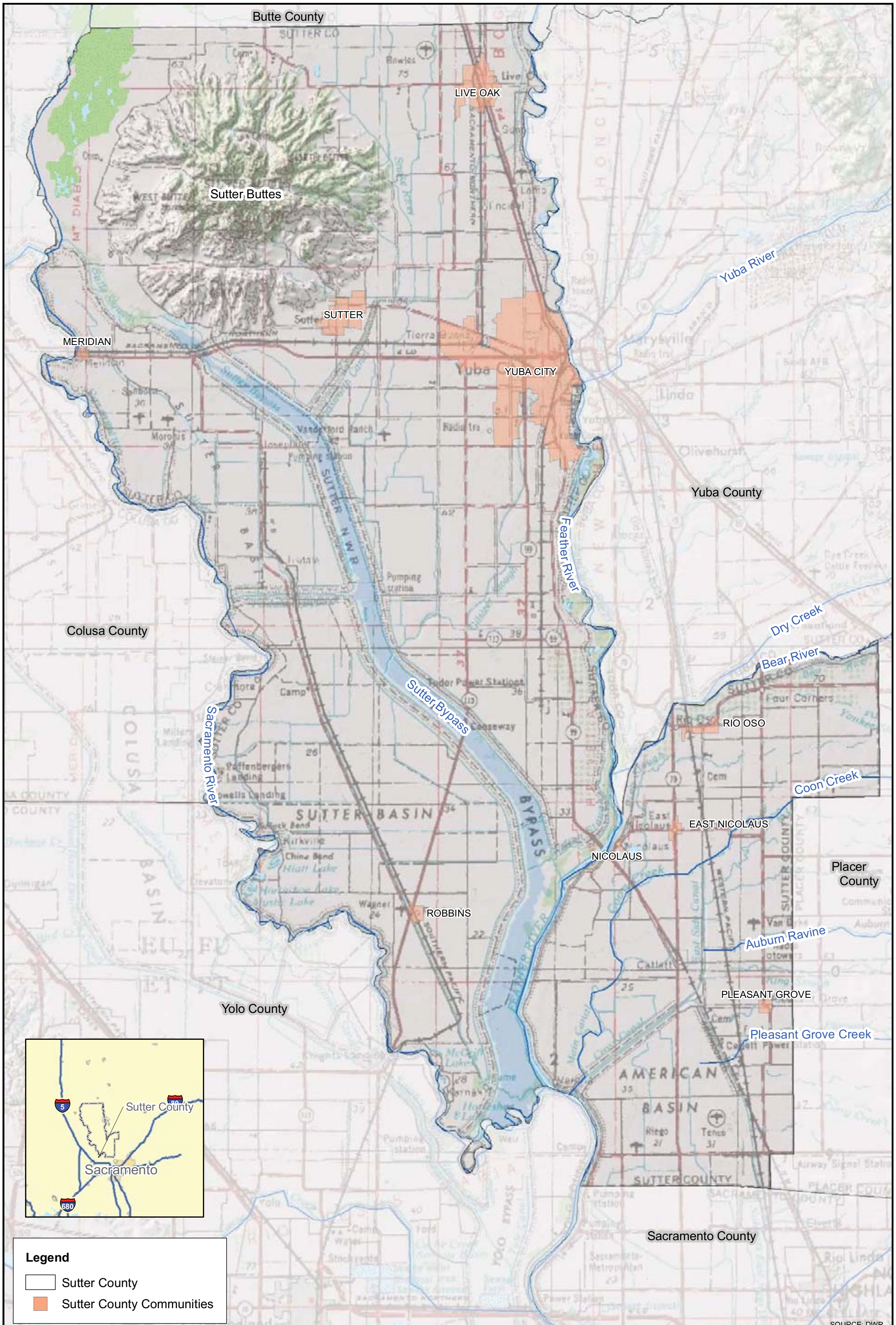

FIGURE 5
PHYSICAL FEATURES
SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012

NORTH
0 1.5 3
MILES

SUTTER COUNTY CALIFORNIA

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J:\Jobs\8337_SutterCounty\GIS\Tasks\20120116 Final Draft\Figure 5 Sutter County Physical Features.mxd 2/7/2012 12:47:54 PM bdemucha

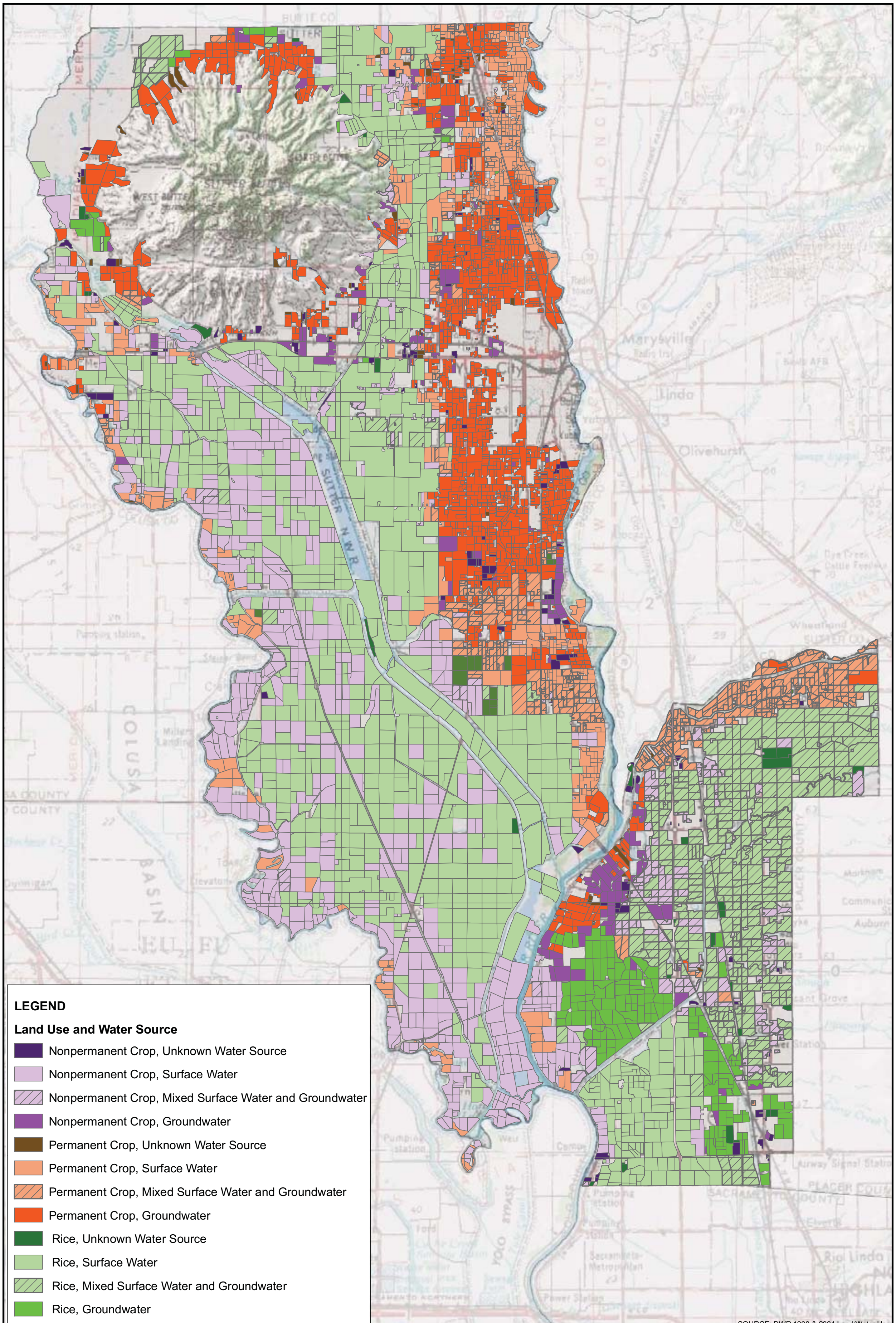

FIGURE 6
WATER SOURCES FOR IRRIGATED CROPS
SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
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NORTH
0 1.5 3
MILES

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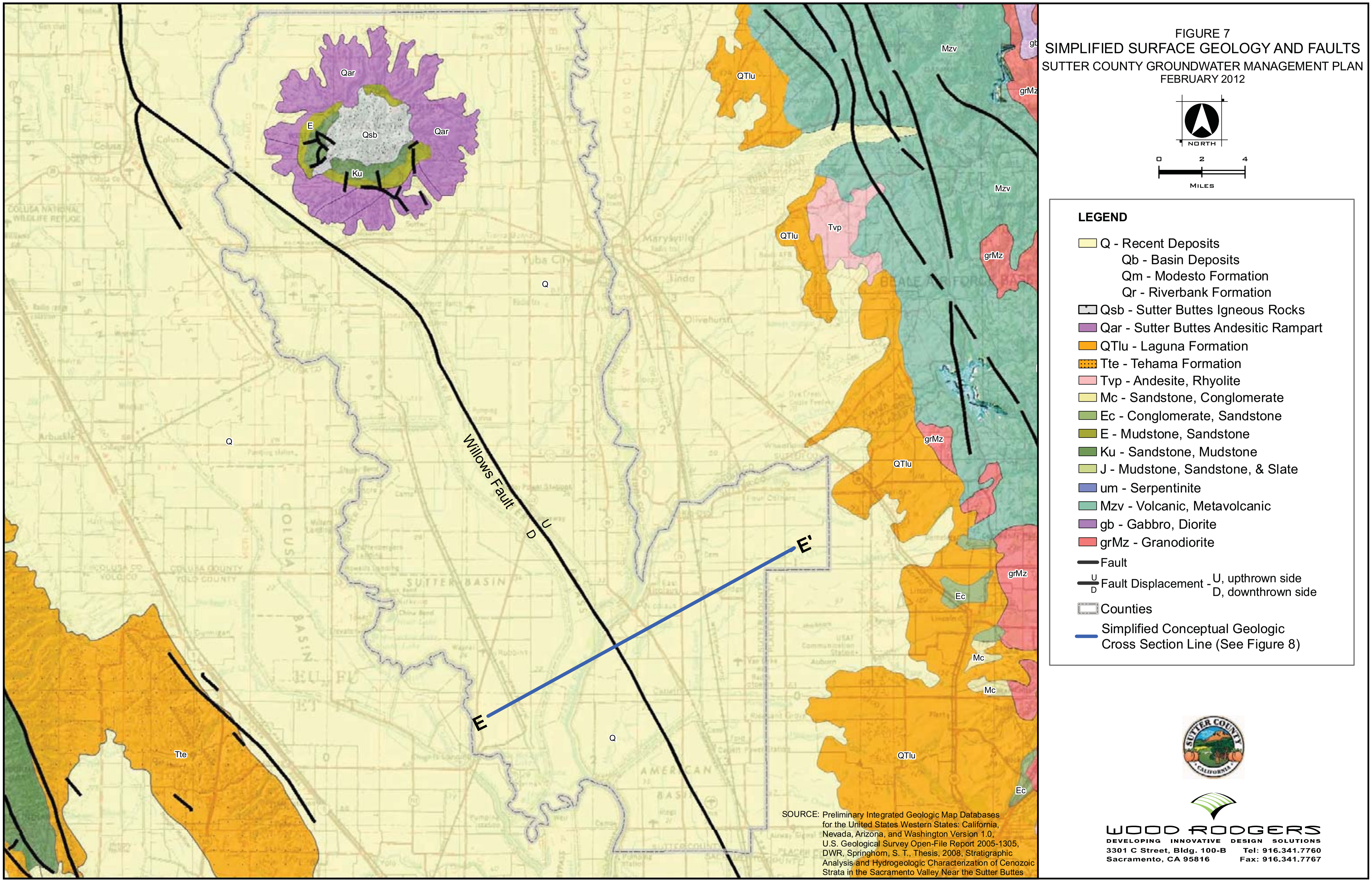
J:\Jobs\8337_SutterCounty\GIS\Tasks\20120116 Final Draft\Figure 6 Water_Source_IRR_Crops_.mxd 2/7/2012 12:52:19 PM bdemucha

FIGURE 7
SIMPLIFIED SURFACE GEOLOGY AND FAULTS
SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012



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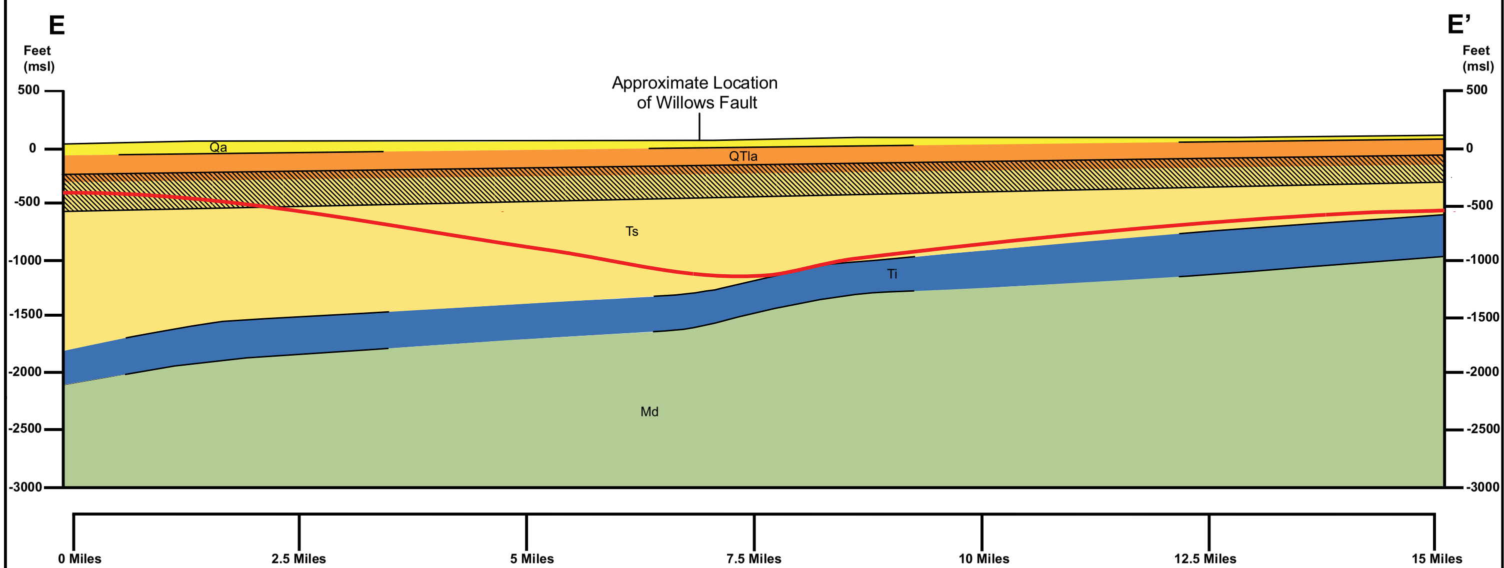
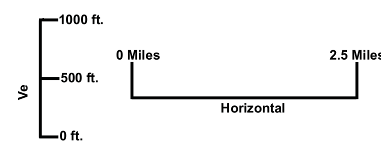
J:\Jobs\8337_SutterCounty\GIS\Tasks\20120116 Final Draft\Figure 7 Simplified Surface Geology and Faults.mxd 2/7/2012 12:54:14 PM bdemucha

FIGURE 8
SIMPLIFIED CONCEPTUAL GEOLOGIC CROSS SECTION
SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012



Cross Section Scale



Explanation

- Qa — Alluvial Deposits
- QTla — Laguna Formation
- Laguna and Sutter Formation Transition (approximate depth)
- Ts — Sutter Formation (map unit, Williams and Curtis, 1977; Helley and Harwood, 1985)
  - Tt — Tuscan Formation (map unit, Helley and Harwood, 1985)
  - Tm — Mehrten Formation (map unit, Helley and Harwood, 1985)
- Ti — Ione Formation (map unit, Helley and Harwood, 1985)
- Md — Marine Deposits
- Inferred Geologic Contact
- Approximate Base of Fresh Water. Line represent depths at which Specific Conductance levels exceed approximately 3,000 umhos/cm

SOURCES: DOGGR; DWR; Springhorn, S. T., Thesis, 2008, Stratigraphic Analysis and Hydrogeologic Characterization of Cenozoic Strata in the Sacramento Valley Near the Sutter Buttes; Berkstresser, C.F. Jr. 1973. Base of Fresh Ground-Water -- Approximately 3,000 micromhos in the Sacramento Valley and Sacramento-San Joaquin Delta, California. U.S. Geological Survey Water-Resource Inv. 40-73; Helley, E. J. and Harwood, D. S., 1985, Geologic Map of Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California.

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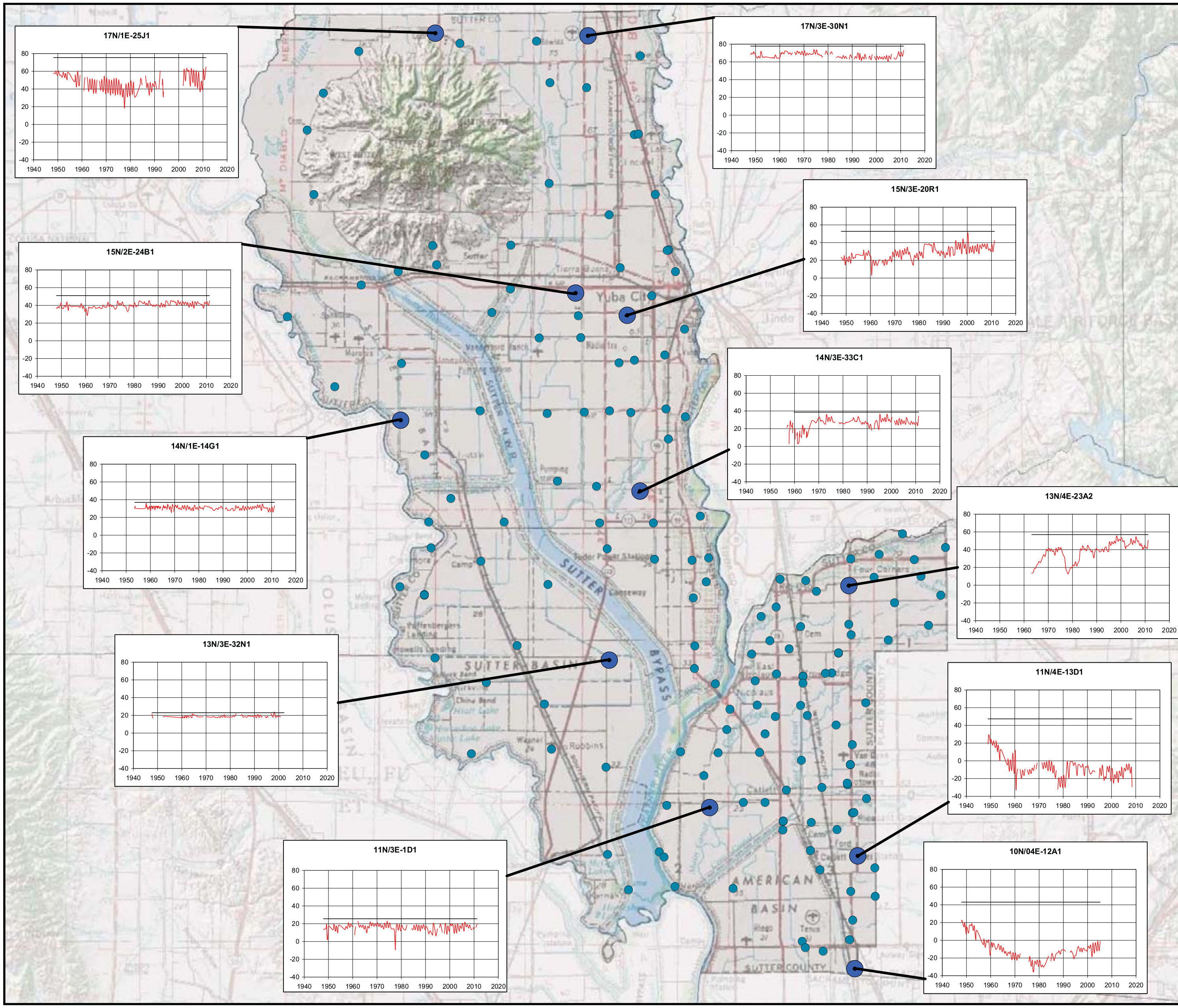


FIGURE 9
HISTORIC GROUNDWATER ELEVATIONS IN SUTTER COUNTY

SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN

FEBRUARY 2012

NORTH

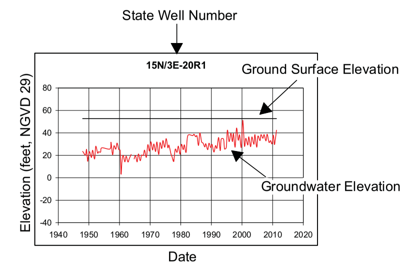
0 2 4 MILES

Legend

- Well with Hydrograph Shown
- Well with Water Level Measurement since 2004

Note: This figure represents wells with historic water level and current measurements either submitted to or obtained by the California Department of Water Resources and may not represent current monitoring activities. Groundwater elevations are in feet above mean sea level.

SOURCE: DWR



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J:\Jobs\8337_SutterCounty\GIS\Tasks\20120116 Final Draft\Figure 9 Historic Groundwater Elevations in Sutter County .mxd 2/7/2012 12:59:56 PM bdemucha

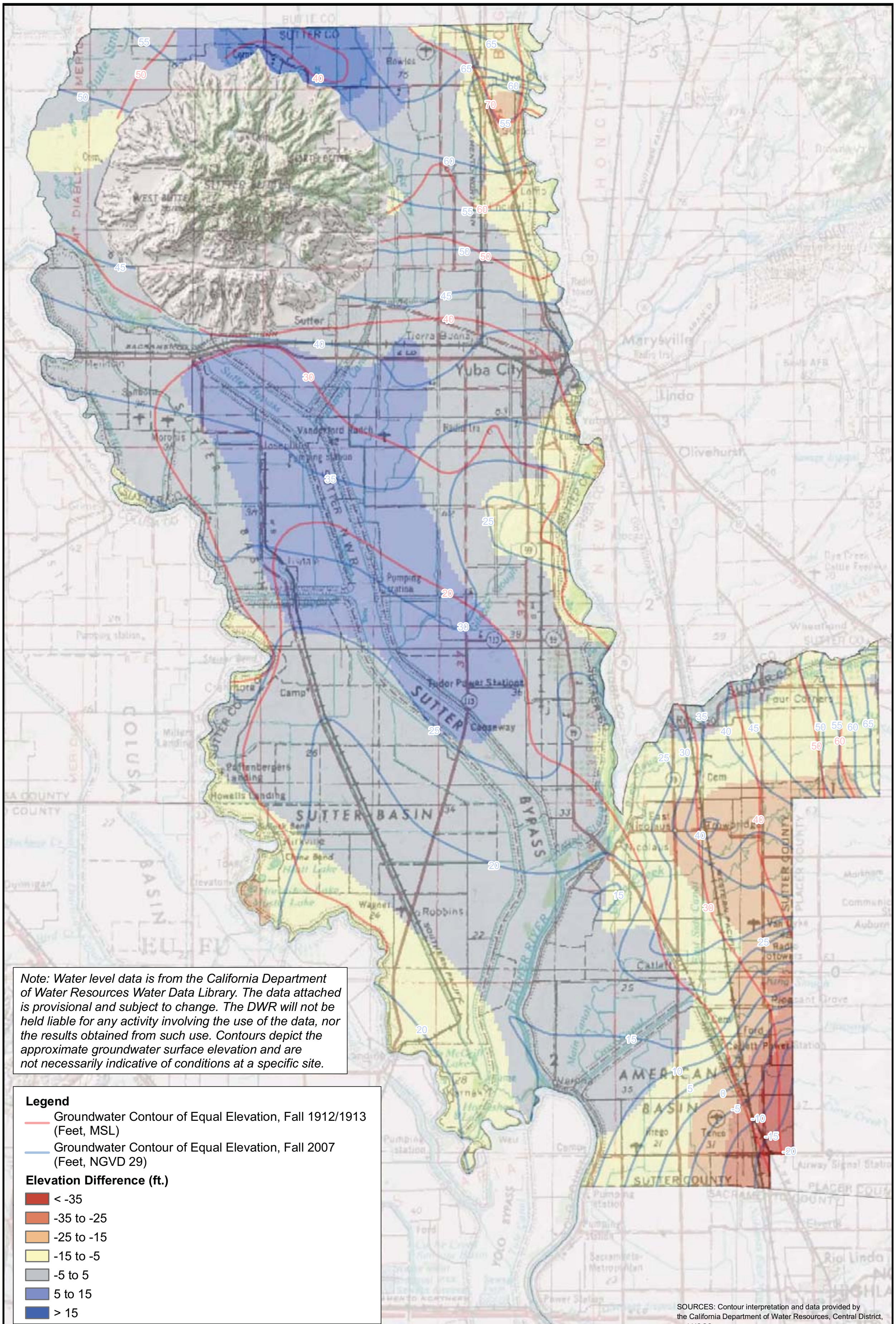

FIGURE 10
GROUNDWATER LEVEL CHANGE MAP
FALL 2007 AND FALL 1912/1913

SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012

NORTH

0 1.5 3
MILES

SUTTER COUNTY CALIFORNIA

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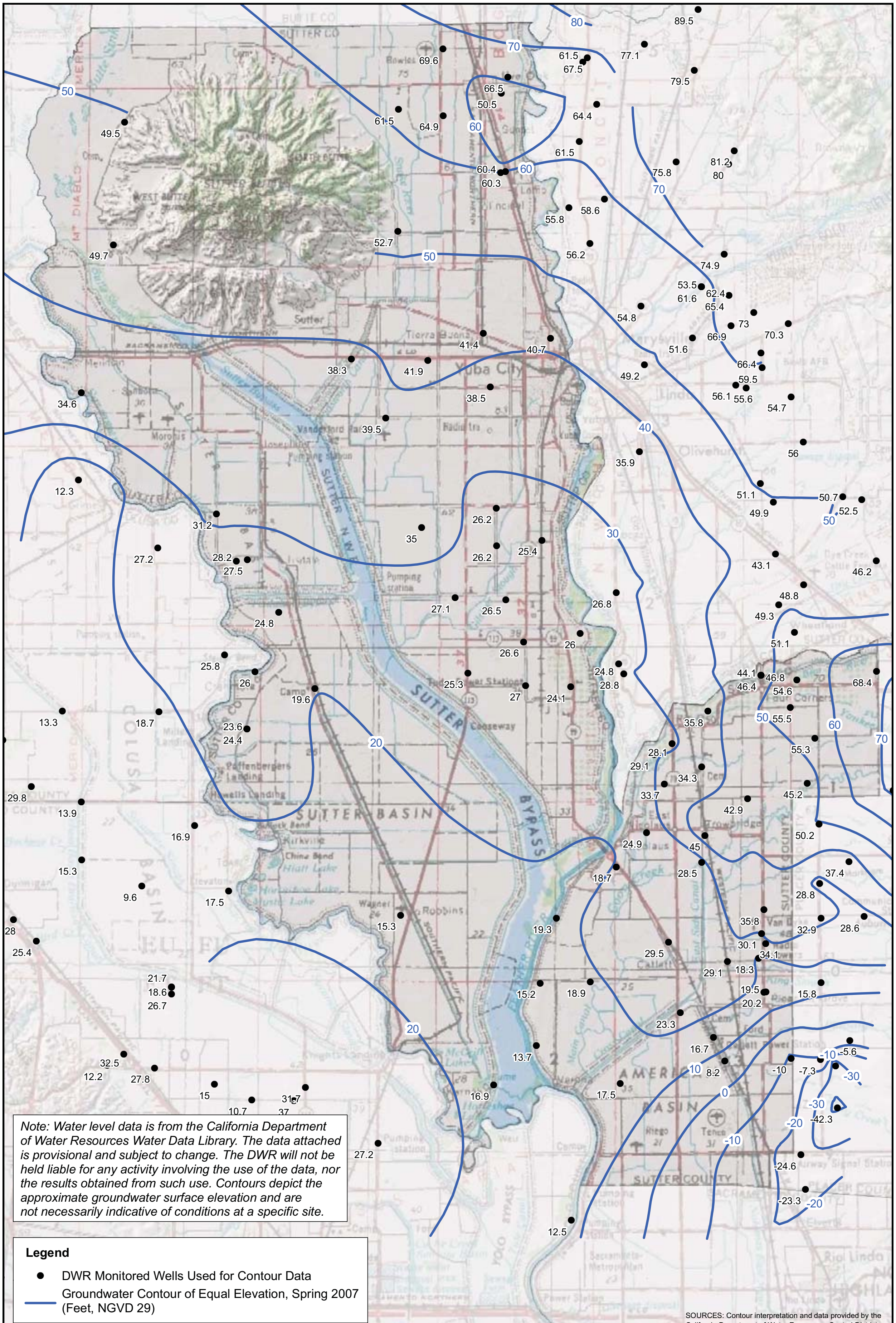
J:\Jobs\8337_SutterCounty\GIS\Tasks\20120201 Final Draft Figure Comments\Figure 10 Groundwater_elevation_change_map.mxd 2/7/2012 5:35:33 PM bdemucha



Note: Water level data is from the California Department of Water Resources Water Data Library. The data attached is provisional and subject to change. The DWR will not be held liable for any activity involving the use of the data, nor the results obtained from such use. Contours depict the approximate groundwater surface elevation and are not necessarily indicative of conditions at a specific site.

Legend

- DWR Monitored Wells Used for Contour Data
- Groundwater Contour of Equal Elevation, Spring 2007 (Feet, NGVD 29)

FIGURE 11
GROUNDWATER ELEVATION CONTOUR MAP
SPRING, 2007

SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012

NORTH

0 1.5 3
MILES

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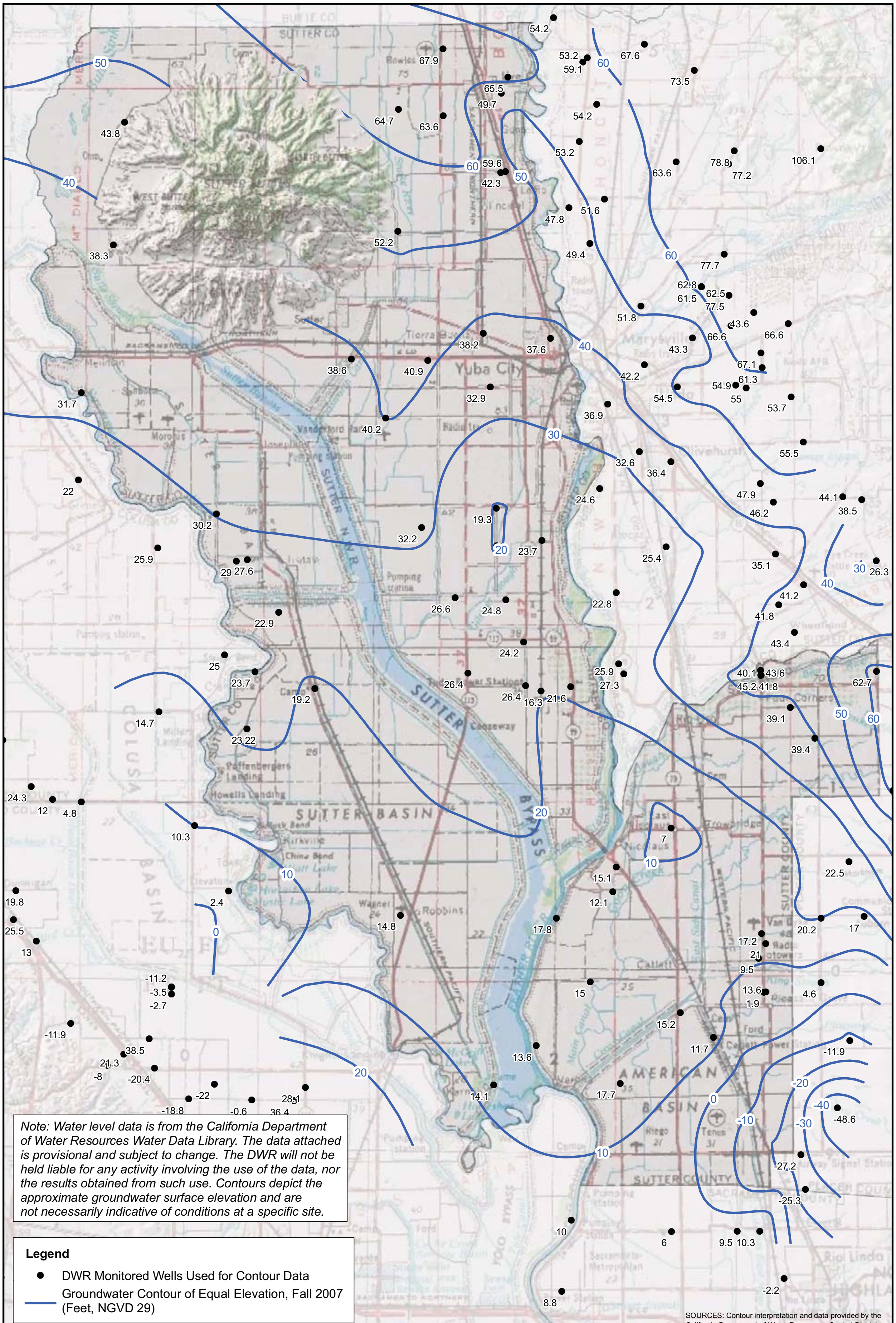

FIGURE 12
GROUNDWATER ELEVATION CONTOUR MAP
FALL, 2007

SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012

NORTH
0 1.5 3
Miles

SUTTER COUNTY CALIFORNIA

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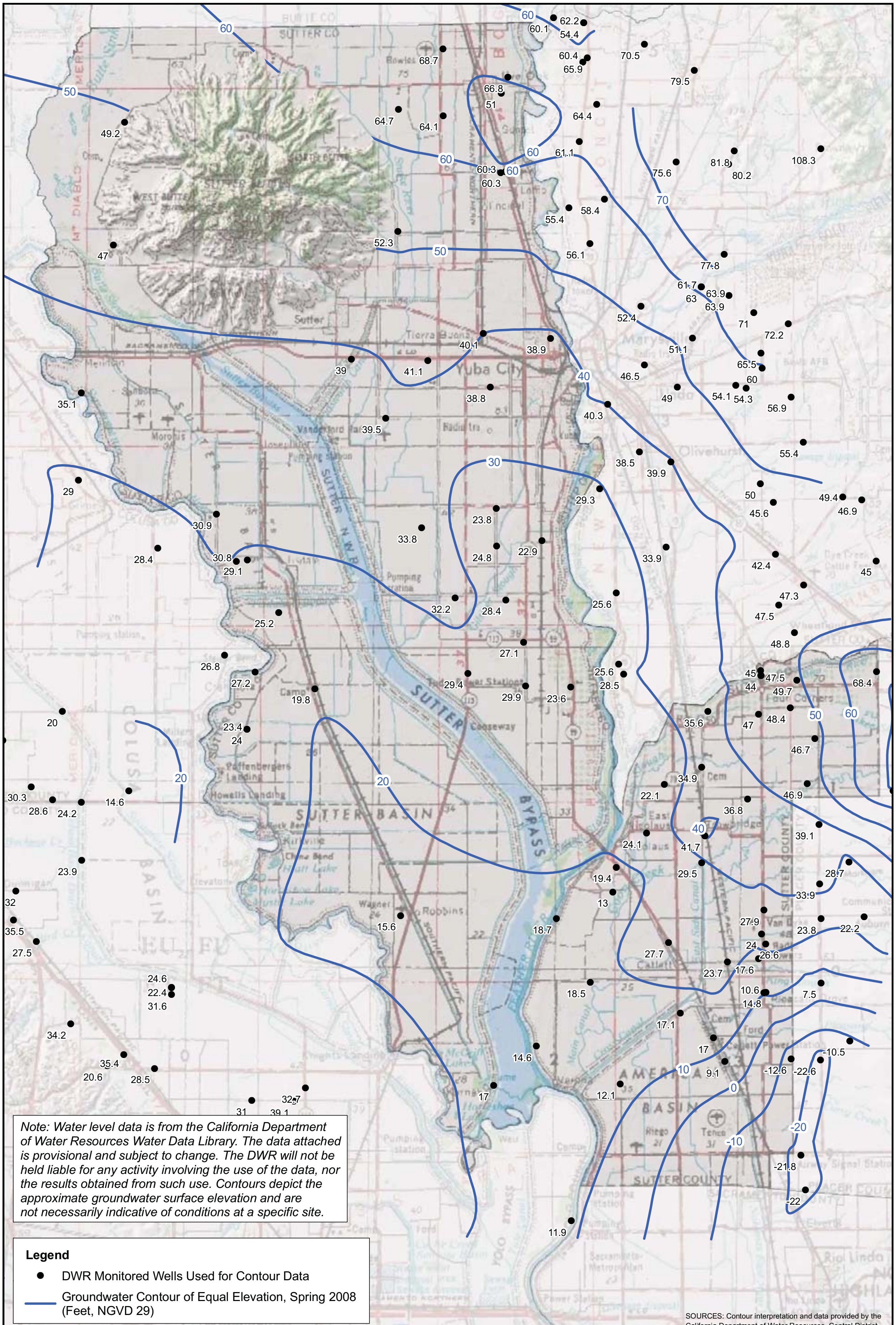

Note: Water level data is from the California Department of Water Resources Water Data Library. The data attached is provisional and subject to change. The DWR will not be held liable for any activity involving the use of the data, nor the results obtained from such use. Contours depict the approximate groundwater surface elevation and are not necessarily indicative of conditions at a specific site.

Legend

- ● DWR Monitored Wells Used for Contour Data
- — Groundwater Contour of Equal Elevation, Spring 2008 (Feet, NGVD 29)

FIGURE 13
GROUNDWATER ELEVATION CONTOUR MAP
SPRING, 2008

SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012

NORTH

0 1.5 3
MILES

SUTTER COUNTY CALIFORNIA

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J:\Jobs\8337_SutterCounty\GIS\Tasks\20120116 Final Draft\Figure 13 Groundwater Elevation Contour Map Spring 2008.mxd 2/7/2012 6:20:59 PM bdemucha

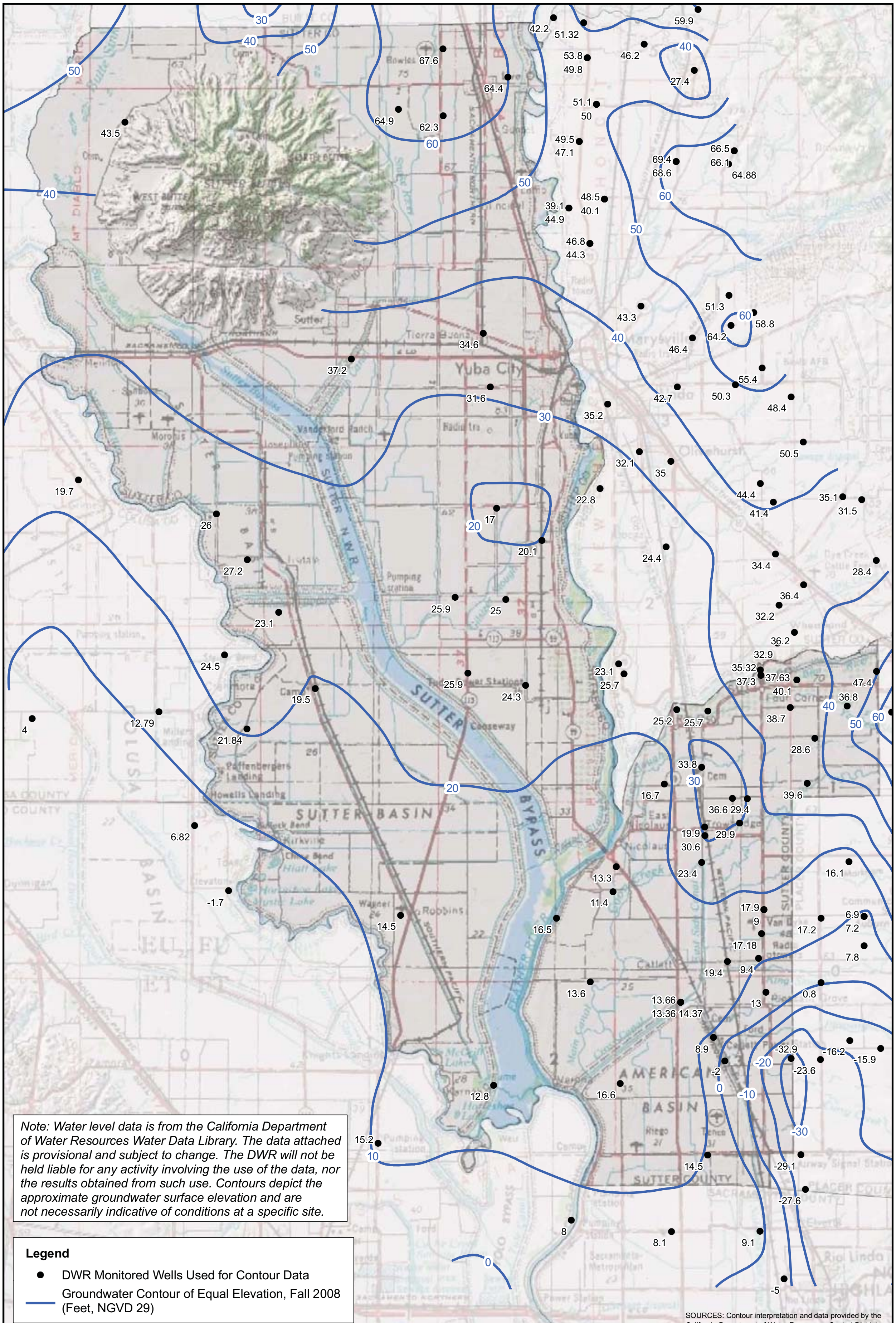

FIGURE 14
GROUNDWATER ELEVATION CONTOUR MAP
FALL, 2008

SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012

NORTH

0 1.5 3
Miles

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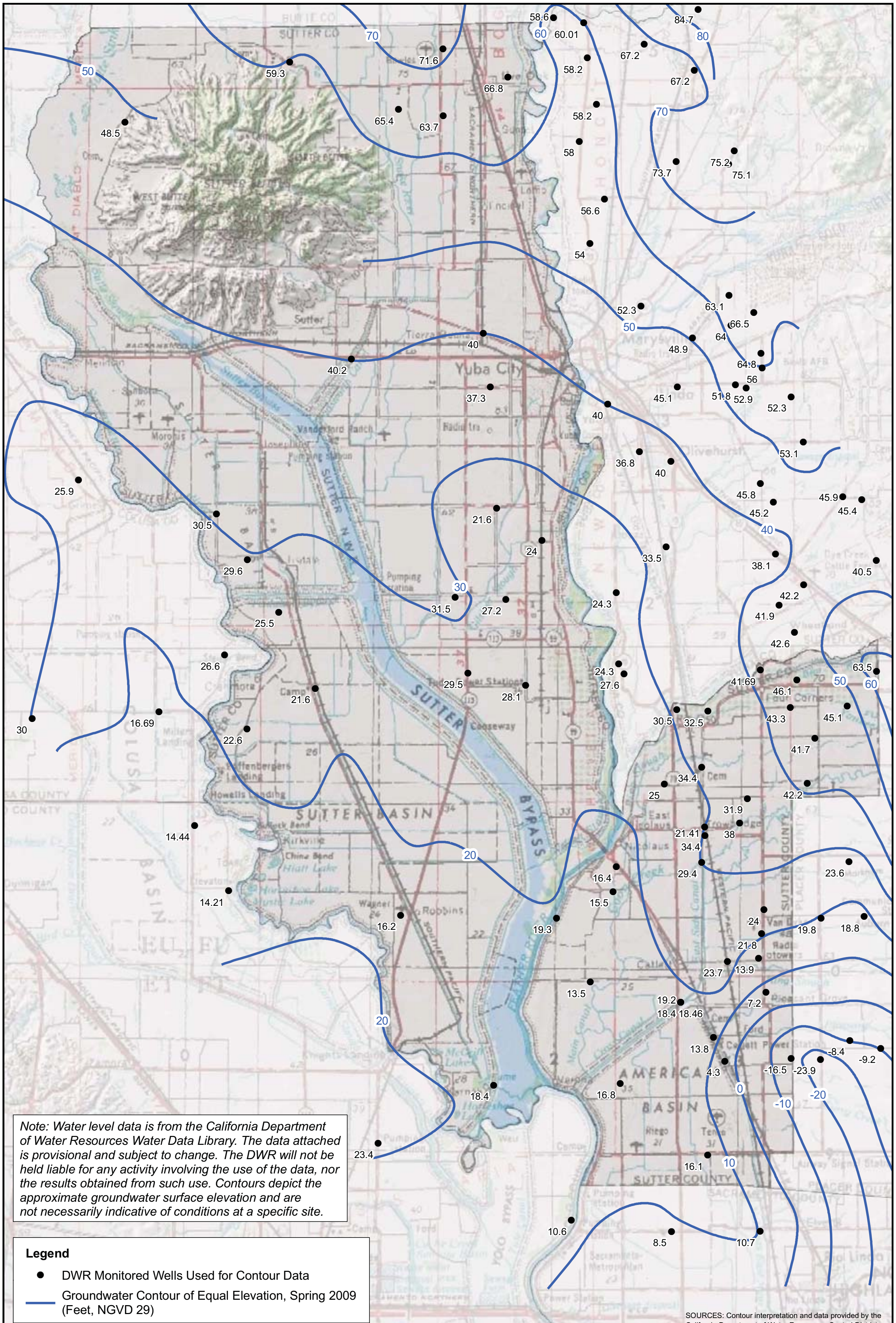
J:\Jobs\8337_SutterCounty\GIS\Tasks\20120116 Final Draft\Figure 14 Groundwater Elevation Contour Map Fall 2008.mxd 2/8/2012 9:20:28 AM bdemucha



Note: Water level data is from the California Department of Water Resources Water Data Library. The data attached is provisional and subject to change. The DWR will not be held liable for any activity involving the use of the data, nor the results obtained from such use. Contours depict the approximate groundwater surface elevation and are not necessarily indicative of conditions at a specific site.

Legend

- DWR Monitored Wells Used for Contour Data
- Groundwater Contour of Equal Elevation, Spring 2009 (Feet, NGVD 29)

FIGURE 15

GROUNDWATER ELEVATION CONTOUR MAP SPRING, 2009

SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012

NORTH

0 1.5 3 MILES

SUTTER COUNTY CALIFORNIA

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J:\Jobs\8337_SutterCounty\GIS\Tasks\20120116 Final Draft\Figure 15 Groundwater Elevation Contour Map Spring 2009.mxd 2/8/2012 9:33:20 AM bdemucha

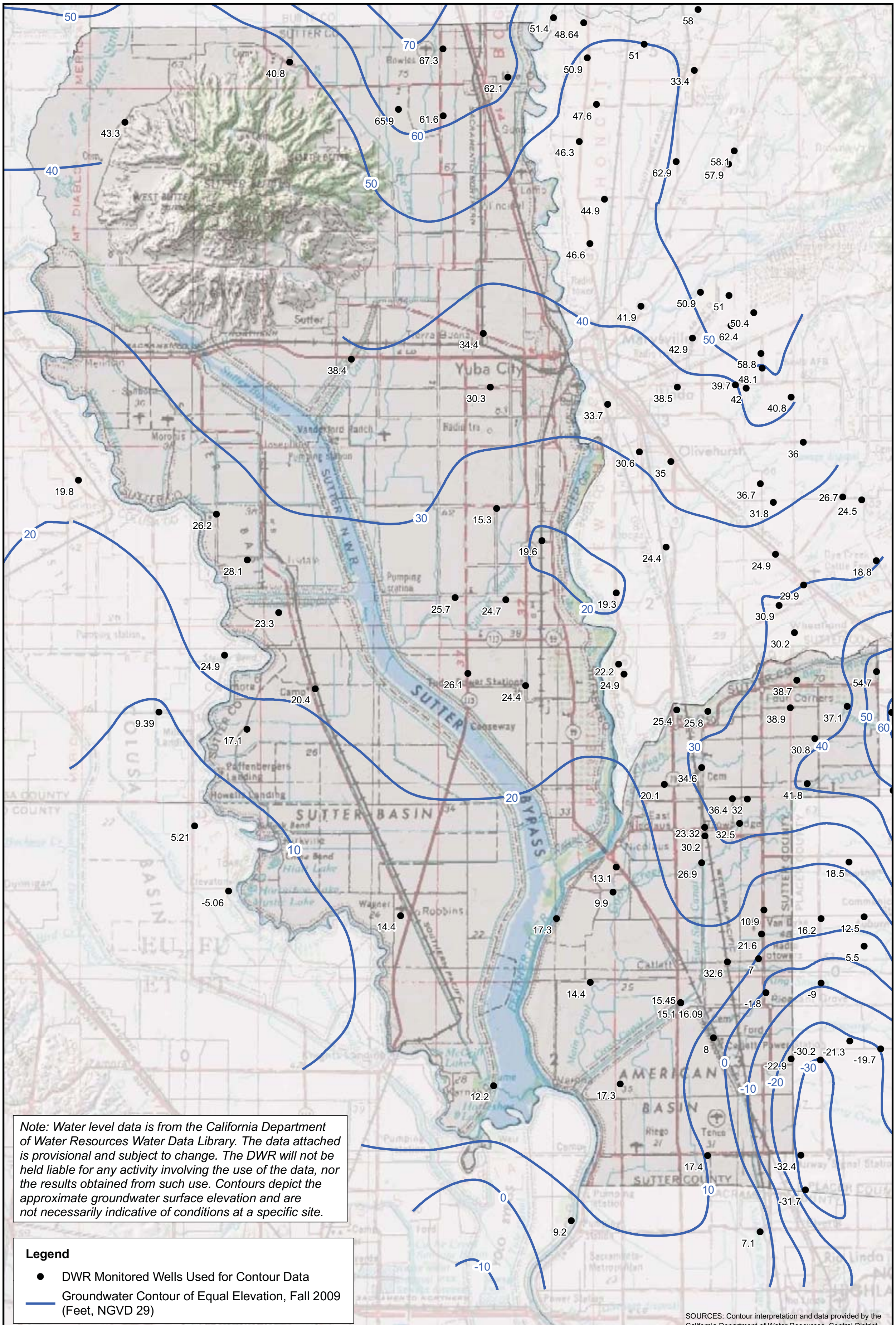

FIGURE 16
GROUNDWATER ELEVATION CONTOUR MAP
FALL, 2009

SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012

NORTH
0 1.5 3
Miles

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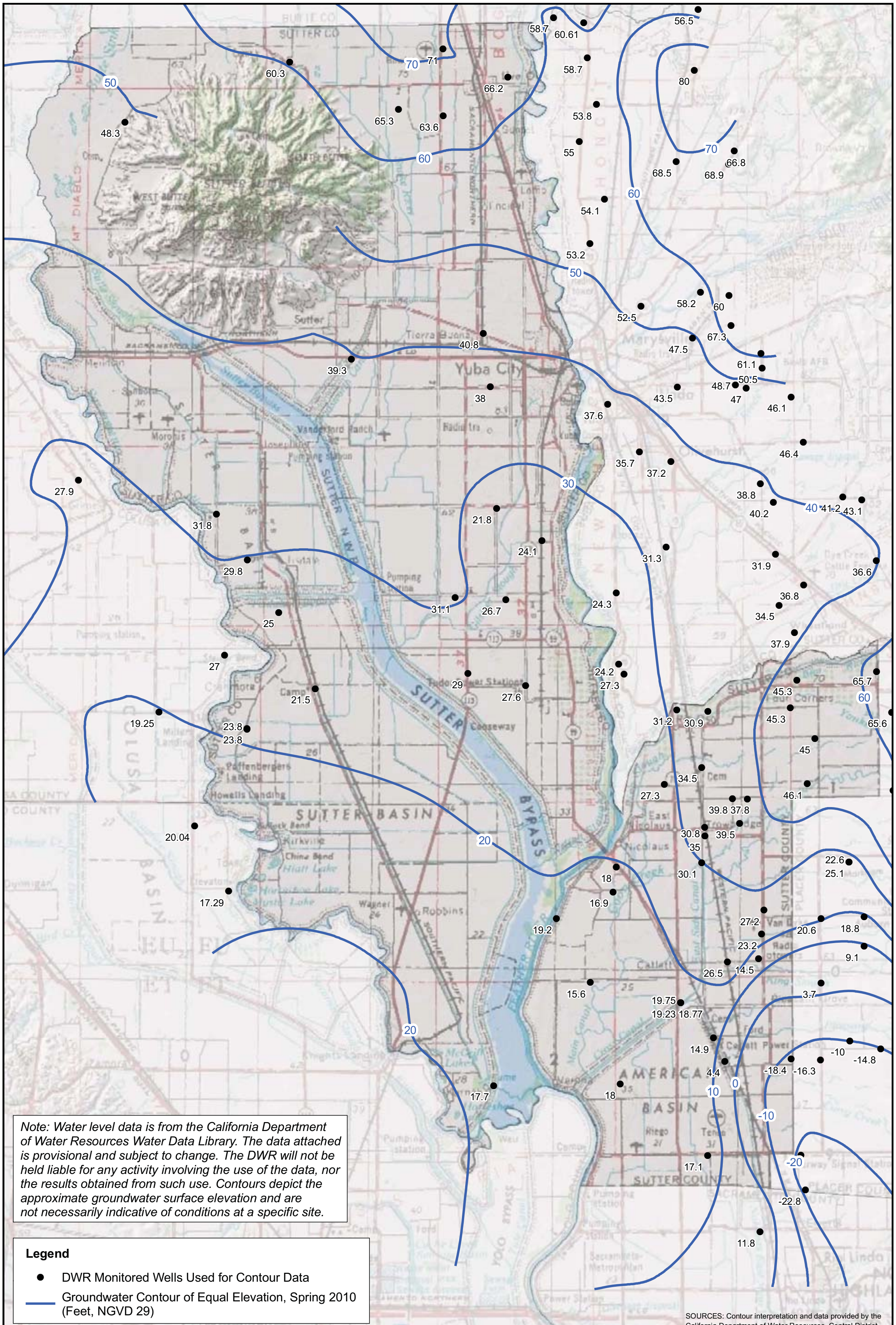

Note: Water level data is from the California Department of Water Resources Water Data Library. The data attached is provisional and subject to change. The DWR will not be held liable for any activity involving the use of the data, nor the results obtained from such use. Contours depict the approximate groundwater surface elevation and are not necessarily indicative of conditions at a specific site.

Legend

- DWR Monitored Wells Used for Contour Data
- Groundwater Contour of Equal Elevation, Spring 2010 (Feet, NGVD 29)

SOURCES: Contour interpretation and data provided by the California Department of Water Resources, Central District

FIGURE 17

GROUNDWATER ELEVATION CONTOUR MAP SPRING, 2010

SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN

FEBRUARY 2012

NORTH

0 1.5 3

MILES

SUTTER COUNTY CALIFORNIA

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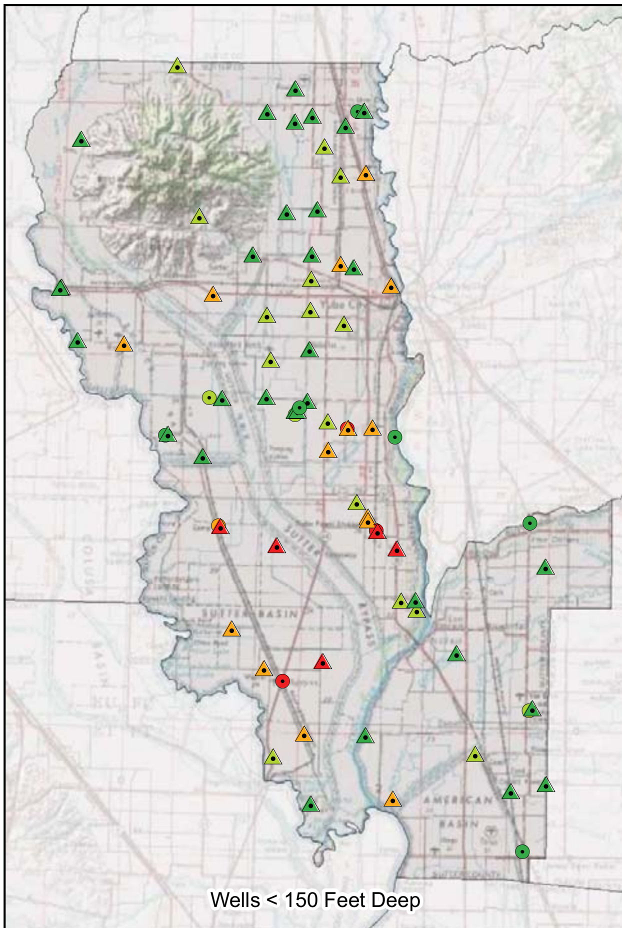
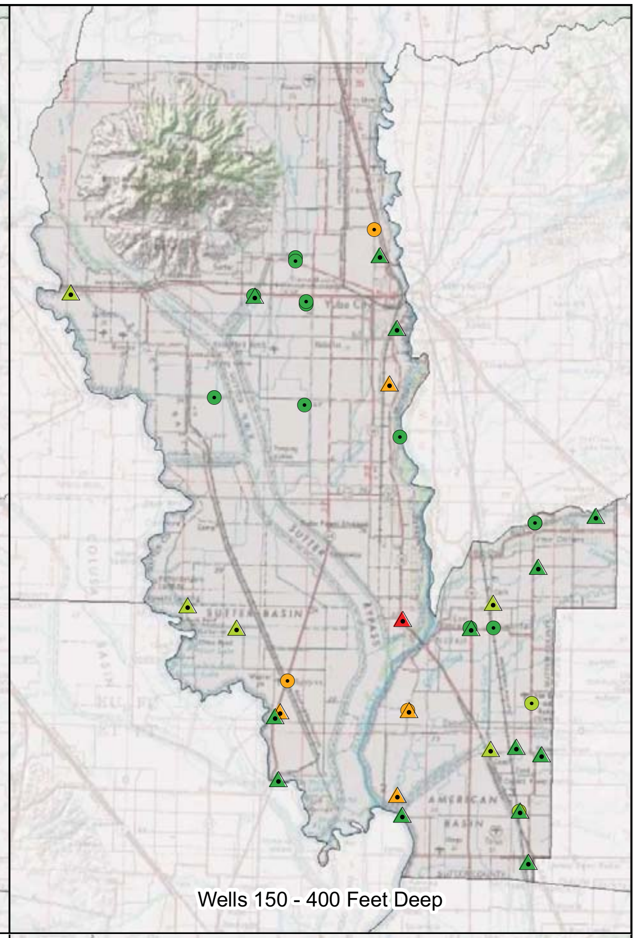
J:\Jobs\8337_SutterCounty\GIS\Tasks\20120116 Final Draft\Figure 17 Groundwater Elevation Contour Map Spring 2010.mxd 2/8/2012 9:53:27 AM bdemucha





EC in DWR Wells (μmhos/cm)

- < 600
- 600 - 900
- 900 - 1600
- > 1600

EC in USGS Wells (μmhos/cm)

- < 600
- 600 - 900
- 900 - 1600
- > 1600

Note:
"EC" is an abbreviation for specific conductance, which is related to the salt content of a water sample.

For public drinking water systems, the secondary (aesthetic) maximum contaminant levels for EC are 900 micromhos/centimeter (μmhos/cm) (recommended), 1600 μmhos/cm (upper), and 2200 μmhos/cm (short-term).

For irrigation, crop yields decrease above a threshold EC value, which is crop-dependent. Crop yield potential decreases above these threshold levels:

Almonds - 1000 μmhos/cm
Beans - 700 μmhos/cm
Rice - 2000 μmhos/cm
Squash - 2100-3100 μmhos/cm
Tomatoes - 1700 μmhos/cm
Wheat - 4000 μmhos/cm

SOURCES: USGS, DWR, SEWD, DHS, FAO, EPA

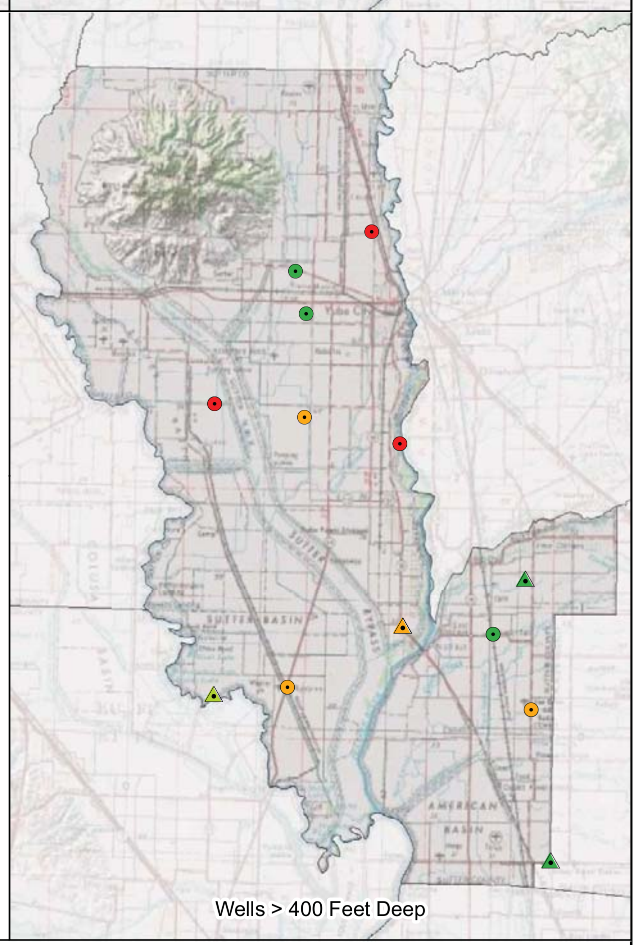


FIGURE 18
SPECIFIC CONDUCTANCE BY WELL DEPTH
SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012

NORTH

0 3 6
Miles

SUTTER COUNTY CALIFORNIA

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Sacramento, CA 95816 Fax: 916.341.7767

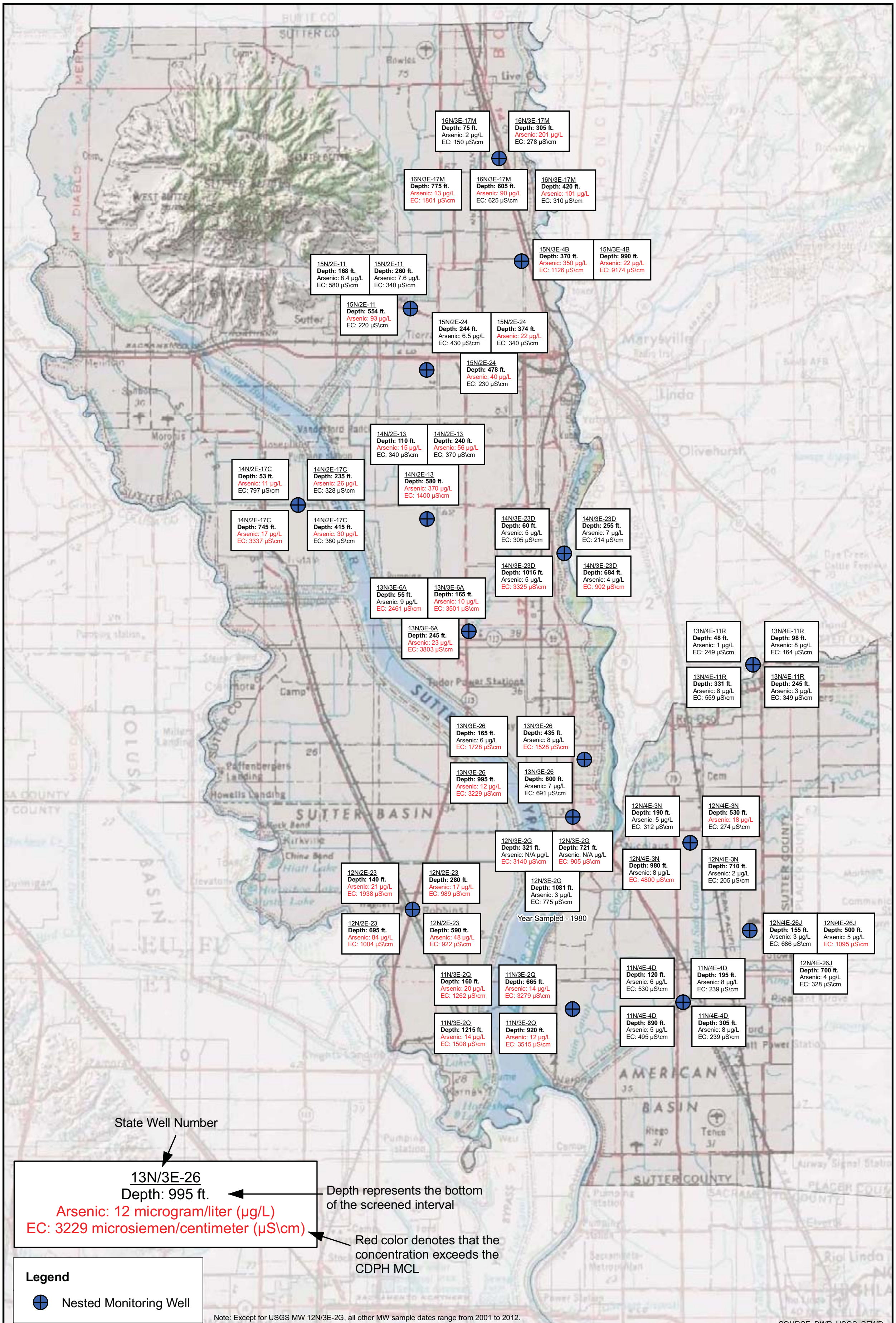

FIGURE 19

DEPTH SPECIFIC ARSENIC AND SPECIFIC CONDUCTANCE CONCENTRATIONS

SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN

FEBRUARY 2012

NORTH

0 1.5 3

MILES

SUTTER COUNTY CALIFORNIA

WOOD RODGERS

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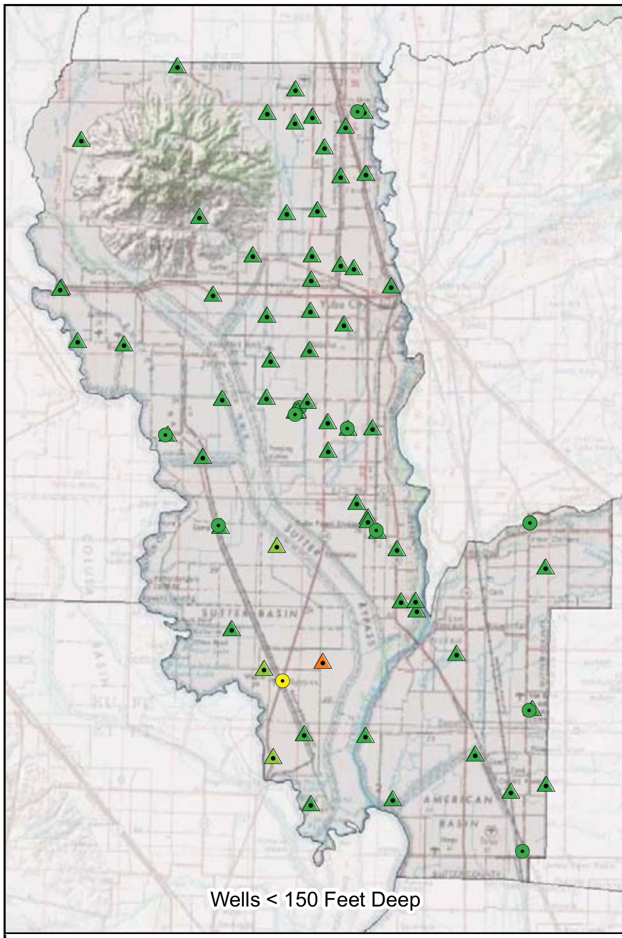
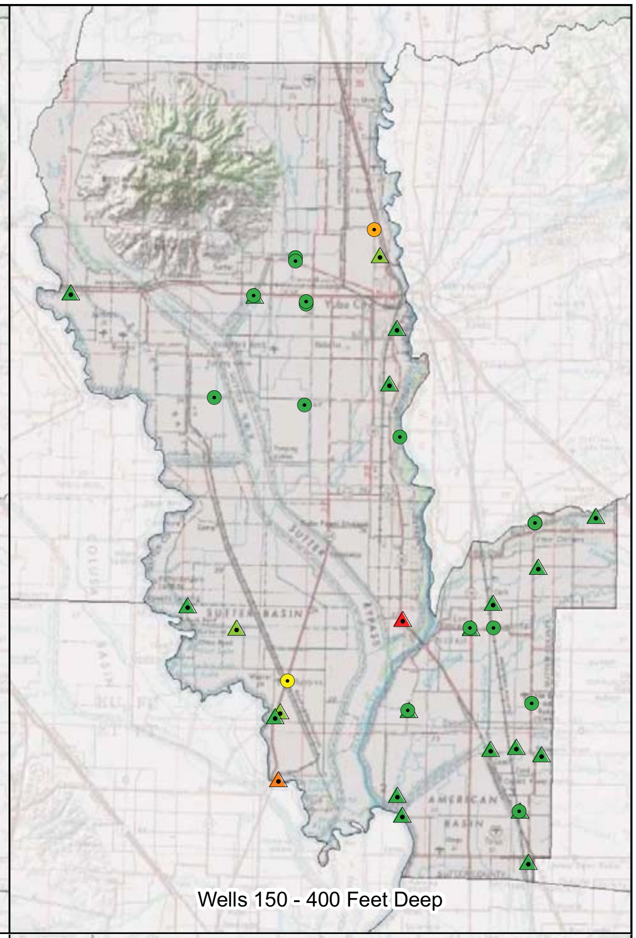
Tel: 916.341.7760 Fax: 916.341.7767

J:\Jobs\8337_SutterCounty\GIS\Tasks\20120201 Final Draft Figure Comments\Figure 19 Depth Specific Arsenic and Specific Conductance.mxd 2/8/2012 11:34:41 AM bdemucha





Boron in DWR Wells (µg/L)

- < 500
- 500 - 750
- 750 - 1000
- 1000 - 2000
- > 2000

Boron in USGS Wells (µg/L)

- < 500
- 500 - 750
- 750 - 1000
- 1000 - 2000
- > 2000

Note:
Boron is naturally occurring and leaches from aquifer materials into groundwater.

For public drinking water systems, there is a notification level for boron of 1000 micrograms/liter (µg/L).

For irrigation, boron is necessary for crop growth but becomes toxic to the point that yields may decrease above these threshold levels:

Beans - 750 - 1000 µg/L
Grapes - 500 - 750 µg/L
Squash - 2000 - 4000 µg/L
Tomatoes - 4000 - 6000 µg/L
Walnuts - 500 - 750 µg/L
Wheat - 750 - 1000 µg/L

Many other trees are vulnerable to boron toxicity above 500 - 750 µg/L.

SOURCES: USGS, DWR, SEWD, DHS, FAO, EPA

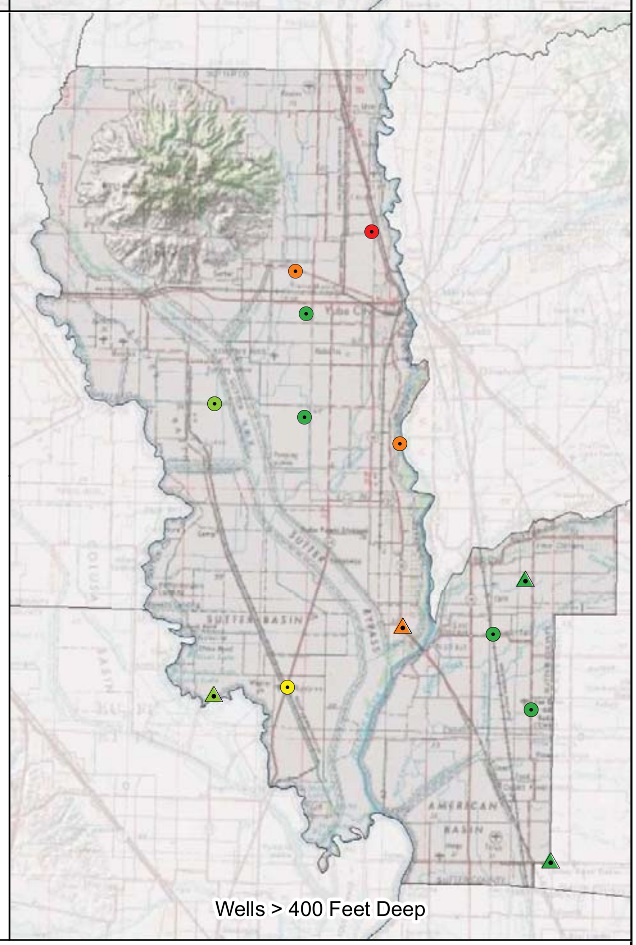


FIGURE 20
BORON BY WELL DEPTHS
SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012

NORTH
0 3 6
MILES

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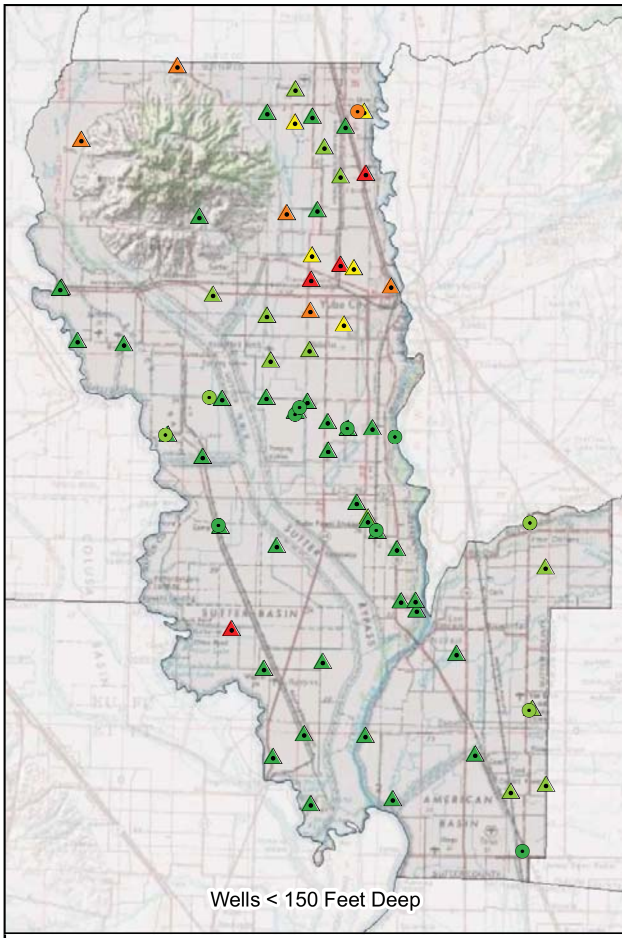
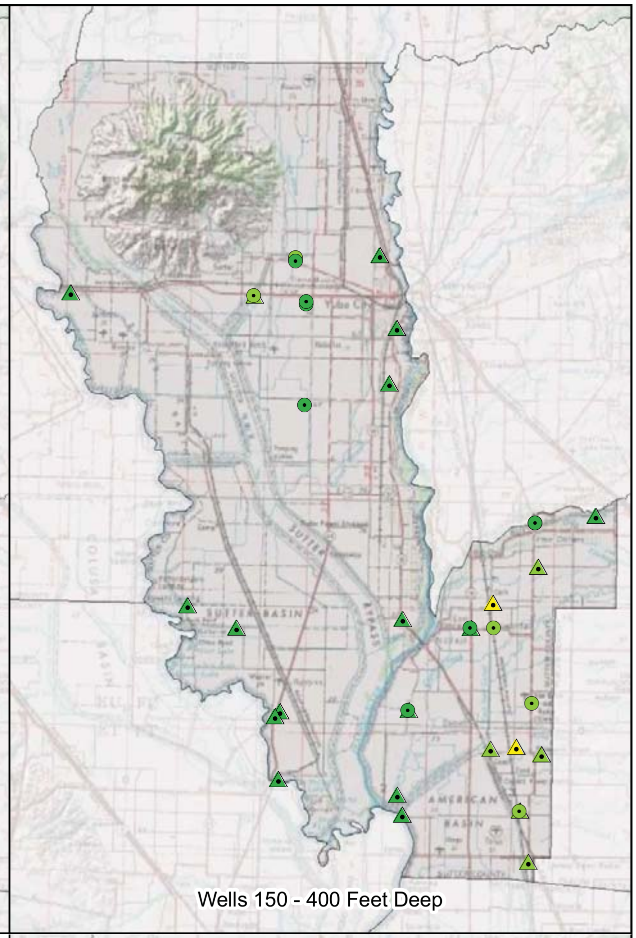
J:\Jobs\8337_SutterCounty\GIS\Tasks\20120116 Final Draft\Figure 20 Boron_Well Depth.mxd 2/8/2012 2:00:06 PM bdemucha





Nitrate in DWR Wells (mg/L)

- ● < 5
- ● 5 - 15
- ● 15 - 30
- ● 30 - 45
- ● > 45

Nitrate in USGS Wells (mg/L)

- ▲ < 15
- ▲ 5 - 15
- ▲ 15 - 30
- ▲ 30 - 45
- ▲ > 45

Note:
Nitrate is generally introduced into groundwater by septic systems, fertilizers, or confined animal operations.

For public drinking water systems, the primary (health-based) maximum contaminant level for nitrate as NO3 is 45 milligrams/liter (mg/L).

At concentrations exceeding the maximum contaminant level, nitrate can interfere with the blood's ability to carry oxygen. This effect can be especially pronounced in infants, where it is known as "blue baby syndrome".

SOURCES: USGS, DWR, SEWD, DHS, FAO, EPA

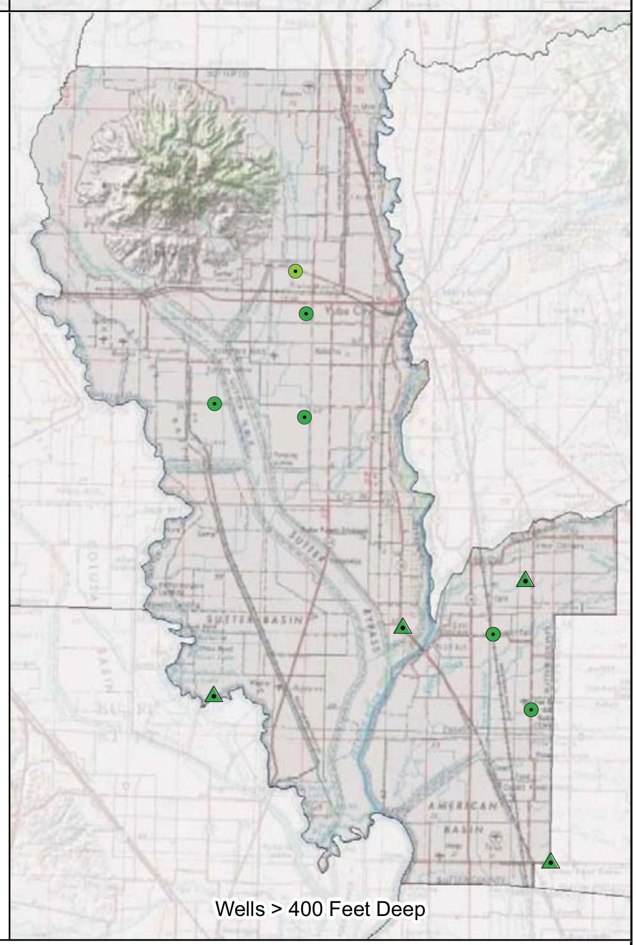


FIGURE 21
NITRATE BY WELL DEPTH
SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012

NORTH
0 3 6
Miles

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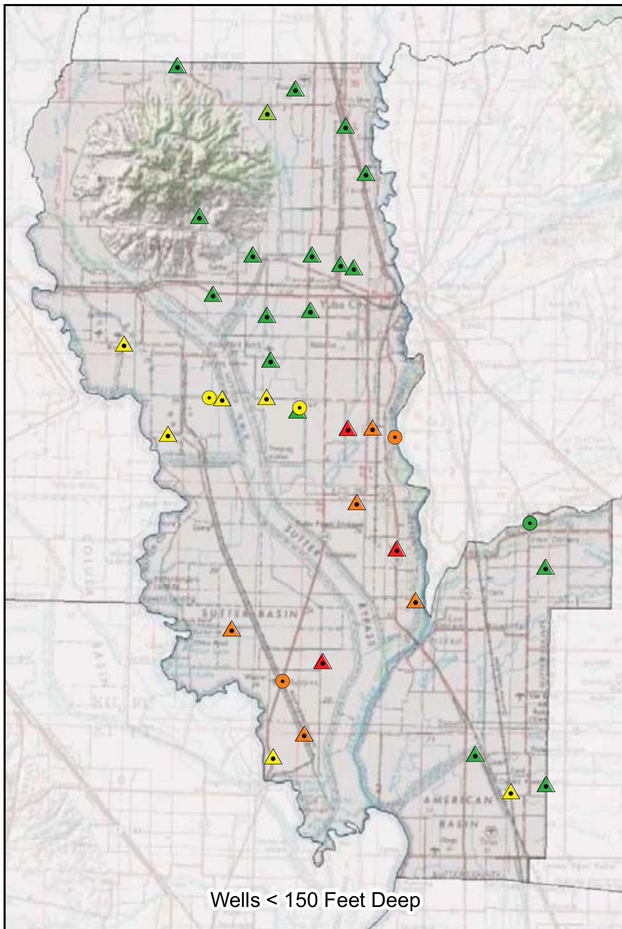

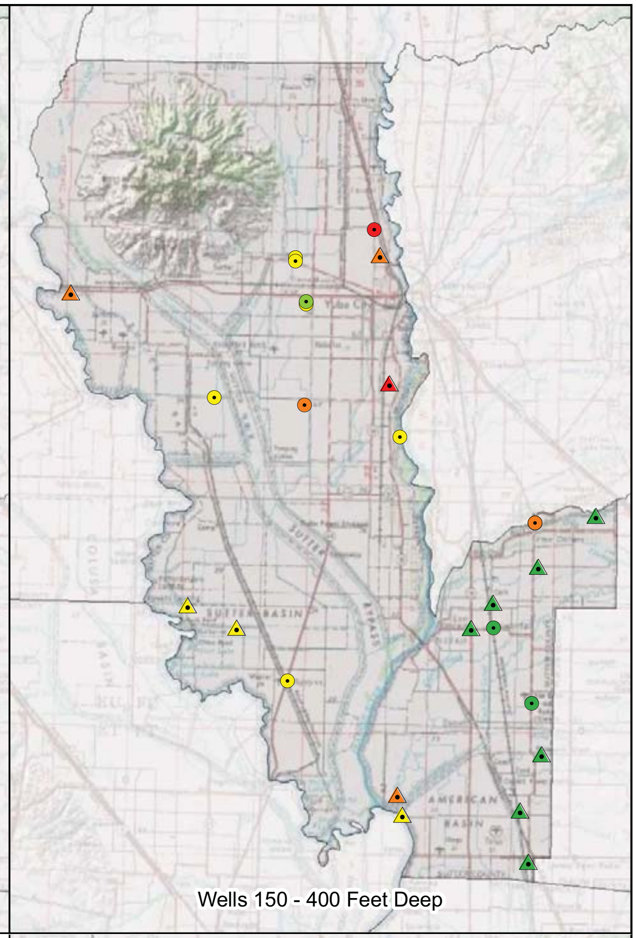

Manganese in DWR Wells (µg/L)

- < 25
- 25 - 50
- 50 - 150
- 150 - 500
- > 500

Manganese in USGS Wells (µg/L)

- < 25
- 25 - 50
- 50 - 150
- 150 - 500
- > 500

Note:
Manganese is naturally occurring and leaches from aquifer materials into groundwater.

For public drinking water systems, the secondary (aesthetic) maximum contaminant level for manganese is 50 micrograms/liter (µg/L). There is also a notification level for manganese of 500 µg/L. Notification levels are health-based advisory levels for chemicals that do not have primary maximum contaminant levels.

Manganese can cause staining of plumbing and fixtures, and can contribute a metallic odor to water. At very high concentrations (above the notification level) manganese may cause neurologic problems.

Analysis for manganese is very sensitive to turbidity of samples - turbid samples will often have artificially high results for manganese.

SOURCES: USGS, DWR, SEWD, DHS, FAO, EPA

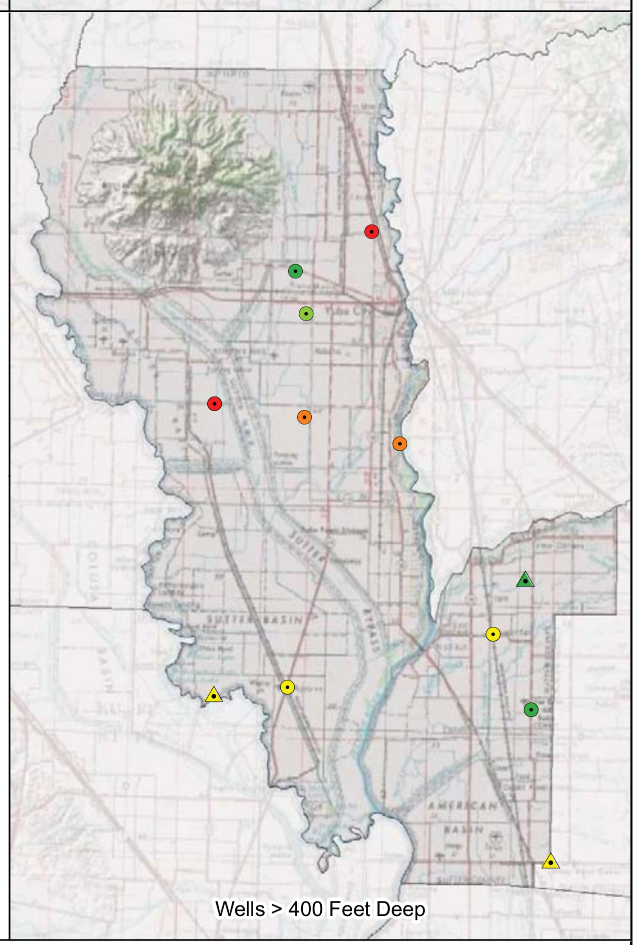

FIGURE 22
MANGANESE BY WELL DEPTHS
SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012

NORTH
0 3 6
Miles

SUTTER COUNTY CALIFORNIA

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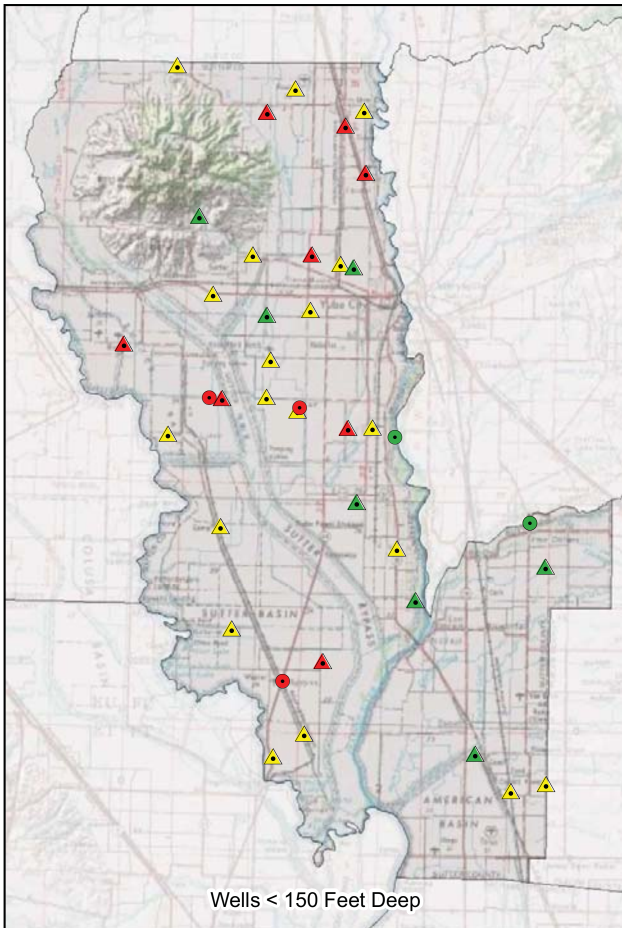
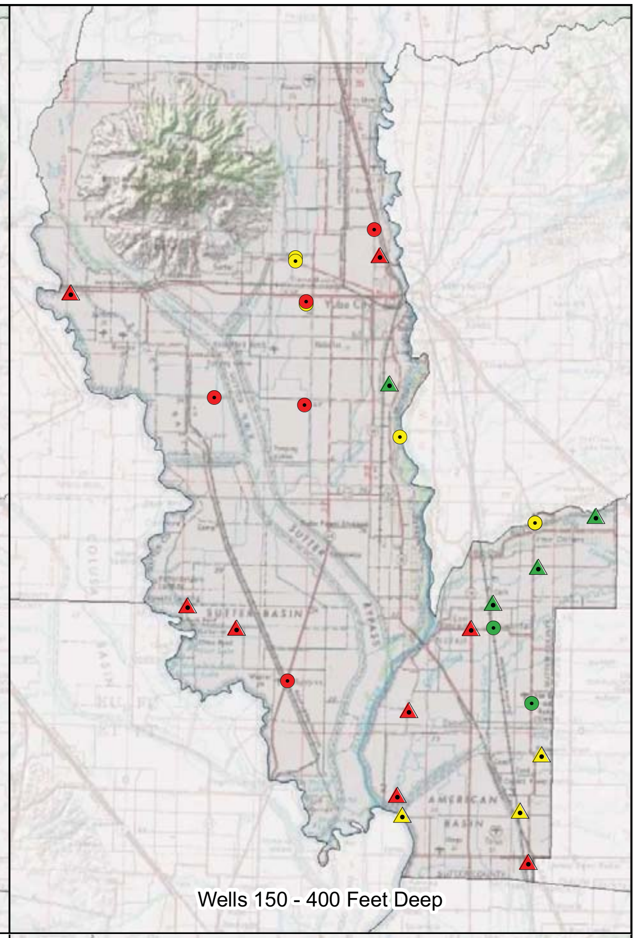




Arsenic in DWR Wells (µg/L)

- < 5
- 5 - 10
- > 10

Arsenic in USGS Wells (µg/L)

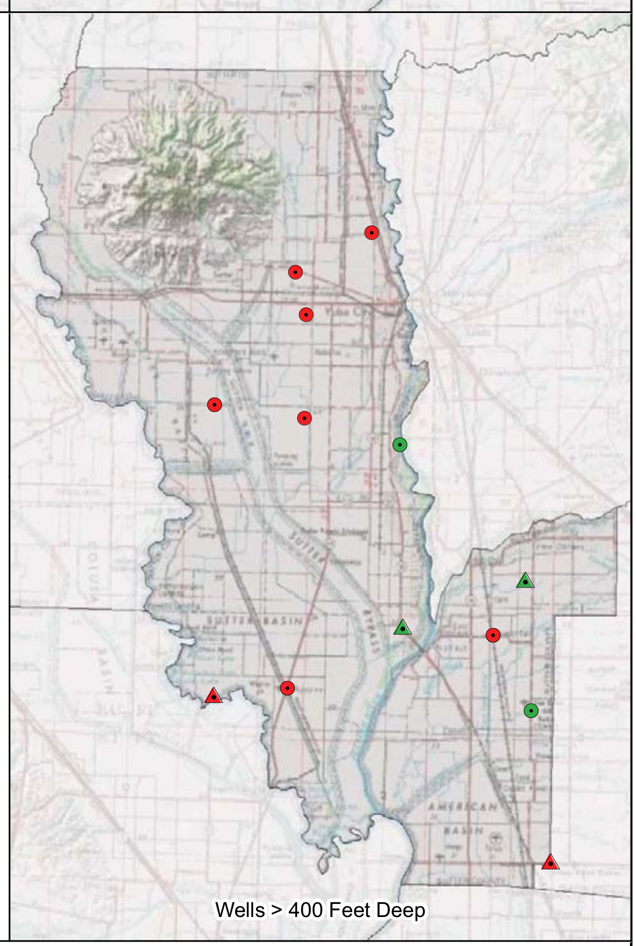
- < 5
- 5 - 10
- > 10

Note:
Arsenic is naturally occurring and leaches from aquifer materials into groundwater.

For public drinking water systems, the primary maximum contaminant level for arsenic is 10 micrograms/liter (µg/L).

Exposure to arsenic can cause both short and long term health effects. Long term exposure to arsenic has been linked to cancer of the bladder, lungs, skin, kidneys, nasal passages, liver and prostate. Short term exposure to high doses of arsenic can cause other adverse health effects.

Analysis for arsenic is very sensitive to turbidity of samples - turbid samples will often have artificially high results for arsenic.



SOURCES: USGS, DWR, SEWD, DHS, FAO, EPA

FIGURE 23
ARSENIC BY WELL DEPTHS
SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012

NORTH
0 3 6
Miles

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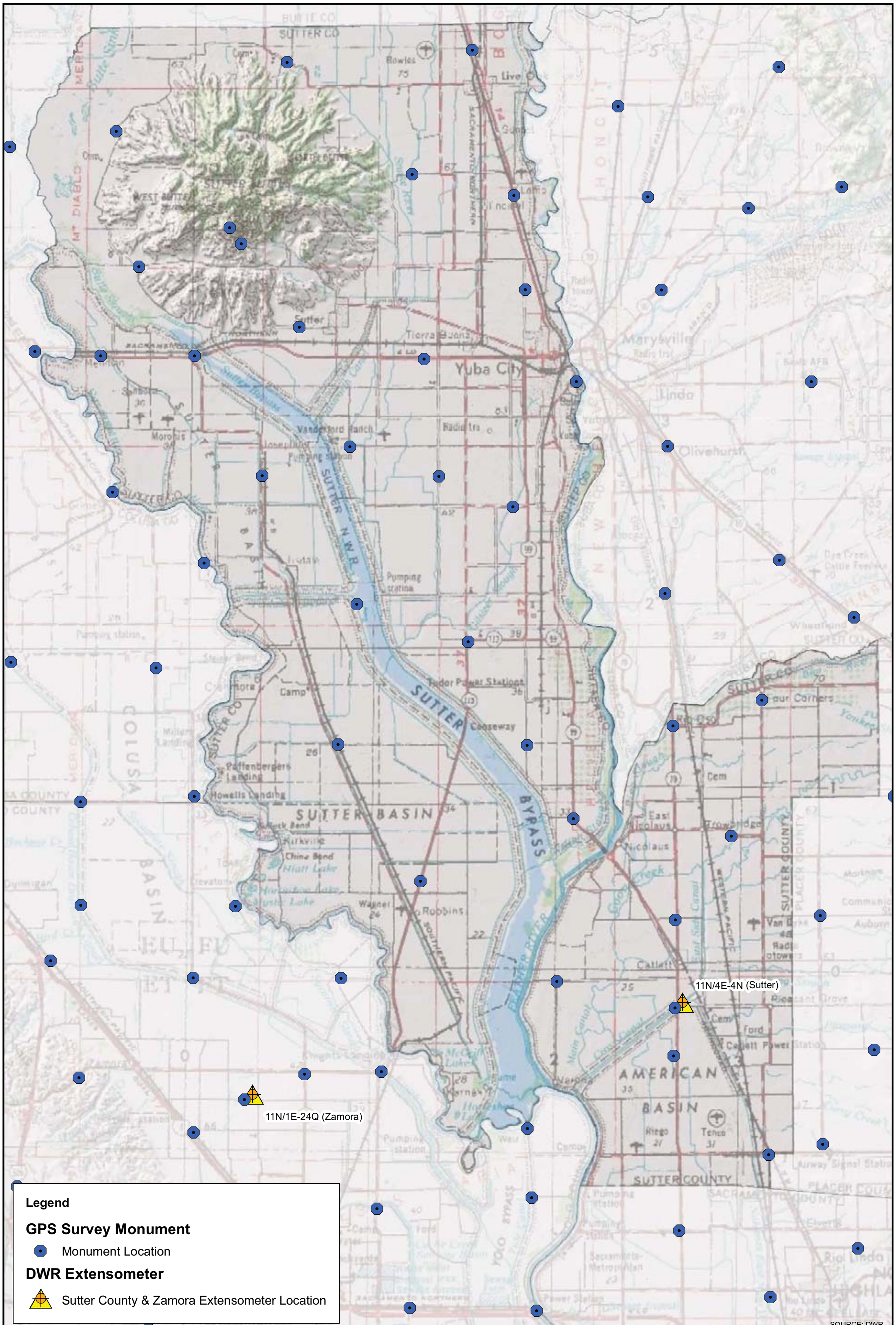

FIGURE 24
LAND SUBSIDENCE NETWORK
SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012

NORTH

0 1.5 3
MILES

WOOD RODGERS
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J:\Jobs\8337_SutterCounty\GIS\Tasks\20120116 Final Draft\Figure 24 Land Subsidence Network.mxd 2/8/2012 2:43:42 PM bdemucha

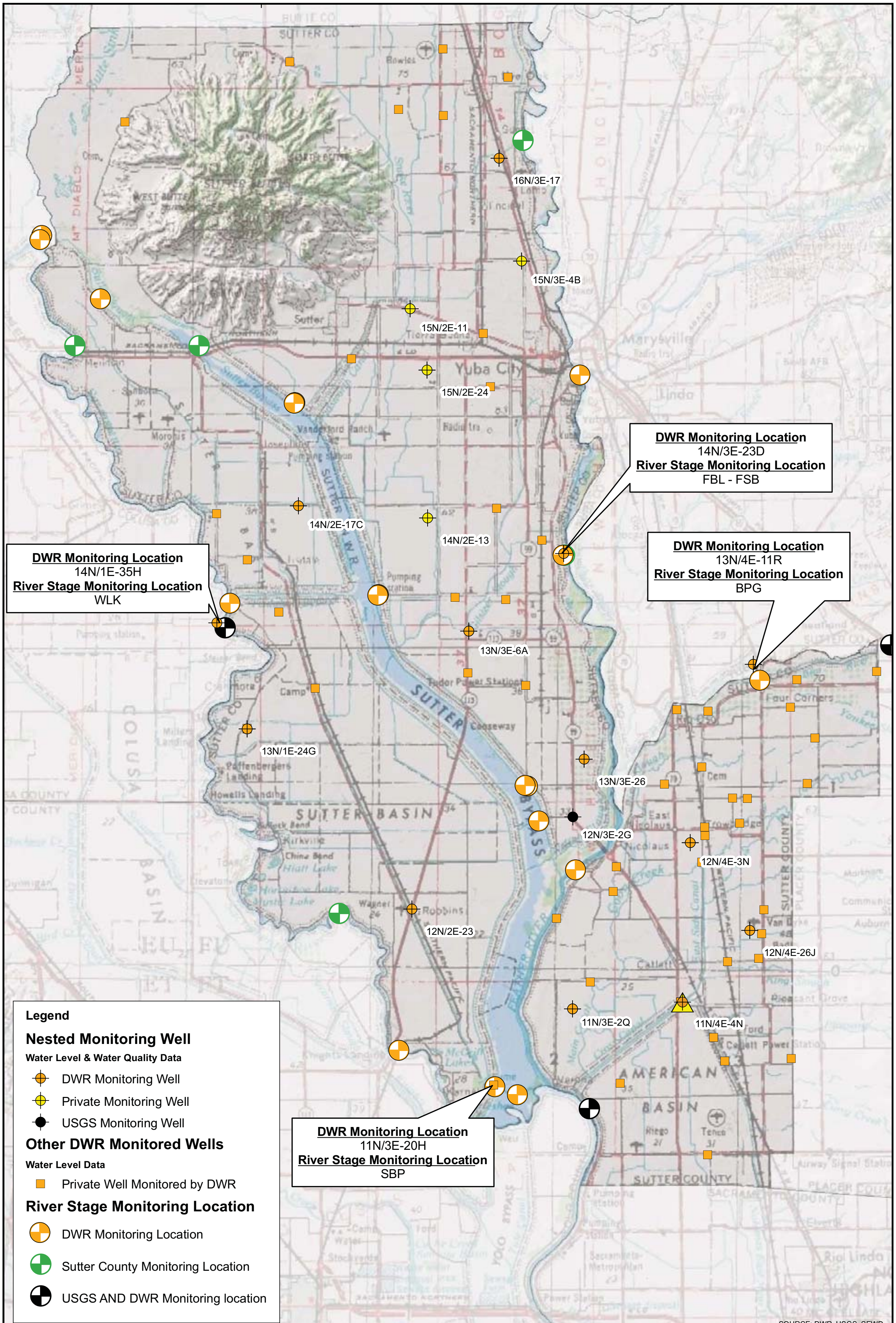

FIGURE 25
GROUNDWATER AND RIVER STAGE MONITORING LOCATIONS

SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN
FEBRUARY 2012

NORTH
0 1.5 3
MILES

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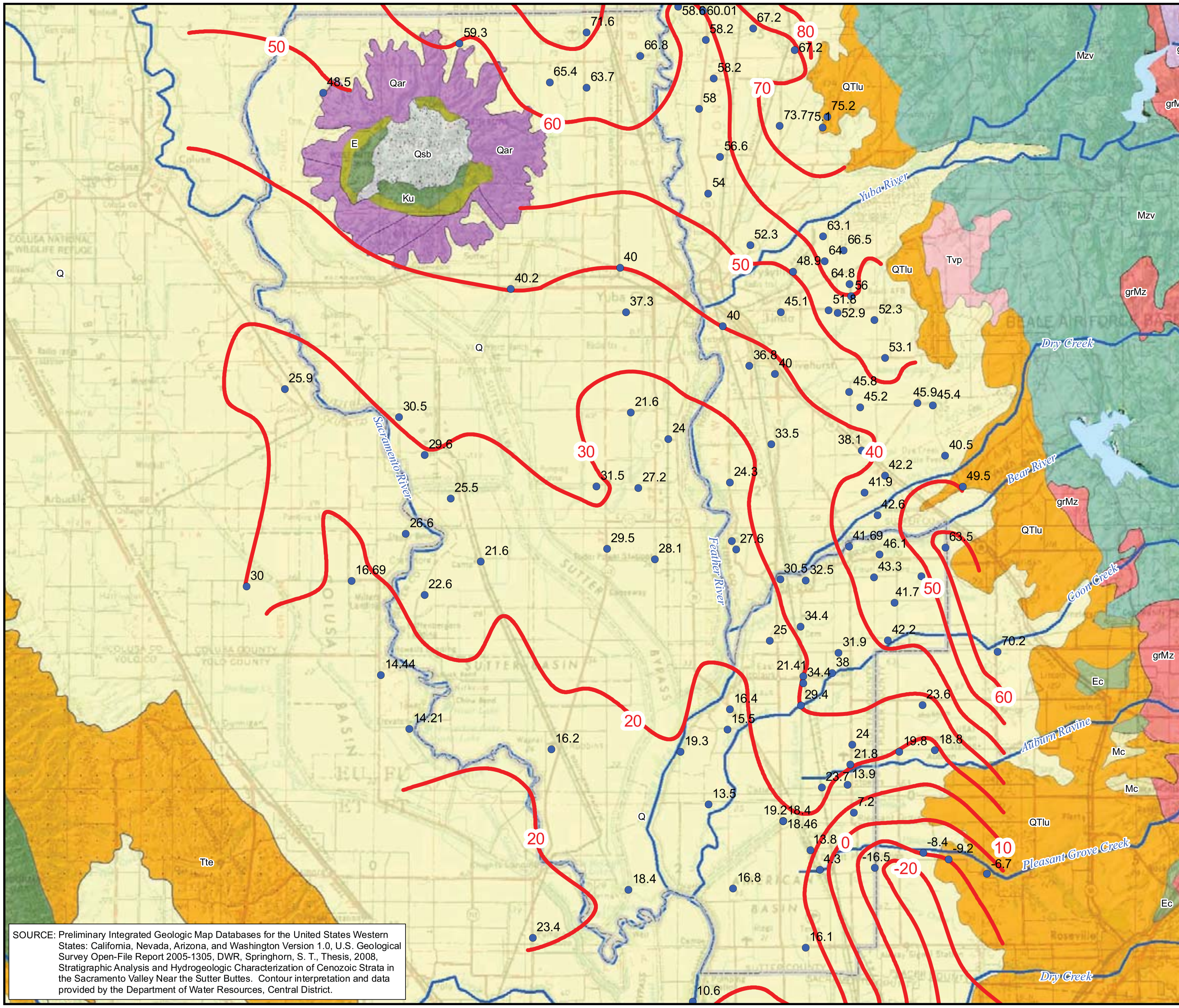
J:\Jobs\8337_SutterCounty\GIS\Tasks\20120116 Final Draft\Figure 25 Groundwater and River Stage Monitoring Locations.mxd 2/8/2012 2:46:51 PM bdemucha

FIGURE 26

RECHARGE AND GROUNDWATER ELEVATION CONTOUR MAP SPRING, 2009

SUTTER COUNTY GROUNDWATER MANAGEMENT PLAN

FEBRUARY 2012



NORTH

0 2 4 MILES

- Q - Recent Deposits
  - Qb - Basin Deposits
  - Qm - Modesto Formation
  - Qr - Riverbank Formation
- Qsb - Sutter Buttes Igneous Rocks
- Qar - Sutter Buttes Andesitic Rampart
- QTlu - Laguna Formation
- Tte - Tehama Formation
- Tvp - Andesite, Rhyolite
- Mc - Sandstone, Conglomerate
- Ec - Conglomerate, Sandstone
- E - Mudstone, Sandstone
- Ku - Sandstone, Mudstone
- J - Mudstone, Sandstone, & Slate
- um - Serpentinite
- Mzv - Volcanic, Metavolcanic
- gb - Gabbro, Diorite
- grMz - Granodiorite
- Sutter County
- DWR Monitored Wells Used for Contours
- Groundwater Contour of Equal Elevation (Feet, NGVD 29)

SOURCE: Preliminary Integrated Geologic Map Databases for the United States Western States: California, Nevada, Arizona, and Washington Version 1.0, U.S. Geological Survey Open-File Report 2005-1305, DWR, Springhorn, S. T., Thesis, 2008, Stratigraphic Analysis and Hydrogeologic Characterization of Cenozoic Strata in the Sacramento Valley Near the Sutter Buttes. Contour interpretation and data provided by the Department of Water Resources, Central District.

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Figure 27
Sutter County
Well Construction By Year

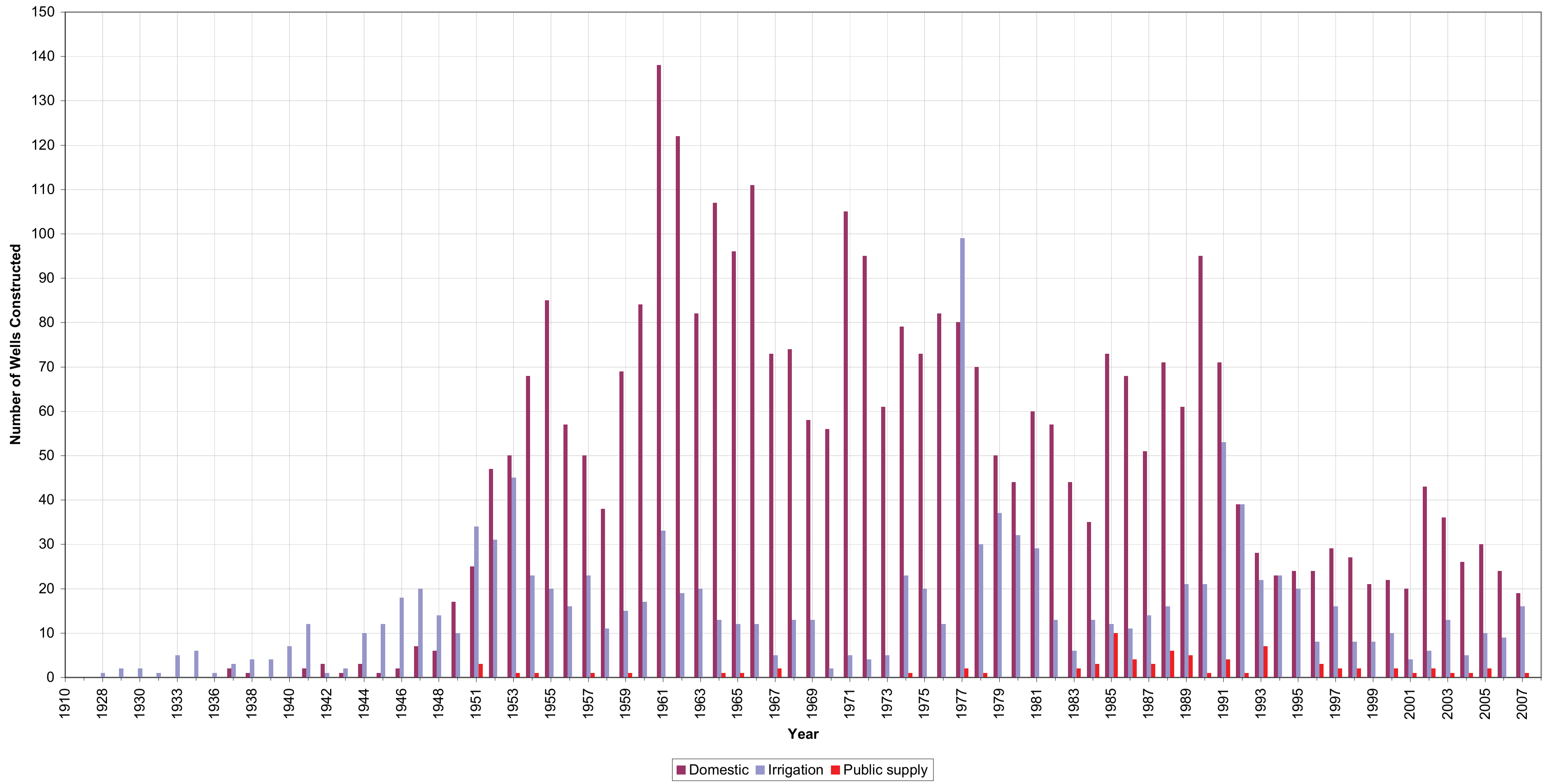
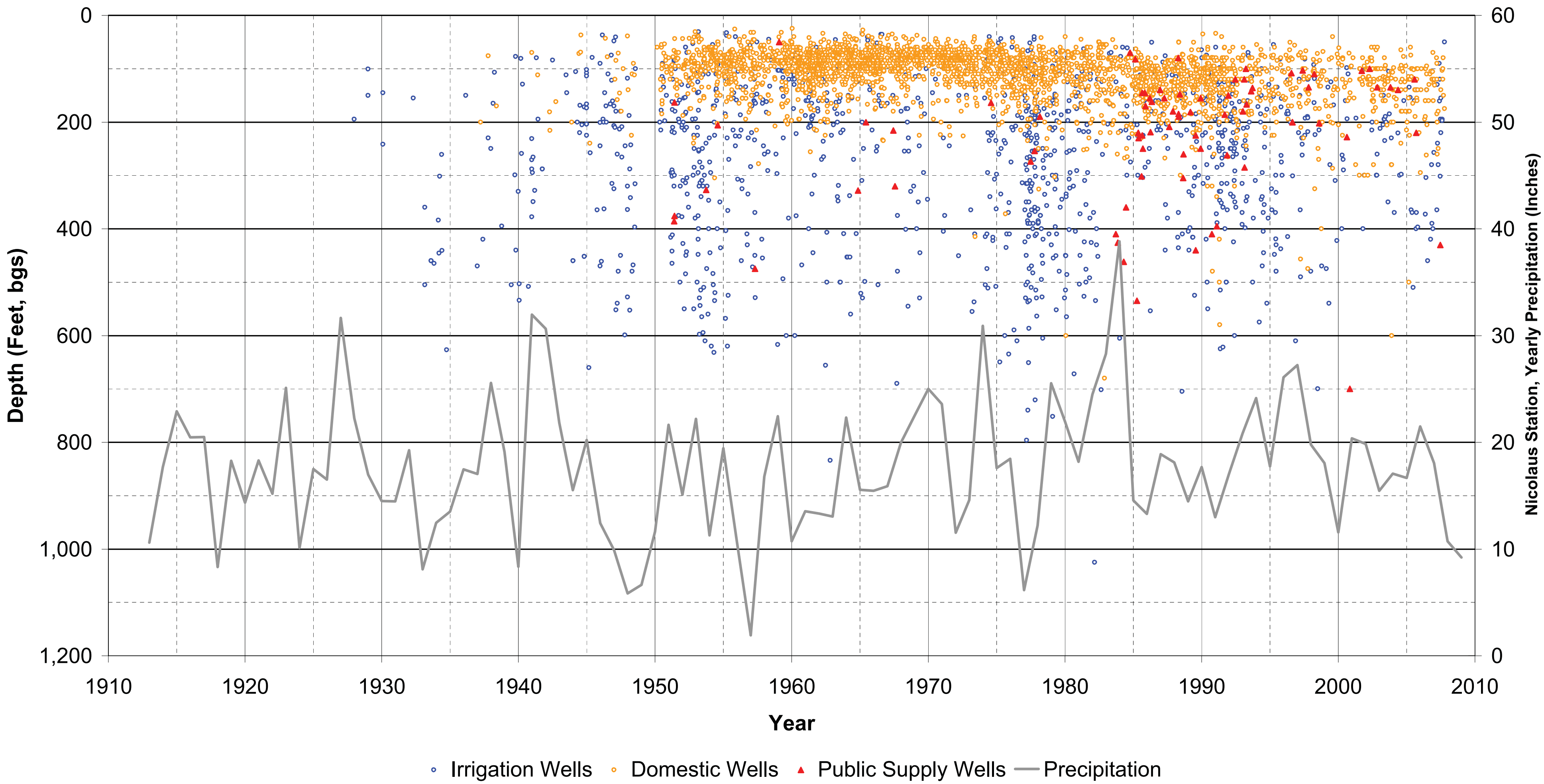


Figure 28
Sutter County
Historic Well Construction by Depth and Annual Precipitation



APPENDIX B
WELL AND GEOPHYSICAL LOGS
USED TO
DEVELOP GEOLOGIC SECTIONS

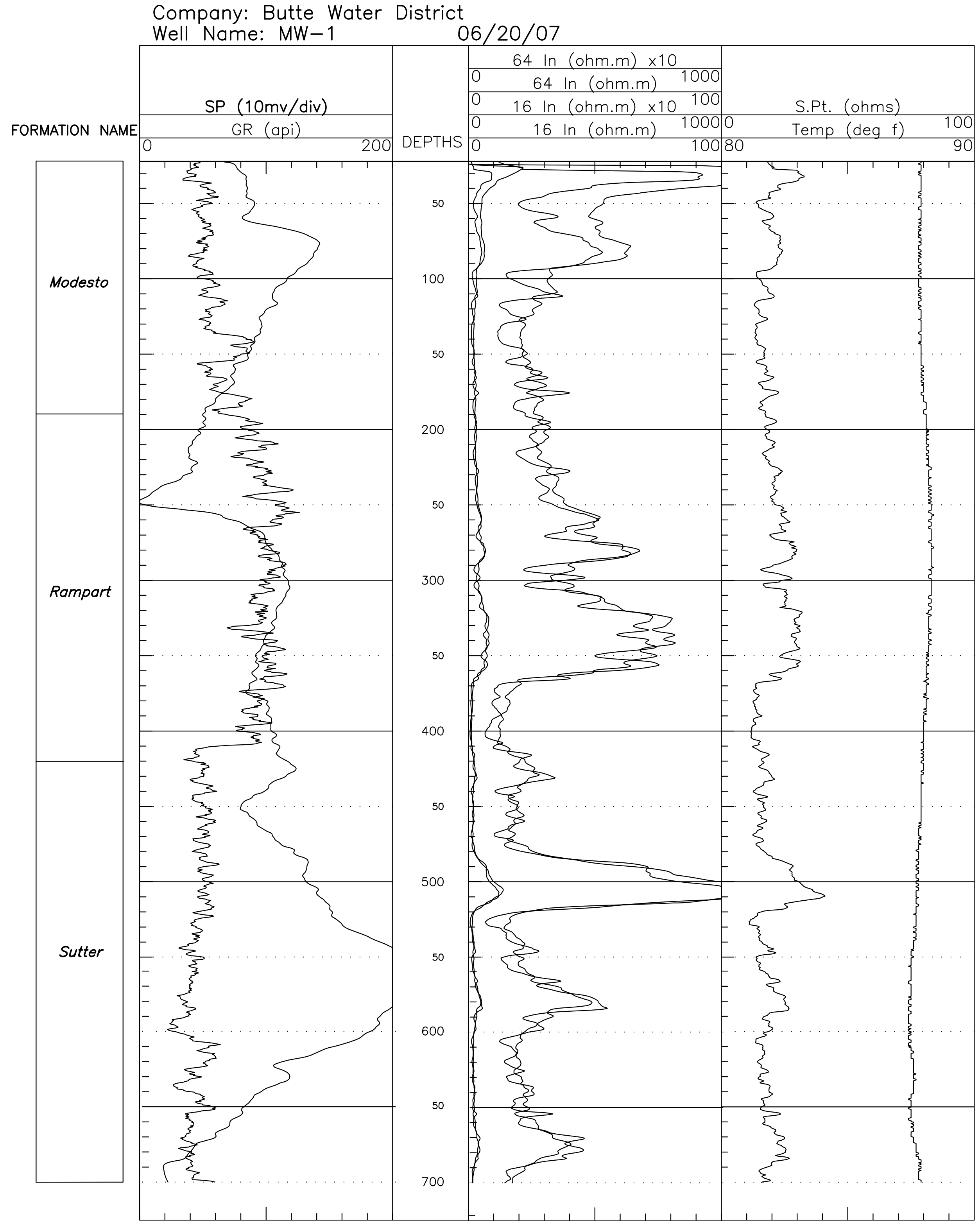
CAUTION: THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE FOR, OR LIABLE FOR, UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE ENGINEER OF RECORD.

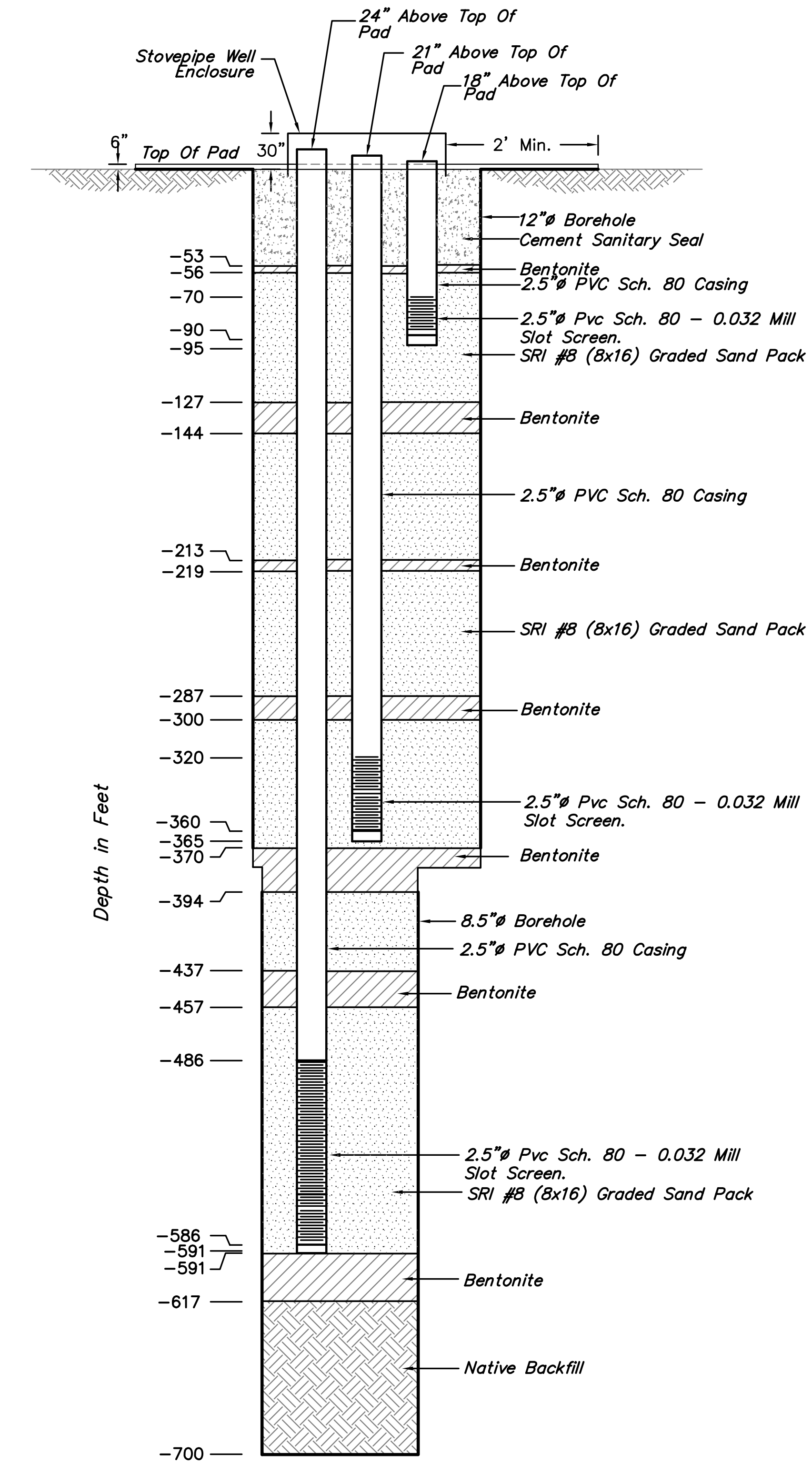
WELL LITHOLOGY

DEPTH	* SYMBOL	& DESCRIPTION
0	CL	Clay. Some Fine Sand
-10	SW	Sand With Brown Clay
-20	SC	Clayey Sand, Light Olive Brown,Angular Clasts
-40	SM	Silty Sand, Dark Yellowish Brown, Subrounded Clasts
-50	SC	Clayey Sand, Light Olive Brown
-70	SM	Silty Sand, Light Olive Brown
-80	SW	Well Graded Sand, Multicolored
-90	SW-SC	Well Graded Sand, Light Olive Brown, Some Gravel
-110	SC	CLayey Sand. Light Olive Brown
-150	SM	Silty Sand With Gravel, Olive, Subangular Clasts
-160	ML	Sandy Silt, Some Gravel, Angular to Subangular Clasts
-226	SM-SW	Silty Sand, Olive
		Increasing Gravel, Brown
		~10% Gravel, Light Olive Brown
		~20% Gravel, Grayish Brown
-370	ML	Sandy Silt, Grayish Green With Some Brown
-411	SM	Silty Sand With Gravel, Dark Greyish Brown
	SM	Sity Sand With Gravel, Olive
-490	GW-GM	Well Graded Gravel With Silt And Sand, Olive, Subrounded to Rounded Clasts
-500	GW	Well Graded Gravel With Sand, Mostly Black, Some Metamorphics
-531	SC	Clayey Sand, Black
-601	CH	Fat Clay With Sand, Dark Gray, Medium Plasticity
-670	CH	Sandy Fat Clay, Dark Gray, Some Fine To Medium Sand With Siliceous, Metamorphic And Volcanic Clasts
-700		

* Classification Symbols are based on the Unified Soil Classification System

** Lithologic Log Interpreted From Sediment Samples And Geophysical Log.





DESIGNED		CHECKED	
DRAWN		APPROVED	

REV	DATE	DESCRIPTION	SUB	APP'D

REGISTERED GEOLOGIST RICHARD W. SHATZ No. 1514 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

BUTTE WATER DISTRICT
BUTTE COUNTY

WARNING:
0 1/2 1
THIS BAR SHOULD MEASURE 1" OR DRAWING IS NOT TO SCALE

GEI Consultants
Bookman-Edmonston Division

BUTTE WATER DISTRICT
CONJUNCTIVE USE PROGRAM

MW-1 AS-BUILT
CONSTRUCTION DETAILS

PROJ. NO: 050790	TASK NO. 10
ISSUE DATE November 2007	SUBMITTAL:

A -3

S:\Water Resource\Projects\050790\As-Built\BWD MW-1\FIGURE 2 MW-1 As-built.dwg C-01-MW-1 Mar 04, 2008 05:20:16 pm

welenco

5201 Woodmere Drive, Bakersfield, CA 93313-- www.welenco.com--(800) 445-9914
California Contractor's License No. 722373

ELECTRIC - GAMMA RAY - TEMPERATURE LOG

FILING NO.

COMPANY Eaton Drilling
WELL DWR-SC-MW-2
FIELD Robbins
STATE California COUNTY Sutter

LOCATION:
Hwy 113 & Reclamation Road

OTHER SERVICES:
Guard
Borehole Geometry
Dual Induction

JOB NO.
12348

SEC: 23 TWP: 12N RGE: 2E LAT.: 38° 52' 33.3" LONG.: 121° 42' 33.8" MERIDIAN.: Mt. Diablo

Permanent Datum: Ground Level , **Elev.** 78 **Ft.** **Elev.: K.B.** ______ **Ft.**
Log Measured From: Ground Level , 0 **Ft. Above Perm. Datum** **D.F.** ______ **Ft.**
Drilling Measured From: Ground Level **G.L.** 78 **Ft.**

Run	One			
Date	Apr. 22, 2010			
Depth-Driller	1500 Ft	Ft	Ft	Ft
Depth-Logger	1498 Ft	Ft	Ft	Ft
Top Logged Interval	20 Ft	Ft	Ft	Ft
Btm. Logged Interval	1498 Ft	Ft	Ft	Ft
Casing-Driller	n/a In @ Ft	In @ Ft	In @ Ft	In @ Ft
Casing-Logger	n/a In @ Ft	In @ Ft	In @ Ft	In @ Ft
Bit Size	8.5 In	In	In	In
Time On Bottom	11:30			
Type Fluid In Hole	Bentonite			
Density / Viscosity	n/a / n/a			
pH / Fluid Loss	n/a / n/a ml	ml	ml	ml
Source of Sample	Circ			
Rm @ Measured Temp.	6.7 @ 82 °F	@ °F	@ °F	@ °F
Rmf @ Measured Temp.	5.4 @ 75 °F	@ °F	@ °F	@ °F
Rmc @ Measured Temp.	n/a @ °F	@ °F	@ °F	@ °F
Source Rmf / Rmc	Meas			
Rm @ BHT	n/a @ °F	@ °F	@ °F	@ °F
Time Since Circulation	2 hr Hr	Hr	Hr	Hr
Max. Rec. Temp.	79.8 °F	°F	°F	°F
Van No. / Location	LV-2 / Sac			
Recorded By	M. F. Sharpless			
Witnessed By	S. Springhorn			

Miscellaneous Information

A recreational GPS accurate to +/- 45 feet set for Datum NAD27 was used to calculate Latitude, Longitude & Elevation values. The Section, Township, and Range then determined using the TRS program (TRS accuracy is not guaranteed). The TRS program converts Latitude and Longitude to Section, Township, and Range. The NOTICE at the bottom of this heading also applies.

SP Calculations For Water Quality

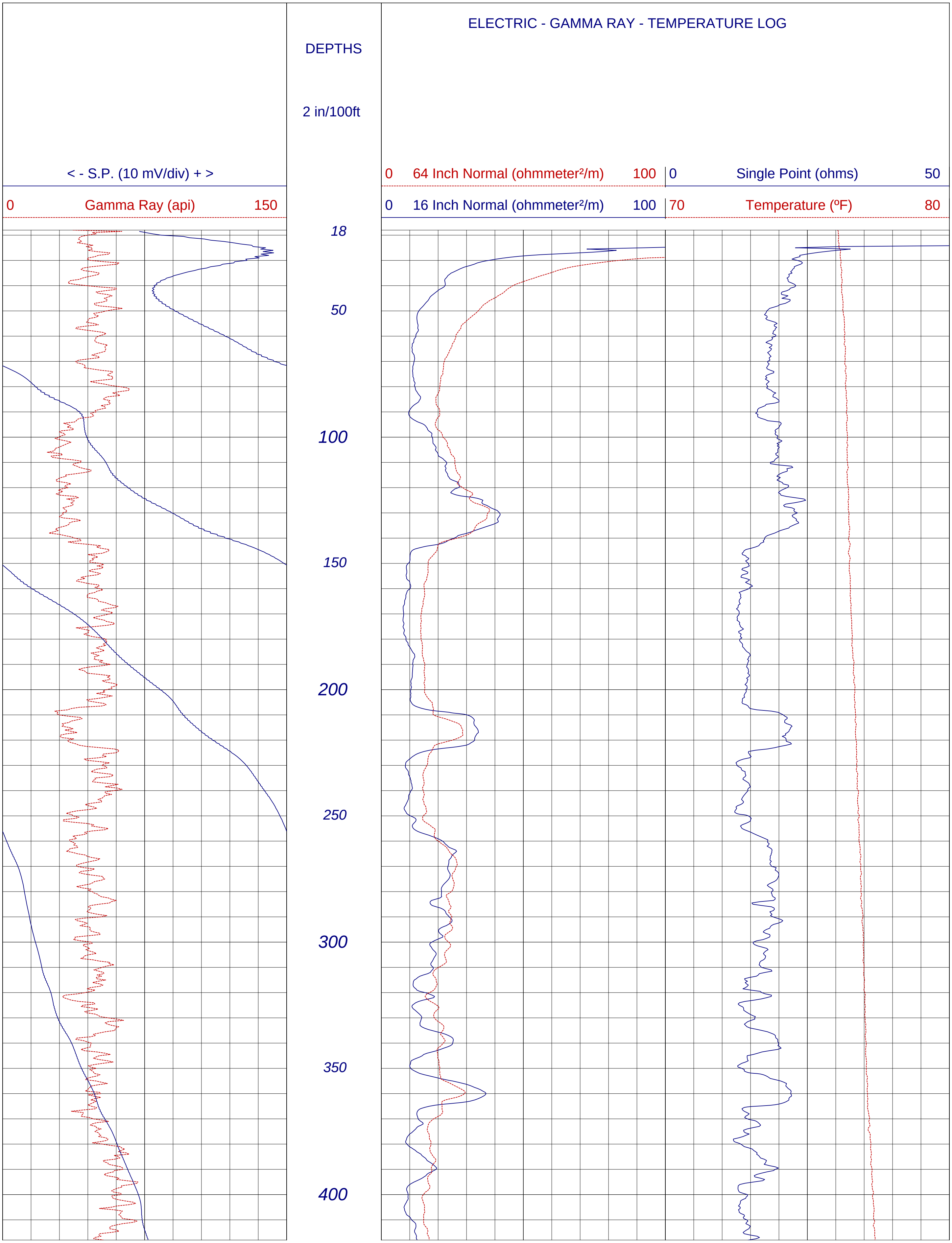
LOG DEPTHS	S.P.	Rwe	Rw RANGE Ohmeters2/M		E.C. RANGE MSiemens		TDS RANGE ppm	
			NaCl	NaHCo3	NaCl	NaHCo3	NaCl	NaHCo3
95 to 145 Feet	-30	2.0	1.9	2.2	5263	4545	2789	5000
205 to 220 Feet	-7	4.3	4.9	5.8	2041	1724	1082	1667
260 to 400 Feet	-3	4.9	5.8	6.8	1724	1471	914	1429
450 to 500 Feet	-2	5.1	6.1	7.2	1639	1389	869	1429
560 to 790 Feet	-2	5.1	6.1	7.2	1639	1389	869	1429
810 to 1000 Feet	-4	4.7	5.5	6.5	1818	1538	964	1429
1200 to 1250 Feet	-20	2.8	2.9	3.4	3448	2941	1828	3333
1250 to 1430 Feet	-38	1.6	1.5	1.8	6667	5556	3533	5000

Class I (Excellent to Good)	Class II (Good to Injurious)	Class III (Injurious to Poor)
Less than 700 ppm	700-2000 ppm	More than 2000 ppm

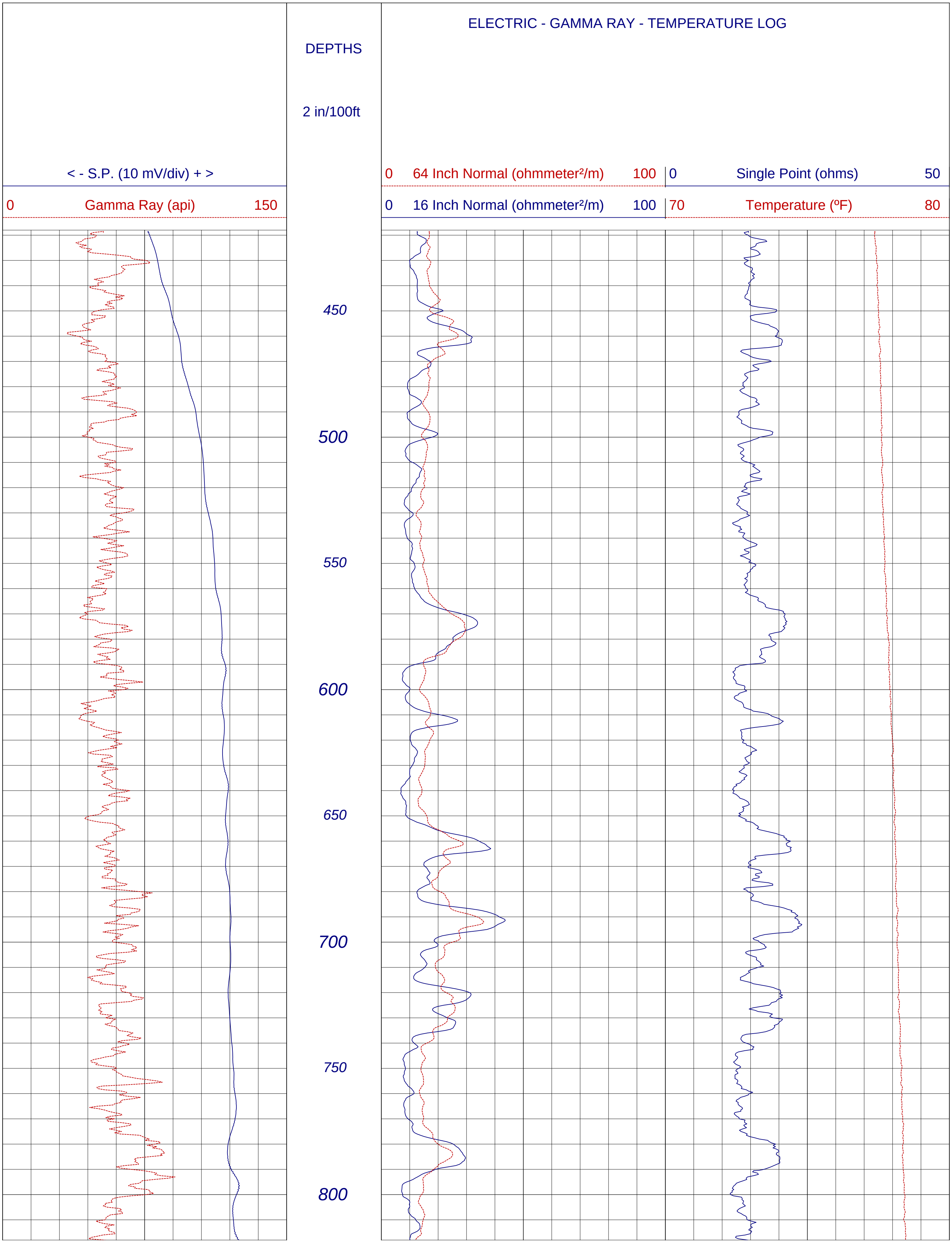
NOTICE

All interpretations are opinions based on inferences from electrical and other measurements and we do not guarantee the accuracy or correctness of any verbal or written interpretation, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by one of our officers, agents or employees. These interpretations are also subject to our General Terms and Conditions as set out in our current Price Schedule.

welenco, inc. April 22, 2010


ELECTRIC - GAMMA RAY - TEMPERATURE LOG
DEPTHS
2 in/100ft
< - S.P. (10 mV/div) + >
0 Gamma Ray (api) 150
0 64 Inch Normal (ohmmeter²/m) 100
0 16 Inch Normal (ohmmeter²/m) 100
0 Single Point (ohms) 50
70 Temperature (ºF) 80
18
50
100
150
200
250
300
350
400

ELECTRIC - GAMMA RAY - TEMPERATURE LOG



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ELECTRIC - GAMMA RAY - TEMPERATURE LOG

DEPTHS

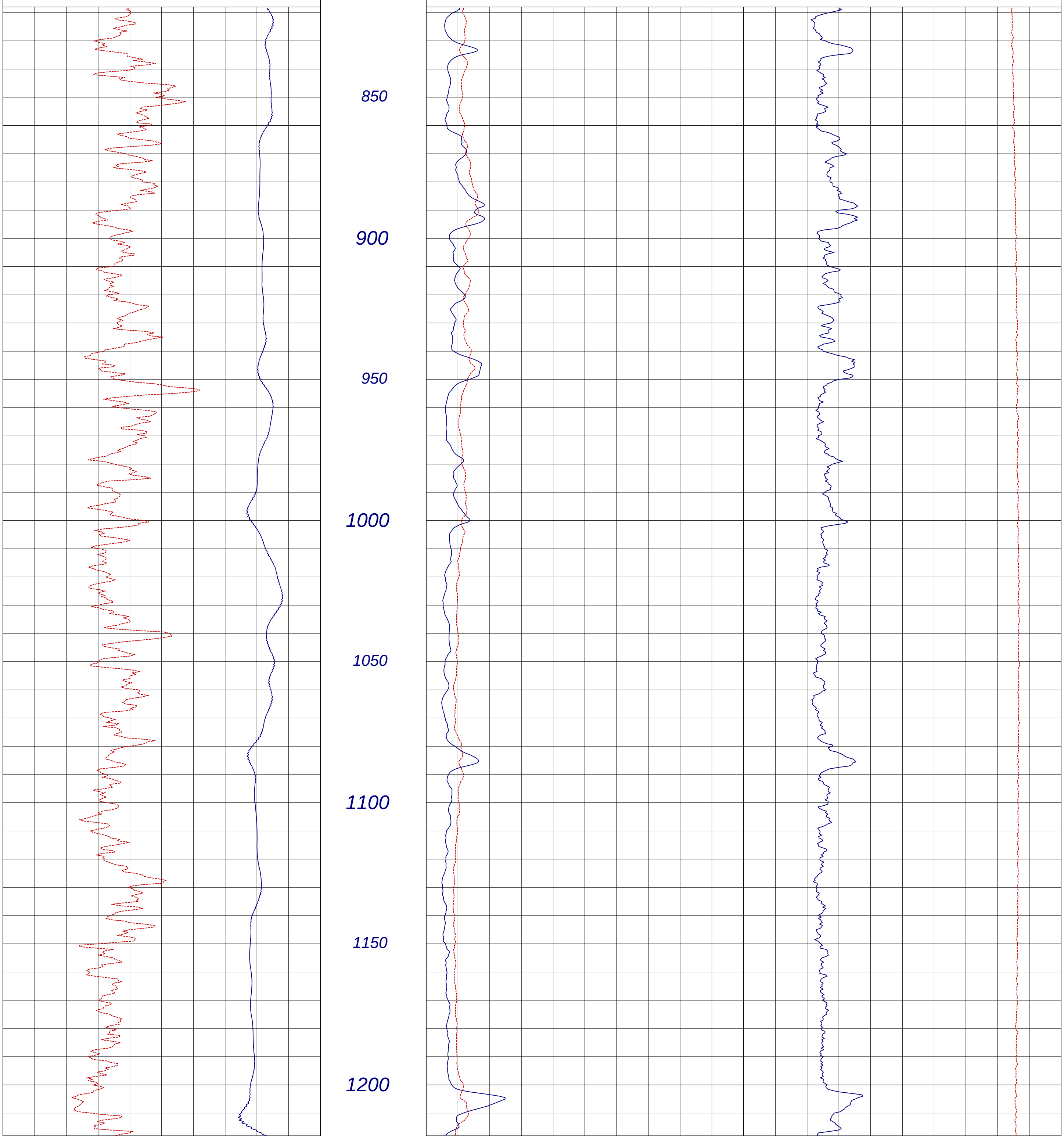
2 in/100ft

< - S.P. (10 mV/div) + >

0 Gamma Ray (api) 150

0 64 Inch Normal (ohmmeter²/m) 100 | 0 Single Point (ohms) 50

0 16 Inch Normal (ohmmeter²/m) 100 | 70 Temperature (ºF) 80



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ELECTRIC - GAMMA RAY - TEMPERATURE LOG

DEPTHS

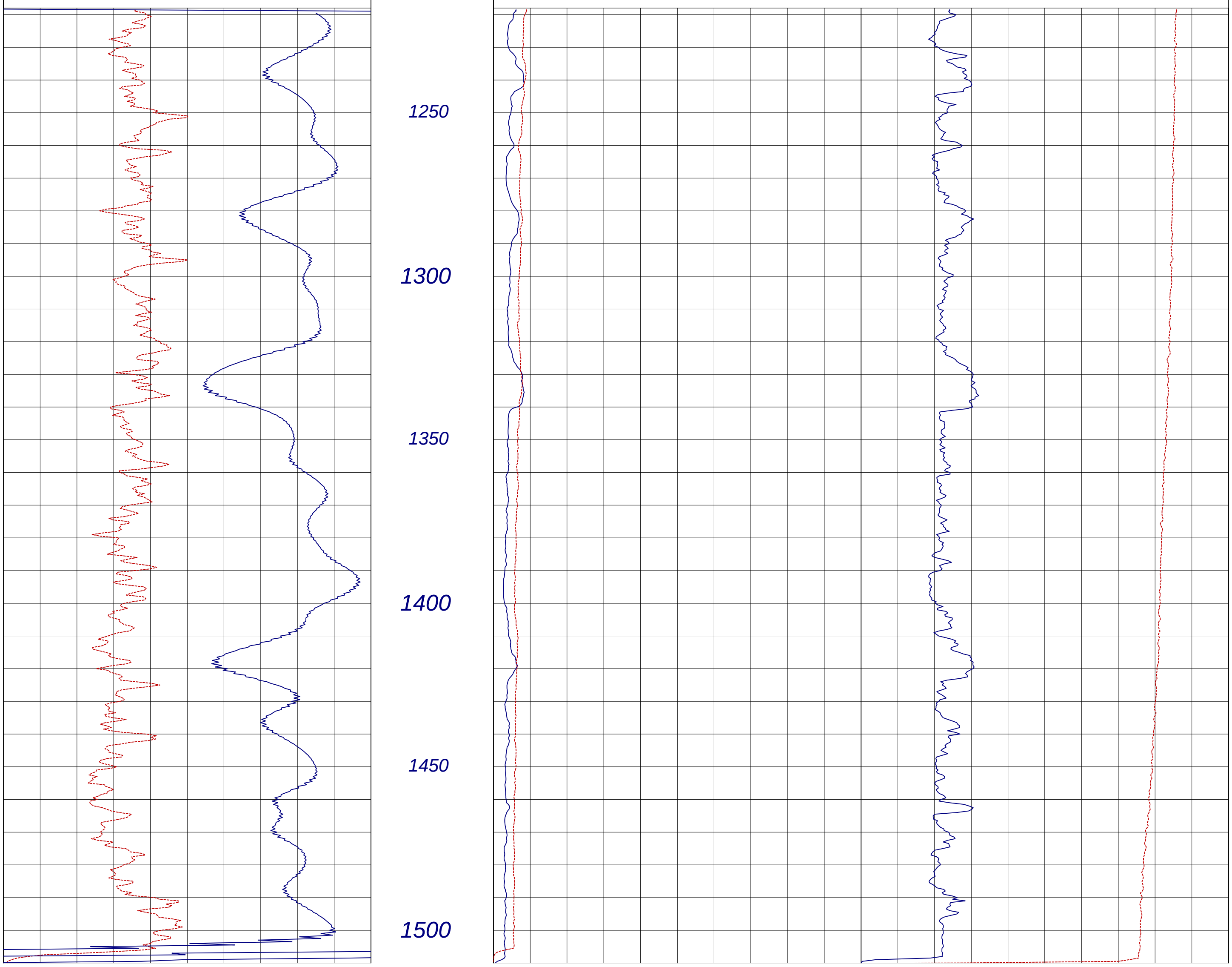
2 in/100ft

< - S.P. (10 mV/div) + >

0 Gamma Ray (api) 150

0 64 Inch Normal (ohmmeter²/m) 100 | 0 Single Point (ohms) 50

0 16 Inch Normal (ohmmeter²/m) 100 | 70 Temperature (ºF) 80



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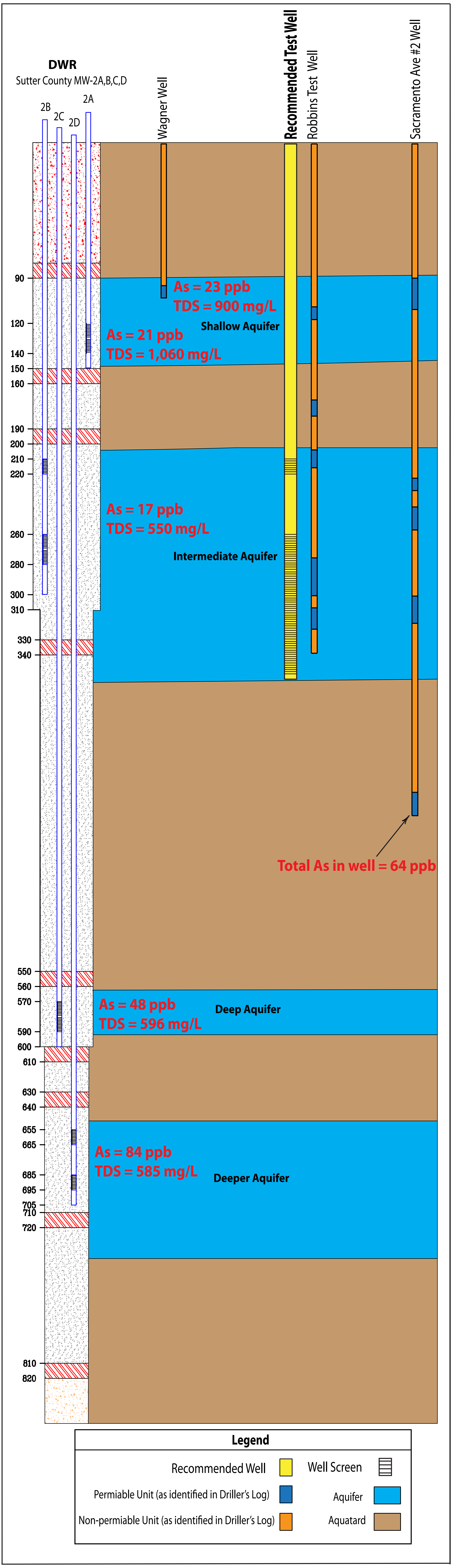

DWR
Sutter County MW-2A,B,C,D
2A
2B
2C
2D
Wagner Well
Recommended Test Well
Robbins Test Well
Sacramento Ave #2 Well
90
120
140
150
160
190
200
210
220
260
280
300
310
330
340
550
560
570
590
600
610
630
640
655
665
685
695
705
710
720
810
820
As = 23 ppb
TDS = 900 mg/L
As = 21 ppb
TDS = 1,060 mg/L
Shallow Aquifer
As = 17 ppb
TDS = 550 mg/L
Intermediate Aquifer
Total As in well = 64 ppb
As = 48 ppb
TDS = 596 mg/L
Deep Aquifer
As = 84 ppb
TDS = 585 mg/L
Deeper Aquifer
Legend
Recommended Well
Well Screen
Permiable Unit (as identified in Driller's Log)
Aquifer
Non-permiable Unit (as identified in Driller's Log)
Aquatard

ORIGINAL
File with DWR

Page 1 of 6

Owner's Well No. 7912

Date Work Began 11/8/05, Ended 11/17/05

Local Permit Agency SUTTER COUNTY HEALTH DEPT

Permit No. 05-0259 Permit Date 10/28/05

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 816295

DWR USE ONLY — DO NOT FILL IN

15N02E11

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD REVERSE FLUID WATER

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION Describe material, grain, size, color, etc.
0	22	WELL GRADED SAND
22	70	CLAY WITH SANDY SILT
70	103	YELLOW BROWN CLAY
103	133	LIGHT YELLOW BROWN SANDY CLAY
133	158	RED BROWN SILT
158	175	RED POORLY GRADED SAND
175	198	BROWN SANDY SILT
198	250	GRAY POORLY GRADED SNAD WITH GRAVEL
250	260	BROWN WELL GRADED GRAVEL WITH SAND
260	445	GRAY CLAYEY SAND WITH GRAVEL
445	500	YELLOW BROWN SAND WITH GRAVEL
500	510	YELLOW BROWN SILTY SAND
510	570	YELLOW BROWN SAND WITH SILTSTONE CHIP
570	630	YELLOW BROWN CLAYEY SAND WITH SILTSTO
630	640	BROWN CLAY WITH SAND
640	650	BROWN CLAYEY SAND
650	665	RED BROWN SILT WITH SAND
665	700	RED GRAY SAND WITH GRAVEL
700	730	GREEN GRAY SILT WITH SAND AND SILTSTON
730	740	GREEN GRAY SAND WITH SILT AND GRAVEL
740	900	GREEN GRAY SANDY SILT WITH GRAVEL

TOTAL DEPTH OF BORING 640 (Feet)

TOTAL DEPTH OF COMPLETED WELL 559 (Feet)

WELL OWNER

Name SUTTER EXTENTION WATER DIS

Mailing Address 4525 FRANKLIN ROAD

YUBA CITY CA 95993

CITY STATE ZIP

WELL LOCATION

Address 100' NOF BUTTE HOUSE RD & 1.05 MI WOF

City TOWNSHIP RD CA

County SUTTER

APN Book 013 Page 240 Parcel 510

Township 15 N Range 2 E Section 11

Latitude ___ DEG. MIN. SEC. Longitude ___ DEG. MIN. SEC.

LOCATION SKETCH

NORTH

WEST EAST

SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

✓ NEW WELL

MODIFICATION/REPAIR
- ___ Deepen
- ___ Other (Specify)

___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
- ___ Domestic ___ Public
- ___ Irrigation ___ Industrial

MONITORING ✓

TEST WELL ___

CATHODIC PROTECTION ___

HEAT EXCHANGE ___

DIRECT PUSH ___

INJECTION ___

VAPOR EXTRACTION ___

SPARGING ___

REMEDIATION ___

OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL ___ (Ft.) & DATE MEASURED ___

ESTIMATED YIELD * ___ (GPM) & TEST TYPE ___

TEST LENGTH ___ (Hrs.) TOTAL DRAWDOWN ___ (Ft.)

May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
ZONE	1									
0	148	14	✓				PVC	2.5	SCH 80	
148	168	14		✓			PVC	2.5	SCH 80	.030
168	173	14	✓				PVC	2.5	SCH 80	
ZONE	2									
0	240	14	✓				PVC	2.5	SCH 80	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	127	✓			SAND SLURRY
127	139		✓		BENTONITE C
139	174			✓	SRI#8 SAND
174	190		✓		BENTONITE C
190	221			✓	SRI#8 SAND
221	230		✓		BENTONITE C

ATTACHMENTS (✓)

- ___ Geologic Log
- ___ Well Construction Diagram
- ___ Geophysical Log(s)
- ___ Soil/Water Chemical Analysis
- ___ Other

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME EATON DRILLING CO

(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

20 WEST KENTUCKY AVE WOODLAND CA 95695

ADDRESS CITY STATE ZIP

Signed [signature] 01/24/06 C57 A HIC - 133783

WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR
Page 2 of 6

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet
No. **816295** pg 2.

DWR USE ONLY — DO NOT FILL IN: 15N02E11
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

Owner's Well No. 7912
Date Work Began 11/8/05, Ended 11/17/05
Local Permit Agency SUTTER COUNTY HEALTH DEPT
Permit No. 05-0259 Permit Date 10/28/05

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD REVERSE FLUID WATER

DEPTH FROM SURFACE Ft. to	Ft.	DESCRIPTION Describe material, grain, size, color, etc.
0	22	WELL GRADED SAND
22	70	CLAY WITH SANDY SILT
70	103	YELLOW BROWN CLAY
103	133	LIGHT YELLOW BROWN SANDY CLAY
133	158	RED BROWN SILT
158	175	RED POORLY GRADED SAND
175	198	BROWN SANDY SILT
198	250	GRAY POORLY GRADED SNAD WITH GRAVEL
250	260	BROWN WELL GRADED GRAVEL WITH SAND
260	445	GRAY CLAYEY SAND WITH GRAVEL
445	500	YELLOW BROWN SAND WITH GRAVEL
500	510	YELLOW BROWN SILTY SAND
510	570	YELLOW BROWN SAND WITH SILTSTONE CHIP
570	630	YELLOW BROWN CLAYEY SAND WITH SILTSTO
630	640	BROWN CLAY WITH SAND
640	650	BROWN CLAYEY SAND
650	665	RED BROWN SILT WITH SAND
665	700	RED GRAY SAND WITH GRAVEL
700	730	GREEN GRAY SILT WITH SAND AND SILTSTON
730	740	GREEN GRAY SAND WITH SILT AND GRAVEL
740	900	GREEN GRAY SANDY SILT WITH GRAVEL

TOTAL DEPTH OF BORING 640 (Feet)
TOTAL DEPTH OF COMPLETED WELL 559 (Feet)

WELL OWNER

Name SUTTER EXTENTION WATER DIS
Mailing Address 4525 FRANKLIN ROAD
YUBA CITY CA 95993
CITY STATE ZIP

WELL LOCATION

Address 100' NOF BUTTE HOUSE RD & 1.05 MI WOF
City TOWNSHIP RD CA
County SUTTER
APN Book 013 Page 240 Parcel 510
Township 15 N Range 2 E Section 11
Latitude ___ DEG. MIN. SEC. Longitude ___ DEG. MIN. SEC.

LOCATION SKETCH

NORTH
WEST EAST
SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

✓ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
___ Irrigation ___ Industrial
MONITORING ✓
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL ___ (Ft.) & DATE MEASURED ___
ESTIMATED YIELD * ___ (GPM) & TEST TYPE ___
TEST LENGTH ___ (Hrs.) TOTAL DRAWDOWN ___ (Ft.)
May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft. to	Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
240	260	14		✓			PVC	2.5	SCH 80	.030
260	265	14	✓				PVC	2.5	SCH 80	
ZONE	3									
0	524	14/8-5/8	✓				PVC	2.5	SCH 80	
524	554	8-8/5		✓			PVC	2.5	SCH 80	.030
554	559	8-5/8	✓				PVC	2.5	SCH 80	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft. to	Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
230	270			✓	SRI#8 SAND
270	281		✓		BENTONITE C
281	493			✓	SRI#8 SAND
493	518		✓		BENTONITE C
518	566			✓	SRI#8 SAND
566	581		✓		BENTONITE C

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analysis
___ Other ___
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.
NAME EATON DRILLING CO
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
20 WEST KENTUCKY AVE WOODLAND CA 95695
ADDRESS CITY STATE ZIP
Signed [signature] 01/24/06 C57 A HIC - 133783
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. **816295** pg. 3

DWR USE ONLY — DO NOT FILL IN
15N02E11
STATE WELL NO./STATION NO.
LATITUDE | LONGITUDE
APN/TRS/OTHER

Owner's Well No. 7912

Date Work Began 11/8/05, Ended 11/17/05

Local Permit Agency SUTTER COUNTY HEALTH DEPT

Permit No. 05-0259 Permit Date 10/28/05

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD REVERSE FLUID WATER

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION (Describe material, grain, size, color, etc.)
0	22	WELL GRADED SAND
22	70	CLAY WITH SANDY SILT
70	103	YELLOW BROWN CLAY
103	133	LIGHT YELLOW BROWN SANDY CLAY
133	158	RED BROWN SILT
158	175	RED POORLY GRADED SAND
175	198	BROWN SANDY SILT
198	250	GRAY POORLY GRADED SNAD WITH GRAVEL
250	260	BROWN WELL GRADED GRAVEL WITH SAND
260	445	GRAY CLAYEY SAND WITH GRAVEL
445	500	YELLOW BROWN SAND WITH GRAVEL
500	510	YELLOW BROWN SILTY SAND
510	570	YELLOW BROWN SAND WITH SILTSTONE CHIP
570	630	YELLOW BROWN CLAYEY SAND WITH SILTSTO
630	640	BROWN CLAY WITH SAND
640	650	BROWN CLAYEY SAND
650	665	RED BROWN SILT WITH SAND
665	700	RED GRAY SAND WITH GRAVEL
700	730	GREEN GRAY SILT WITH SAND AND SILTSTON
730	740	GREEN GRAY SAND WITH SILT AND GRAVEL
740	900	GREEN GRAY SANDY SILT WITH GRAVEL

TOTAL DEPTH OF BORING 640 (Feet)

TOTAL DEPTH OF COMPLETED WELL 559 (Feet)

WELL OWNER

Name SUTTER EXTENTION WATER DIS

Mailing Address 4525 FRANKLIN ROAD

YUBA CITY CA 95993

CITY STATE ZIP

WELL LOCATION

Address 100' NOF BUTTE HOUSE RD & 1.05 MI WOF

City TOWNSHIP RD CA

County SUTTER

APN Book 013 Page 240 Parcel 510

Township 15 N Range 2 E Section 11

Latitude ___ DEG. MIN. SEC. Longitude ___ DEG. MIN. SEC.

LOCATION SKETCH

NORTH / WEST / EAST / SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. **PLEASE BE ACCURATE & COMPLETE.**

ACTIVITY (✓)

✓ NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
___ Irrigation ___ Industrial

MONITORING ✓
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL ___ (Ft.) & DATE MEASURED ___

ESTIMATED YIELD * ___ (GPM) & TEST TYPE ___

TEST LENGTH ___ (Hrs.) TOTAL DRAWDOWN ___ (Ft.)

May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
ZONE	1									
0	148	14	✓				PVC	2.5	SCH 80	
148	168	14		✓			PVC	2.5	SCH 80	.030
168	173	14	✓				PVC	2.5	SCH 80	
ZONE	2									
0	240	14	✓				PVC	2.5	SCH 80	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
581	605			✓	SRI#8 SAND
605	624		✓		BENTONITE C
624	640			✓	SRI#8 SAND

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analysis
___ Other

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

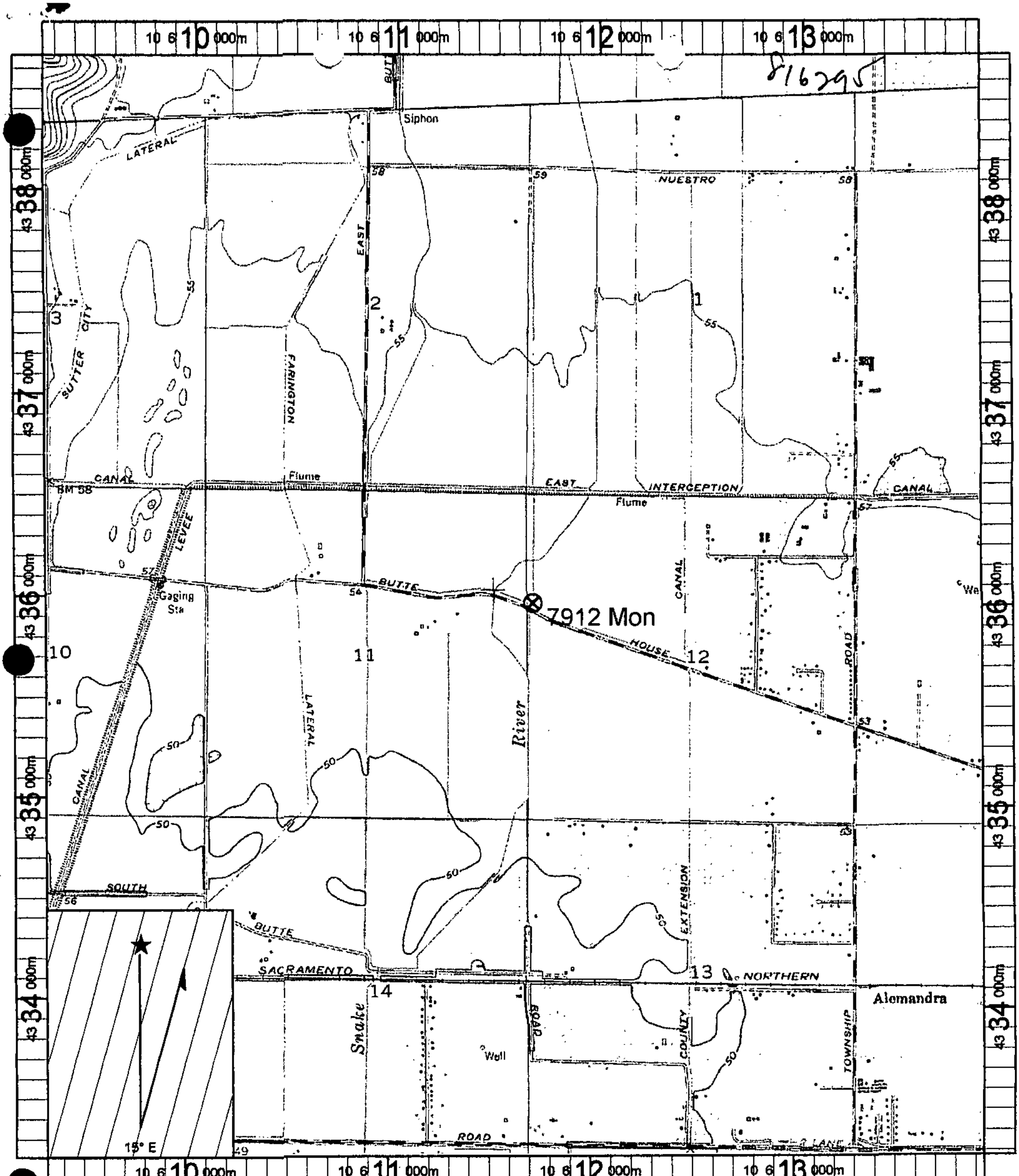
NAME EATON DRILLING CO
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

20 WEST KENTUCKY AVE WOODLAND CA 95695
ADDRESS CITY STATE ZIP

Signed Mark Damion 01/24/06 C57 A HIC - 133783
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM



Name: SUTTER
Date: 10/28/2005
Scale: 1 inch equals 2000 feet

Caption: Sutter Extension Water District - Job# 7812 Mon
APN: 013-240-510
T15N R2E s12

ORIGINAL
File with DWR
Page 1 of 6

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet
No. E036360

Owner's Well No. 7913
Date Work Began 1/27/06, Ended 2/7/06
Local Permit Agency SUTTER COUNTY HEALTH DEPT
Permit No. 05-0260 Permit Date 10/28/05

DWR USE ONLY — DO NOT FILL IN
15N02E24
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD ROTARY FLUID MUD

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION Describe material, grain, size, color, etc.
0	20	TOP SOIL AND BROWN CLAY WITH SAND
20	55	YELLOW BROWN CLAY WITH COARSE SAND
55	100	SAND AND GRAVEL
100	160	LARGE GRAVEL WITH SANDY YELLOW CLAY
160	300	YELLOW BROWN CLAY WITH SAND AND GRAV
300	360	SAND AND GRAVEL WITH YELLOW BROWN CL
360	650	SAND AND SMALL GRAVEL WITH YELLOW
		BROWN CLAY
650	670	SAND AND SMALL GRAVEL WITH RED
		BROWN CLAY
670	700	BLACK COARSE SAND

TOTAL DEPTH OF BORING 620 (Feet)
TOTAL DEPTH OF COMPLETED WELL 488 (Feet)

WELL OWNER

Name SUTTER EXTENTION WATER DIS
Mailing Address 4525 FRANKLIN ROAD
YUBA CITY CA 95993
CITY STATE ZIP

WELL LOCATION

Address 300' NOF FRANKLIN RD & .52 MI WOF TOWNSHI
City RD CA
County SUTTER
APN Book 013 Page 280 Parcel 054
Township 15 N Range 2 E Section 24
Latitude ___ DEG. MIN. SEC. Longitude ___ DEG. MIN. SEC.

LOCATION SKETCH

NORTH
WEST EAST
SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. **PLEASE BE ACCURATE & COMPLETE.**

ACTIVITY (✓)

✓ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
___ Irrigation ___ Industrial
MONITORING ✓
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL ___ (Ft.) & DATE MEASURED ___
ESTIMATED YIELD * ___ (GPM) & TEST TYPE ___
TEST LENGTH ___ (Hrs.) TOTAL DRAWDOWN ___ (Ft.)
* *May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
ZONE	1									
0	204	14	✓				PVC	2.5	SCH 80	
204	244	14		✓			PVC	2.5	SCH 80	.030
244	254	14	✓				PVC	2.5	SCH 80	
ZONE	2									
0	354	14	✓				PVC	2.5	SCH 80	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	178	✓			SAND SLURRY
178	192		✓		BENTONITE C
192	276			✓	SRI#8 SAND
276	290		✓		BENTONITE C
290	318			✓	SRI#8 SAND
318	330		✓		BENTONITE C

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analysis
___ Other
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.
NAME EATON DRILLING CO
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
20 WEST KENTUCKY AVE WOODLAND CA 95695
ADDRESS CITY STATE ZIP
Signed [signature] 02/23/06 C57 A HIC - 133783
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97
IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. **E036360**

DWR USE ONLY — DO NOT FILL IN
15N 02E24
STATE WELL NO./STATION NO.
LATITUDE | LONGITUDE
APN/TRS/OTHER

Owner's Well No. 7913
Date Work Began 1/27/06, Ended 2/7/06
Local Permit Agency SUTTER COUNTY HEALTH DEPT
Permit No. 05-0260 Permit Date 10/28/05

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD ROTARY FLUID MUD

DEPTH FROM SURFACE Ft. to	Ft.	DESCRIPTION (Describe material, grain, size, color, etc.)
0	20	TOP SOIL AND BROWN CLAY WITH SAND
20	55	YELLOW BROWN CLAY WITH COARSE SAND
55	100	SAND AND GRAVEL
100	160	LARGE GRAVEL WITH SANDY YELLOW CLAY
160	300	YELLOW BROWN CLAY WITH SAND AND GRAV
300	360	SAND AND GRAVEL WITH YELLOW BROWN CL
360	650	SAND AND SMALL GRAVEL WITH YELLOW
		BROWN CLAY
650	670	SAND AND SMALL GRAVEL WITH RED
		BROWN CLAY
670	700	BLACK COARSE SAND

TOTAL DEPTH OF BORING 620 (Feet)
TOTAL DEPTH OF COMPLETED WELL 488 (Feet)

WELL OWNER

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Mailing Address 4525 FRANKLIN ROAD
YUBA CITY CA 95993
CITY STATE ZIP

WELL LOCATION

Address 300' NOF FRANKLIN RD & .52 MI WOF TOWNSHI
City RD CA
County SUTTER
APN Book 013 Page 280 Parcel 054
Township 15 N Range 2 E Section 24
Latitude ___ DEG. MIN. SEC. Longitude ___ DEG. MIN. SEC.

LOCATION SKETCH

NORTH / WEST / EAST / SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. **PLEASE BE ACCURATE & COMPLETE.**

ACTIVITY (✓)

✓ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
___ Irrigation ___ Industrial
MONITORING ✓
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL ___ (Ft.) & DATE MEASURED ___
ESTIMATED YIELD * ___ (GPM) & TEST TYPE ___
TEST LENGTH ___ (Hrs.) TOTAL DRAWDOWN ___ (Ft.)
May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft. to	Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
354	374	14		✓			PVC	2.5	SCH 80	.030
374	379	14	✓				PVC	2.5	SCH 80	
ZONE	3									
0	438	14/8.5	✓				PVC	2.5	SCH 80	
438	478	8.5		✓			PVC	2.5	SCH 80	.030
478	488	8.5	✓				PVC	2.5	SCH 80	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft. to	Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
330	380			✓	SRI#8 SAND
380	406		✓		BENTONITE C
406	490			✓	SRI#8 SAND
490	498		✓		BENTONITE C
498	537			✓	SRI#8 SAND
537	548		✓		BENTONITE C

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analysis
___ Other
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.
NAME EATON DRILLING CO
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
20 WEST KENTUCKY AVE WOODLAND CA 95695
ADDRESS CITY STATE ZIP
Signed [signature] 02/23/06 C57 A HIC - 133783
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. E036360 pg. 3

DWR USE ONLY — DO NOT FILL IN
13N02E24
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

Owner's Well No. 7913
Date Work Began 1/27/06, Ended 2/7/06
Local Permit Agency SUTTER COUNTY HEALTH DEPT
Permit No. 05-0260 Permit Date 10/28/05

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD ROTARY FLUID MUD

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION Describe material, grain, size, color, etc.
0	20	TOP SOIL AND BROWN CLAY WITH SAND
20	55	YELLOW BROWN CLAY WITH COARSE SAND
55	100	SAND AND GRAVEL
100	160	LARGE GRAVEL WITH SANDY YELLOW CLAY
160	300	YELLOW BROWN CLAY WITH SAND AND GRAV
300	360	SAND AND GRAVEL WITH YELLOW BROWN CL
360	650	SAND AND SMALL GRAVEL WITH YELLOW
		BROWN CLAY
650	670	SAND AND SMALL GRAVEL WITH RED
		BROWN CLAY
670	700	BLACK COARSE SAND

TOTAL DEPTH OF BORING 620 (Feet)
TOTAL DEPTH OF COMPLETED WELL 488 (Feet)

WELL OWNER

Name SUTTER EXTENTION WATER DIS
Mailing Address 4525 FRANKLIN ROAD
YUBA CITY CA 95993
CITY STATE ZIP

WELL LOCATION

Address 300' NOF FRANKLIN RD & .52 MI WOF TOWNSHI
City RD CA
County SUTTER
APN Book 013 Page 280 Parcel 054
Township 15 N Range 2 E Section 24
Latitude ___ DEG. MIN. SEC. Longitude ___ DEG. MIN. SEC.

LOCATION SKETCH

NORTH
WEST EAST
SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. **PLEASE BE ACCURATE & COMPLETE.**

ACTIVITY (✓)

✓ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
___ Irrigation ___ Industrial
MONITORING ✓
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL ___ (Ft.) & DATE MEASURED ___
ESTIMATED YIELD * ___ (GPM) & TEST TYPE ___
TEST LENGTH ___ (Hrs.) TOTAL DRAWDOWN ___ (Ft.)
May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
ZONE	1									
0	204	14	✓				PVC	2.5	SCH 80	
204	244	14		✓			PVC	2.5	SCH 80	.030
244	254	14	✓				PVC	2.5	SCH 80	
ZONE	2									
0	354	14	✓				PVC	2.5	SCH 80	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
548	602			✓	SRI#8 SAND
602	608		✓		BENTONITE C
608	620			✓	NATIVE FILL

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analysis
___ Other
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

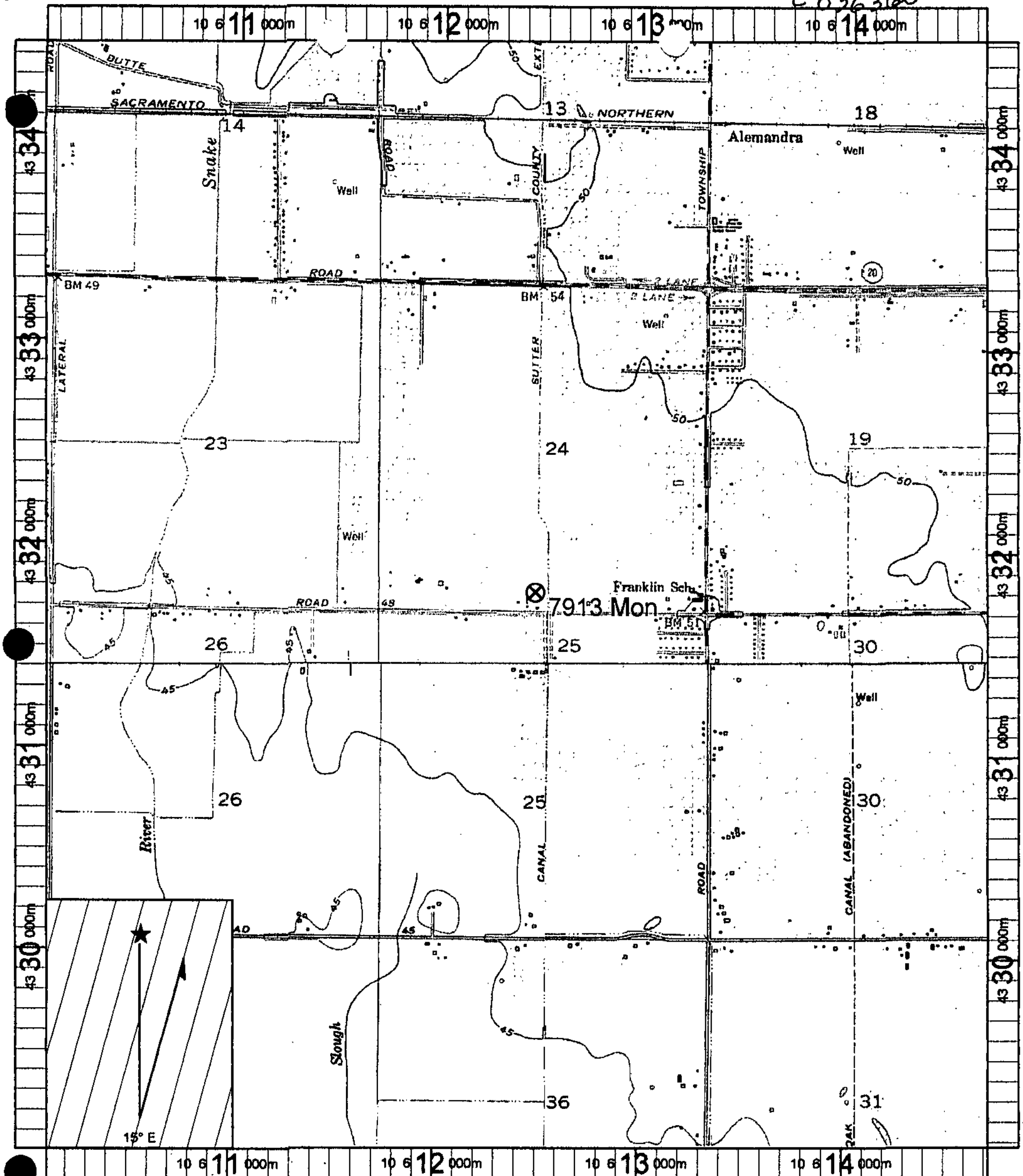
CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.
NAME EATON DRILLING CO
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
20 WEST KENTUCKY AVE WOODLAND CA 95695
ADDRESS CITY STATE ZIP
Signed [signature] 02/23/06 C57 A HIC - 133783
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

E 0363160



Name: SUTTER
Date: 10/28/2005
Scale: 1 inch equals 2000 feet

Caption: Sutter Extension Water District - Job# 7813 Mon
APN: 013-280-054
T15N R2E s24

ORIGINAL
File with DWR

Page 1 of 6

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. E038757

DWR USE ONLY -- DO NOT FILL IN: 14N02E13A003M
STATE WELL NO./STATION NO. 004M
LATITUDE / LONGITUDE 005M
APN/TRS/OTHER

Owner's Well No. 7914
Date Work Began 11/21/2005, Ended 12/1/2005
Local Permit Agency SUTTER COUNTY HEALTH DEPT
Permit No. 05-0258 Permit Date 10/28/2005

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD ROTARY FLUID MUD

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain, size, color, etc.*
0	10	SANDY CLAY
10	35	BROWN CLAY
35	90	GRAVELLY SAND
90	115	GRAVEL
115	195	GRAVELLY CLAY
195	280	CLAY TO SILT
280	300	SILT TO CLAY
300	348	CLAY WITH GRAVEL TO SILT WITH GRAVEL
348	397	SILT TO CLAY
397	536	SANDY CLAY
536	548	SILT TO CLAY
548	571	WELL GRADED GRAVEL WITH CLAY
571	613	CLAY WITH SAND
613	662	WELL GRADED SAND WITH CLAY AND GRAVEL
662	678	CLAY WITH SAND
678	700	CLAYEY SAND
700	710	CLAY TO SILT
710	750	CLAYEY SAND

A - 003M
B - 004M
C - 005M

TOTAL DEPTH OF BORING 740 (Feet)
TOTAL DEPTH OF COMPLETED WELL 585 (Feet)

WELL OWNER

Name SUTTER EXTENTION WATER DIS
Mailing Address 4525 FRANKLIN ROAD
YUBA CITY CA 95993
CITY STATE ZIP

WELL LOCATION

Address 250' SOF OSWALD RD & 75' WOF S
City TOWNSHIP RD CA
County SUTTER
APN Book 021 Page 310 Parcel 048
Township 14 N Range 2 E Section 13
Latitude ___ DEG. MIN. SEC. Longitude ___ DEG. MIN. SEC.

LOCATION SKETCH

NORTH / WEST / EAST / SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

✓ NEW WELL
MODIFICATION/REPAIR
— Deepen
— Other (Specify)
— DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
— Domestic — Public
— Irrigation — Industrial
MONITORING ✓
TEST WELL —
CATHODIC PROTECTION —
HEAT EXCHANGE —
DIRECT PUSH —
INJECTION —
VAPOR EXTRACTION —
SPARGING —
REMEDIATION —
OTHER (SPECIFY) —

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ____ (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL ____ (Ft.) & DATE MEASURED ____
ESTIMATED YIELD * ____ (GPM) & TEST TYPE ____
TEST LENGTH ____ (Hrs.) TOTAL DRAWDOWN ____ (Ft.)
May not be representative of a well's long-term yield.

CASING (S)

	DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
A	ZONE	1									
	0	88	14	✓				PVC	2.5	SCH 80	
	88	108	14		✓			PVC	2.5	SCH 80	.030
	108	113	14	✓				PVC	2.5	SCH 80	
B	ZONE	2									
	0	208	14	✓				PVC	2.5	SCH 80	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	68	✓			SAND SLURRY
68	80		✓		BENTONITE C
80	128			✓	SRI#8 SAND
128	140		✓		BENTONITE C
140	170			✓	PEA GRAVEL
170	181		✓		BENTONITE C

ATTACHMENTS (✓)

— Geologic Log
— Well Construction Diagram
— Geophysical Log(s)
— Soil/Water Chemical Analysis
— Other ____

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME EATON DRILLING CO.
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
20 WEST KENTUCKY AVE WOODLAND CA 95695
ADDRESS CITY STATE ZIP
Signed [signature] WELL DRILLER/AUTHORIZED REPRESENTATIVE
05/02/06 DATE SIGNED
C57 A HIC - 133783 C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR
Page 2 of 6

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet

No. E038757 A, B, C

DWR USE ONLY — DO NOT FILL IN
STATE WELL NO./STATION NO. 14N02E13A003M 004M 005M
LATITUDE | LONGITUDE
APN/TRS/OTHER

Owner's Well No. 7914
Date Work Began 11/21/2005, **Ended** 12/1/2005
Local Permit Agency SUTTER COUNTY HEALTH DEPT
Permit No. 05-0258 **Permit Date** 10/28/2005

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD ROTARY FLUID MUD

DEPTH FROM SURFACE Ft	to Ft	DESCRIPTION Describe material, grain, size, color, etc.
0	10	SANDY CLAY
10	35	BROWN CLAY
35	90	GRAVELLY SAND
90	115	GRAVEL
115	195	GRAVELLY CLAY
195	280	CLAY TO SILT
280	300	SILT TO CLAY
300	348	CLAY WITH GRAVEL TO SILT WITH GRAVEL
348	397	SILT TO CLAY
397	536	SANDY CLAY
536	548	SILT TO CLAY
548	571	WELL GRADED GRAVEL WITH CLAY
571	613	CLAY WITH SAND
613	662	WELL GRADED SAND WITH CLAY AND GRAVEL
662	678	CLAY WITH SAND
678	700	CLAYEY SAND
700	710	CLAY TO SILT
710	750	CLAYEY SAND

A - 003M
B - 004M
C - 005M

TOTAL DEPTH OF BORING 740 (Feet)
TOTAL DEPTH OF COMPLETED WELL 585 (Feet)

WELL OWNER

Name SUTTER EXTENTION WATER DIS
Mailing Address 4525 FRANKLIN ROAD
YUBA CITY CA 95993
CITY STATE ZIP

WELL LOCATION

Address 250' SOF OSWALD RD & 75' WOF S
City TOWNSHIP RD CA
County SUTTER
APN Book 021 Page 310 Parcel 048
Township 14 N Range 2 E Section 13
Latitude ___ DEG. MIN. SEC. Longitude ___ DEG. MIN. SEC.

LOCATION SKETCH

NORTH
WEST EAST
SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. **PLEASE BE ACCURATE & COMPLETE.**

ACTIVITY (✓)

✓ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
___ Irrigation ___ Industrial
MONITORING ✓
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL ___ (Ft.) & DATE MEASURED ___
ESTIMATED YIELD * ___ (GPM) & TEST TYPE ___
TEST LENGTH ___ (Hrs.) TOTAL DRAWDOWN ___ (Ft.)
May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft	to Ft	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
208	238	14		✓			PVC	2.5	SCH 80	.030
238	243	14	✓				PVC	2.5	SCH 80	
C ZONE	3									
0	550	14/8.75	✓				PVC	2.5	SCH 80	
550	580	8.75		✓			PVC	2.5	SCH 80	.030
580	585	8.75	✓				PVC	2.5	SCH 80	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft	to Ft	CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
181	250			✓	SRI#8 SAND
250	261		✓		BENTONITE C
261	411			✓	PEA GRAVEL
411	425		✓		BENTONITE C
425	535			✓	PEA GRAVEL
535	543		✓		BENTONITE C

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analysis
___ Other ___
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.
NAME EATON DRILLING CO.
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
20 WEST KENTUCKY AVE WOODLAND CA 95695
ADDRESS CITY STATE ZIP
Signed Mark Dawson 05/02/06 C57 A HIC - 133783
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. E038757

DWR USE ONLY — DO NOT FILL IN
14N02E13A003M
STATE WELL NO./STATION NO. 004M 005M
LATITUDE / LONGITUDE
APN/TRS/OTHER

Owner's Well No. 7914
Date Work Began 11/21/2005, Ended 12/1/2005
Local Permit Agency SUTTER COUNTY HEALTH DEPT
Permit No. 05-0258 Permit Date 10/28/2005

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD ROTARY FLUID MUD

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION — Describe material, grain, size, color, etc.
0	10	SANDY CLAY
10	35	BROWN CLAY
35	90	GRAVELLY SAND
90	115	GRAVEL
115	195	GRAVELLY CLAY
195	280	CLAY TO SILT
280	300	SILT TO CLAY
300	348	CLAY WITH GRAVEL TO SILT WITH GRAVEL
348	397	SILT TO CLAY
397	536	SANDY CLAY
536	548	SILT TO CLAY
548	571	WELL GRADED GRAVEL WITH CLAY
571	613	CLAY WITH SAND
613	662	WELL GRADED SAND WITH CLAY AND GRAVEL
662	678	CLAY WITH SAND
678	700	CLAYEY SAND
700	710	CLAY TO SILT
710	750	CLAYEY SAND

TOTAL DEPTH OF BORING 740 (Feet)
TOTAL DEPTH OF COMPLETED WELL 585 (Feet)

WELL OWNER

Name SUTTER EXTENTION WATER DIS
Mailing Address 4525 FRANKLIN ROAD
YUBA CITY CA 95993
CITY STATE ZIP

WELL LOCATION

Address 250' SOF OSWALD RD & 75' WOF S
City TOWNSHIP RD CA
County SUTTER
APN Book 021 Page 310 Parcel 048
Township 14 N Range 2 E Section 13
Latitude ___ DEG. MIN. SEC. Longitude ___ DEG. MIN. SEC.

LOCATION SKETCH

NORTH / WEST / EAST / SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. **PLEASE BE ACCURATE & COMPLETE.**

ACTIVITY (✓)

✓ NEW WELL
MODIFICATION/REPAIR
— Deepen
— Other (Specify)
— DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
— Domestic — Public
— Irrigation — Industrial
MONITORING ✓
TEST WELL —
CATHODIC PROTECTION —
HEAT EXCHANGE —
DIRECT PUSH —
INJECTION —
VAPOR EXTRACTION —
SPARGING —
REMEDIATION —
OTHER (SPECIFY) —

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL ___ (Ft.) & DATE MEASURED ___
ESTIMATED YIELD * ___ (GPM) & TEST TYPE ___
TEST LENGTH ___ (Hrs.) TOTAL DRAWDOWN ___ (Ft.)
*May not be representative of a well's long-term yield.

CASING (S)

	DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
A	ZONE	1									
	0	88	14	✓				PVC	2.5	SCH 80	
	88	108	14		✓			PVC	2.5	SCH 80	.030
	108	113	14	✓				PVC	2.5	SCH 80	
B	ZONE	2									
	0	208	14	✓				PVC	2.5	SCH 80	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
543	600			✓	SR#8 SAND
600	610		✓		BENTONITE C
610	659			✓	PEA GRAVEL
659	669		✓		BENTONITE C
669	740			✓	BACKFILL

ATTACHMENTS (✓)

— Geologic Log
— Well Construction Diagram
— Geophysical Log(s)
— Soil/Water Chemical Analysis
— Other
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

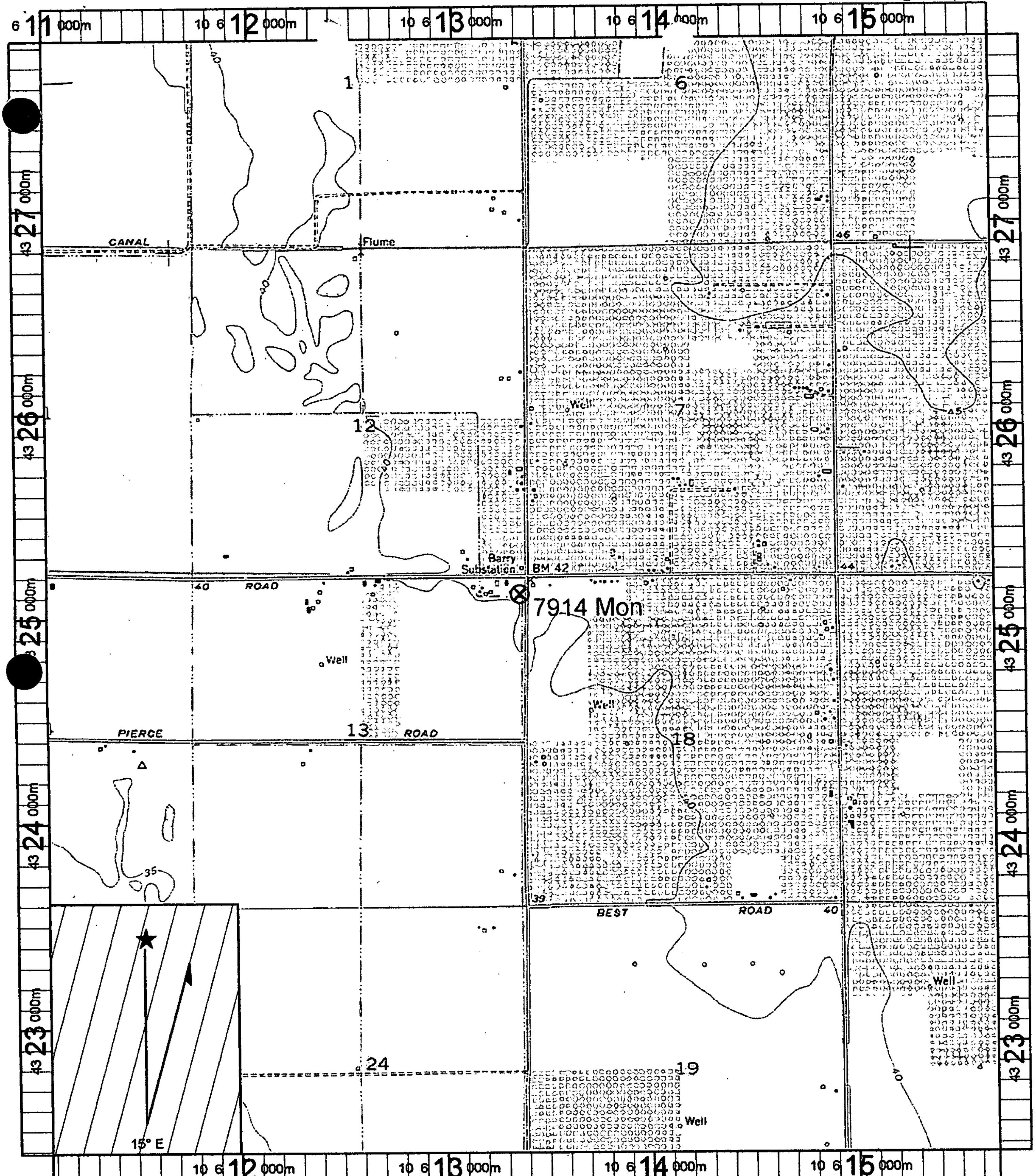
CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.
NAME EATON DRILLING CO.
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
20 WEST KENTUCKY AVE WOODLAND CA 95695
ADDRESS CITY STATE ZIP
Signed Mark Damion 05/02/06 C57 A HIC - 133783
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

e038757



Name: GILSIZER SLOUGH
Date: 10/28/2005
Scale: 1 inch equals 2000 feet

Caption: Sutter Extension Water District - Job# 7814 Mon
APN: 021-310-048
T14N R2E s13

ORIGINAL
File with DWR

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet

Owner's Well No. 8519 MW-6 A,B,C
E 124062 A-C

Date Work Began 12/20/2010, Ended 12/22/2010

Local Permit Agency Sutter County Health Dept

Permit No. 10-0310 Permit Date 12/7/2010

DWR USE ONLY — DO NOT FILL IN
13N03E06A001M
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD ROTARY FLUID MUD

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain, size, color, etc.*
0	10	Top soil
10	20	Yellow brown clay
20	60	Sand and gravel
60	170	Sandy yellow clay
170	800	Gray clay with sand
800	1300	Brittle gray clay with sand

MW-6A — 13N03E06A001M
MW-6B — A002M
MW-6C — A003M

TOTAL DEPTH OF BORING 1300 (Feet)
TOTAL DEPTH OF COMPLETED WELL 255 (Feet)

WELL OWNER

Name DWR - Central
Mailing Address 901 P Street, 2nd Floor
Sacramento CA 95814
CITY STATE ZIP

WELL LOCATION

Address 80' Wof S George Washington Blvd & .37
City Mi Nof Tudor Rd CA
County SUTTER
APN Book 025 Page 010 Parcel 004
Township 13 N Range 3 E Section 6
Latitude 39 0 32 DEG. MIN. SEC. Longitude 121 40 29 DEG. MIN. SEC.

LOCATION SKETCH

NORTH
WEST
EAST
SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

✓ NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
___ Irrigation ___ Industrial

MONITORING ✓
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL ___ (Ft.) & DATE MEASURED ___
ESTIMATED YIELD * ___ (GPM) & TEST TYPE ___
TEST LENGTH ___ (Hrs.) TOTAL DRAWDOWN ___ (Ft.)
** May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
A 'Zone	1									
0	45	12	✓				PVC	2.5	SCH 80	
45	55	12		✓			PVC	2.5	SCH 80	.030
55	65	12	✓				PVC	2.5	SCH 80	
B Zone	2									
0	155	12	✓				PVC	2.5	SCH 80	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	20	✓			Sand Slurry
20	35		✓		Bentonite Seal
35	90			✓	SRI#8 Sand
90	100		✓		Bentonite Seal
100	130			✓	SRI#8 Sand
130	140		✓		Bentonite Seal

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analysis
___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME EATON DRILLING CO.
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

20 W. Kentucky Ave Woodland CA 95695
ADDRESS CITY STATE ZIP

Signed [signature] 01/21/11 C57 A 133783
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

Owner's Well No. 8519

€0124062

Date Work Began 12/20/2010, Ended 12/22/2010

Local Permit Agency Sutter County Health Dept

Permit No. 10-0310 Permit Date 12/7/2010

DWR USE ONLY — DO NOT FILL IN

13N03E06

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD ROTARY FLUID MUD

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	10	Top soil
10	20	Yellow brown clay
20	60	Sand and gravel
60	170	Sandy yellow clay
170	800	Gray clay with sand
800	1300	Brittle gray clay with sand

TOTAL DEPTH OF BORING 1300 (Feet)

TOTAL DEPTH OF COMPLETED WELL 255 (Feet)

WELL OWNER

Name DWR - Central

Mailing Address 901 P Street, 2nd Floor

Sacramento CA 95814

CITY STATE ZIP

WELL LOCATION

Address 80' Wof S George Washington Blvd & .37

City Mi Nof Tudor Rd CA

County SUTTER

APN Book 025 Page 010 Parcel 004

Township 13 N Range 3 E Section 6

Latitude ___ DEG. MIN. SEC. Longitude ___ DEG. MIN. SEC.

LOCATION SKETCH

NORTH

WEST EAST

SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. **PLEASE BE ACCURATE & COMPLETE.**

ACTIVITY (✓)

✓ NEW WELL

MODIFICATION/REPAIR
- ___ Deepen
- ___ Other (Specify)

___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
- ___ Domestic ___ Public
- ___ Irrigation ___ Industrial

MONITORING ✓
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL ___ (Ft.) & DATE MEASURED ___

ESTIMATED YIELD * ___ (GPM) & TEST TYPE ___

TEST LENGTH ___ (Hrs.) TOTAL DRAWDOWN ___ (Ft.)

May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
155	165	12		✓			PVC	2.5	SCH 80	.030
165	175	12	✓				PVC	2.5	SCH 80	
Zone	3									
0	235	12/8	✓				PVC	2.5	SCH 80	
235	245	8		✓			PVC	2.5	SCH 80	.030
~~245~~	~~255~~	~~8~~	✓				~~PVC~~	~~2.5~~	~~SCH 80~~	

C

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
140	180			✓	SRI#8 Sand
180	190		✓		Bentonite Seal
190	215			✓	SRI#8 Sand
215	225		✓		Bentonite Seal
225	260			✓	SRI#8 Sand
~~260~~	~~280~~		✓		~~Bentonite Seal~~

ATTACHMENTS (✓)

- ___ Geologic Log
- ___ Well Construction Diagram
- ___ Geophysical Log(s)
- ___ Soil/Water Chemical Analysis
- ___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME EATON DRILLING CO.
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

20 W. Kentucky Ave Woodland CA 95695
ADDRESS CITY STATE ZIP

Signed [signature] 01/21/11 C57 A 133783
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet

e0 124062

DWR USE ONLY — DO NOT FILL IN
15N03E06
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

Owner's Well No. 8519
Date Work Began 12/20/2010, Ended 12/22/2010
Local Permit Agency Sutter County Health Dept
Permit No. 10-0310 Permit Date 12/7/2010

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD ROTARY FLUID MUD

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION Describe material, grain, size, color, etc.
0	10	Top soil
10	20	Yellow brown clay
20	60	Sand and gravel
60	170	Sandy yellow clay
170	800	Gray clay with sand
800	1300	Brittle gray clay with sand

TOTAL DEPTH OF BORING 1300 (Feet)
TOTAL DEPTH OF COMPLETED WELL 255 (Feet)

WELL OWNER

Name DWR - Central
Mailing Address 901 P Street, 2nd Floor
Sacramento CA 95814
CITY STATE ZIP

WELL LOCATION

Address 80' Wof S George Washington Blvd & .37
City Mi Nof Tudor Rd CA
County SUTTER
APN Book 025 Page 010 Parcel 004
Township 13 N Range 3 E Section 6
Latitude ___ DEG. MIN. SEC. Longitude ___ DEG. MIN. SEC.

LOCATION SKETCH

NORTH / WEST / EAST / SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

✓ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
___ Irrigation ___ Industrial
MONITORING ✓
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL ___ (Ft.) & DATE MEASURED ___
ESTIMATED YIELD * ___ (GPM) & TEST TYPE ___
TEST LENGTH ___ (Hrs.) TOTAL DRAWDOWN ___ (Ft.)
*May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
280	300			✓	Native Fill
300	1300	✓			Sand Slurry

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analysis
___ Other ___

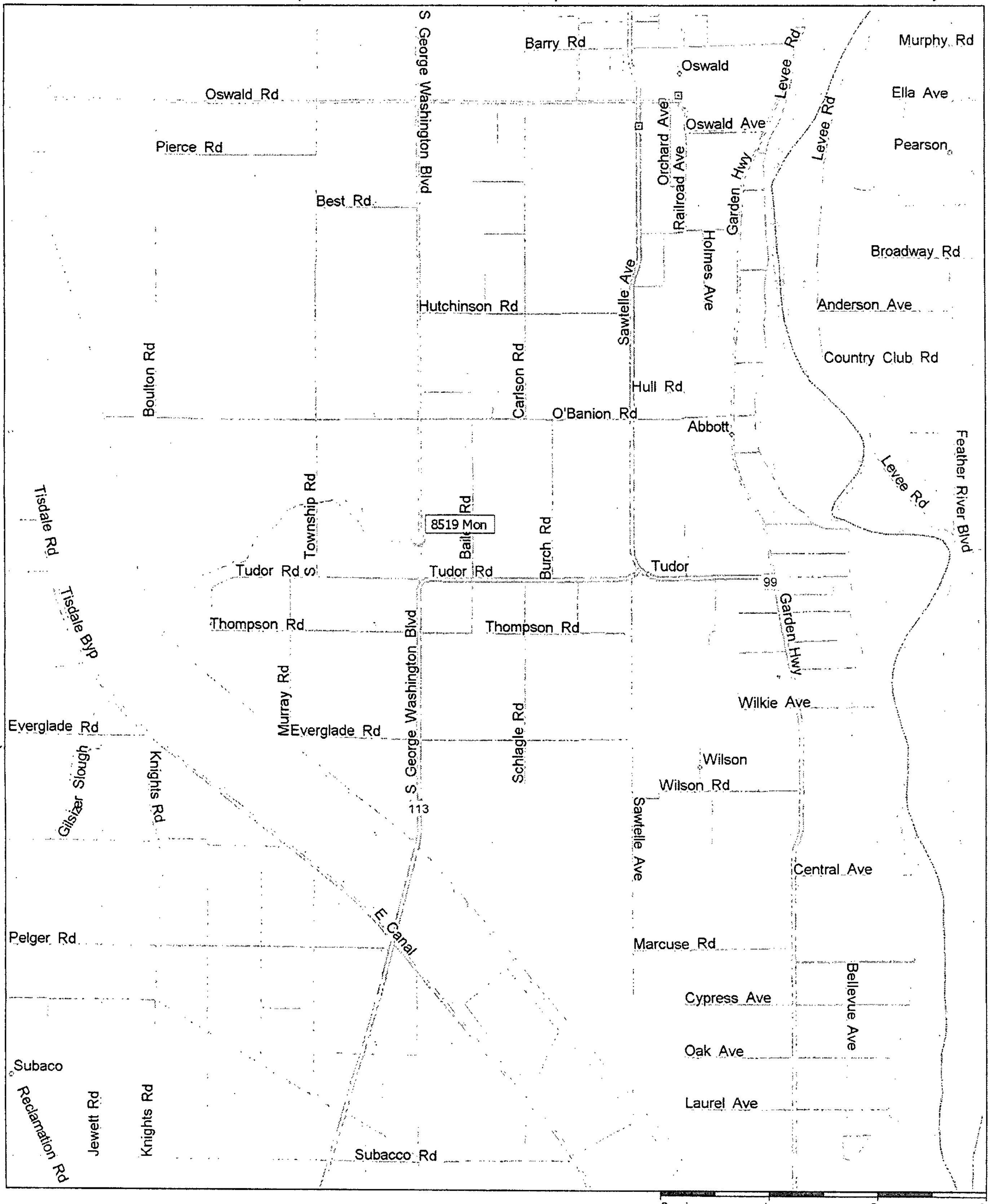
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.
NAME EATON DRILLING CO.
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
20 W. Kentucky Ave Woodland CA 95695
ADDRESS CITY STATE ZIP
Signed [signature] 01/21/11 C57 A 133783
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

DWR (Feather Water District) - Job# 8519 Mon   e0124062



State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
DRILL HOLE LOG

PROJECT American Basin Conjunctive Use
HOLE NUMBER AB-1
FEATURE SSWD Corporation Yard
DATE DRILLED 5/22/96-5/23/96
LOCATION
LOGGED BY Senter/Killingsworth
CONTRACTOR Eaton Drilling
ATTITUDE Vertical
DRILLER Duane Smith
DEPTH TO WATER Not determined
DRILL RIG Mayhew 1000, modified
HOLE DEPTH 1008 ft
ELEVATION N/A

Depth	Log	Field Classification and Description	Mode	Remarks
0 20	SM	0-30': SANDY SILT: soft, buff brown to red orange in color, interbedded with SAND, medium to pebble size, angular to subrounded, predominantly lithic clasts.	RD	Spudded @ 1000 hrs
40	CL	30-50': CLAY: lean, contains non-plastic fines, soft, orange-brown to gray-brown in color.		
60 80	SP	50-100': SAND: coarse to med grained, loose (uncemented), angular to subangular, clasts appear to be primarily of granitic origin w/ up to 10% mafic lithic fragments. Occasional stringers of SANDY SILT. Grades coarser, becomes iron-oxide stained, and composed predominantly of maficof non-granitic fragments below 60'.		65': rough drilling
100 120	SM	100-125': SANDY SILT: brittle (stiff), red-brown to orange-brown in color, contains up to 10% medium to coarse grained lithic fragments w/ occasional gravel-size clasts.		
140	SP	125-145': SAND: coarse to medium-grain size, angular to subangular, composed of mafic mineral fragments and lithic fragments of metamorphic & igneous origin.		
160	SM	145-180': SANDY SILT: brittle, as above, w/ common soft, non-plastic interbeds.		

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
DRILL HOLE LOG

Project & Feature American Basin Conjunctive Use, SSWD Monitoring Well — Hole No. AB-1

Depth	Log	Field Classification and Description	Mode	Remarks
160	SM	SANDY SILT continued	RD	
180	SP	180-200': SAND: fine to med grained minerals and lithic clasts, angular to subrounded, loose. Up to 30% of sand fragments appear to be sandstone, weakly indurated, friable. Possible lahar?		Driller said water return only about 50% from 160-180'
200	SM	200-330': SILTY SAND/SANDY SILT interbedded: reddish brown, brittle silts, subangular, med to coarse sand. Occasional soft SANDY SILT interbeds, esp. below 220'. Color changes to dark gray at 230'.		
220				
240		Color alternates between gray and red-brown. Degree of induration increases with depth; cuttings become harder. Below 250', color is predominantly dark gray , w/ minor orange-red interbeds. MEHRTEN FORMATION: gray to greenish, interbedded, tuffaceous sands, silts, clays, claystones, some interbedded gravels, gray tuffs, all as described below.		Assume that color change at 250' corresponds to top of Mehrten Formation Hole taking water
260				
280				
300				
320				
	SP	330-340': SAND: fine to medium grained, dark gray, angular, loose.		5/23/96: probable Mehrten
340	SM	340-390: SANDY SILT with occasional silty sand interbeds: brittle w/ occasional soft interbeds, dark gray w/ infrequent red-orange interbeds; sand is fine to med grained.		
360				

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
DRILL HOLE LOG

Project & Feature American Basin Conjunctive Use, SSWD Monitoring Well — Hole No. AB-1

Depth	Log	Field Classification and Description	Mode	Remarks
360	SM	SANDY SILT continued	RD	
380				
	GP	390-400': SANDY GRAVEL: loose, dark gray, subangular to rounded lithic and mineral clasts. Appear to be mainly metamorphics; fine; max diam. 0.5". Some basalt clasts <5%.		390': rough drilling 5/23/96 gravel zone definitely appears to be Mehrten
400	SP	400-410': SAND with CLAY: gray, coarse grained, otherwise same as above; contains about 10% med plastic clay		
	Tuff	410-500': TUFF: andesitic, gray, brittle; may occasionally grade to stiff clay; trace of subrounded pebbles.		
420				Good water return: about 80%
440				
460				Fast drilling
480				
500	SC	500-650': CLAYEY SAND: tuffaceous; dark gray-green, coarse grained, angular to subrounded; qtz and metamorphic grains, abundant greenish metavolcanic grains		
520				Fast drilling; good water returns about 80%
540				
560				

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
DRILL HOLE LOG

Project & Feature American Basin Conjunctive Use, SSWD Monitoring Well — Hole No. AB-1

Depth	Log	Field Classification and Description	Mode	Remarks
560	SC	CLAYEY SAND continued	RD	Driller says added 4 sacks bentonite earlier in day
580				
600				
620				Stopped drilling at 620'; added 5 sacks bentonite, circulated, pulled drill string Ended shift @2015 5/23/96: began shift @ 0700; ran in hole, circulated; began new hole @ 1000 hrs.
640				
	SP	650-700': SAND: med to coarse, uncemented, dark gray, angular to subangular, predominantly metamorphic clasts; qtz uncommon (<5%), contains +/-10% andestic (?) clasts: plag. & hornblende xtals in red groundmass.		
660				Penetration rate is faster than circulation rate; cuttings samples taken @ 10-' intervals are probably composite of 20' drill length
680		Below 680', qtz becomes more abundant, but still no more than 5% of returns. Cuttings also contain chips of gray, angular clasts that resemble siltstone, but are probably tuff; minor soft clay.		
700	Tuff	700-720': SANDY TUFF: hard, gray w/medium grain-size lithic clasts of metamorphic origin, some rhyolite/dacite; resembles siltstone.		
720	SP/ Tuff	720-820: Interbedded SAND and TUFF: as above; difficult to distinguish individual layers because tuff cuttings are the same size as sand clasts. Overall, there appears to be a 30/70 split between sand particles and sand-size tuff cuttings.		1100 hrs; fast drilling
740				
760				

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
DRILL HOLE LOG

Project & Feature American Basin Conjunctive Use, SSWD Monitoring Well — Hole No. AB-1

Depth	Log	Field Classification and Description	Mode	Remarks
760	SP/ Tuff	Interbedded SAND and TUFF continued.	RD	
780				
800				Circulating @ 1200 hrs
820	CH	820-860': FAT CLAY: blue-gray, tuffaceous, high plasticity, contains abundant frags of tuff <1/8" diameter.		
840				
860	Tuff	860-940': TUFF with SAND: gray to mostly bluish-green, andesitic tuff and/or lahar w/ minor interbedded med to coarse sand(<5%); grains are angular to subrounded, qtz, basalt, greenstone and some orange-brown tuffaceous clasts.		Circulating @1330 hrs, reamed borehole due to swelling formation; driller says fluid return is about 70%
880				Fast drilling
900				
920				
940	SP	940-970': SAND: tuffaceous, as previuosly described at 500-580', but not clayey.		
960				

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
DRILL HOLE LOG

Project & Feature American Basin Conjunctive Use, SSWD Monitoring Well — Hole No. AB-1

Depth	Log	Field Classification and Description	Mode	Remarks
960	SP	SAND continued	RD	
	Tuff	970-980': TUFF with SAND: andesitic, as previously described.		
980	Tuff	980-1000': TUFF: andesitic, as previously described, no sand or pebbles.		
1000				
		1008': BOTTOM OF HOLE		
1020				
1040				
1060				
1080				
1100				
1120				
1140				
1160				

51-1071

State of California
The Resources Agency
Department of Water Resources

State Well No. 12N04E03N04M

DISTRICT Central

WELL DATA

Owner California Department of Water Resources
Address 3251 S Street, Sacramento 95816
Tenant
Address

State Well No. 12N04E03N04M
Other No. AB-1, Shallow

Type of Well: Hydrograph [x] Key [ ] Index [ ] Semiannual [ ]
Location: County Sutter Basin North American No. 5-21.64
U.S.G.S. Quad. Nicholaus Quad. No.

SW 1/4 SW ¼ Section 03, Township 12N, Range 04E MD SB H Base & Meridian

Description Single vault, quadruple-completion, nested piezometer. Each peizometer is 2" in diameter, steel cased, with a stainless-steel perforated interval. Vault is secured with a padlock – lock is available at Central District office.

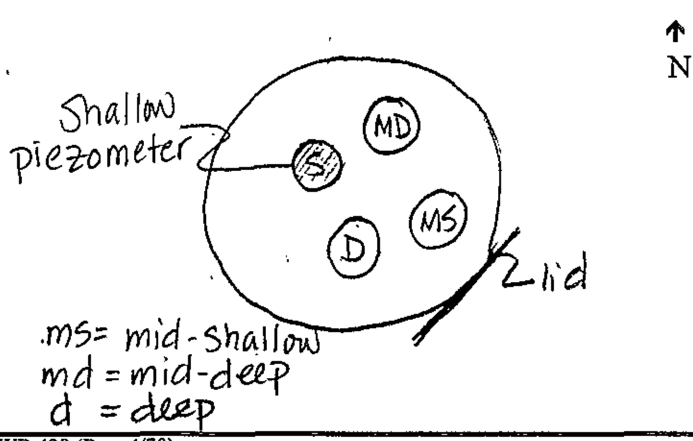
Reference Point description Top of the 2" piezometer, with cap removed. Shallow well is the tallest of the four casings.

Which is 1.2 ft. Above/Below land surface. Ground Elevation 48 ft.
Reference Point Elev. 49.2 ft. Determined from USGS Quad
Well: Use Monitoring Condition Very good – nearly new Depth 190 ft.
Casing, size 2 in., perforations 170 – 180 feet bgs

Measurement By: DWR [x] USGS [ ] USBR [ ] County [ ] Irr. Dist. [ ] Water Dist. [ ] Cons. Dist. [ ]
Chief Aquifer: Name Depth to Top Aq. Depth to Bot. Aq.
Type of Material Perm. Rating Thickness
Gravel Packed? Yes [x] No [ ] Depth to Top Gr. 80 feet Depth to Bot. Gr. 200 feet
Supp. Aquifer Depth to Top Aq. Depth to Bot. Aq.
Driller Eaton Drilling
Date drilled May 22-23, 1996 Log, filed yes Open (1) x Confidential (2)
Equipment: Pump, type Make
Serial No. Size of discharge pipe in.
Power, Kind Make
H.P. Motor Serial No.
Elec. Meter No. Transformer No.
Yield GPM Pumping level ft.

Water Analysis: Min. (1) x San. (2) H.M.(3)
Water Levels Available: Yes (1) x No
Period of Record: Begin 07/11/96 End active
Collecting Agency California Department of Water Resources
Prod. Rec. (1) Pump Test (2) Yield (3)

SKETCH



REMARKS

This is the shallow well of a quadruple-completion monitoring well. The middle-shallow well is 530 feet deep, the middle-deep well is 710 feet, and the deep well is 980 feet. The four wells are separated by bentonite seals. A 1" steel air tube is attached to the well casing at 150' depth, and was used for well development. The well is located within the boundaries of RD 108 and was constructed with their permission. See attached map for location. Electric log of well is on file.

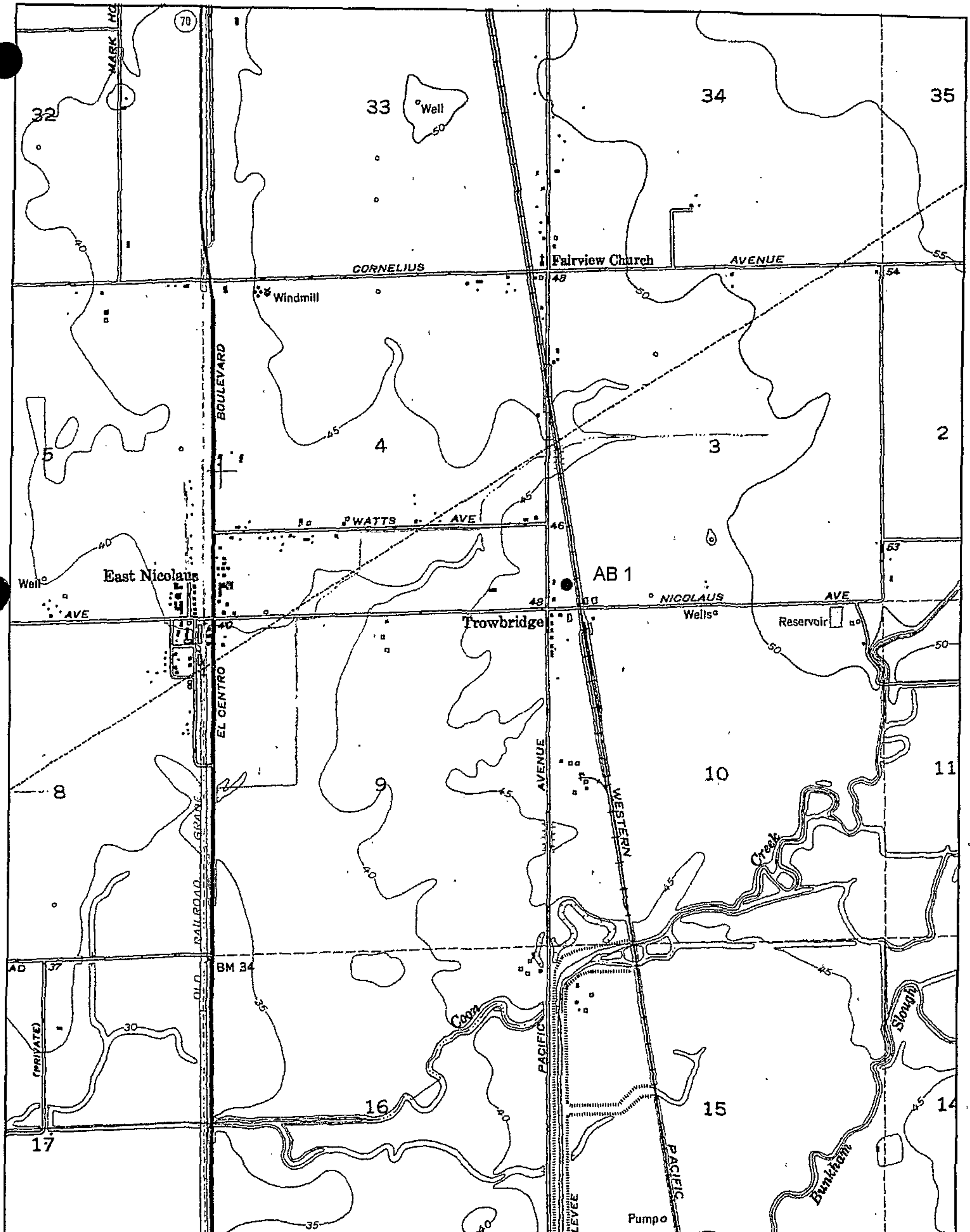
Recorded by: Naomi Kalman
Date: 01/10/01

DWR 429 (Rev. 4/70)

Location of AB 1
Nicholaus Quad

51-1071

1:7272



51-1069

State of California
The Resources Agency
Department of Water Resources

State Well No. 12N04E03N02M

DISTRICT Central

WELL DATA

Owner: California Department of Water Resources
Address: 3251 S Street, Sacramento 95816
Tenant:
Address:

State Well No. 12N04E03N02M
Other No. AB-1, Middle-Deep

Type of Well: Hydrograph [x] Key [ ] Index [ ] Semiannual [ ]
Location: County Sutter Basin North American No. 5-21.64
U.S.G.S. Quad. Nicholaus Quad. No.

SW 1/4 SW ¼ Section 03, Township. 12N, Range. 04E MD SB H Base & Meridian

Description: Single vault, quadruple-completion, nested piezometer. Each peizometer is 2" in diameter, steel cased, with a stainless-steel perforated interval. Vault is secured with a padlock – lock is available at Central District office.

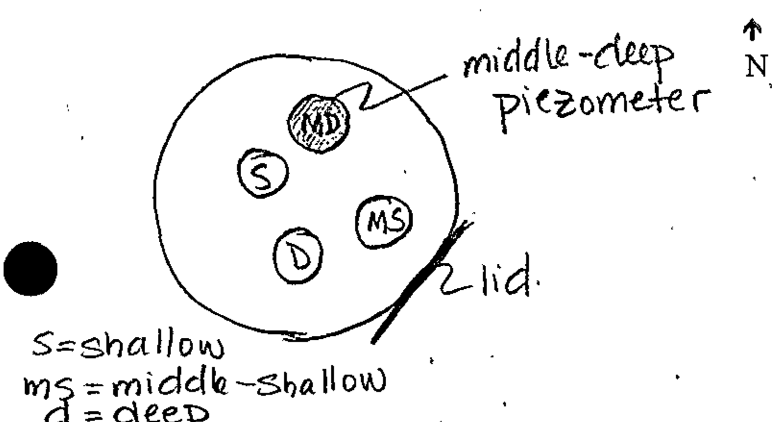
Reference Point description: Top of the 2" piezometer, with cap removed. Middle-deep well is the second shortest of the four casings.

Which is 0.9 ft. Above/Below land surface. Ground Elevation 48 ft.
Reference Point Elev. 48.9 ft. Determined from USGS Quad
Well: Use Monitoring Condition Very good – nearly new Depth 710 ft.
Casing, size 2 in., perforations 680 – 700 feet bgs

Measurement By: DWR [x] USGS [ ] USBR [ ] County [ ] Irr. Dist. [ ] Water Dist. [ ] Cons. Dist. [ ]
Chief Aquifer: Name Depth to Top Aq. Depth to Bot. Aq.
Type of Material Perm. Rating Thickness
Gravel Packed? Yes [x] No [ ] Depth to Top Gr. 620 feet Depth to Bot. Gr. 855 feet
Supp. Aquifer Depth to Top Aq. Depth to Bot. Aq.
Driller Eaton Drilling
Date drilled May 22-23, 1996 Log, filed yes Open (1) x Confidential (2)
Equipment: Pump, type Make
Serial No. Size of discharge pipe in.
Power, Kind Make
H.P. Motor Serial No.
Elec. Meter No. Transformer No.
Yield GPM Pumping level ft.

Water Analysis: Min. (1) x San. (2) H.M.(3)
Water Levels Available: Yes (1) x No
Period of Record: Begin 07/11/96 End active
Collecting Agency California Department of Water Resources
Prod. Rec. (1) Pump Test (2) Yield (3)

SKETCH



REMARKS

This is the middle-deep well of a quadruple-completion monitoring well. The shallow well is 190 feet deep, the middle-shallow well is 530 feet, and the deep well is 980 feet. The four wells are separated by bentonite seals. A 1" steel air tube is attached to the well casing at 150' depth, and was used for well development. The well is located within the boundaries of RD 108 and was constructed with their permission. See attached map for location. Electric log of well is on file.

Recorded by: Naomi Kalman
Date: 01/10/01

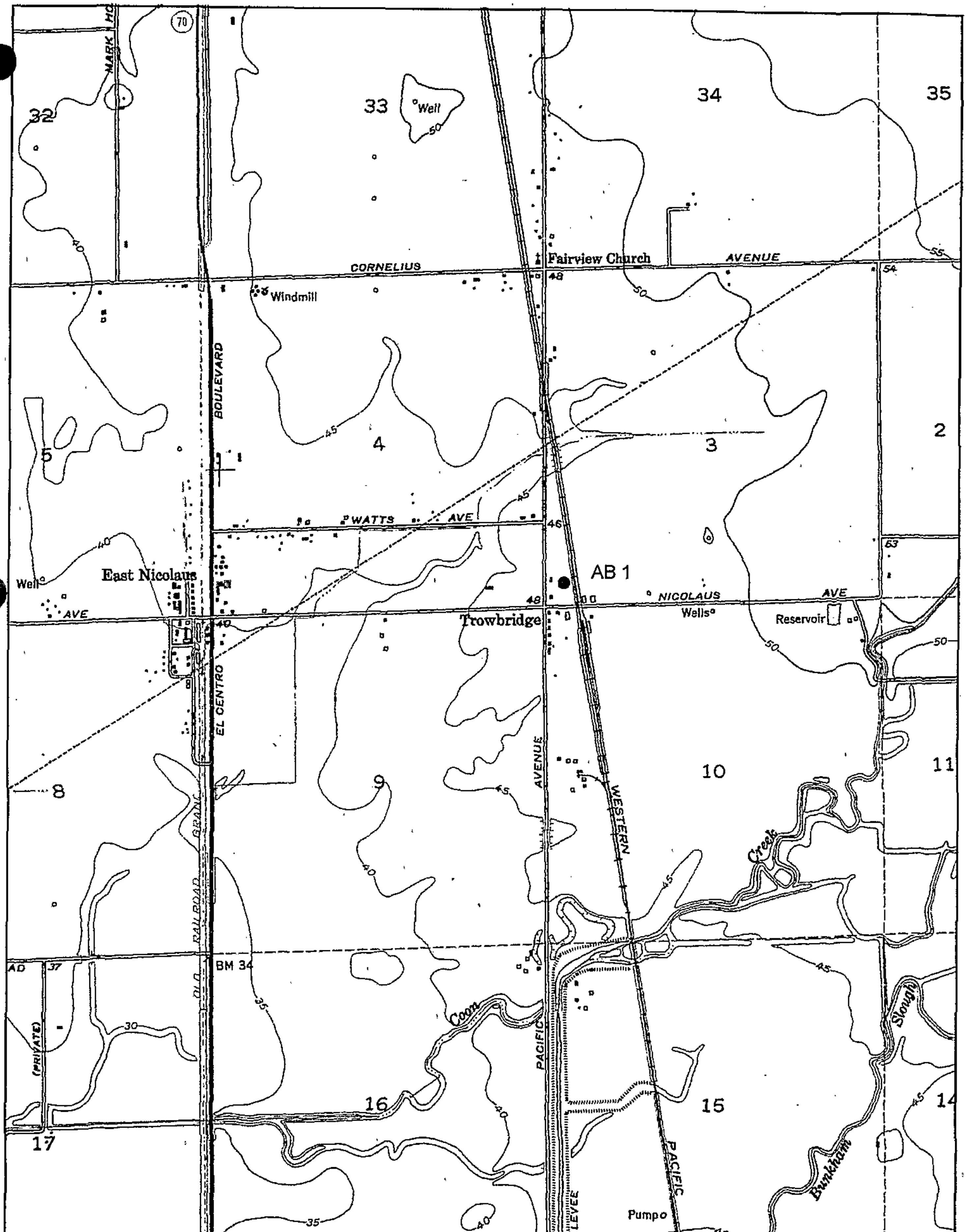
DWR 429 (Rev. 4/70)

Location of AB 1
Nicholaus Quad

51-1069

N

1:7272



51-1070

State of California
The Resources Agency
Department of Water Resources

State Well No. 12N04E03N03M

DISTRICT Central

WELL DATA

Owner California Department of Water Resources
Address 3251 S Street, Sacramento 95816
Tenant
Address

State Well No. 12N04E03N03M
Other No. AB-1, Middle-Shallow

Type of Well: Hydrograph [x] Key [ ] Index [ ] Semiannual [ ]
Location: County Sutter Basin North American No. 5-21.64
U.S.G.S. Quad. Nicholaus Quad. No.

SW 1/4 SW ¼ Section 03, Township. 12N, Range. 04E MD SB H Base & Meridian

Description Single vault, quadruple-completion, nested piezometer. Each peizometer is 2" in diameter, steel cased, with a stainless-steel perforated interval. Vault is secured with a padlock – lock is available at Central District office.

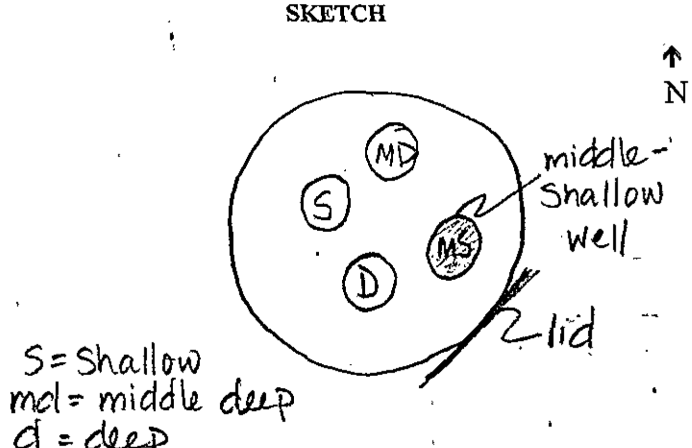
Reference Point description Top of the 2" piezometer, with cap removed. Middle-shallow well is the second-tallest of the four casings.

Which is 1.0 ft. Above/Below land surface. Ground Elevation -48 ft.
Reference Point Elev. 49 ft. Determined from USGS Quad
Well: Use Monitoring Condition Very good – nearly new Depth 530 ft.
Casing, size 2 in., perforations 390 – 400 and 510 – 520 feet bgs

Measurement By: DWR [x] USGS [ ] USBR [ ] County [ ] Irr. Dist. [ ] Water Dist. [ ] Cons. Dist. [ ]
Chief Aquifer: Name Depth to Top Aq. - Depth to Bot. Aq.
Type of Material Perm. Rating Thickness
Gravel Packed? Yes [x] No [ ] Depth to Top Gr. 370 feet Depth to Bot. Gr. 600 feet
Supp. Aquifer Depth to Top Aq. Depth to Bot. Aq.
Driller Eaton Drilling
Date drilled May 22-23, 1996 Log, filed yes Open (1) x Confidential (2)
Equipment: Pump, type Make
Serial No. Size of discharge pipe in.
Power, Kind Make
H.P. Motor Serial No.
Elec. Meter No. Transformer No.
Yield GPM Pumping level ft.

Water Analysis: Min. (1) x San. (2) H.M.(3)
Water Levels Available: Yes (1) x No
Period of Record: Begin 07/11/96 End active
Collecting Agency California Department of Water Resources
Prod. Rec. (1) Pump Test (2) Yield (3)

SKETCH



REMARKS

This is the middle-shallow of a quadruple-completion monitoring well. The shallow well is 190 feet deep, the middle-deep well is 710 feet, and the deep well is 980 feet. The four wells are separated by bentonite seals. A 1" steel air tube is attached to the well casing at 150' depth, and was used for well development. The well is located within the boundaries of RD 108 and was constructed with their permission. See attached map for location. Electric log of well is on file.

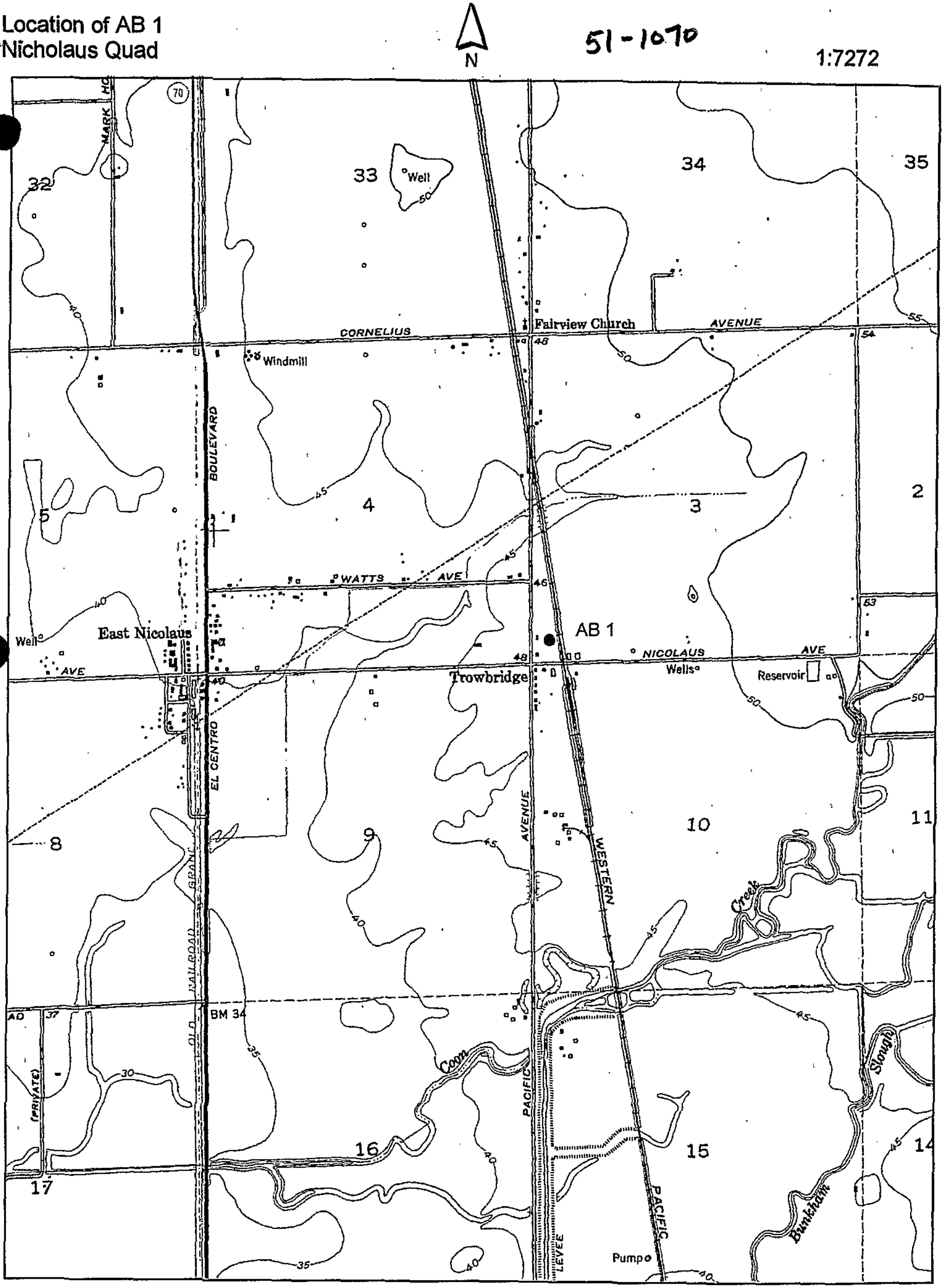
Recorded by: Naomi Kalman
Date: 01/10/01

DWR 429 (Rev. 4/70)

Location of AB 1
Nicholaus Quad

51-1070

1:7272



51-1068

State of California
The Resources Agency
Department of Water Resources

State Well No. 12N04E03N01M

DISTRICT Central

WELL DATA

Owner: California Department of Water Resources
Address: 3251 S Street, Sacramento 95816
Tenant:
Address:

State Well No. 12N04E03N01M
Other No. AB-1, Deep

Type of Well: Hydrograph [x] Key [ ] Index [ ] Semiannual [ ]
Location: County Sutter Basin North American No. 5-21.64
U.S.G.S. Quad. Nicholaus Quad. No.

SW 1/4 SW ¼ Section 03, Township. 12N, Range. 04E MD SB H Base & Meridian

Description: Single vault, quadruple-completion, nested piezometer. Each peizometer is 2" in diameter, steel cased, with a stainless-steel perforated interval. Vault is secured with a padlock – lock is available at Central District office.

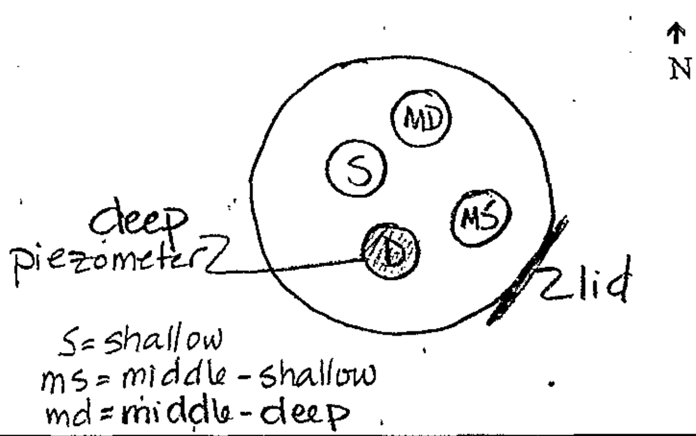
Reference Point description: Top of the 2" piezometer, with cap removed. Deep well is the shortest of the four casings.

Which is '0.4 ft. Above/Below land surface. Ground Elevation 48 ft.
Reference Point Elev. 48.4 ft. Determined from USGS Quad
Well: Use Monitoring Condition Very good – nearly new Depth 980 ft.
Casing, size 2 in., perforations 950 – 970 feet bgs

Measurement By: DWR [x] USGS [ ] USBR [ ] County [ ] Irr. Dist. [ ] Water Dist. [ ] Cons. Dist. [ ]
Chief Aquifer: Name Depth to Top Aq. Depth to Bot. Aq.
Type of Material Perm. Rating Thickness
Gravel Packed? Yes [x] No [ ] Depth to Top Gr. 895 feet Depth to Bot. Gr. 1000 feet
Supp. Aquifer Depth to Top Aq. Depth to Bot. Aq.
Driller Eaton Drilling
Date drilled May 22-23, 1996 Log, filed yes Open (1) x Confidential (2)
Equipment: Pump, type Make
Serial No. Size of discharge pipe in.
Power, Kind Make
H.P. Motor Serial No.
Elec. Meter No. Transformer No.
Yield GPM Pumping level ft.

Water Analysis: Min. (1) x San. (2) H.M.(3)
Water Levels Available: Yes (1) x No
Period of Record: Begin 07/11/96 End active
Collecting Agency California Department of Water Resources
Prod. Rec. (1) Pump Test (2) Yield (3)

SKETCH



REMARKS

This is the deep well of a quadruple-completion monitoring well. The shallow well is 190 feet deep, the middle-shallow well is 530 feet, and the middle-deep well is 710 feet. The four wells are separated by bentonite seals. A 1" steel air tube is attached to the well casing at 150' depth, and was used for well development. The well is located within the boundaries of RD 108 and was constructed with their permission. See attached map for location. Electric log of well is on file.

Recorded by: Naomi Kalman
Date: 01/10/01

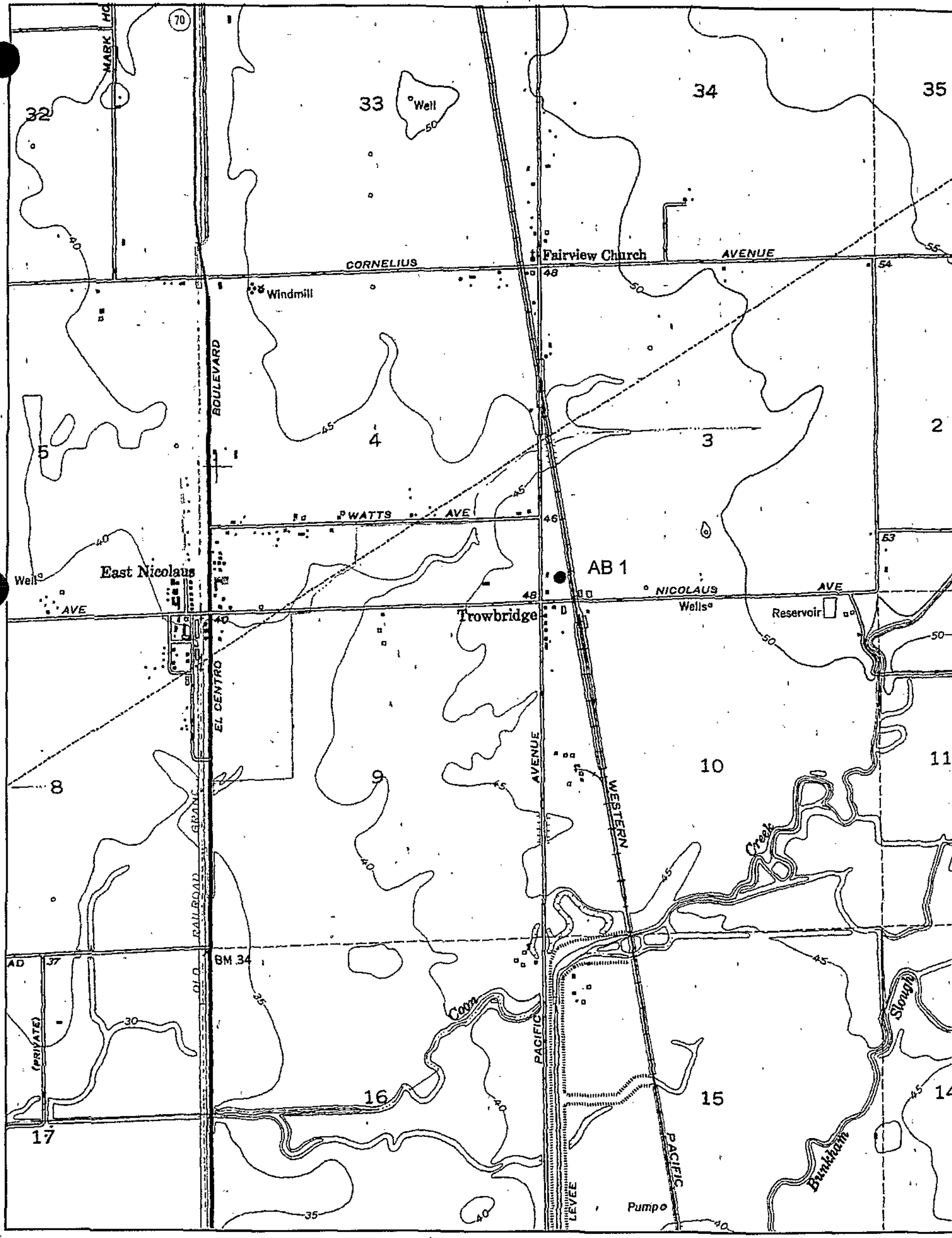
DWR 429 (Rev. 4/70)

Location of AB 1
Nicholaus Quad

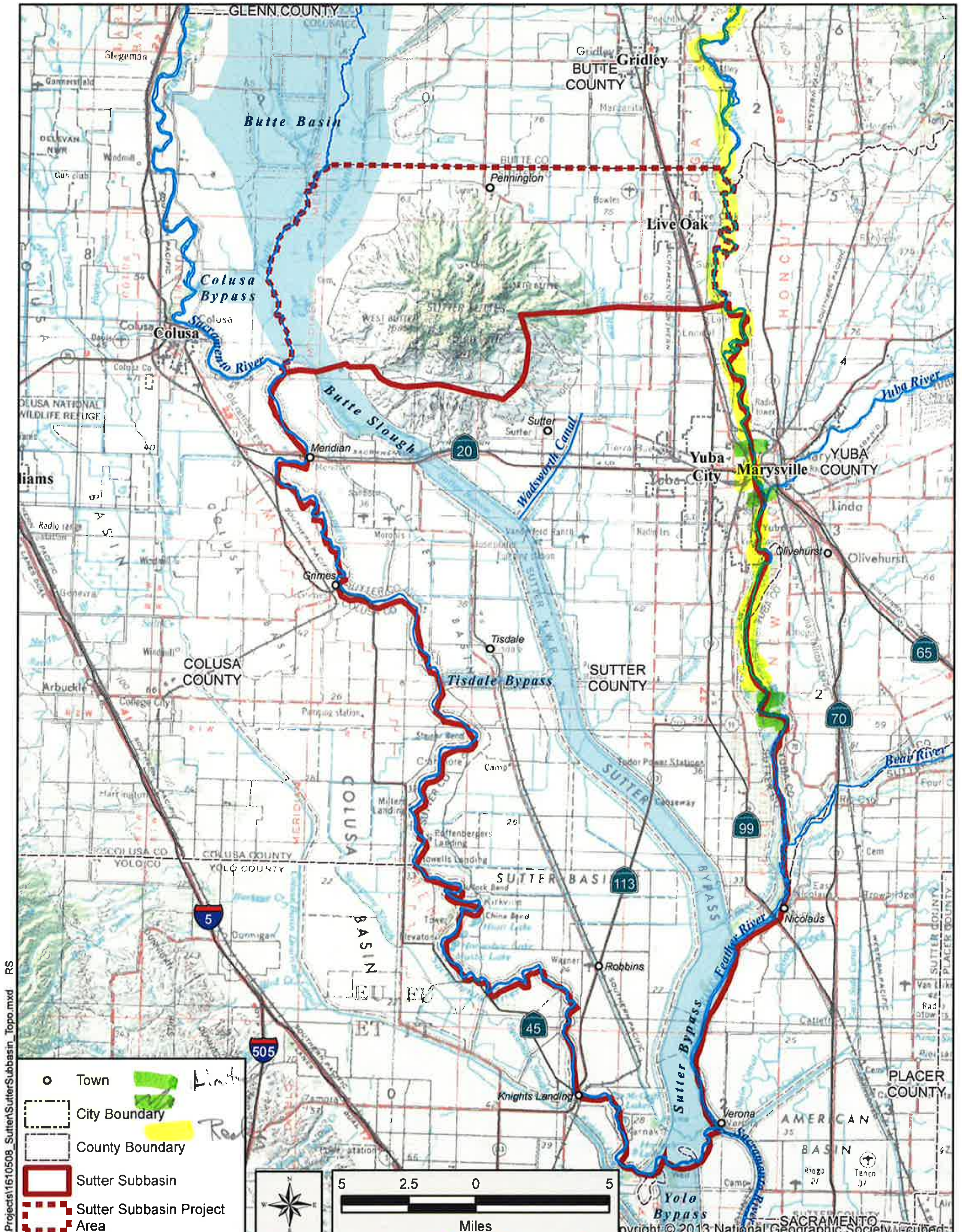
N

51-1068

1:7272

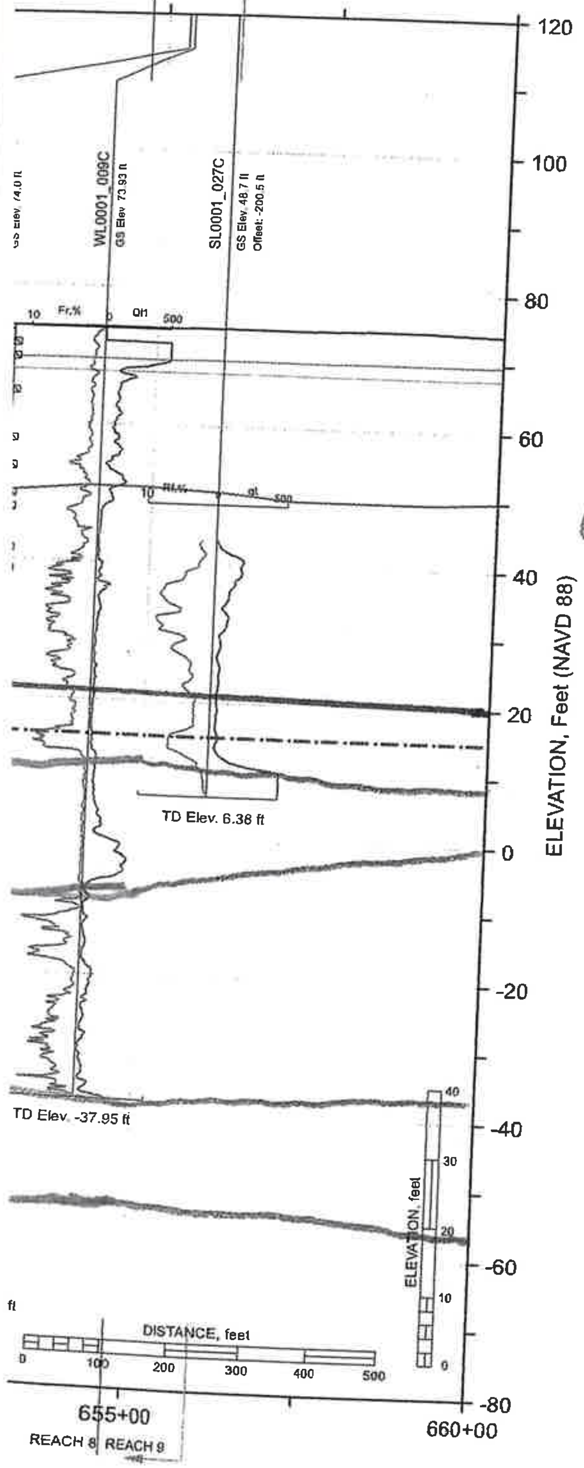


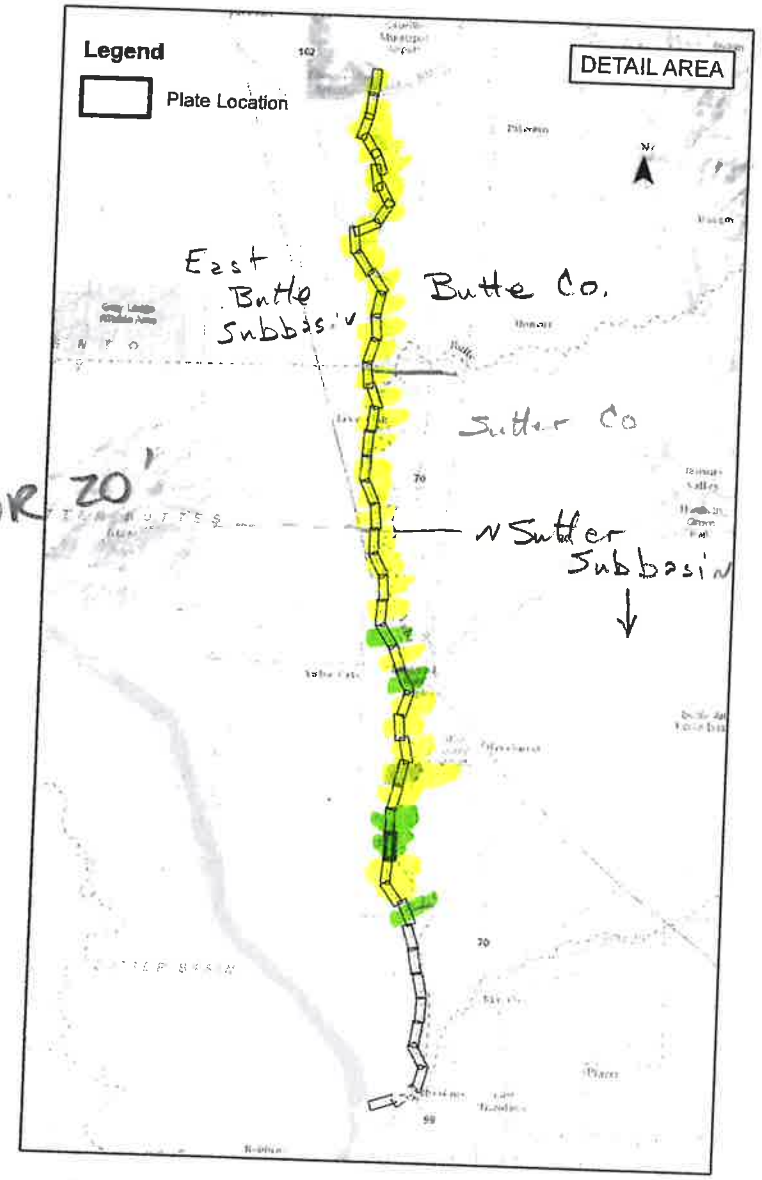
APPENDIX C
GEOLOGIC SECTIONS
FEATHER RIVER LEVEES



Project Title Location	GEI Consultants	Sutter Groundwater Subbasin and By-Passes Geology
Client		SEPTEMBER 2016 DRAFT FIGURE

Groundwater Recharge Areas from Rivers





FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 610+00 to Station 660+00

URS

Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency

FEATHER RIVER WEST LEVEE PROJECT

Appendix A15

~~Direct~~ Sand and Gravel opposite invert of River, not previously blocked by slurry wall (pre-2013)

Clay to silt opposite invert of River ~~Not~~

LEGEND FOR PLAN VIEW

EXPLORATIONS & LEVEE FEATURES

- SBFCA TO1 FRWL Project Boring
- SBFCA TO1 FRWL Project CPT
- SBFCA TO2 & TO4 FRWL Project Boring
- SBFCA TO2 & TO4 FRWL Project CPT
- Historical Boring
- Historical CPT
- Levee Miles
- SBFCA FRWL Project Levee Stationing
- Analysis Cross-Section
- Analysis Cross-Section: Sensitivity Only
- Reach
- Levee District Boundary
- Maintenance Area Boundary
- Reclamation District Boundary

EXISTING IMPROVEMENT MEASURE, KNOWN OR REPORTED

- Berm
- Ditch/Canal
- Levee Raise
- Levee Raise and Widening
- Levee Reconstruction
- *Relief Well
- Revetment
- Riprap
- Seepage Interceptor System
- Bentonite-Tire Slurry Wall
- Slurry Cutoff Wall
- Toe Drain
- Waterside Slope Repair
- Proposed Mitigation Measure (See specifics on each plate)

*Dots are not representative of actual locations of relief wells

DOCUMENTED HISTORICAL LEVEE DISTRESS

- Boil
- Cracking
- Sinkhole
- Area of Concern
- Boil
- Breach, Levee Failure
- Erosion
- Seepage
- Sinkhole
- Slope Instability

SURFICIAL GEOLOGY LEGEND (Source: DWR, 2010a)

Surfical Geology was mapped at 1:20,000.

Geologic contact; dashed where approximate, dotted where concealed, queried where uncertain; solid contacts within 30' of line shown on map

W 1911	Water bodies, circa 1911
W 1937	Water bodies, circa 1937
BP	Borrow pits present in 1937

GEOLOGIC UNITS*

Historical

L	Levee; Culturally deposited
SP	Spoils pie, Artificial fill, circa 1937
DT	Dredge tailings: Spoils material from gold dredge operations
Rob	Overbank deposits; sand, silt, and clay; deposited during high-stage water flow, overtopping channel banks
Rcs	Crevasse splay deposits; Fine to coarse sand, with minor lenses of clay deposited from breaching of natural or artifical levees
Rdf	Distributary fan deposits; Sand, silt and clay
Rdc	Distributary channel deposits; Distributary channel deposits, trace gravel, sand, silt, and clay; channelized flow conducting sediment to floodplain
Rofc	Overflow channels; Vertically stratified sand, silt and clay in channels occupiedwhen high-stage water overtops channel banks
Rsl	Slough deposits, Sand, silt and clay, fining upward facies, low-energy channel deposit
Rcu	Crevasse splay deposits; Cut off channel (chute); occurs on insides of meander bends within the river channel; on flood plain – entrenchment of overflow channels into hydraulic mining debris
Rch	Channel deposits, Sorted sands and silts; fining upward (Rch 1911: channels as shown on historic topo)
Rb	Channel bar deposits; fine gravel, sand, and silt deposited in or along channel lateral margins
Rms	Channel meander scroll deposits, Sand, silt and clay from lateral channel migration
Ra	Alluvial deposits, undifferentiated; sand, silt, and minor lenses of fine gravel

Holocene

Hob	Overbank deposits; sand, silt, and clay; deposited during high-stage water flow, overtopping channel banks
Hcs	Crevasse splay deposits; Fine to coarse sand, with minor lenses of clay deposited from breaching of natural or artifical levees
Hdf	Distributary fan deposits; Sand, silt and clay
Hofc	Overflow channels; Vertically stratified sand, silt and clay in channels occupied when high-stage water overtops channel banks
Ha	Alluvial deposits undifferentiated, Sand, silt, and minor lenses of gravel; under cultivation in 1937
Hch	Channel deposits, Sorted sands and silts; fining upward
Hb	Channel bar deposits; Fine gravel, sand, and silt deposited in or along channel lateral margins
Hms	Channel meander scroll deposits; Sand, silt and clay from lateral channel migration
Hdc	Distributary channel deposits, sand, silt, and clay
Hsl	Slough deposits, sand, silt and clay, fining upward facies, low energy channel deposit
Hfy	Alluvial fan deposits; Well graded gravel, sand, silt and clay; volcanic lithologies
Qa	Alluvial deposits undifferentiated, Sand, silt, and minor lenses of fine gravel, under urbanization in 1937
Qn	Basin deposits; Fine sand, silt and clay, dark yellow to dark yellowish brown, under cultivation in 1937
Qt	Marsh deposits; Silt and clay, likely organic rich; perennially or seasonally submerged

Pleistocene

Qmu	Modesto Formation; upper member; Unconsolidated gravel, sand, silt, and clay
Qml	Modesto Formation; lower member; Unconsolidated to semi-consolidated gravel, sand, silt and clay
Qru	Riverbank Formation; upper member; Semi-consolidated to consolidated gravel, sand, silt and minor clay
Qrl	Riverbank Formation; lower member; Consolidated gravel, sand, silt, and clay, generally associated with strong durpan soil horizon

Pliocene / Pleistocene

QTtn	Tuff breccia; Volcanic tuff breccia (andesitic and rhyolitic) from Sutter Buttes, latest Pliocene

LEGEND FOR STICK LOG FIGURES

PROFILE LEGEND

- Levee Crest
- Landside Levee Toe
- Ditch/Canal
- Existing Cutoff Wall (Based on As-Built Drawings)
- Existing Cutoff Wall (Based on Design Drawings)
- Proposed Mitigation Measure (See specifics on each plate)
- 1955/1957 Design Water Surface Elevation
- 200-Year Water Surface Elevation
- Analysis Cross-Section (Dashed for Sensitivity Only)

ASSIGNMENT OF BORING ID NUMBER

SX**_###Y**

- "S" for SBFCA; "W" for DWR
- **Local District Category**: "R" for Reclamation District; "L" for Levee District; "M" for Maintenance Area; "C" for County of Local Maintenance Agency; "S" for State. For areas not within any of the above districts or areas; "P" for Private. Non-State and doesn't fit into any of the above categories.
- **Local District Number/Special Designation**: Use "0" at font if it is less than 4 digits. If "S", "C" or "P" is used in the Local District Category, a four character abbreviation describing the river or channel where the levee is located will be used here.
- **Underscore**: "_" as a Separator
- **Exploration Number**: Use 001 through 999
- **Hole Type Code**: "A" for Auger (Hollow Stem); "B" for Boring (Mud Rotary); "C" for CPT; "H" for Hand-Auger; "S" for Sonic; "M" for Monitoring Well; "T" for Test Pit; "K" for Bucket Auger; "V" for Vane Shear Exploration

SAMPLER GRAPHIC SYMBOLS

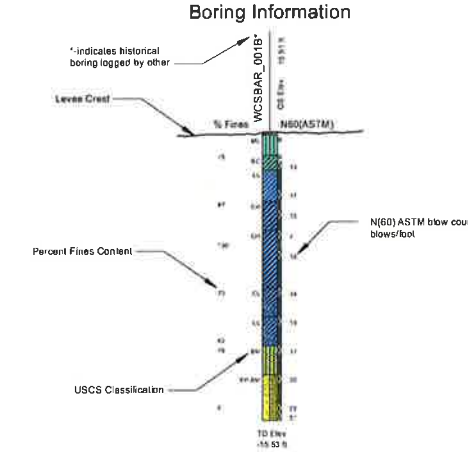
- Standard Penetration Test
- Standard California
- Modified California
- Shelby Tube
- Punch Core
- Sonic Core
- Bag Sample

SOIL CLASSIFICATIONS

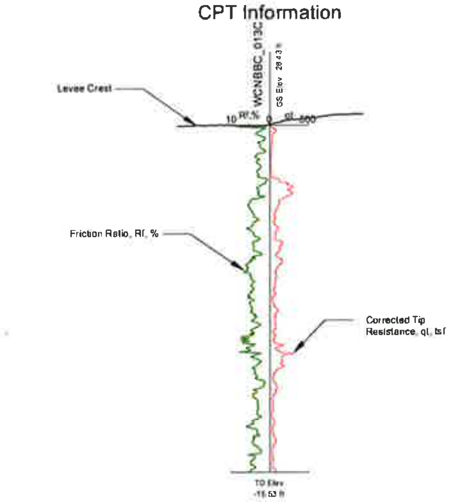
Asphalt	Boulders and cobbles	Concrete	Fill	Boulders and cobbles
Fat Clay (CH)	Fat Clay with Sand (CH)	Fat Clay with Gravel (CH)	Gravelly Fat Clay (CH)	Gravelly Fat Clay with Sand (CH)
Sandy Fat Clay (CH)	Sandy Fat Clay with Gravel (CH)	Lean Clay (CL)	Lean Clay with Sand (CL)	Silty Clay (CL-ML)
Silty Clay with Sand (CL-ML)	Silty Clay with Gravel (CL-ML)	Gravelly Silty Clay (CL-ML)	Gravelly Silty Clay with Sand (CL-ML)	Sandy Silty Clay (CL-ML)
Sandy Silty Clay with Gravel (CL-ML)	Lean to Fat Clay (CL/CH)	Lean to Fat Clay with Sand (CL/CH)	Lean to Fat Clay with Gravel (CL/CH)	Gravelly Lean to Fat Clay (CL/CH)
Gravelly Lean to Fat Clay with Sand (CL/CH)	Sandy Lean to Fat Clay (CL/CH)	Sandy Lean to Fat Clay with Gravel (CL/CH)	Silty Clay to Clayey Silt (CL/ML)	Silty Clay to Clayey Silt with Sand (CL/ML)
Silty Clay to Clayey Silt with Gravel (CL/ML)	Gravelly Silty Clay to Clayey Silt (CL/ML)	Gravelly Silty Clay to Clayey Silt with Sand (CL/ML)	Sandy Silty Clay to Clayey Silt (CL/ML)	Sandy Silty Clay to Clayey Silt with Gravel (CL/ML)
Lean Clay with Gravel (CL)	Gravelly Lean Clay (CL)	Gravelly Lean Clay with Sand (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay with Gravel (CL)
Clayey Gravel (GC)	Silty, Clayey Gravel (GC-GM)	Silty, Clayey Gravel with Sand (GC-GM)	Clayey Gravel with Sand (GC)	Silty Gravel (GM)
Silty Gravel with Sand (GM)	Poorly Graded Gravel (GP)	Poorly Graded Gravel with Clay (GP-GC)	Poorly Graded Gravel with Clay and Sand (GP-GC)	Poorly Graded Gravel with Silt (GP-GM)
Poorly Graded Gravel with Silt and Sand (GP-GM)	Poorly Graded Gravel with Sand (GP)	Well-Graded Gravel (GW)	Well-Graded Gravel with Clay (GW-GC)	Well-Graded Gravel with Clay and Sand (GW-GC)
Well-Graded Gravel with Silt (GW-GM)	Well-Graded Gravel with Silt and Sand (GW-GM)	Well-Graded Gravel with Sand (GW)	Elastic Silt (MH)	Elastic Silt with Sand (MH)
Elastic Silt with Gravel (MH)	Gravelly Elastic Silt (MH)	Gravelly Elastic Silt with Sand (MH)	Sandy Elastic Silt (MH)	Sandy Elastic Silt with Gravel (MH)
Silt (ML)	Silt with Sand (ML)	Clayey Silt (ML/CL)	Clayey Silt with Sand (ML/CL)	Clayey Silt with Gravel (ML/CL)
Gravelly Clayey Silt (ML/CL)	Gravelly Clayey Silt with Sand (ML/CL)	Sandy Clayey Silt (ML/CL)	Sandy Clayey Silt with Gravel (ML/CL)	Silt with Gravel (ML)
Gravelly Silt (ML)	Gravelly Silt with Sand (ML)	Sandy Silt (ML)	Sandy Silt with Gravel (ML)	Organic Fat Clay (OH)
Organic Fat Clay with Sand (OH)	Organic Fat Clay with Gravel (OH)	Gravelly Organic Fat Clay (OH)	Gravelly Organic Fat Clay with Sand (OH)	Sandy Organic Fat Clay (OH)
Sandy Organic Fat Clay with Gravel (OH)	Organic Elastic Silt (OH)	Organic Elastic Silt with Sand (OH)	Organic Elastic Silt with Gravel (OH)	Gravelly Organic Elastic Silt (OH)
Gravelly Organic Elastic Silt with Sand (OH)	Sandy Organic Elastic Silt (OH)	Sandy Organic Elastic Silt with Gravel (OH)	Organic Lean Clay (OL)	Organic Lean Clay with Sand (OL)
Organic Lean Clay with Gravel (OL)	Gravelly Organic Lean Clay (OL)	Gravelly Organic Lean Clay with Sand (OL)	Sandy Organic Lean Clay (OL)	Sandy Organic Lean Clay with Gravel (OL)
Organic Silt (OL)	Organic Silt with Sand (OL)	Organic Silt with Gravel (OL)	Gravelly Organic Silt (OL)	Gravelly Organic Silt with Sand (OL)
Sandy Organic Silt (OL)	Sandy Organic Silt with Gravel (OL)	Peat (PT)	Clayey Sand (SC)	Silty, Clayey Sand (SC-SM)
Silty, Clayey Sand with Gravel (SC-SM)	Clayey Sand with Gravel (SC)	Silty Sand (SM)	Silty Sand with Gravel (SM)	Poorly Graded Sand (SP)
Poorly Graded Sand with Clay (SP-SC)	Poorly Graded Sand with Clay and Gravel (SP-SC)	Poorly Graded Sand with Silt (SP-SM)	Poorly Graded Sand with Silt and Gravel (SP-SM)	Poorly Graded Sand with Gravel (SP)
Well-Graded Sand (SW)	Well-Graded Sand with Clay (SW-SC)	Well-Graded Sand with Clay and Gravel (SW-SC)	Well-Graded Sand with Silt (SW-SM)	Well-Graded Sand with Silt and Gravel (SW-SM)
Well-Graded Sand with Gravel (SW)				

NOTE:
Some historical locations may not have stick figures in the profile view due to:
1. **Incomplete data.**
2. **Available exploration on the plans and stick logs show comparable stratigraphy as historical explorations and are therefore not included due to limited space. However, all historical explorations are included in the GDR.**

Boring Information



CPT Information

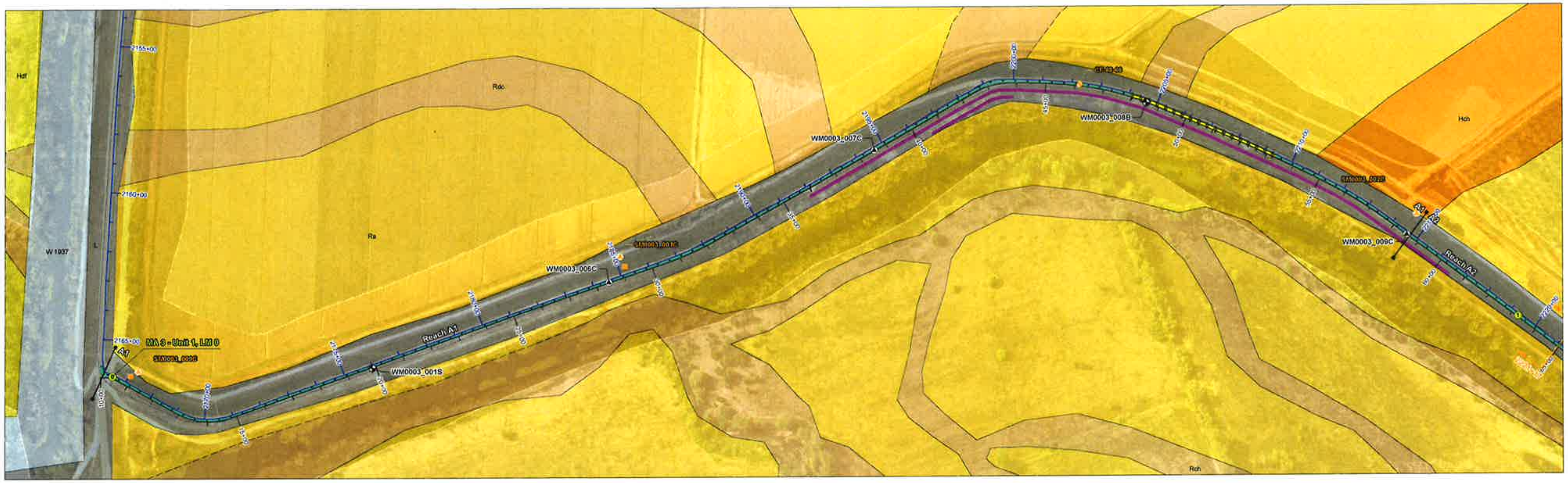


FRWL Project Plan Views and Stick Log Figures
Plate Legend

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A2

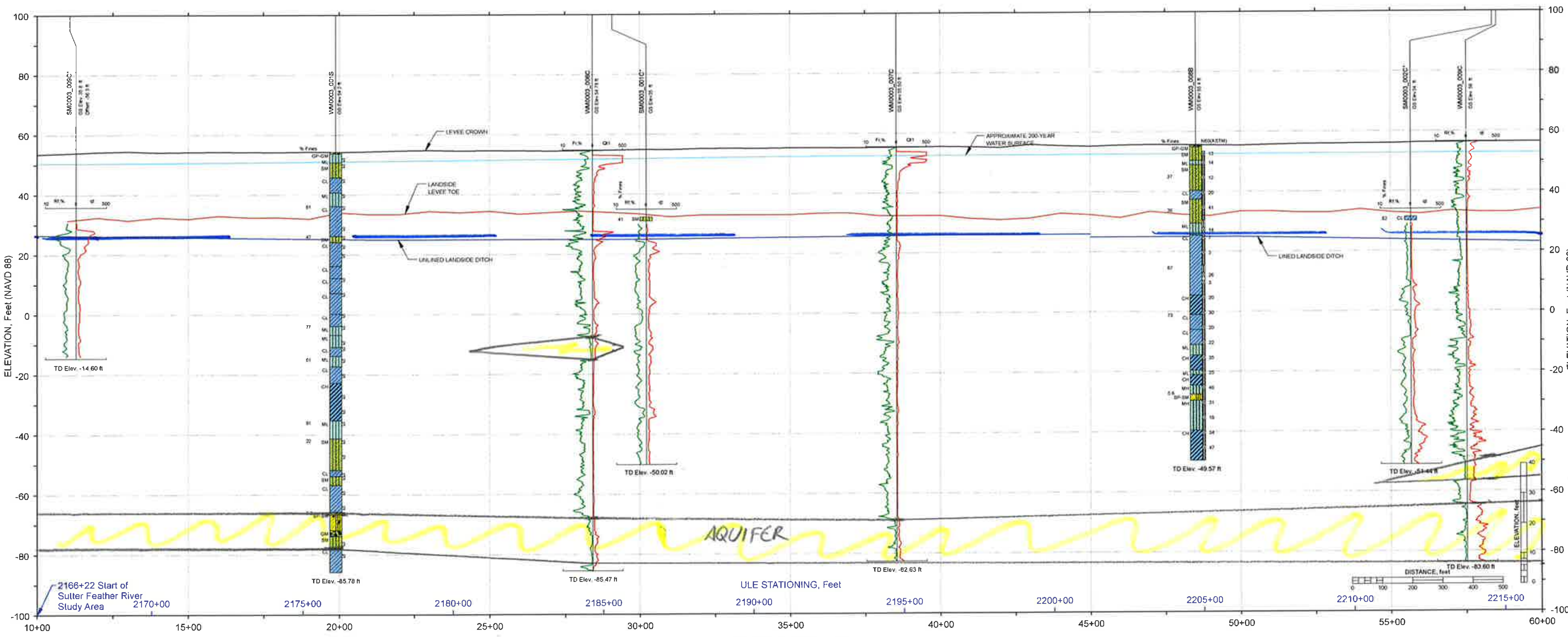


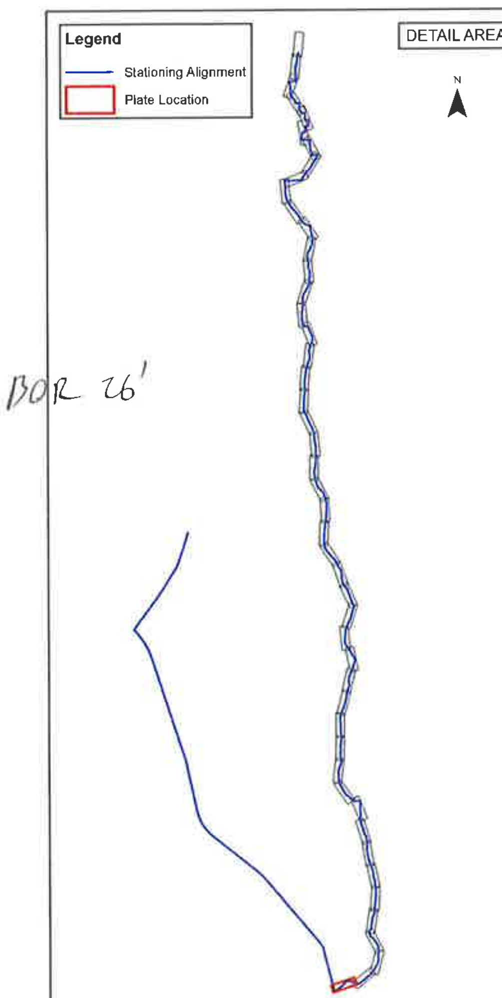
N

0 100 200
Feet

1 inch equals 200 feet

NOTES:
1. These Plan and Profile plates were adapted from Sutter Butte Flood Control Agency (SBFCA) Geotechnical Design Recommendation Report (GDRR) Plan and Profile Plates.
2. Elevations of levee crown, landside toe, and ditch inverts are approximate.
3. Historical borings in the profile are denoted by an asterisk (*) after the boring name. Historical boring locations and profiles are based on available information. Some historic explorations are shown on the plan but not in the profile.
4. Historical exploration symbols may represent a boring, CPT, or other exploration type.
5. Refer to the preceding P1GDR and/or SGDR for the Sutter Study Area and SBFCA GDR for a full understanding of the historical exploration information and data to assist with interpreting the information within this GER.
6. USCS classification labels are not presented on the profiles for soil lenses (thickness less than 1.5 ft).
7. Where multiple exploration symbols overlap, see labels for clarification.
8. The information provided in these Plan and Profile plates has been compiled from a variety of sources. The URS team does not attest to the accuracy, completeness, or reliability of geotechnical exploration and other subsurface data by others that are included or referenced in these plates.





Department of Water Resources
Division of Flood Management

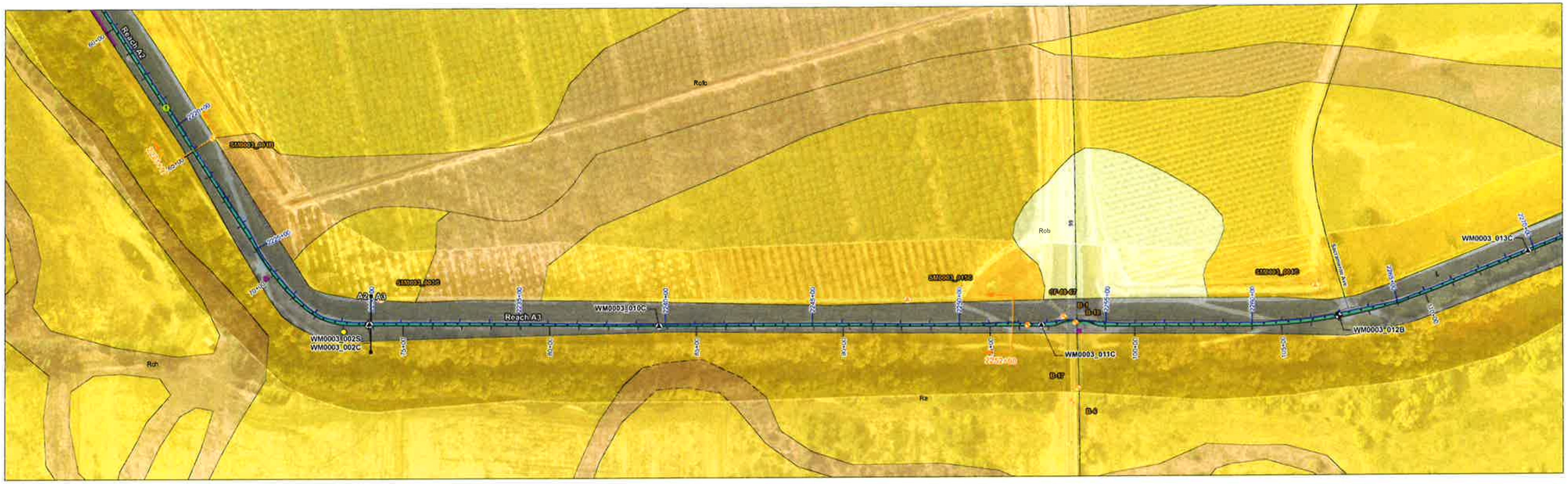
URS
in association with
GEI

Sutter Feather River Plan and Profile
Station 2166+22 to Station 2216+22

URBAN LEVEE EVALUATIONS

Plate
3

Geotechnical Evaluation Report

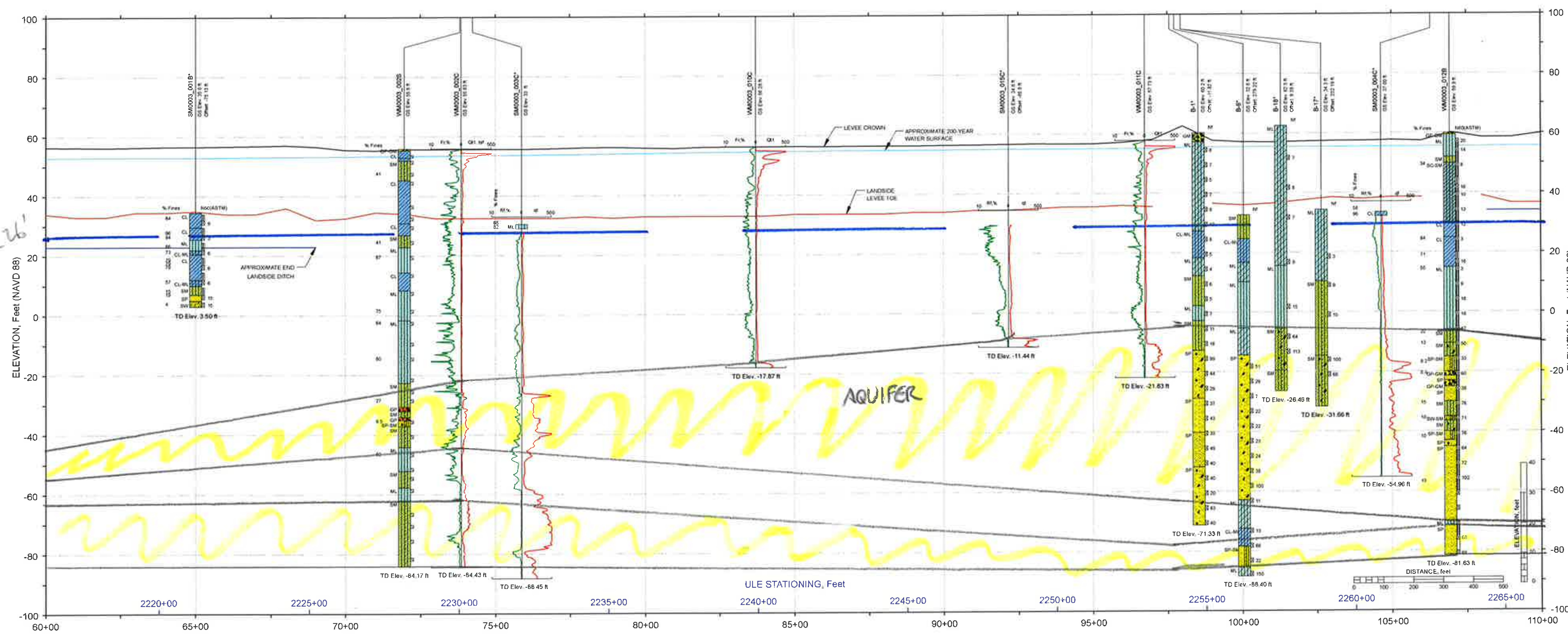


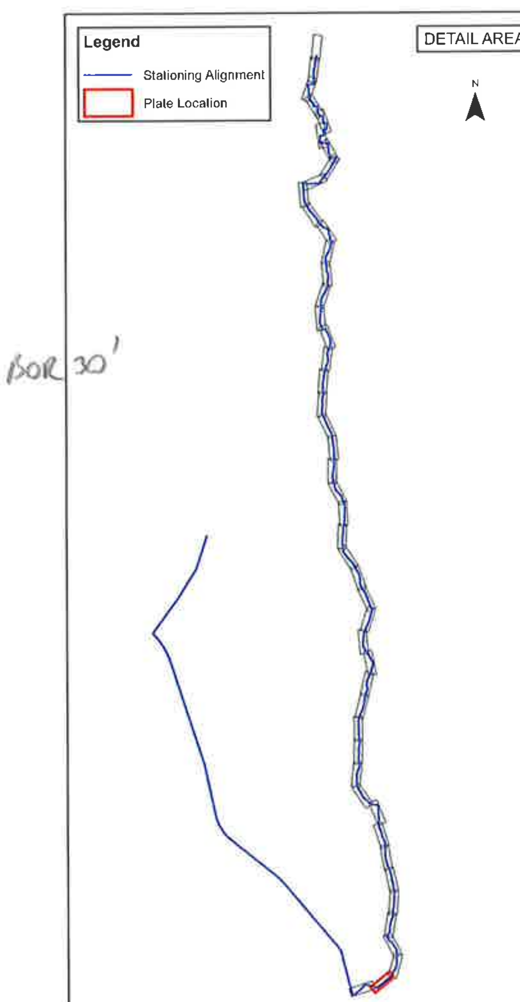
N
0 100 200
Feet

1 inch equals 200 feet

NOTES:

1. These Plan and Profile plates were adapted from Sutter Butte Flood Control Agency (SBFCA) Geotechnical Design Recommendation Report (GDRR) Plan and Profile Plates.
2. Elevations of levee crown, landside toe, and ditch inverts are approximate.
3. Historical borings in the profile are denoted by an asterisk (*) after the boring name. Historical boring locations and profiles are based on available information. Some historic explorations are shown on the plan but not in the profile.
4. Historical exploration symbols may represent a boring, CPT, or other exploration type.
5. Refer to the preceding P1GDR and/or SGDR for the Sutter Study Area and SBFCA GDR for a full understanding of the historical exploration information and data to assist with interpreting the information within this GER.
6. USCS classification labels are not presented on the profiles for soil lenses (thickness less than 1.5 ft).
7. Where multiple exploration symbols overlap, see labels for clarification.
8. The information provided in these Plan and Profile plates has been compiled from a variety of sources. The URS team does not attest to the accuracy, completeness, or reliability of geotechnical exploration and other subsurface data by others that are included or referenced in these plates.





Department of Water Resources
Division of Flood Management

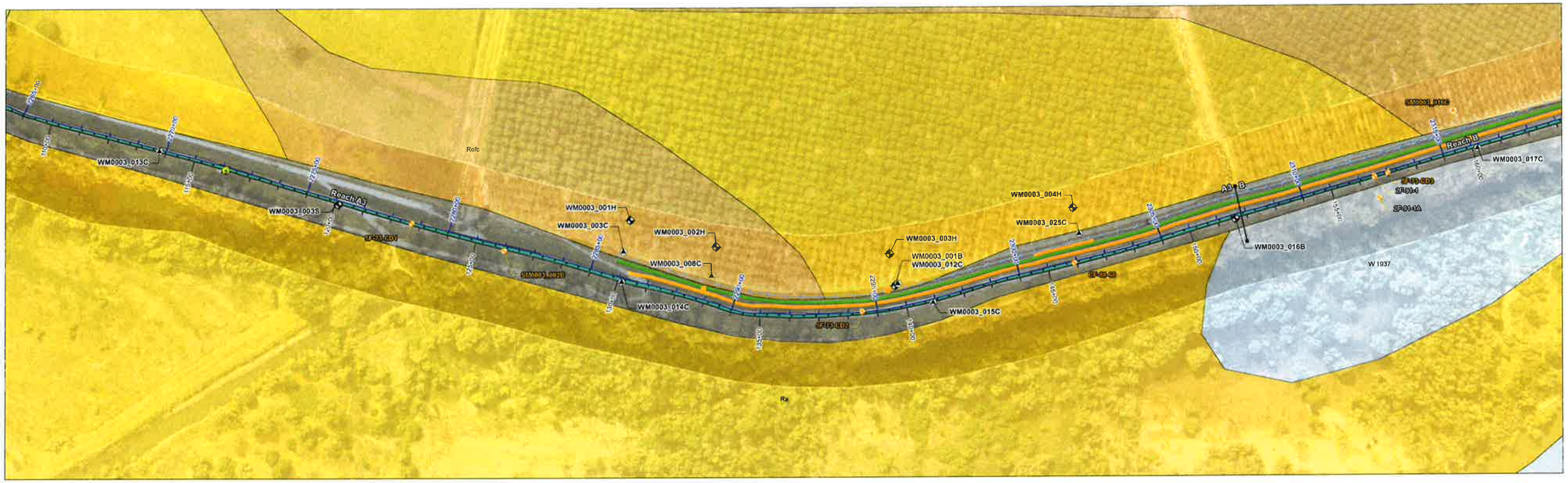
URS
in association with:
GEI

Sutter Feather River Plan and Profile
Station 2216+22 to Station 2266+22

URBAN LEVEE EVALUATIONS

Plate 4

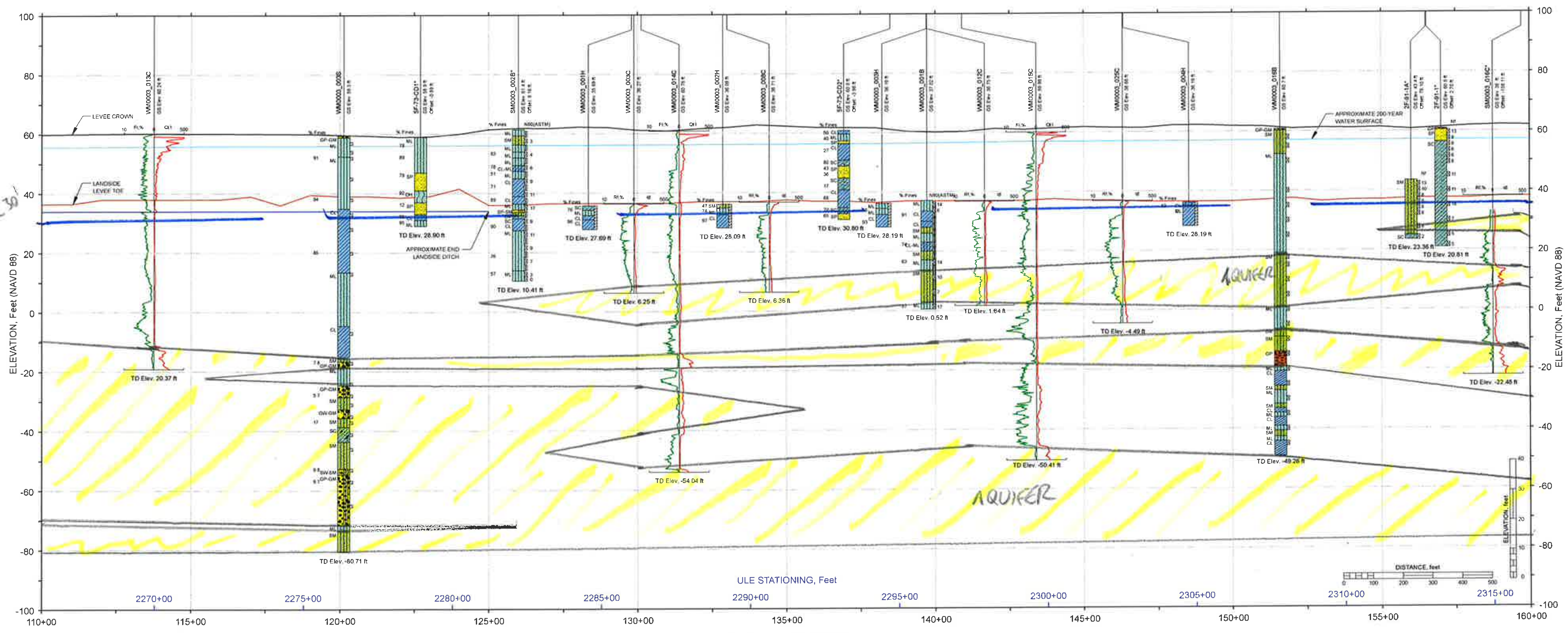
Geotechnical Evaluation Report

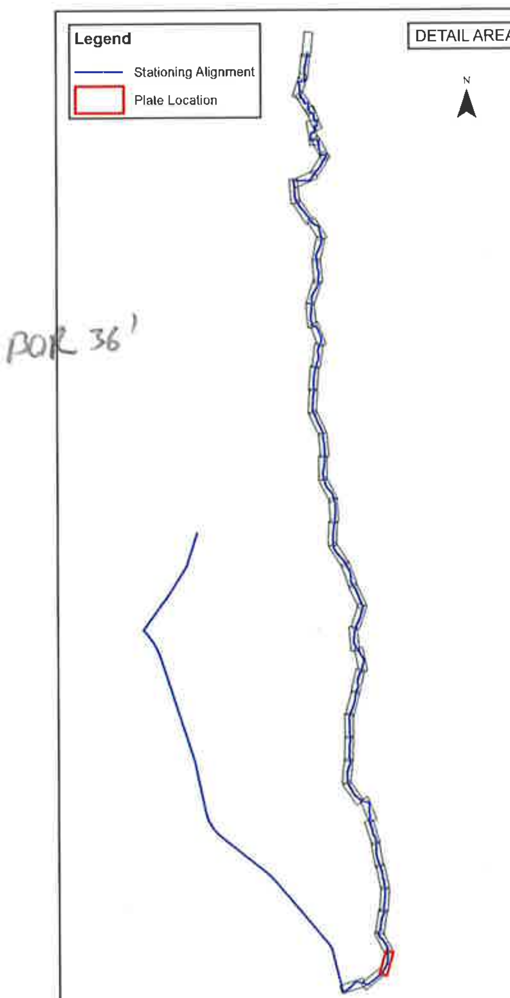


1 inch equals 200 feet

NOTES:

1. These Plan and Profile plates were adapted from Sutter Butte Flood Control Agency (SBFCA) Geotechnical Design Recommendation Report (GDRR) Plan and Profile Plates.
2. Elevations of levee crown, landside toe, and ditch inverts are approximate.
3. Historical borings in the profile are denoted by an asterisk (*) after the boring name. Historical boring locations and profiles are based on available information. Some historic explorations are shown on the plan but not in the profile.
4. Historical exploration symbols may represent a boring, CPT, or other exploration type.
5. Refer to the preceding P1GDR and/or SGDR for the Sutter Study Area and SBFCA GDR for a full understanding of the historical exploration information and data to assist with interpreting the information within this GER.
6. USCS classification labels are not presented on the profiles for soil lenses (thickness less than 1.5 ft).
7. Where multiple exploration symbols overlap, see labels for clarification.
8. The information provided in these Plan and Profile plates has been compiled from a variety of sources. The URS team does not attest to the accuracy, completeness, or reliability of geotechnical exploration and other subsurface data by others that are included or referenced in these plates.





Department of Water Resources
Division of Flood Management

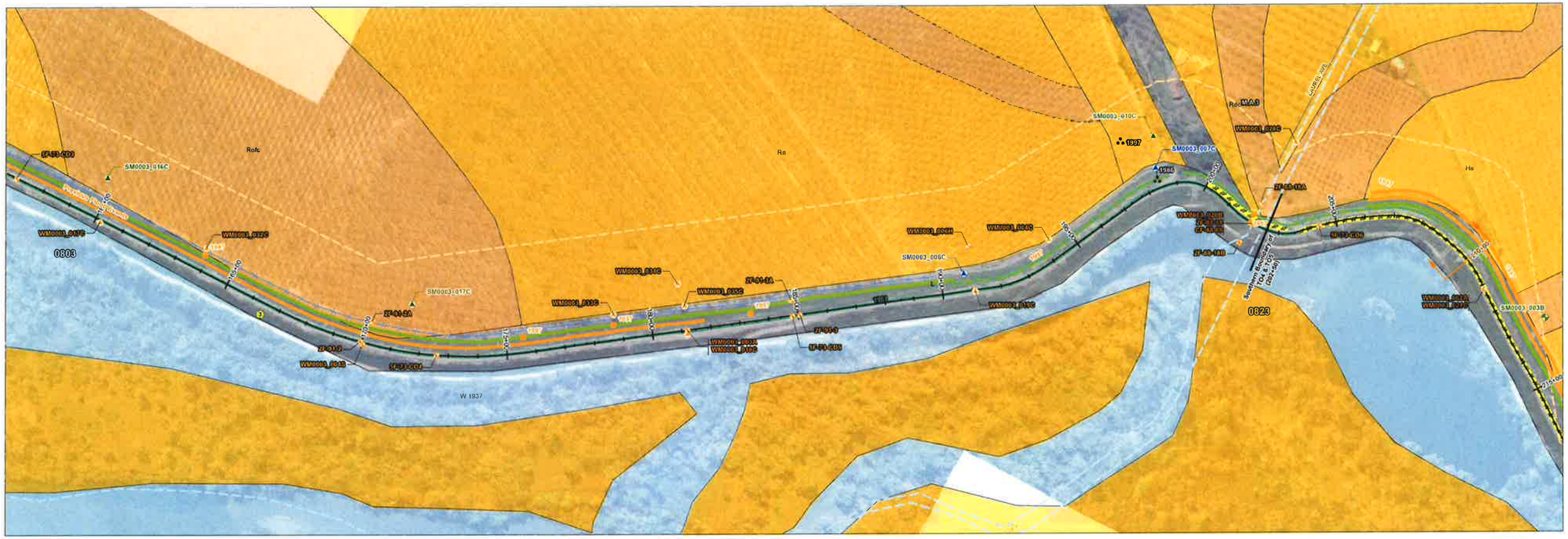
URS in association with: GEI

Sutter Feather River Plan and Profile
Station 2266+22 to Station 2316+22

URBAN LEVEE EVALUATIONS

Plate 5

Geotechnical Evaluation Report



NOTES:
1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LiDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
2. The water surface elevations are based on information provided by Peterson Brustad, Inc. in their July 26, 2012 report entitled "Design Water Surface Profiles for the Feather River West Levee Rehabilitation Project Addendum #1".
3. Locations of explorations are approximate. Stick logs represent general soil conditions encountered at the time of exploration. For more detailed information on the materials encountered, refer to boring and CPT logs in the Geotechnical Data Report for the FRWL Project. No warranty is provided regarding the continuity of soil conditions between individual explorations.
4. When reported, N_{60}(ASTM), refers to N_{60}(ASTM) = N_{field} * Hammer Efficiency (%). See Geotechnical Data Report for the FRWL Project for hammer efficiency data for individual borings.
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7. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
9. Surficial geology was mapped at 1:20,000 scale. (Source: SGDR for DWR ULE Project, URS,2010).
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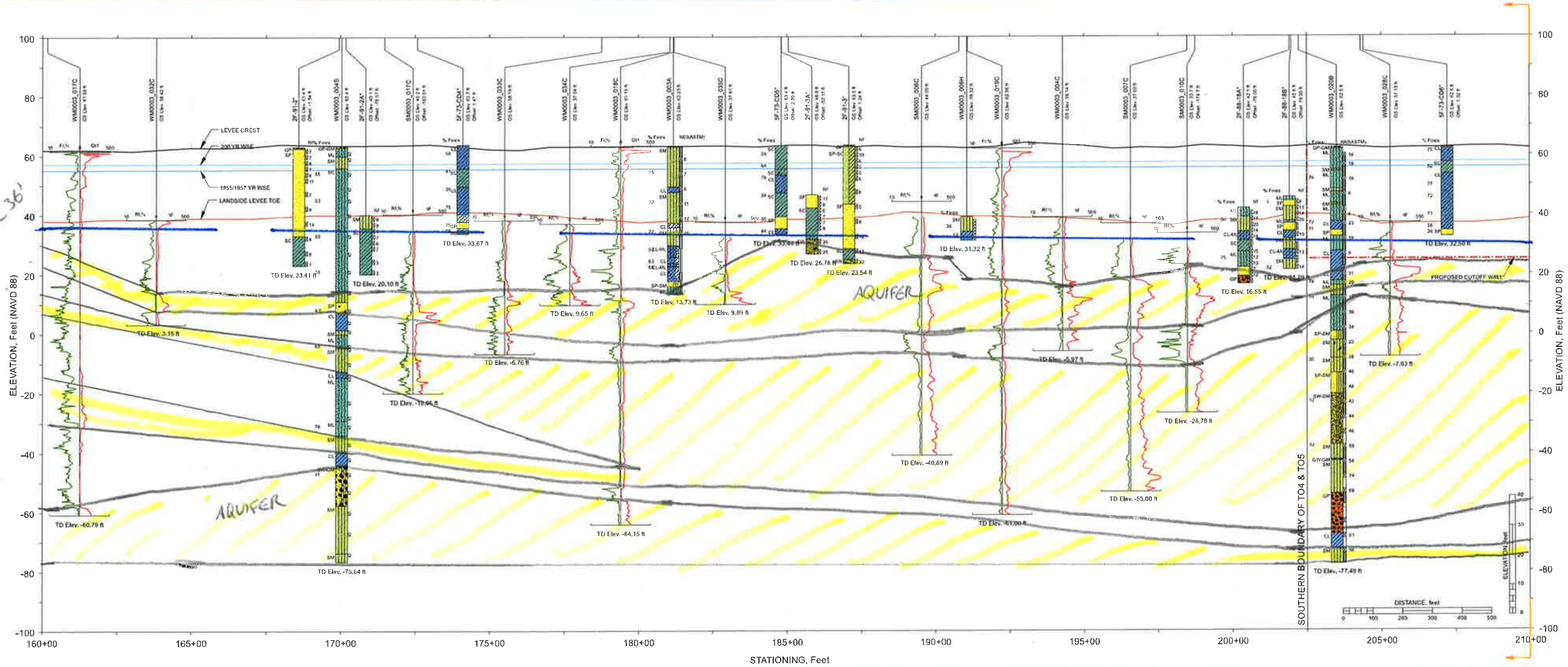
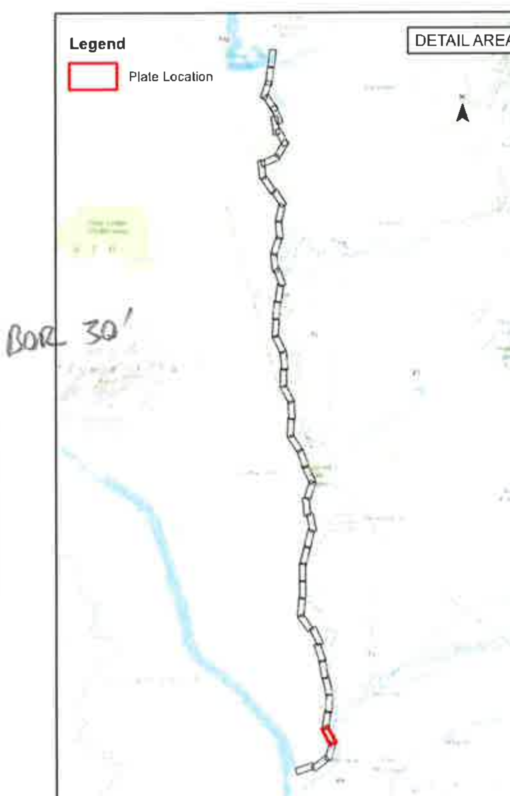
12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.





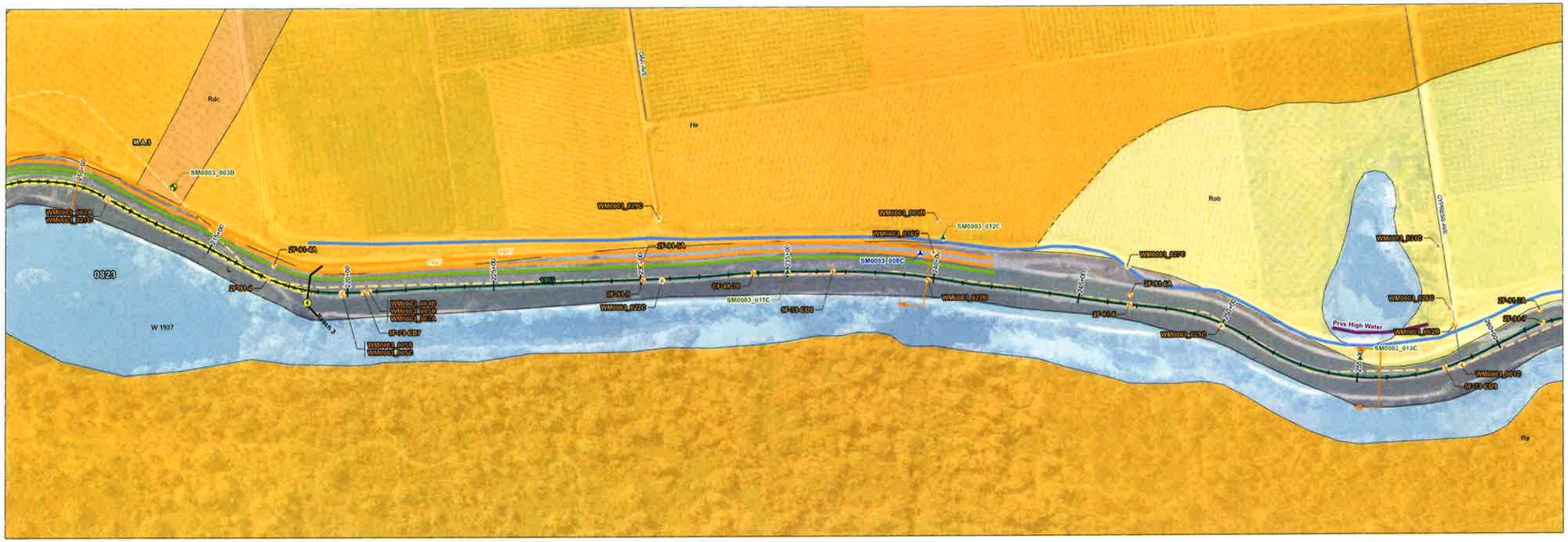
FRWL Project Plan Views and Stick Log Figures

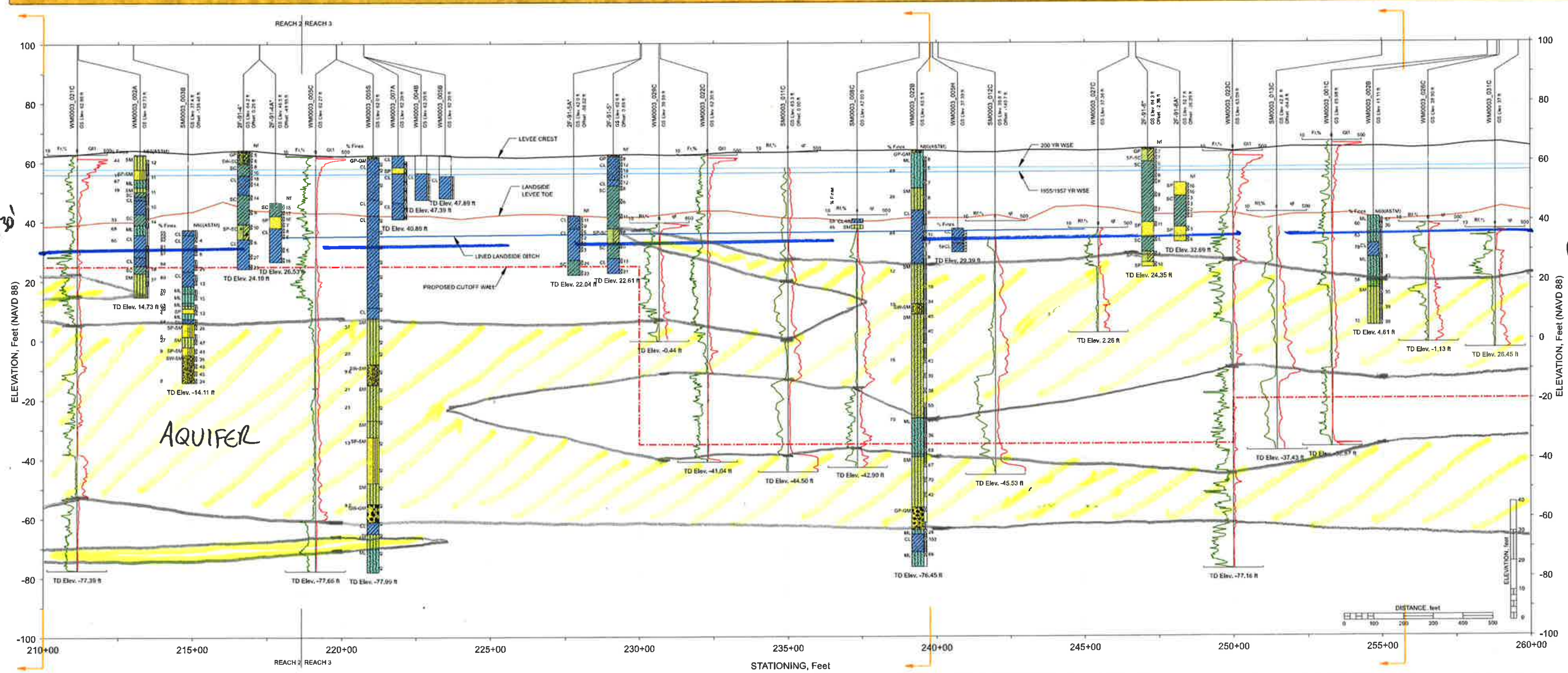
FRWL Project: Station 160+00 to Station 210+00

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A6





NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LIDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
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8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 Inches).
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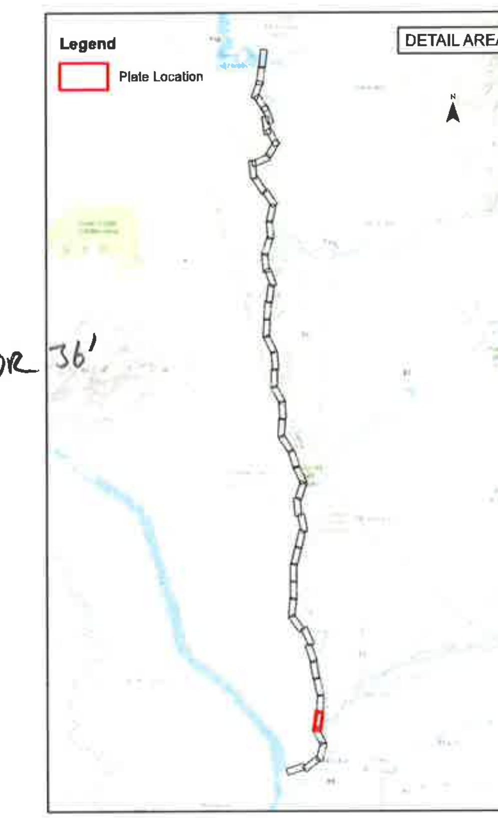
12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.



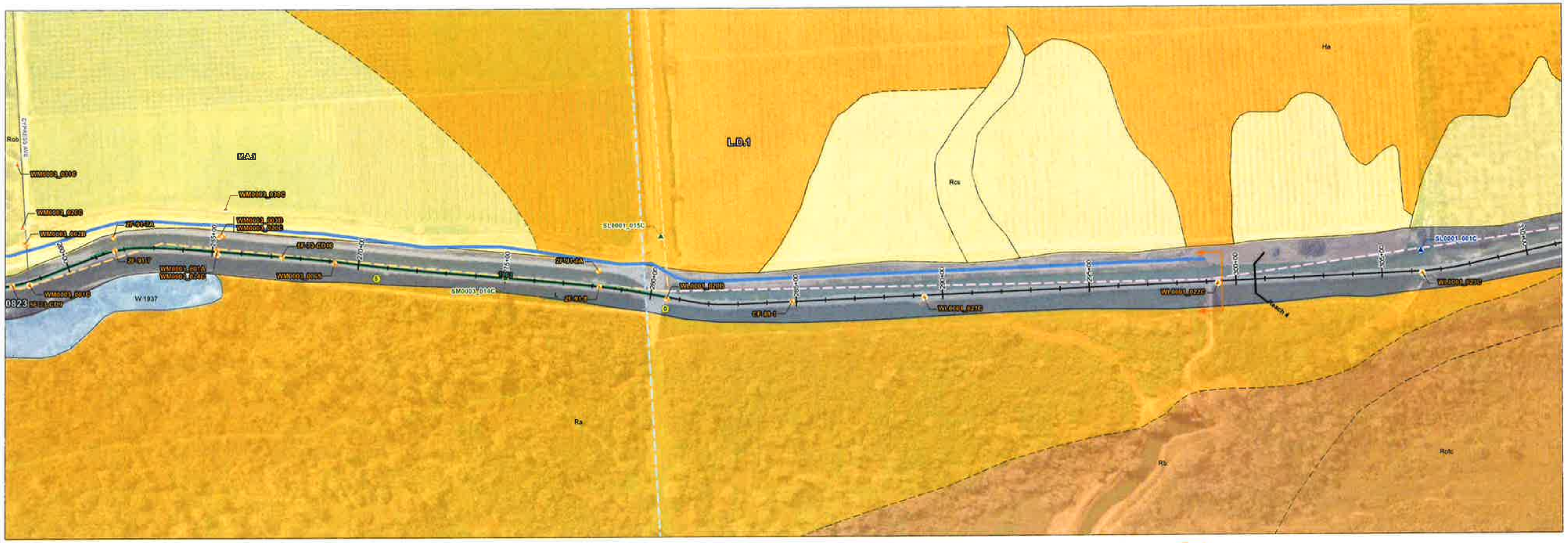
FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 210+00 to Station 260+00

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A7



Feet

NOTES:

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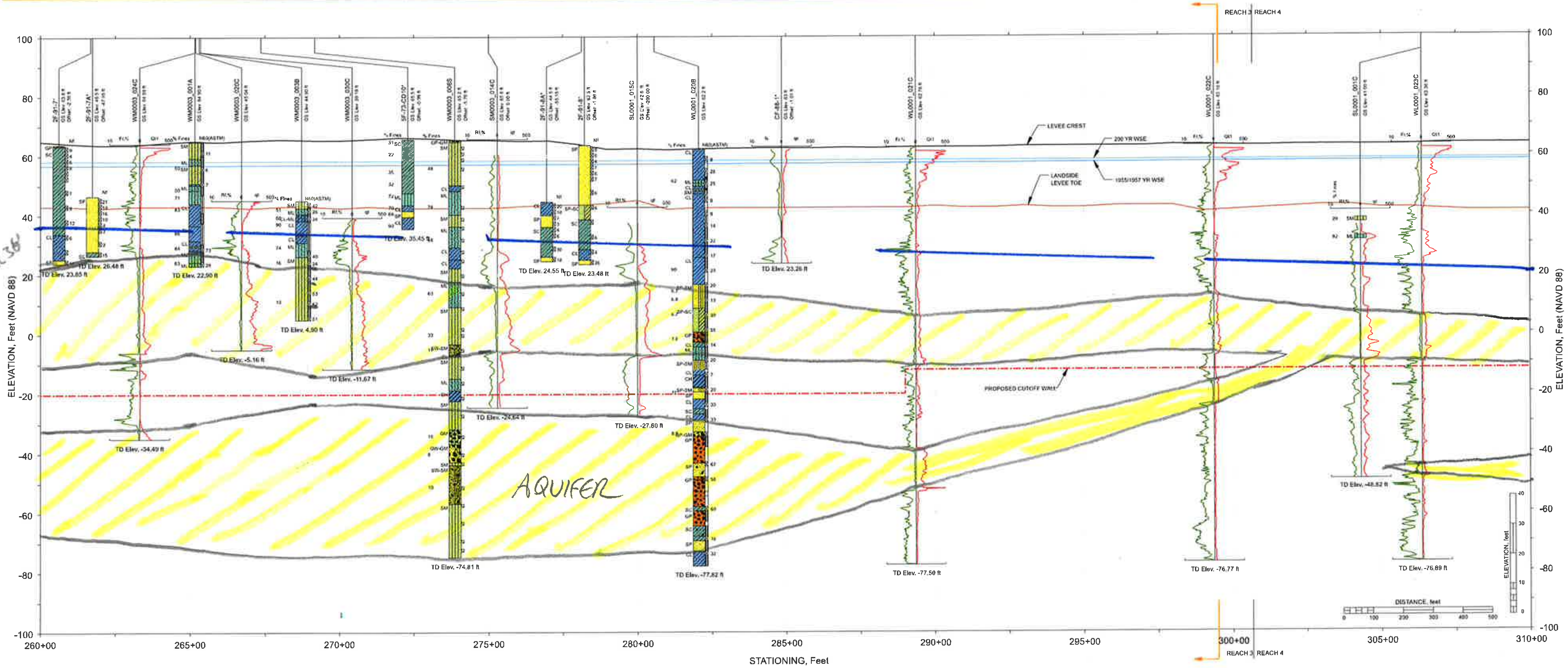
12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.



Legend

Plate Location

DETAIL AREA

FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 260+00 to Station 310+00

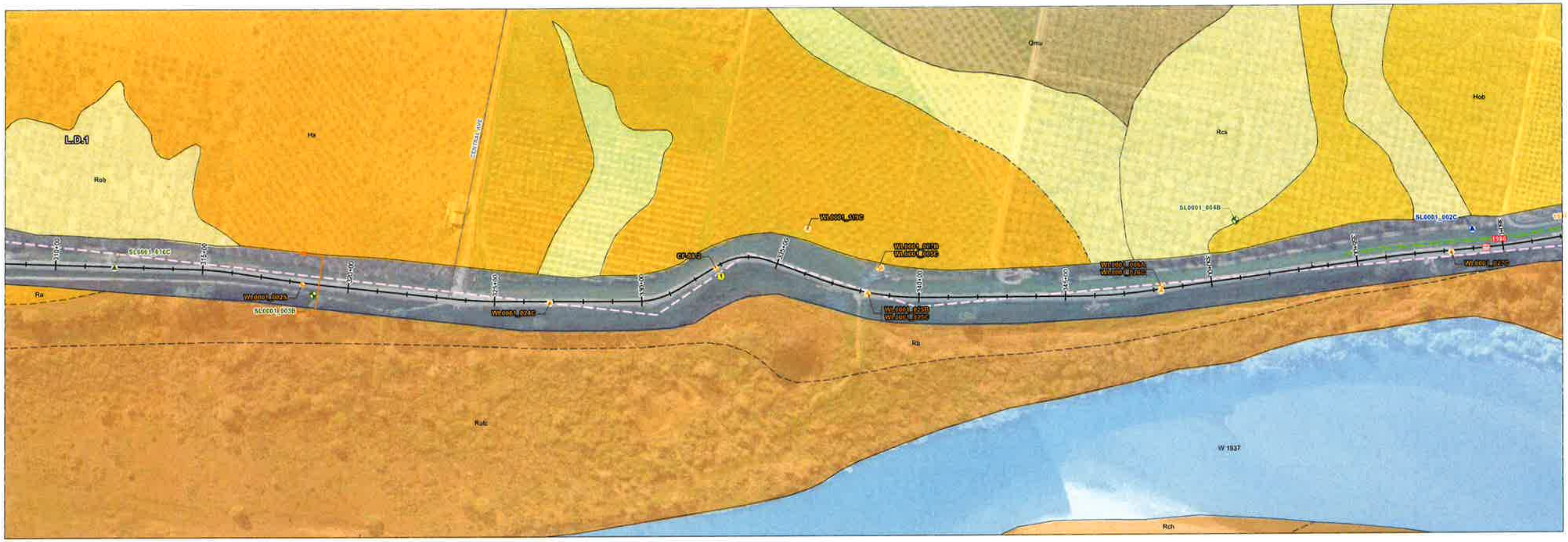
URS

Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency

FEATHER RIVER WEST LEVEE PROJECT

Appendix A8



N

0 100 200

Feet

NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LIDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
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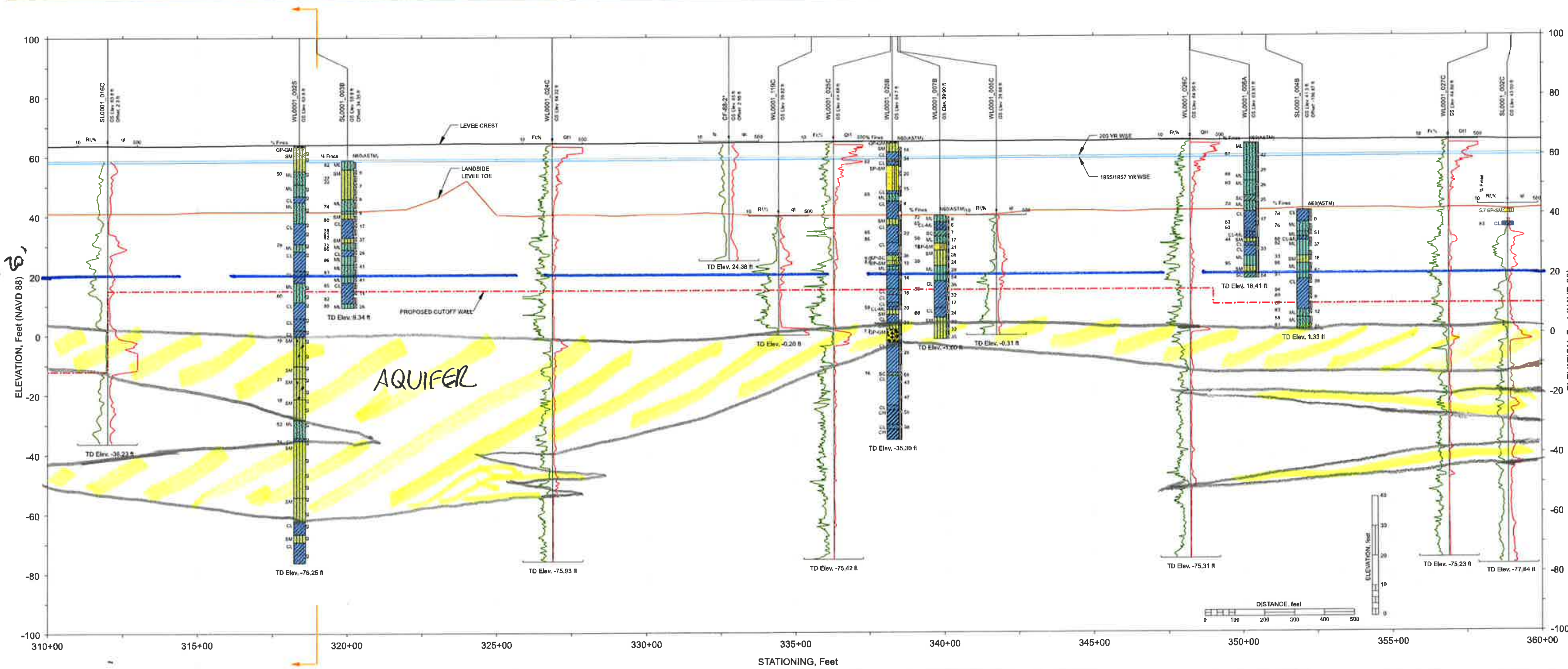
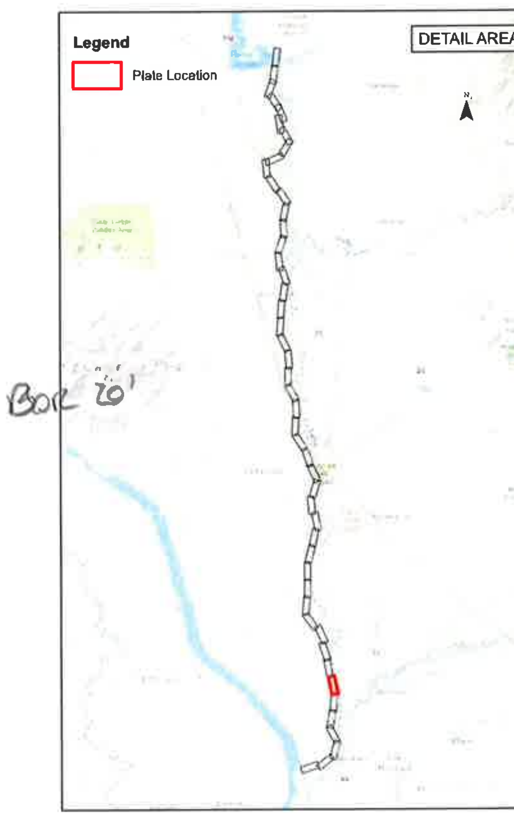




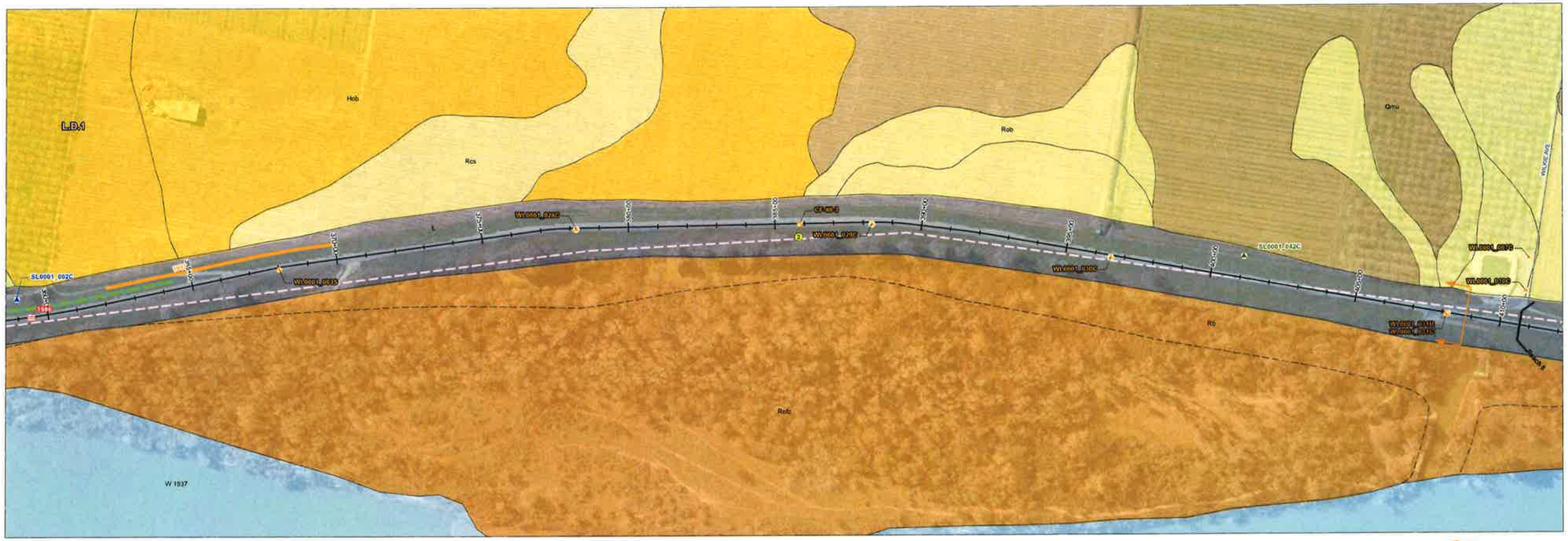
FRWL Project Plan Views and Stick Log Figures

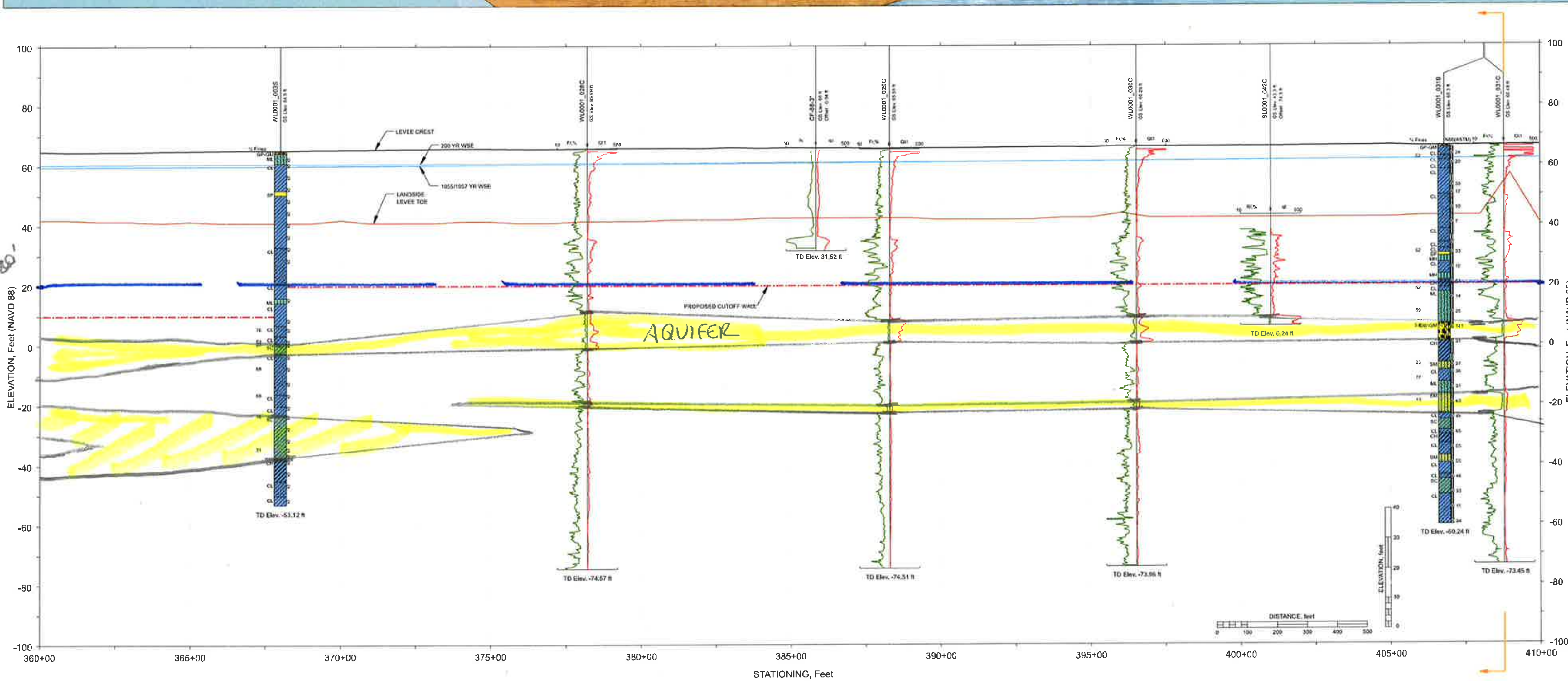
FRWL Project: Station 310+00 to Station 360+00

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A9





Feet

NOTES:

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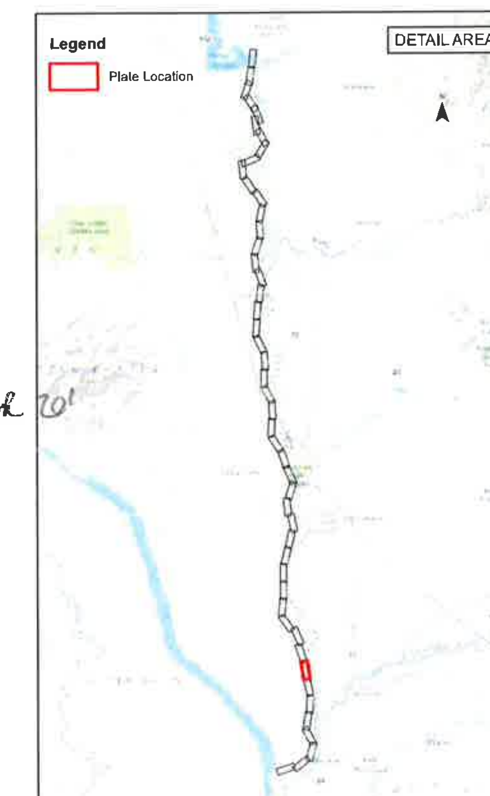


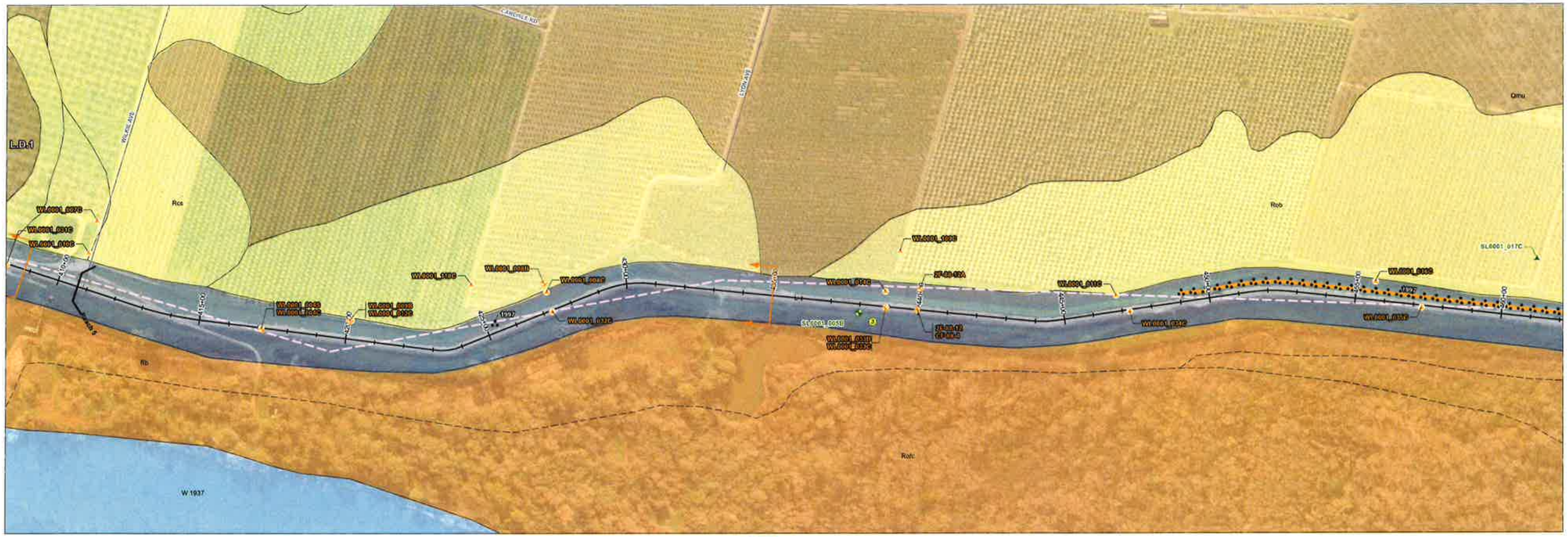
FRWL Project Plan Views and Stick Log Figures

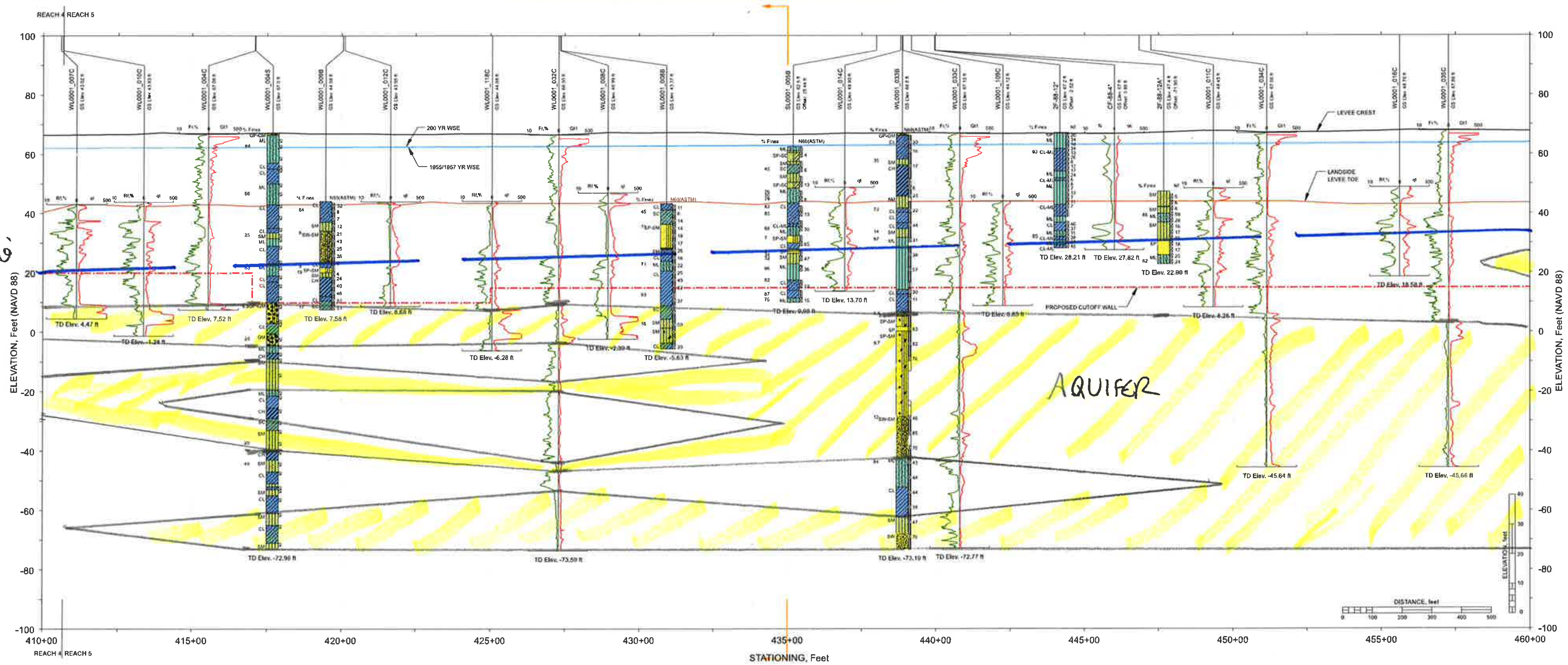
FRWL Project: Station 360+00 to Station 410+00

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A10





0 100 200
Feet

NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LiDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
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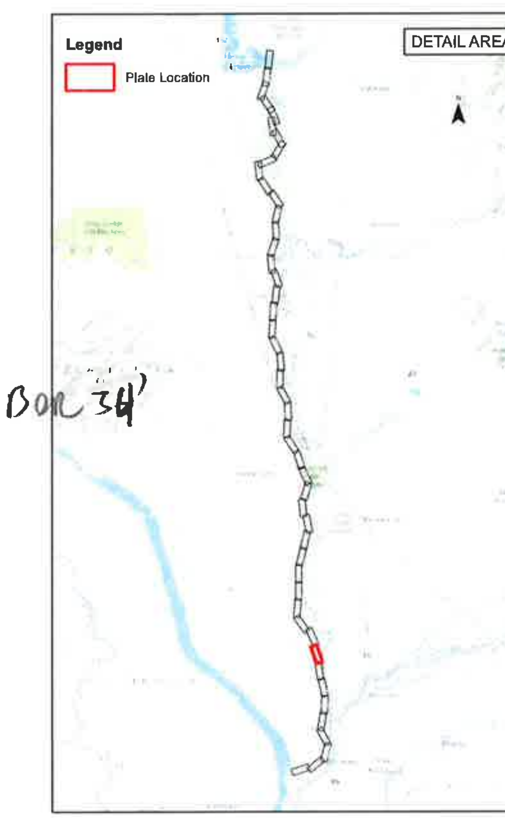


FRWL Project Plan Views and Stick Log Figures

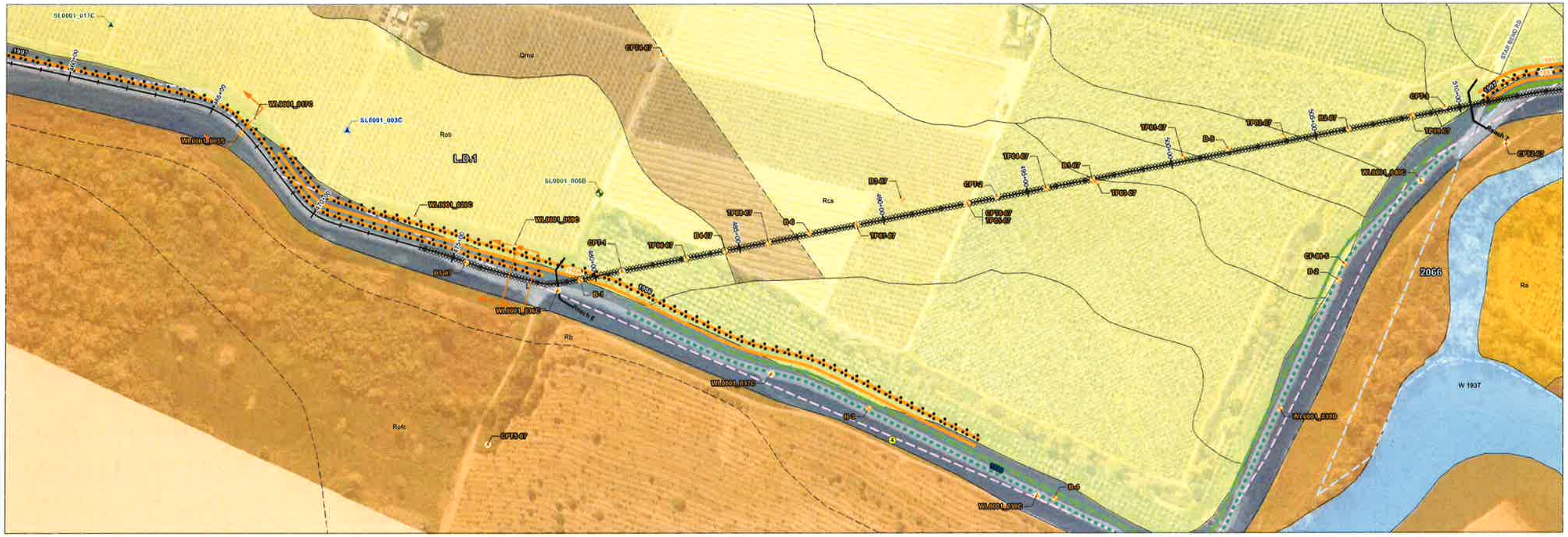
FRWL Project: Station 410+00 to Station 460+00

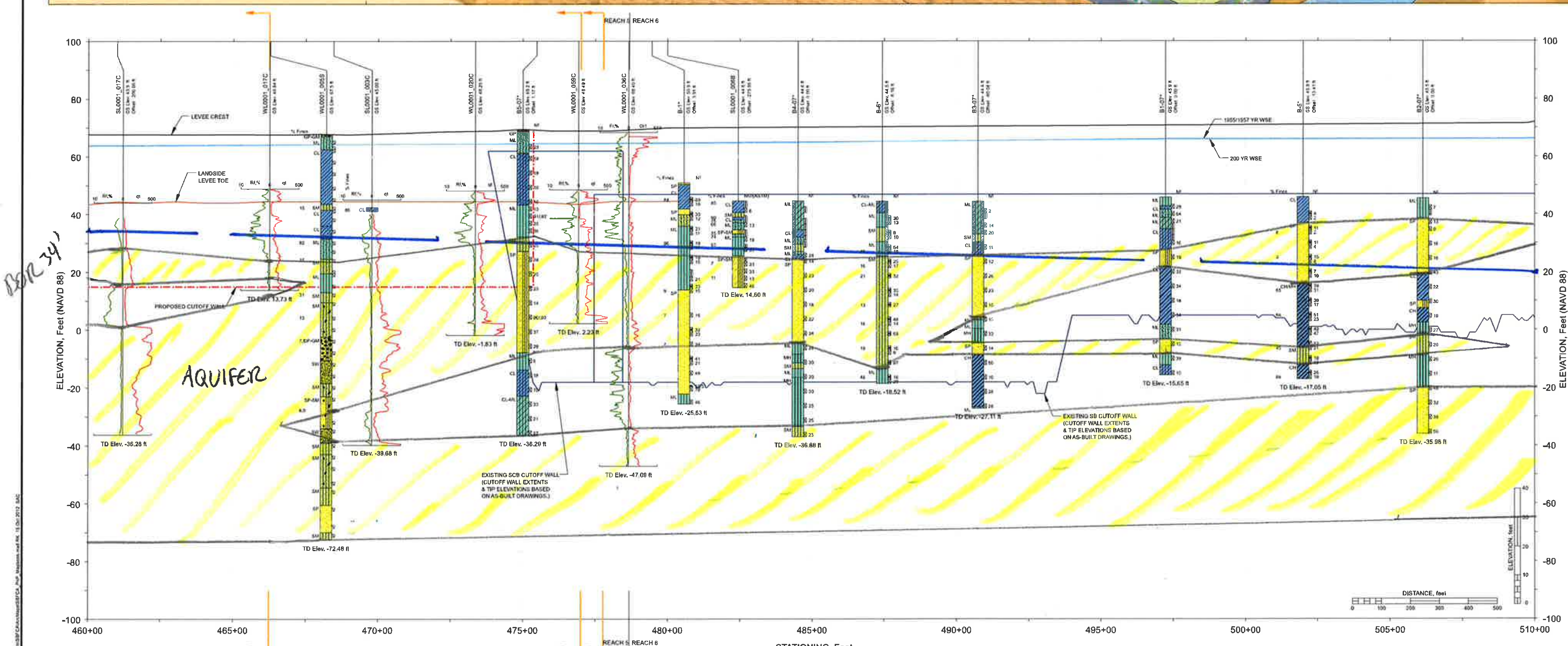
URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A11

PART OF NEW WALL, ALL OF EXISTING WALL CUTS OFF UPPER AQUIFER





0 100 200
Feet

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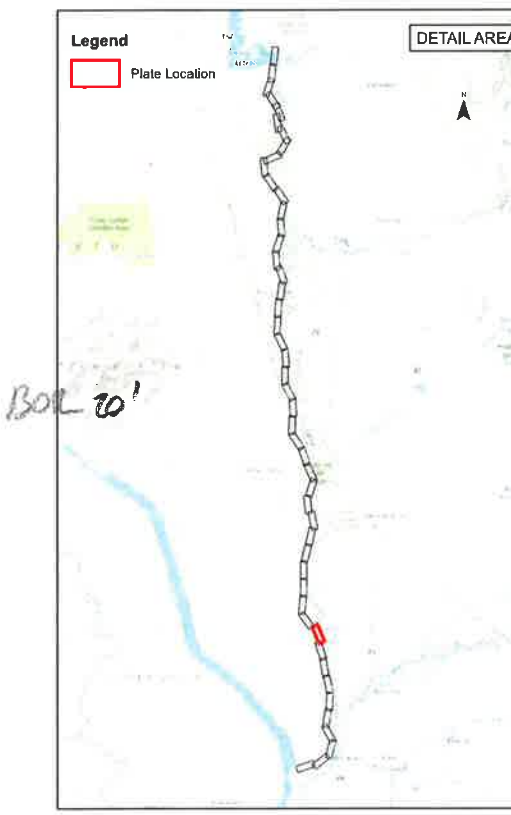


FRWL Project Plan Views and Stick Log Figures

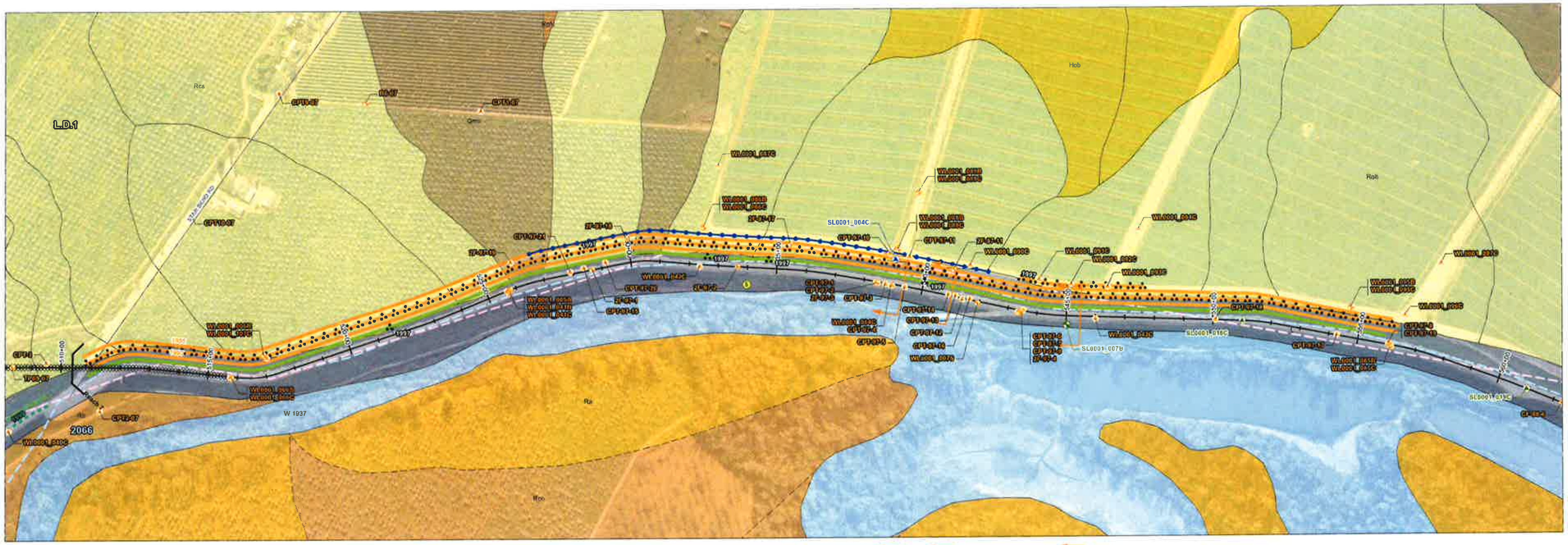
FRWL Project: Station 460+00 to Station 510+00

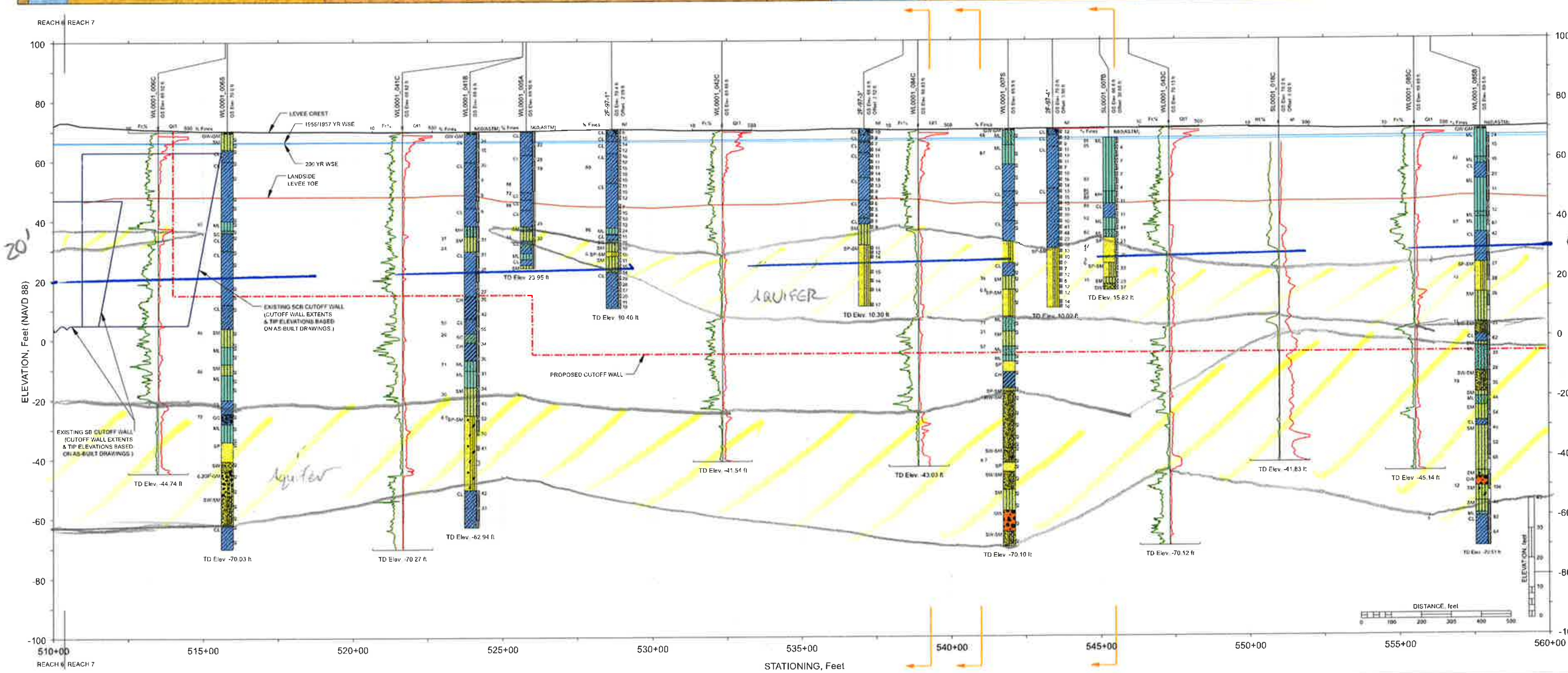
URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A12

NEW WALL CUTS OFF UPPER AQUIFER





0 100 200
Feet

NOTES:

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8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
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12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.

Legend

Plate Location

DETAIL AREA

FRWL Project Plan Views and Stick Log Figures

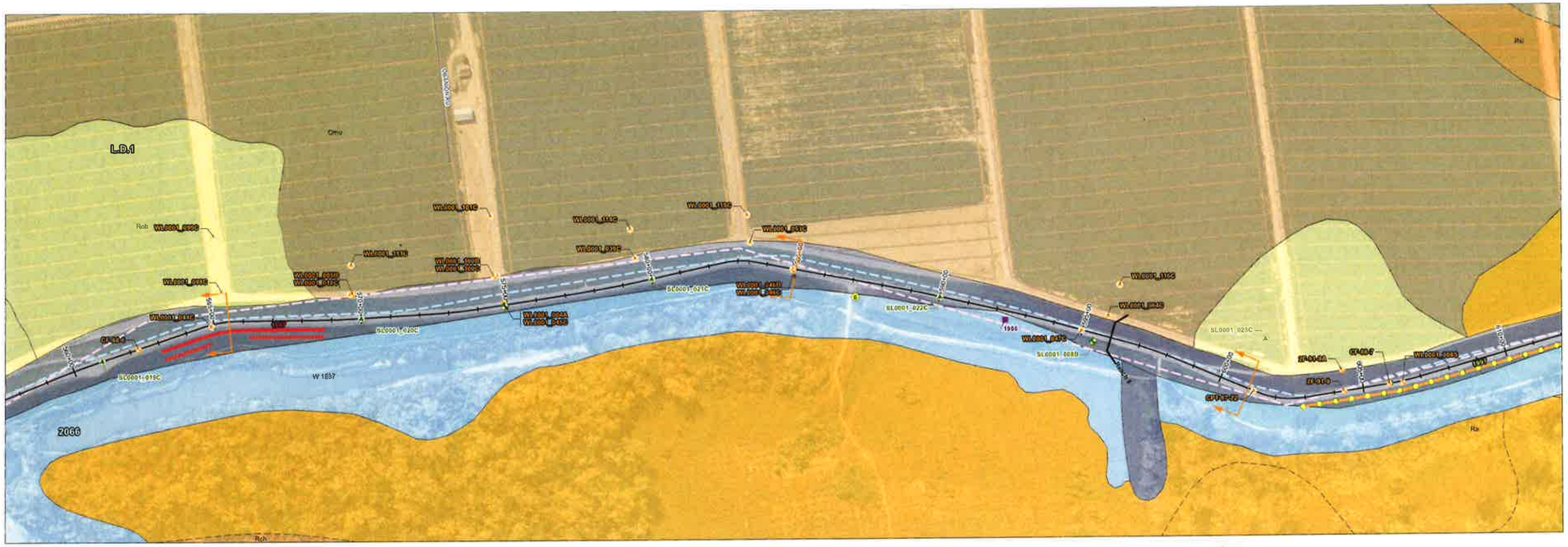
FRWL Project: Station 510+00 to Station 560+00

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A13-A

NEW WALL CUTS OFF UPPER AQUIFER TO STA. 595+00



Z

0 100 200
Feet

NOTES:
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9. Surficial geology was mapped at 1:20,000 scale. (Source: SGDR for DWR ULE Project, URS,2010).
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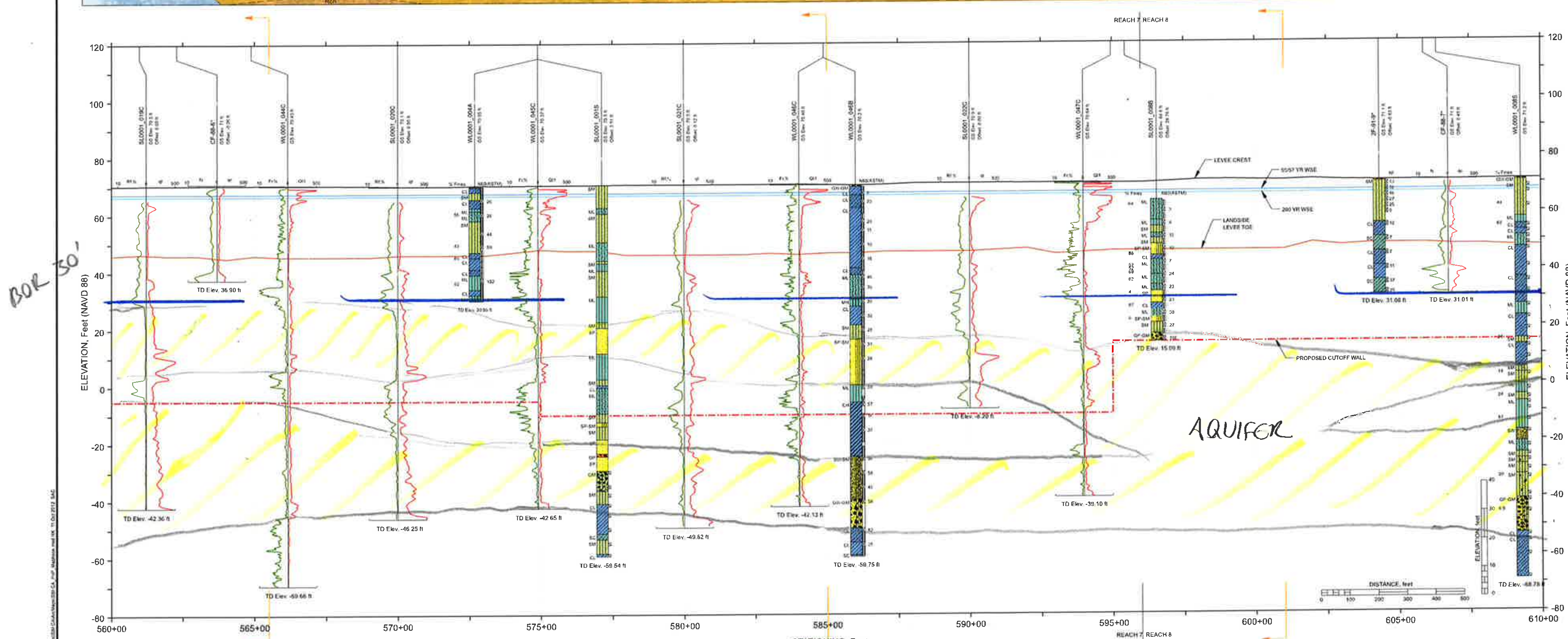
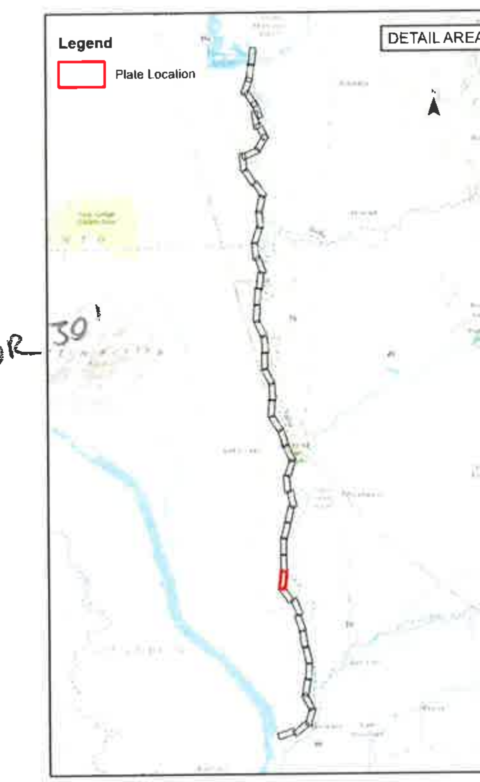
12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.





FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 560+00 to Station 610+00

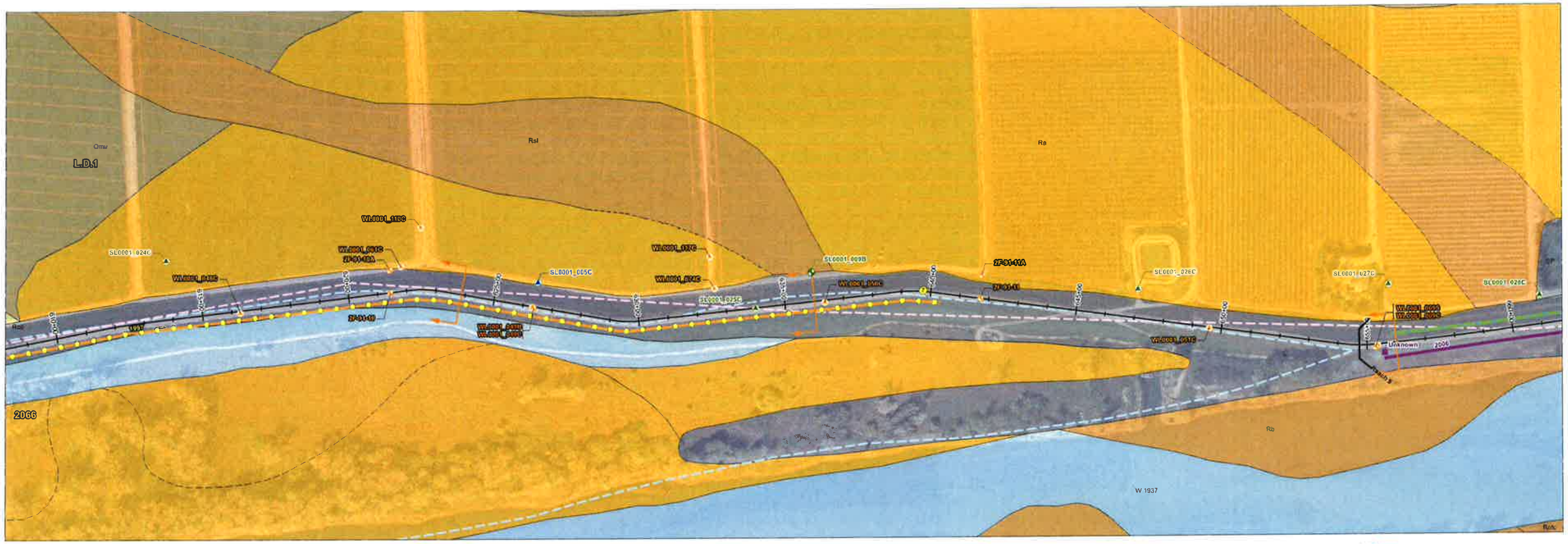
URS

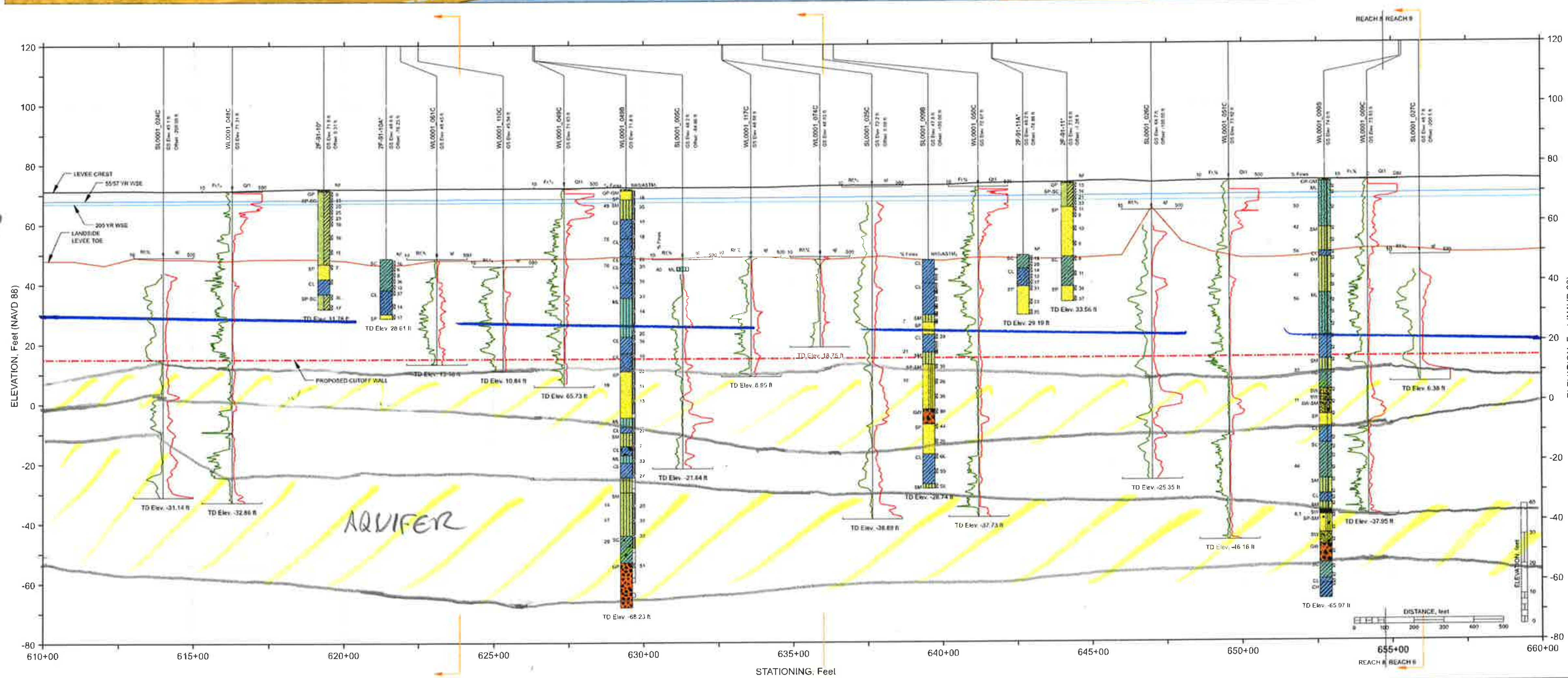
Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency

FEATHER RIVER WEST LEVEE PROJECT

Appendix A14-A





0 100 200
Feet

NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LiDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
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6. USCS classification labels are not presented on the stick logs for soil lenses (thickness less than 1.5 feet).
7. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
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12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.

FRWL Project Plan Views and Stick Log Figures

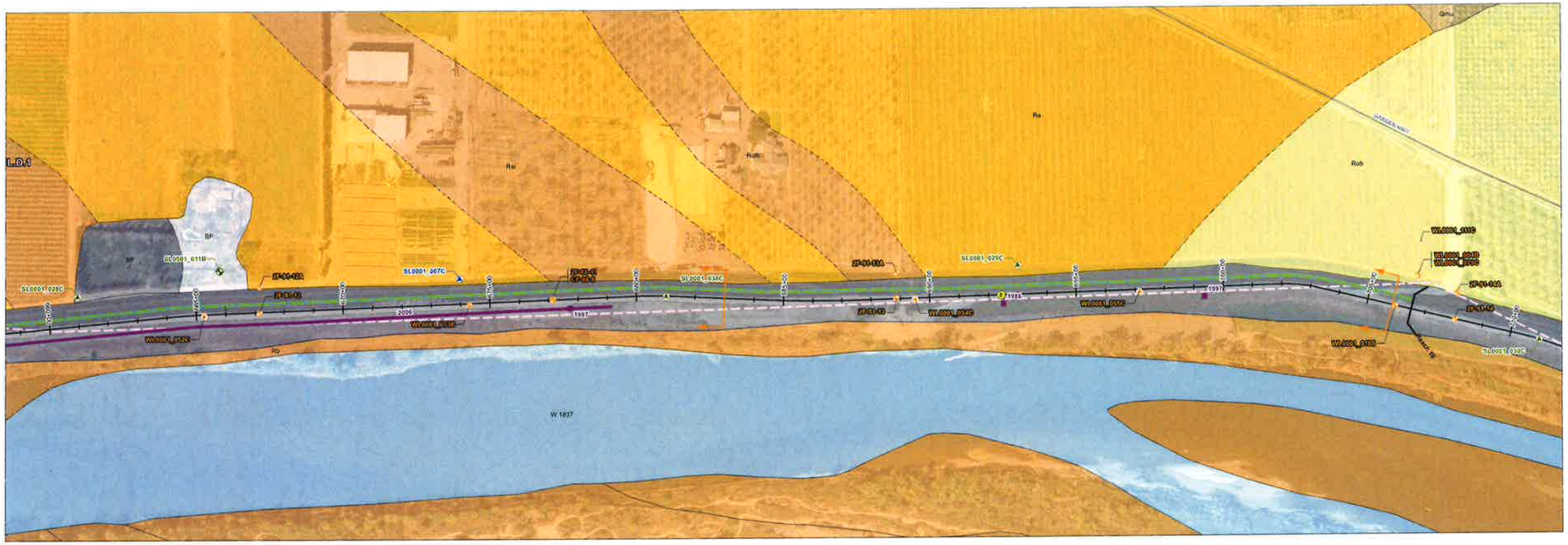
FRWL Project: Station 610+00 to Station 660+00

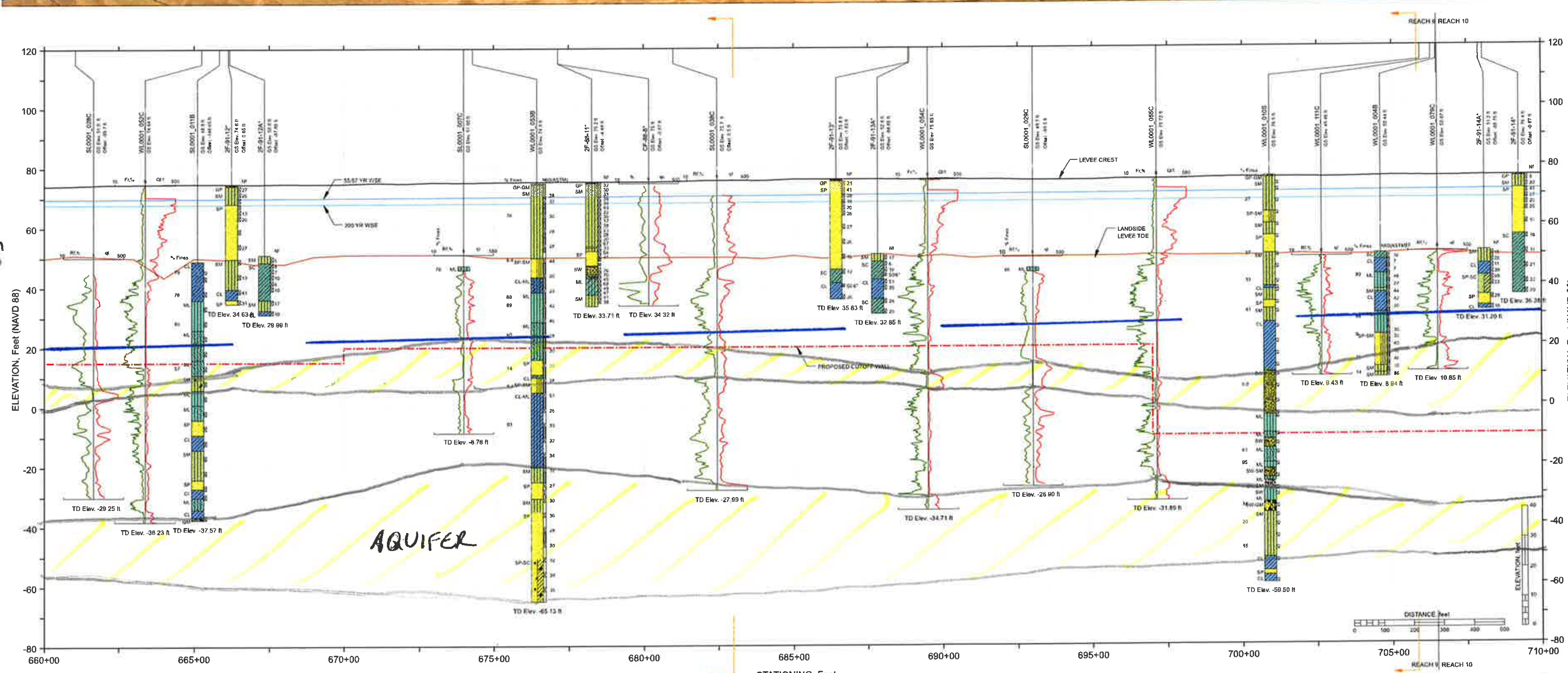
URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A15

NEW WALL CUTS OFF UPPER AQUIFER FROM ~STA. 697+00 TO 750+00





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8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
9. Surficial geology was mapped at 1:20,000 scale. (Source: SGDR for DWR ULE Project, URS,2010).
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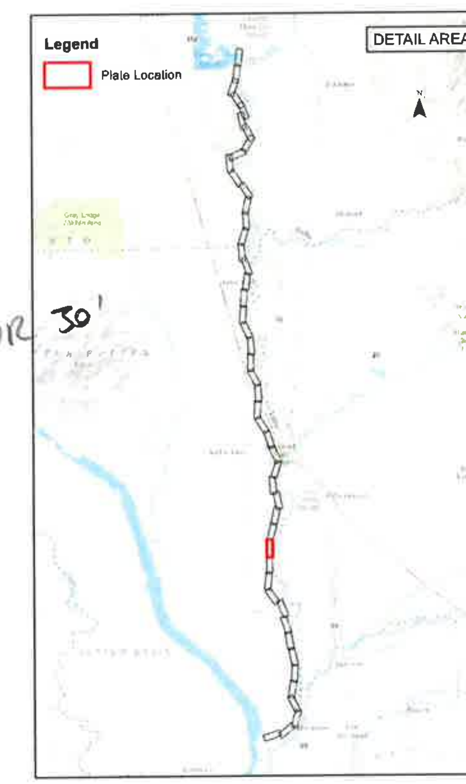
12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.



FRWL Project Plan Views and Stick Log Figures

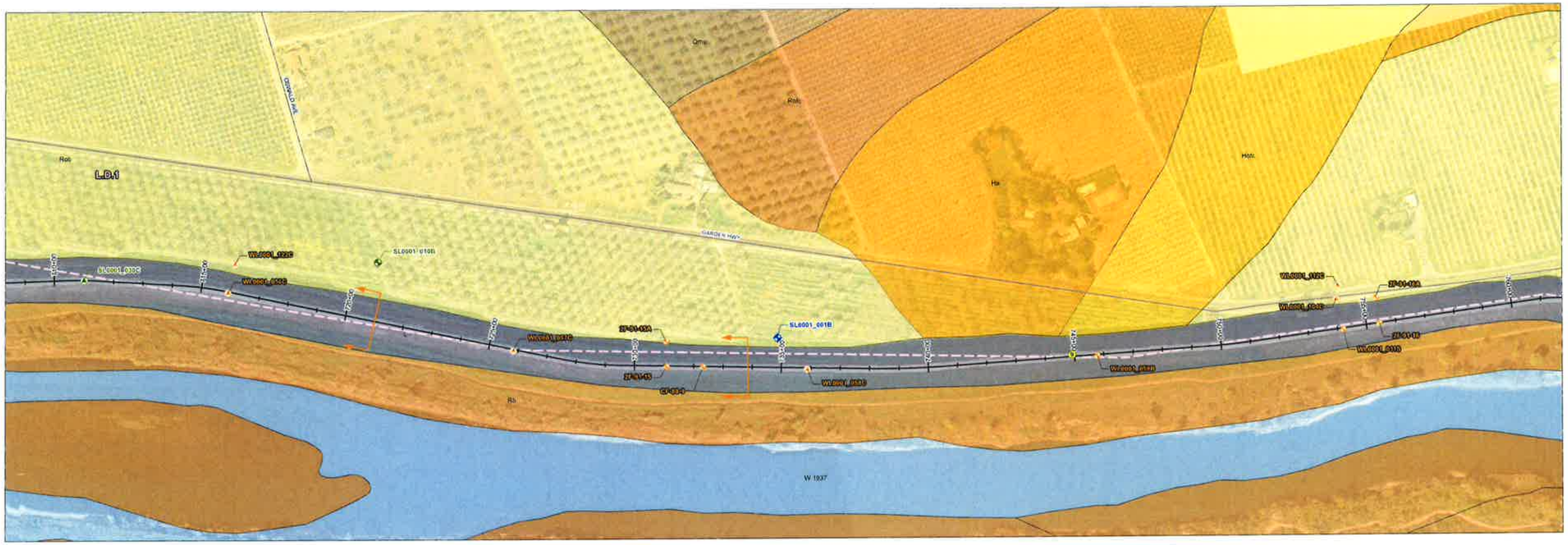
FRWL Project: Station 660+00 to Station 710+00

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency — FEATHER RIVER WEST LEVEE PROJECT

Appendix A16

NEW WALL CUTS OFF UPPER AQUIFER FROM ~ STA. 697+00 TO 750+00



0 100 200
Feet

NOTES:

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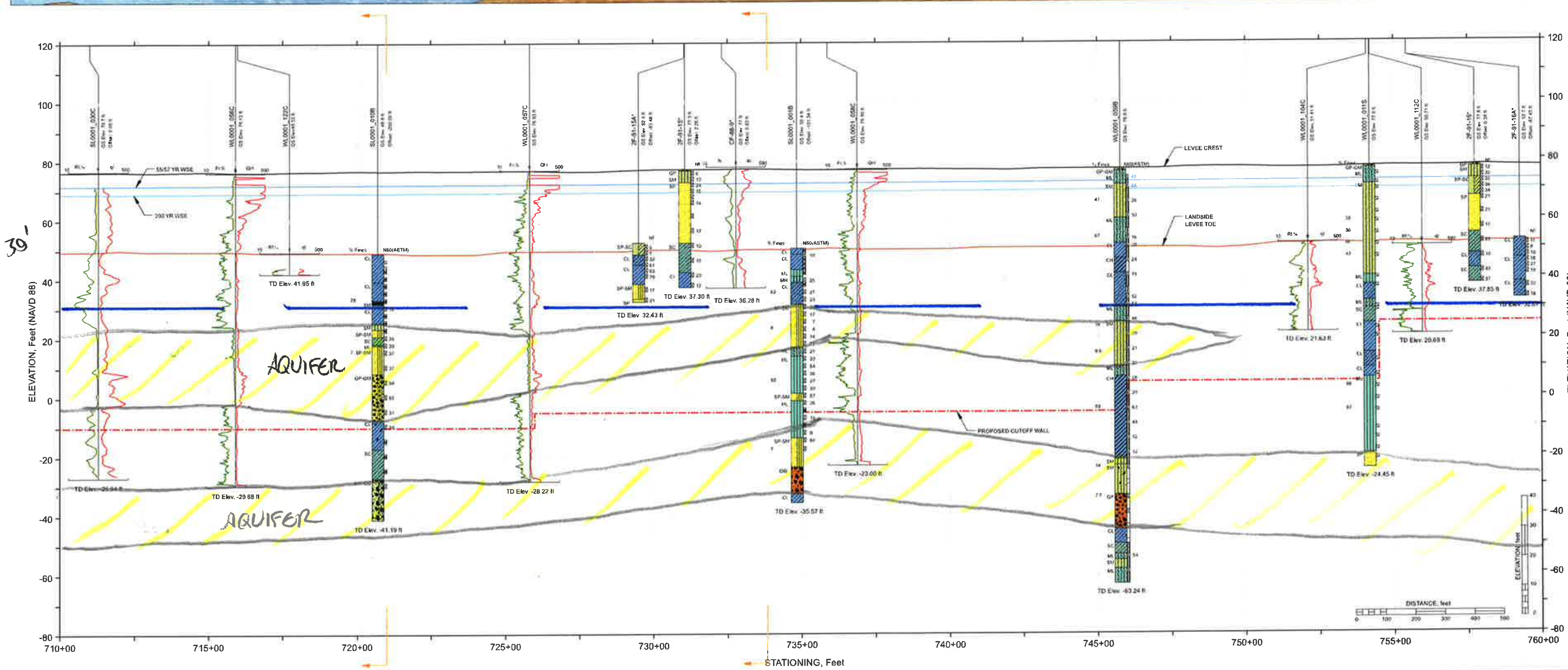
12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.



FRWL Project Plan Views and Stick Log Figures

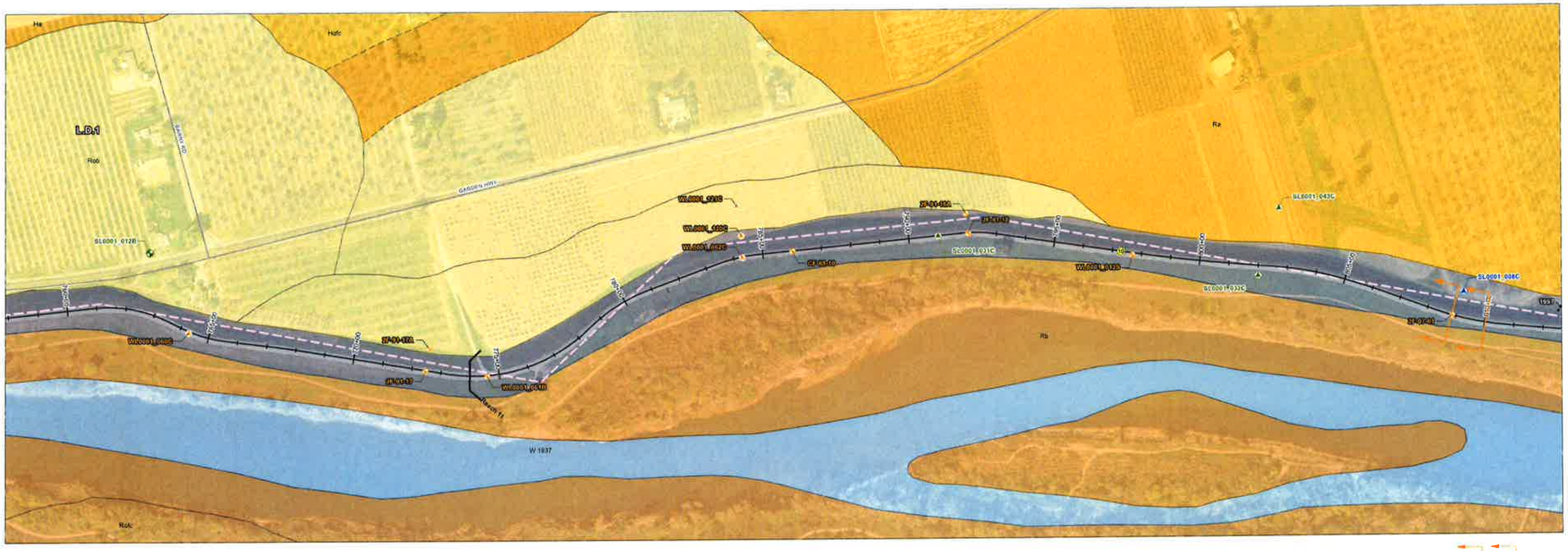
FRWL Project: Station 710+00 to Station 760+00

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A17

NEW WALL CUTS OFF UPPER AQUIFER FROM ~STA. 784+50 TO 827+50



Feet
0 100 200

NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LIDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
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6. USCS classification labels are not presented on the stick logs for soil lenses (thickness less than 1.5 feet).
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8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
9. Surficial geology was mapped at 1:20,000 scale. (Source: SGDR for DWR ULE Project, URS,2010).
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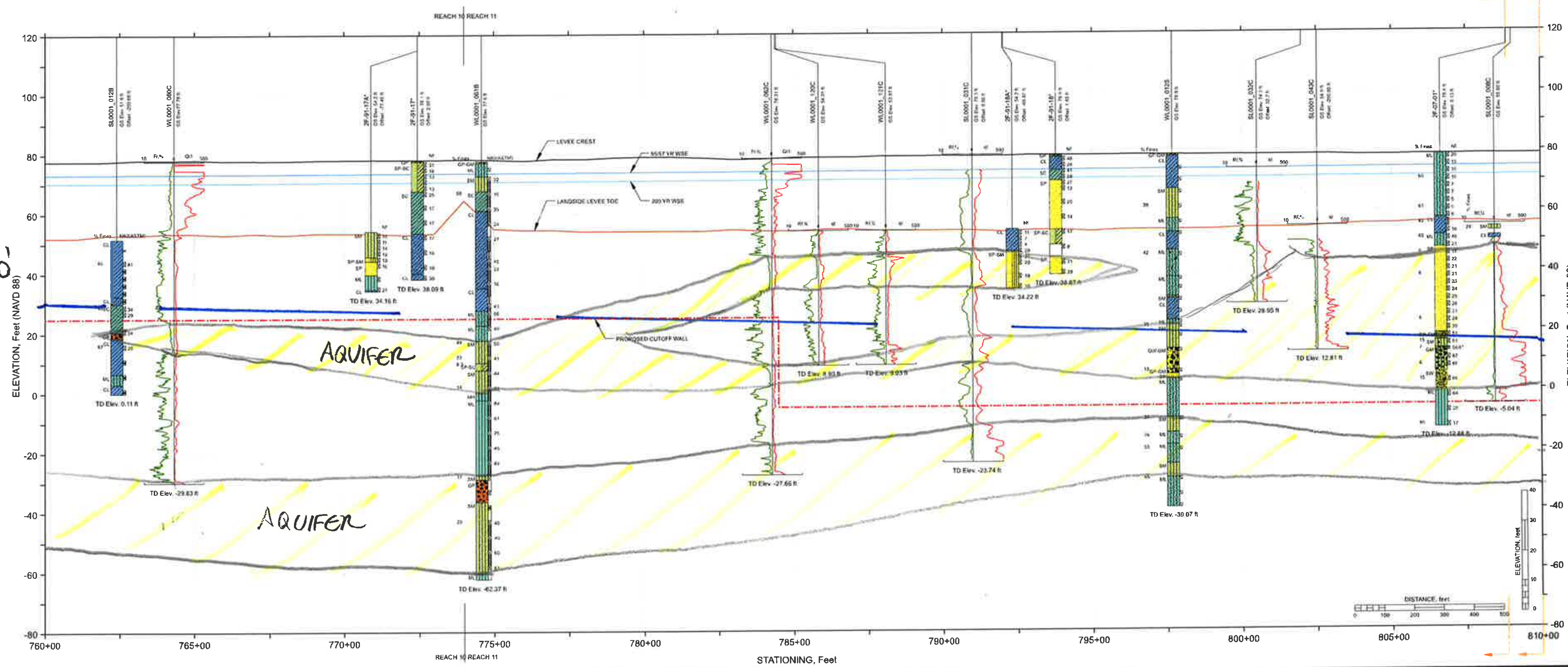
12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.



FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 760+00 to Station 810+00

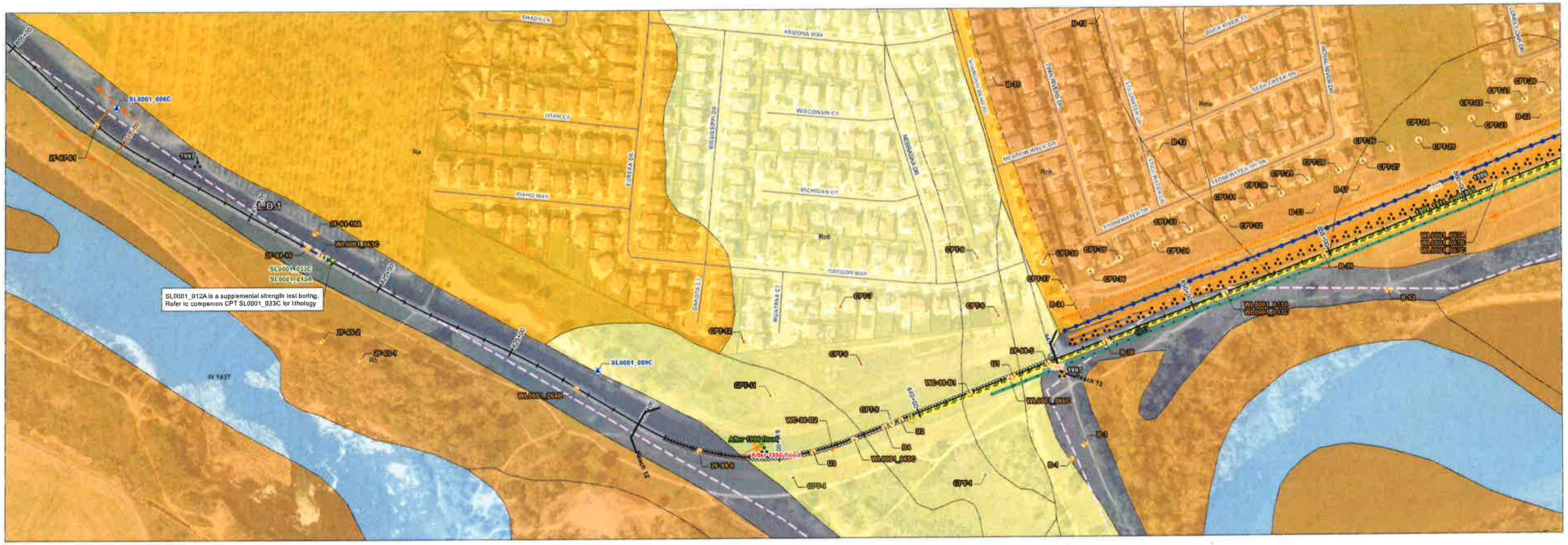
URS

Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix
A18

NEW WALL CUTS OFF UPPER AND LARGE PORTION OF DEEPER AQUIFER FROM 844+50 TO 897+50



0 100 200
Feet

NOTES:

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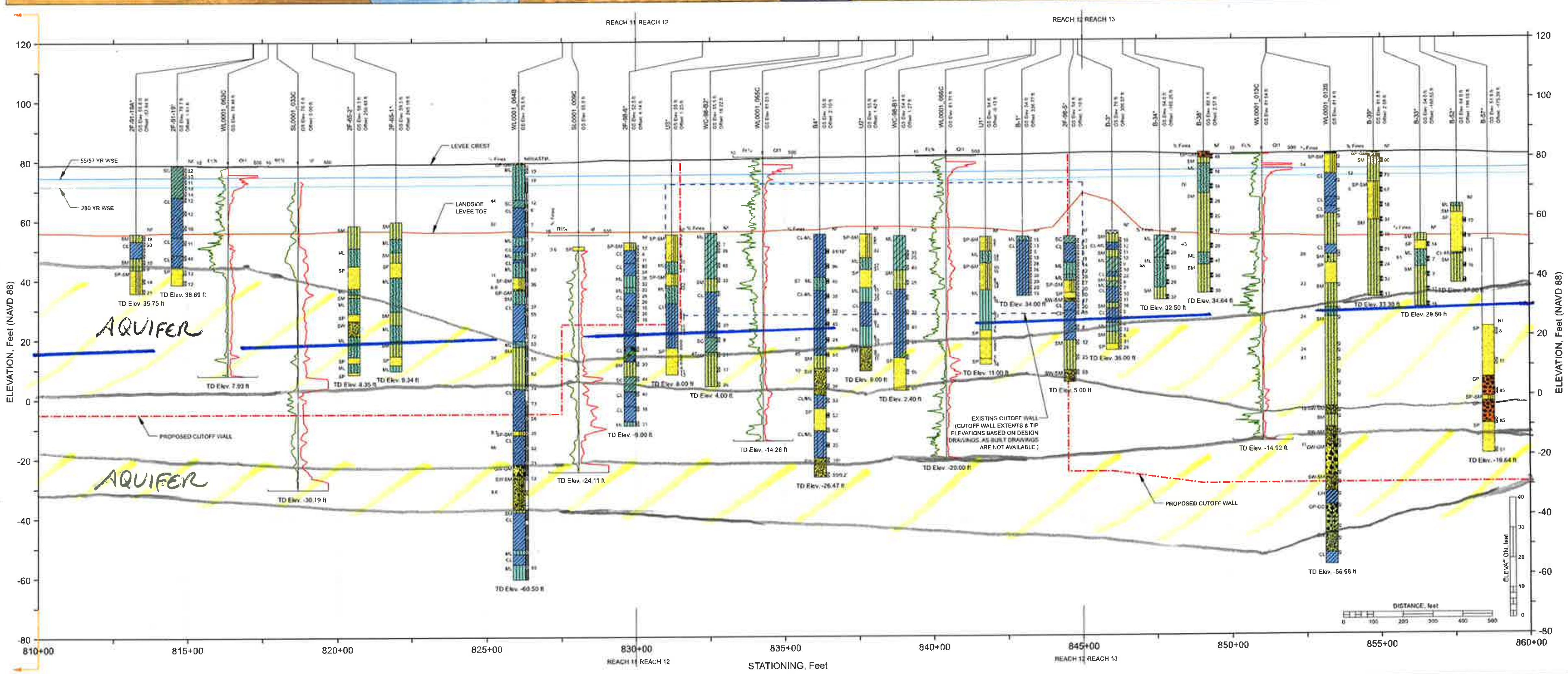
12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.



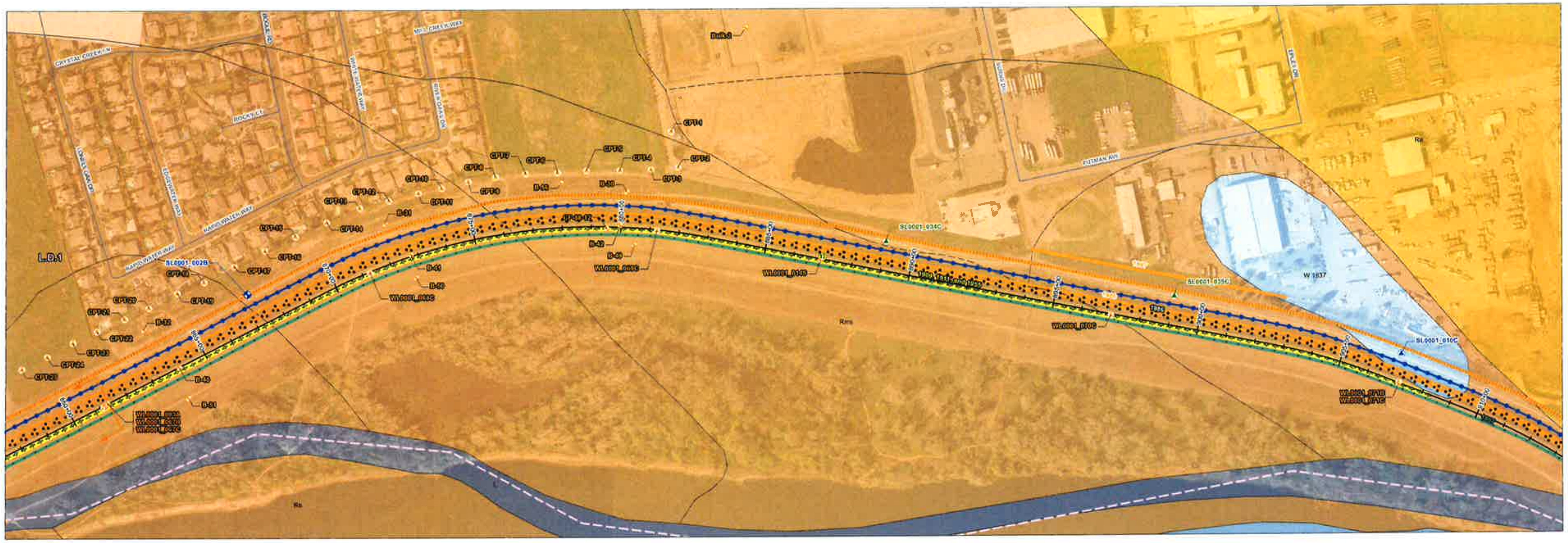
FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 810+00 to Station 860+00

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A19



N

0 100 200
Feet

NOTES:

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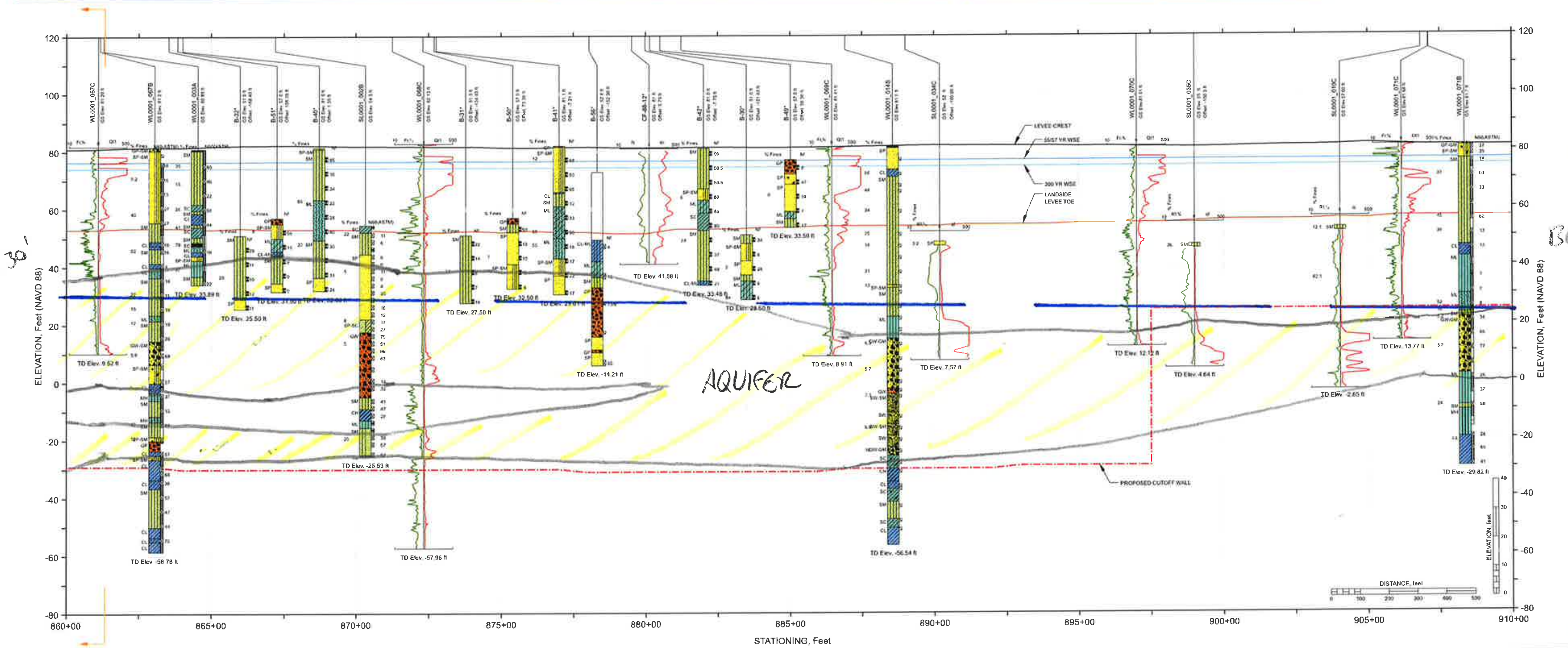


Legend

Plate Location

DETAIL AREA

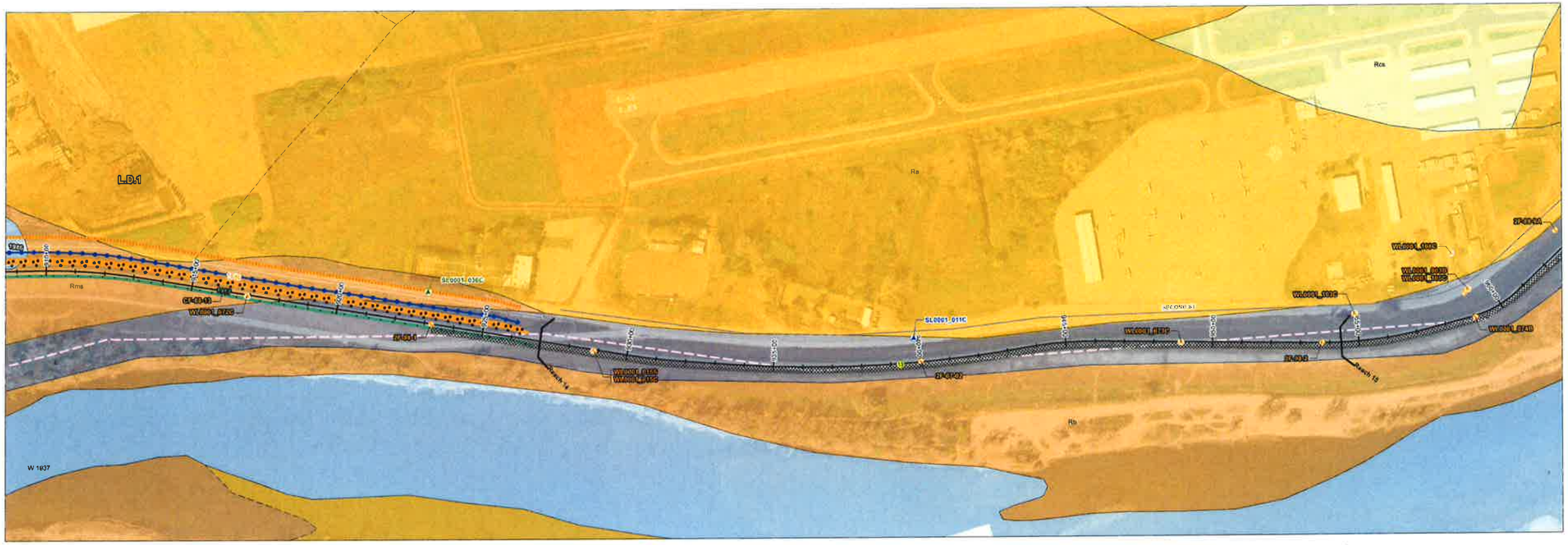
FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 860+00 to Station 910+00

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A20



0 100 200
Feet

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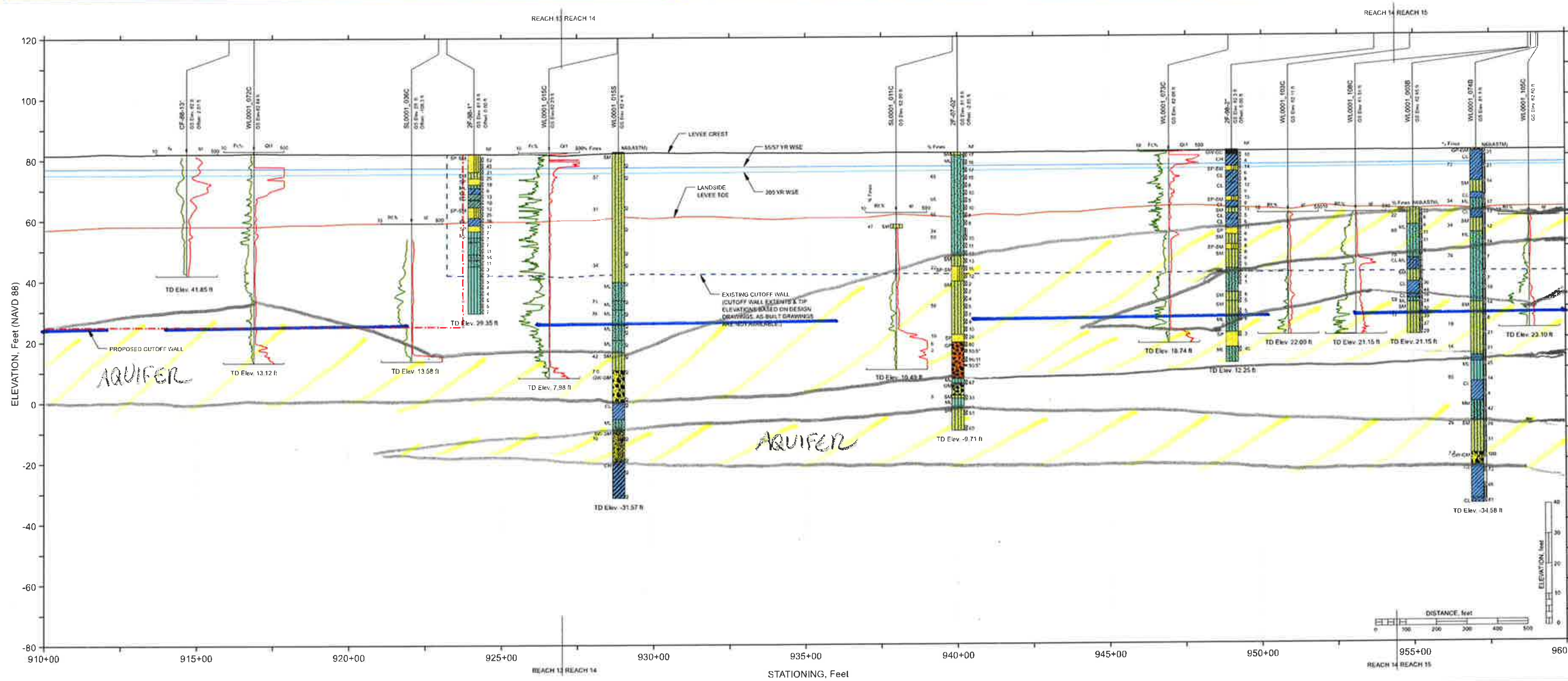


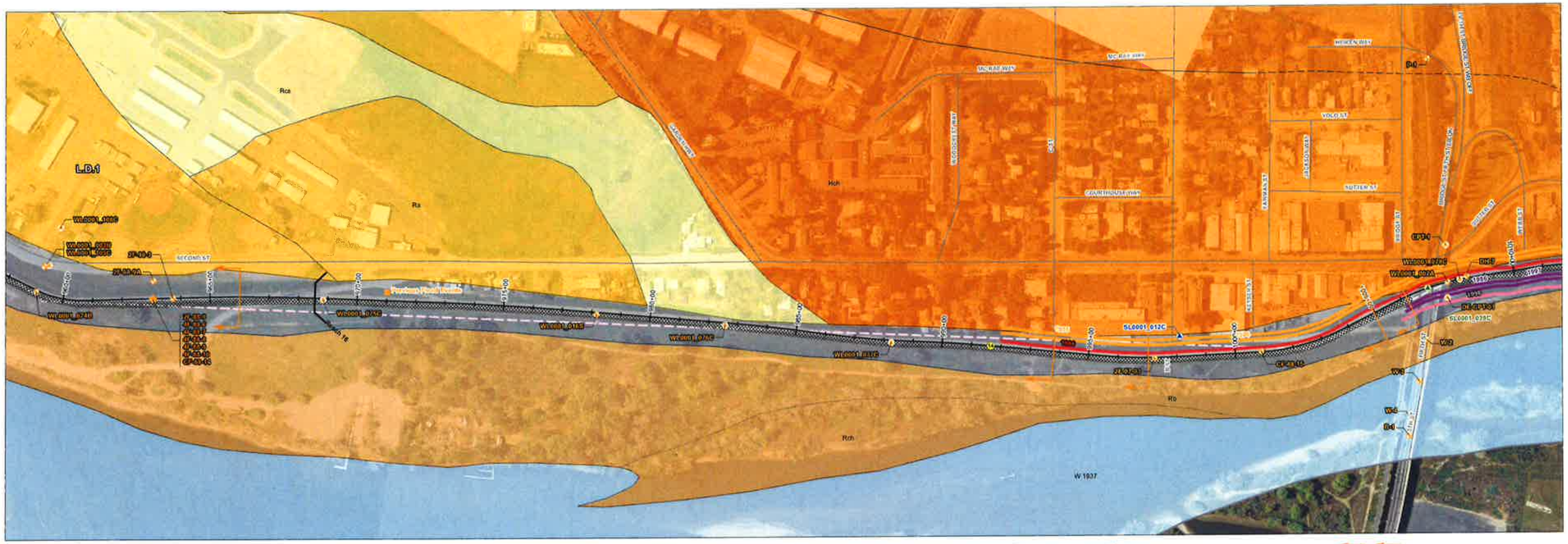
FRWL Project Plan Views and Stick Log Figures

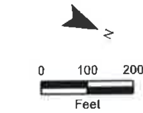
FRWL Project: Station 910+00 to Station 960+00

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A21





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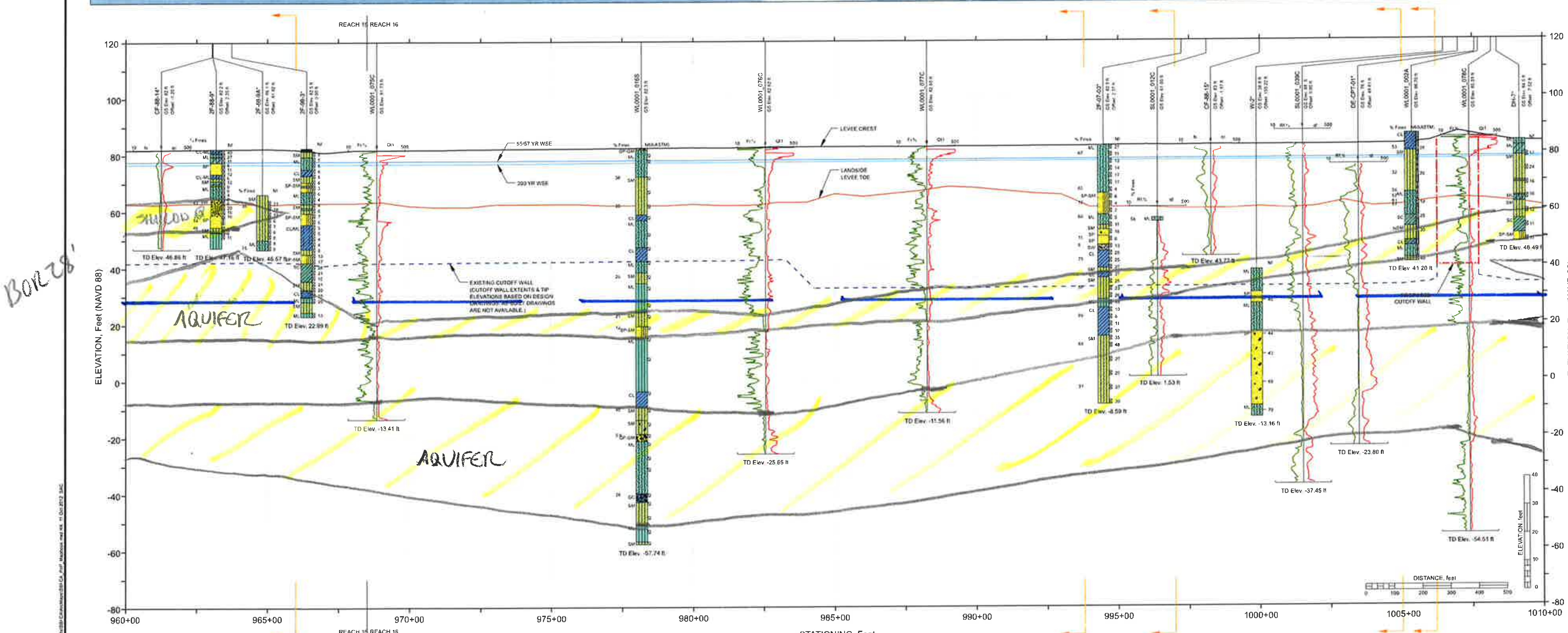

FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 960+00 to Station 1010+00

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A22

0 100 200
Feet

NOTES:
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5. These drawings do not include all historical explorations on the profile view. Historical explorations from the DWR ULE project are shown; "other" historical explorations are identified by an asterisk (*) in the exploration ID. For these "other" historical borings, blow counts are field blow counts (Nf) and USCS classifications are visual classifications.
6. USCS classification labels are not presented on the stick logs for soil lenses (thickness less than 1.5 feet).
7. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
9. Surficial geology was mapped at 1:20,000 scale. (Source: SGDR for DWR ULE Project, URS,2010).
10. The information provided in these plans and stick-log plates has been compiled from a variety of sources. URS does not attest to the accuracy, completeness, or reliability of geotechnical exploration and other subsurface data by others that are included or referenced in these plates.
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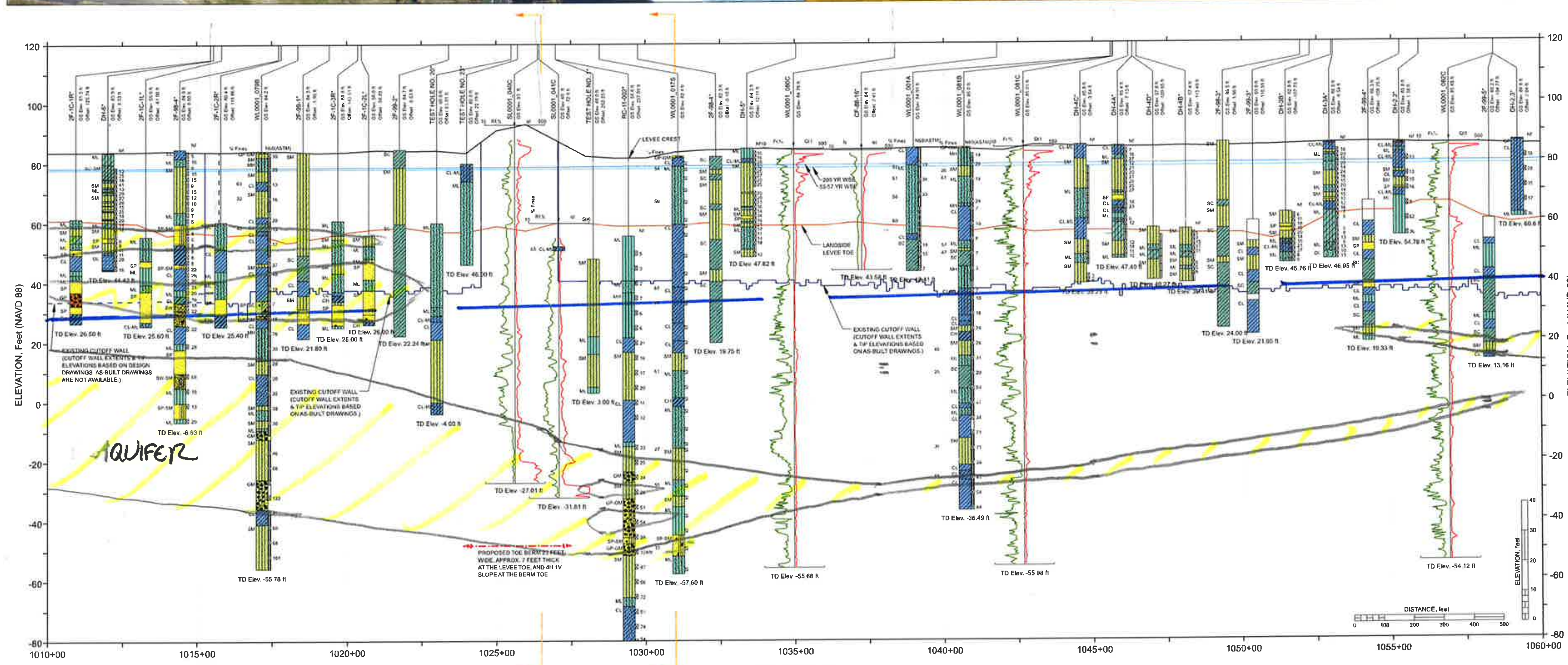
12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.



FRWL Project Plan Views and Stick Log Figures
FRWL Project: Station 1010+00 to Station 1060+00

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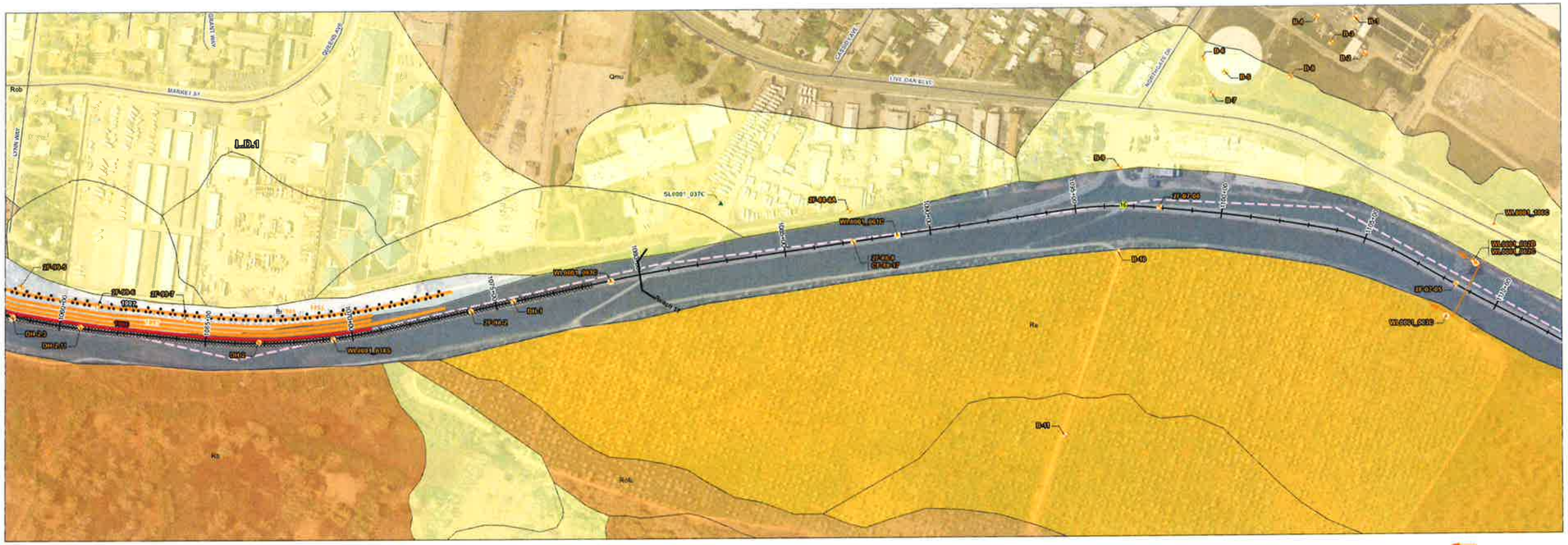
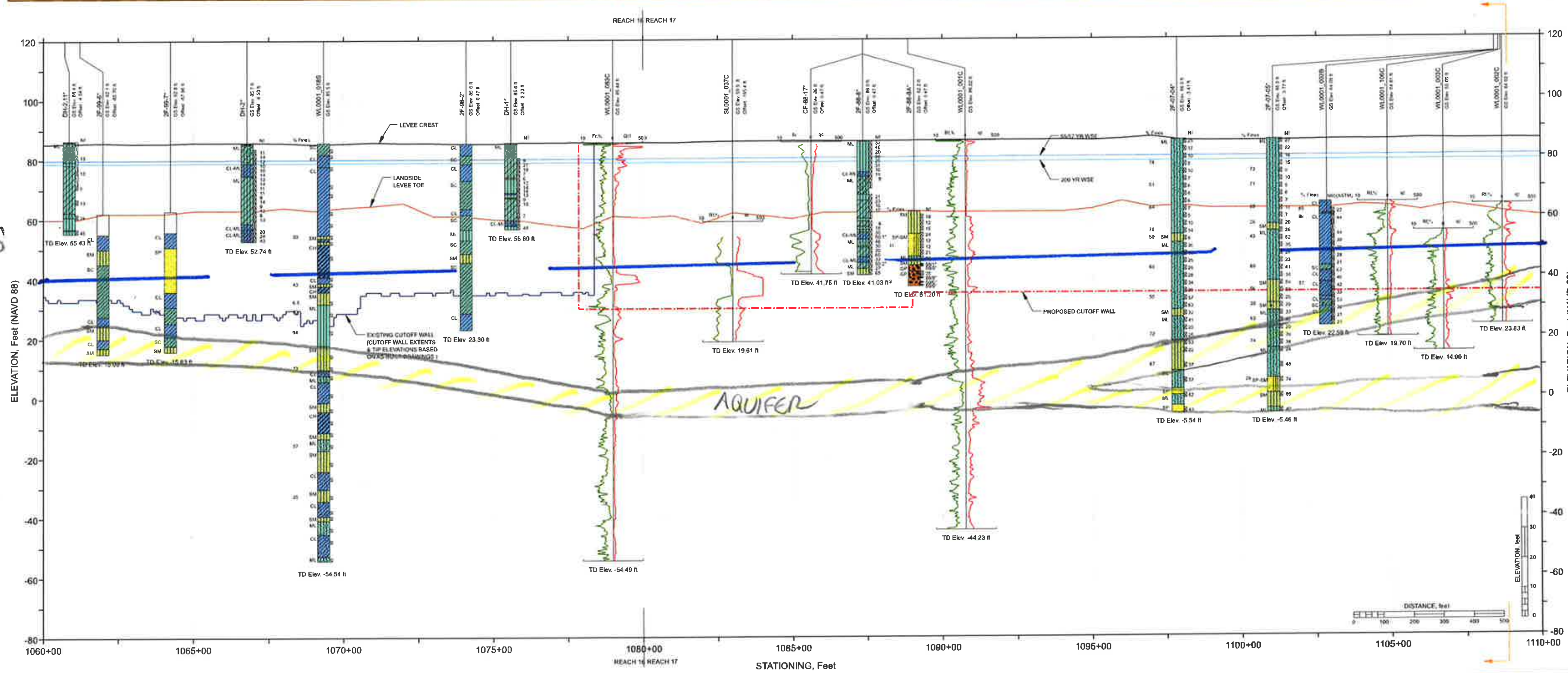
Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A23





0 100 200

Feet

NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LIDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
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6. USCS classification labels are not presented on the stick logs for soil lenses (thickness less then 1.5 feet).
7. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
9. Surficial geology was mapped at 1:20,000 scale. (Source: SGDR for DWR ULE Project, URS,2010).
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12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.

Legend

Plate Location

DETAIL AREA

FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 1060+00 to Station 1110+00

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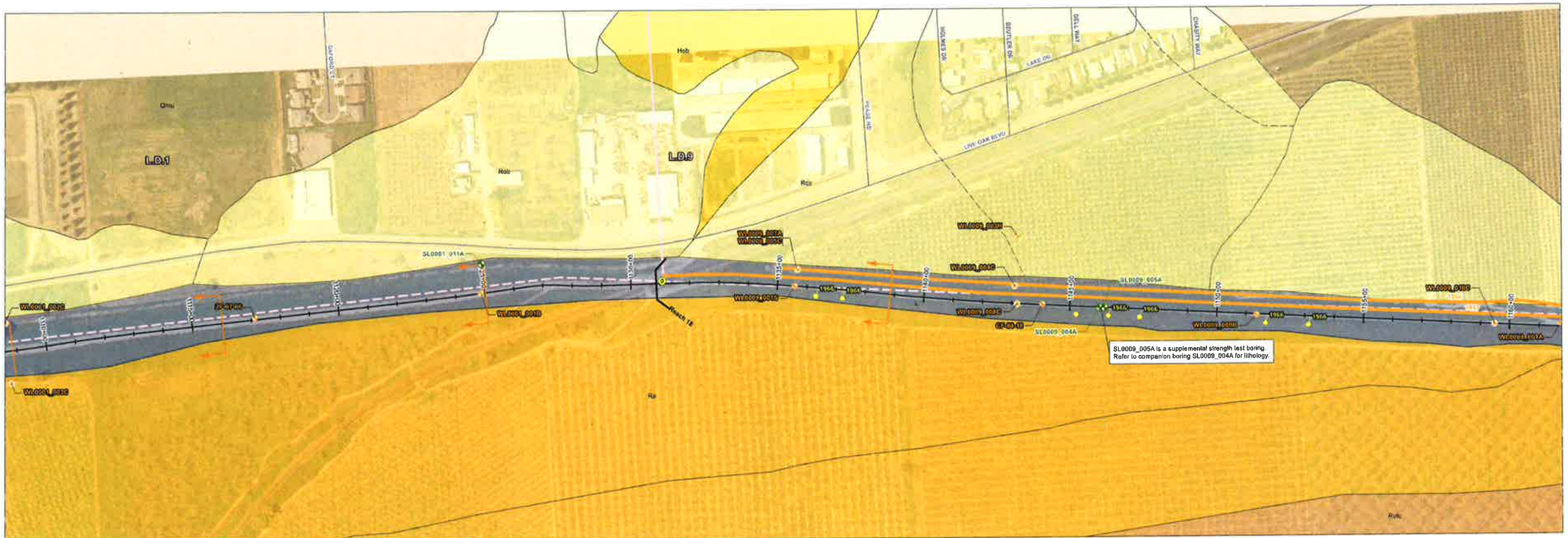
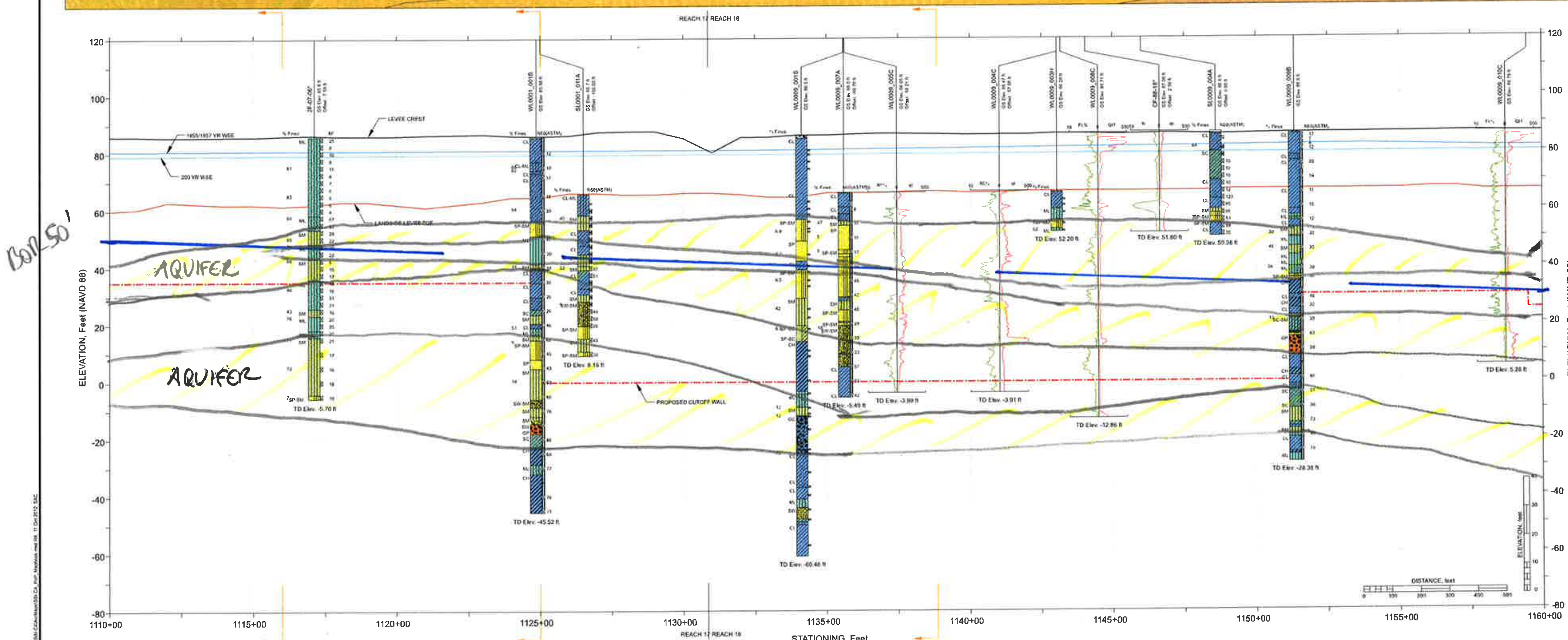
FEATHER RIVER WEST LEVEE PROJECT

Appendix A24

NEW WALL CUTS OF UPPER AQUIFER





0 100 200

Feet

NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LiDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
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9. Surficial geology was mapped at 1:20,000 scale. (Source: SGDR for DWR ULE Project, URS,2010).
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12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.

FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 1110+00 to Station 1160+00

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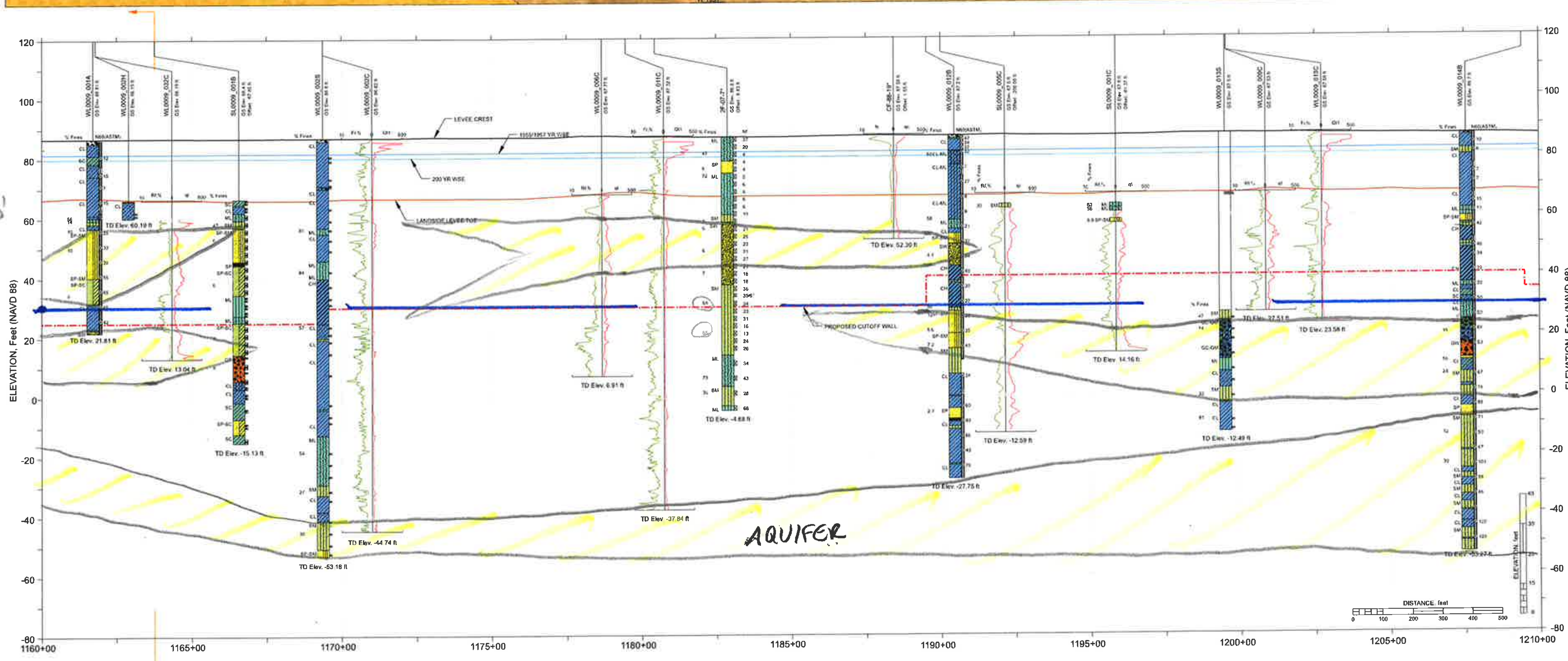
FEATHER RIVER WEST LEVEE PROJECT

Appendix A25

NEW WALL CUTS OFF UPPER AQUIFER



0 100 200

Feet

NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LIDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
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7. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
9. Surficial geology was mapped at 1:20,000 scale. (Source: SGDR for DWR ULE Project, URS,2010).
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12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.

FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 1160+00 to Station 1210+00

URS — Geotechnical Design Recommendations Report

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FEATHER RIVER WEST LEVEE PROJECT

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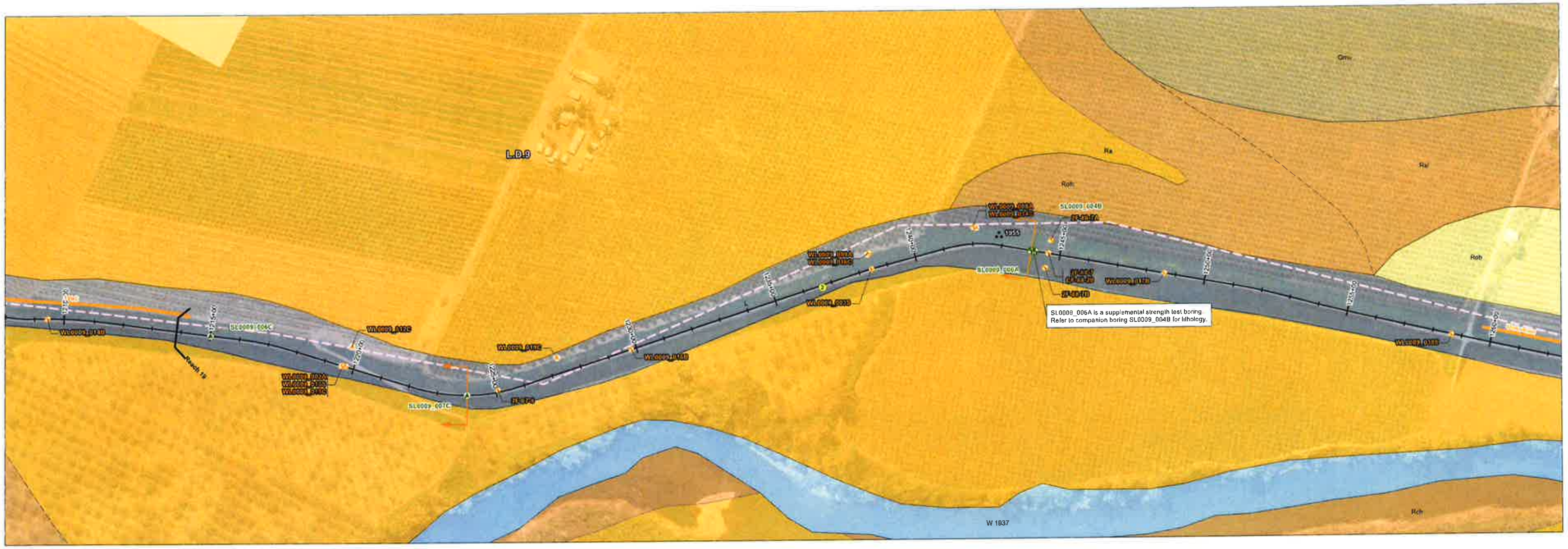
NEW WALL CUTS OFF AQUIFER



Feet

NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LiDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
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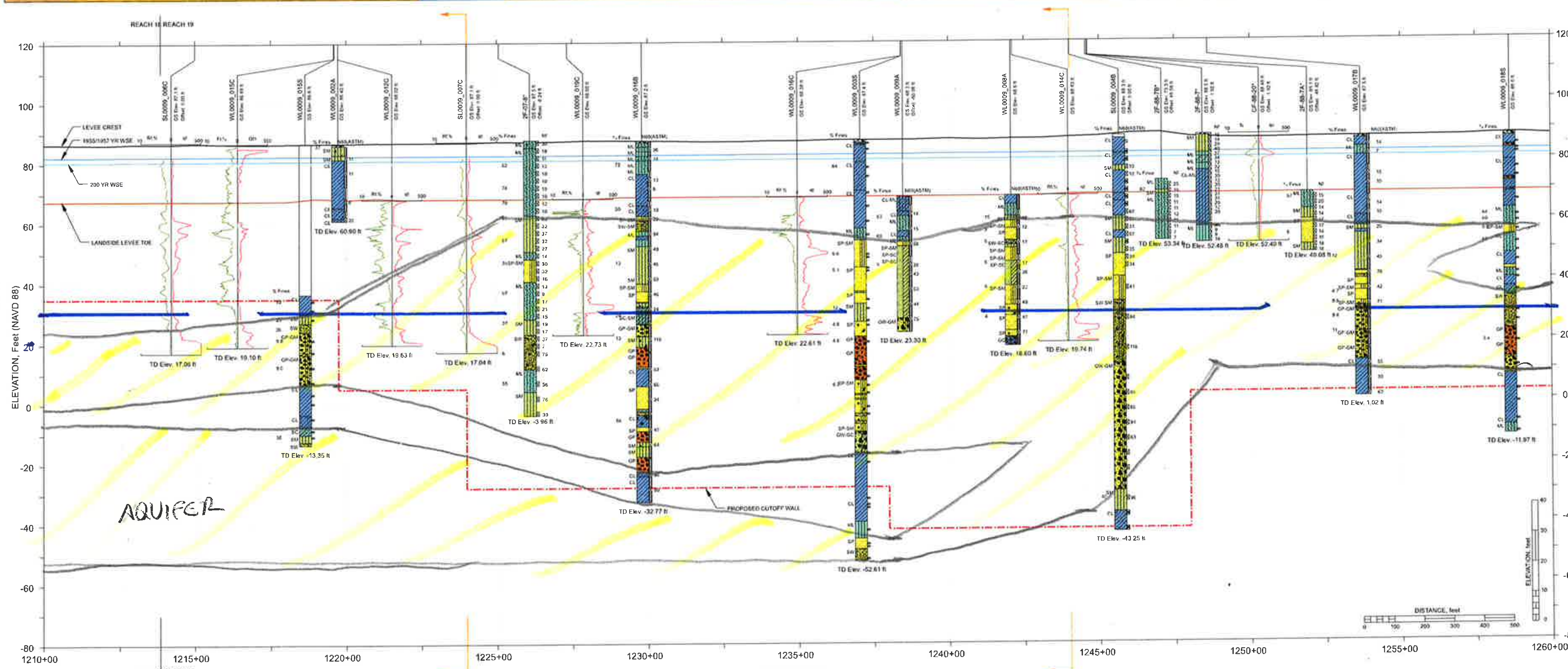
12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.



FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 1210+00 to Station 1260+00

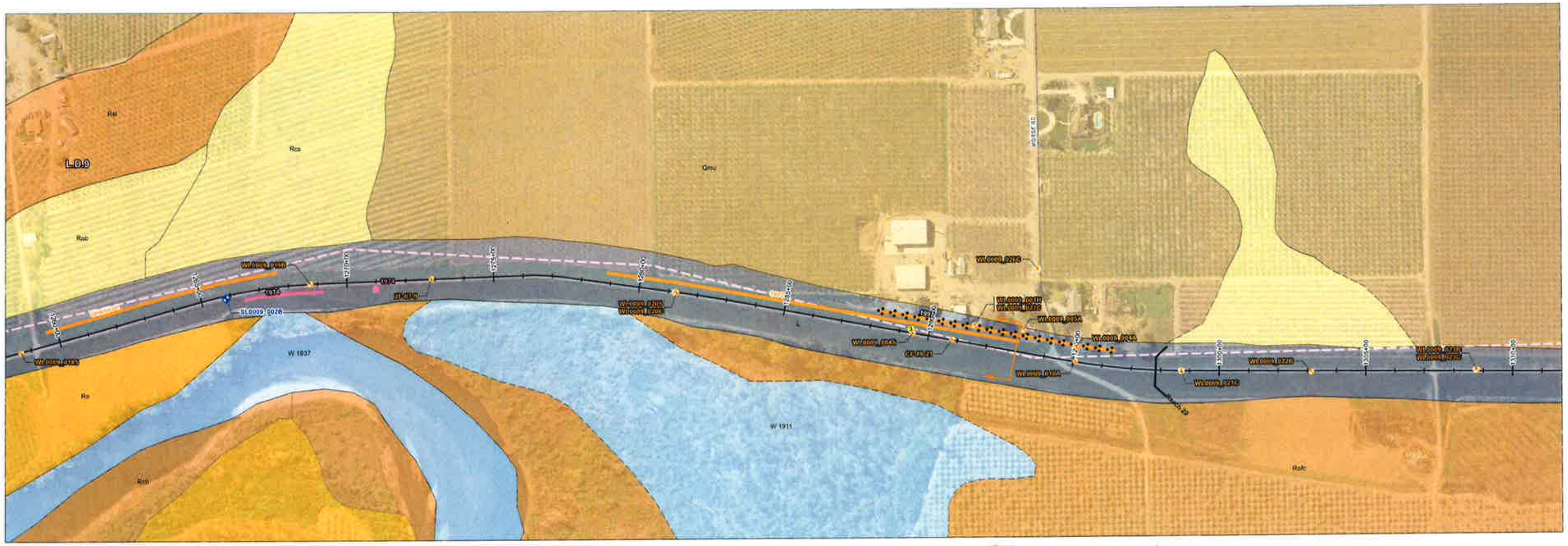
URS

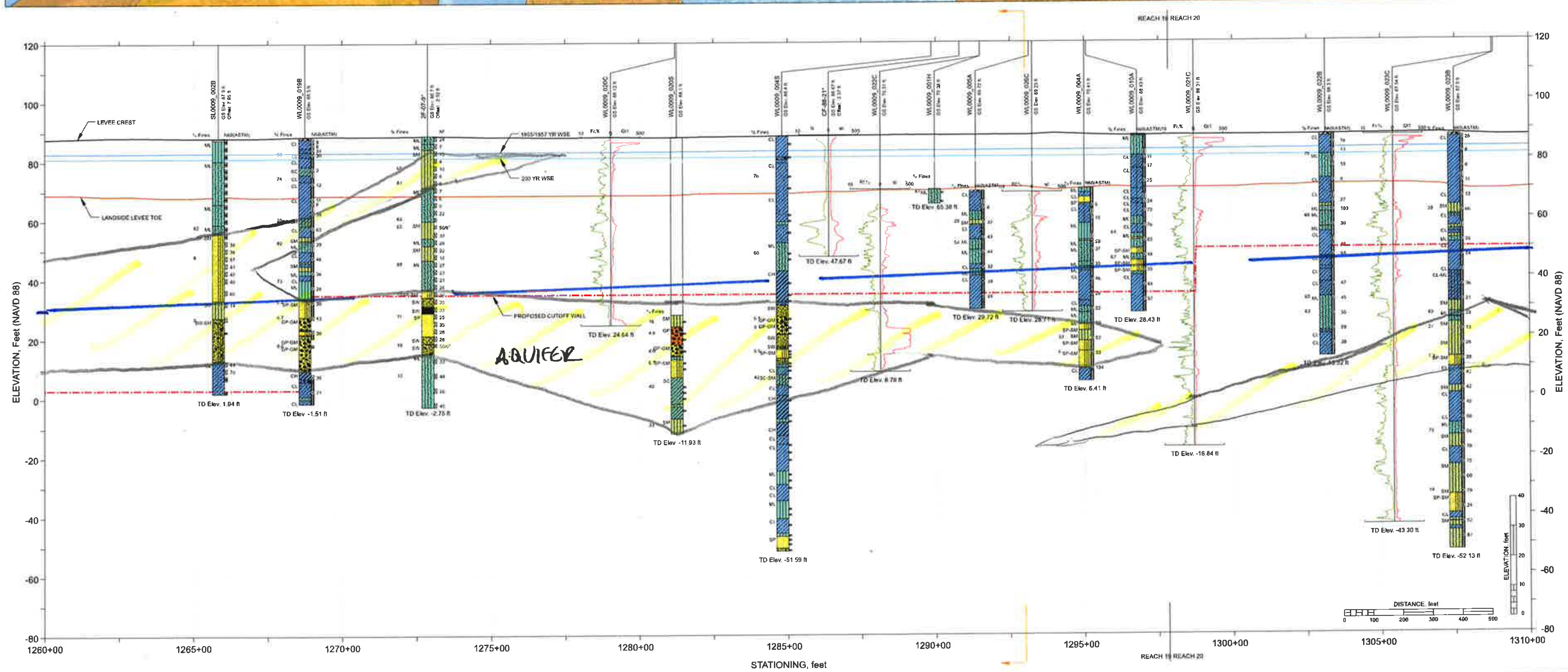
Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency

FEATHER RIVER WEST LEVEE PROJECT

Appendix A27





N

0 100 200
Feet

NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LIDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe Information, please refer to the FRWL Project civil drawings.
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8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
9. Surficial geology was mapped at 1:20,000 scale. (Source: SGDR for DWR ULE Project, URS,2010).
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FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 1260+00 to Station 1310+00

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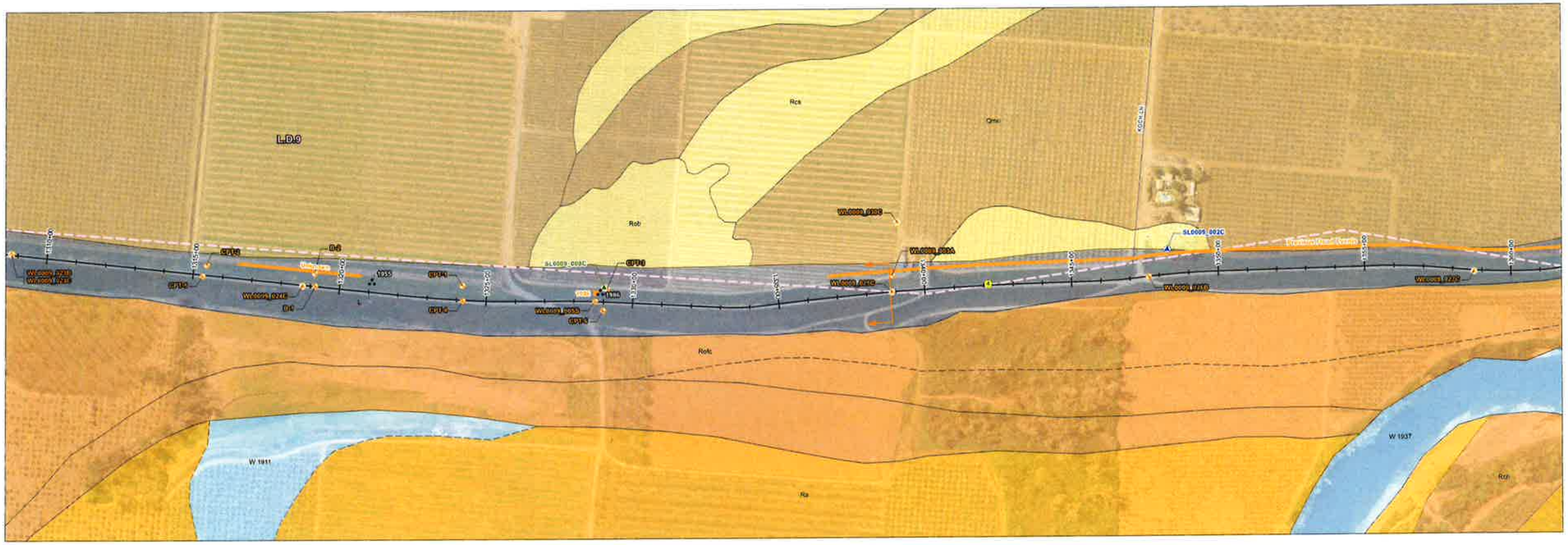
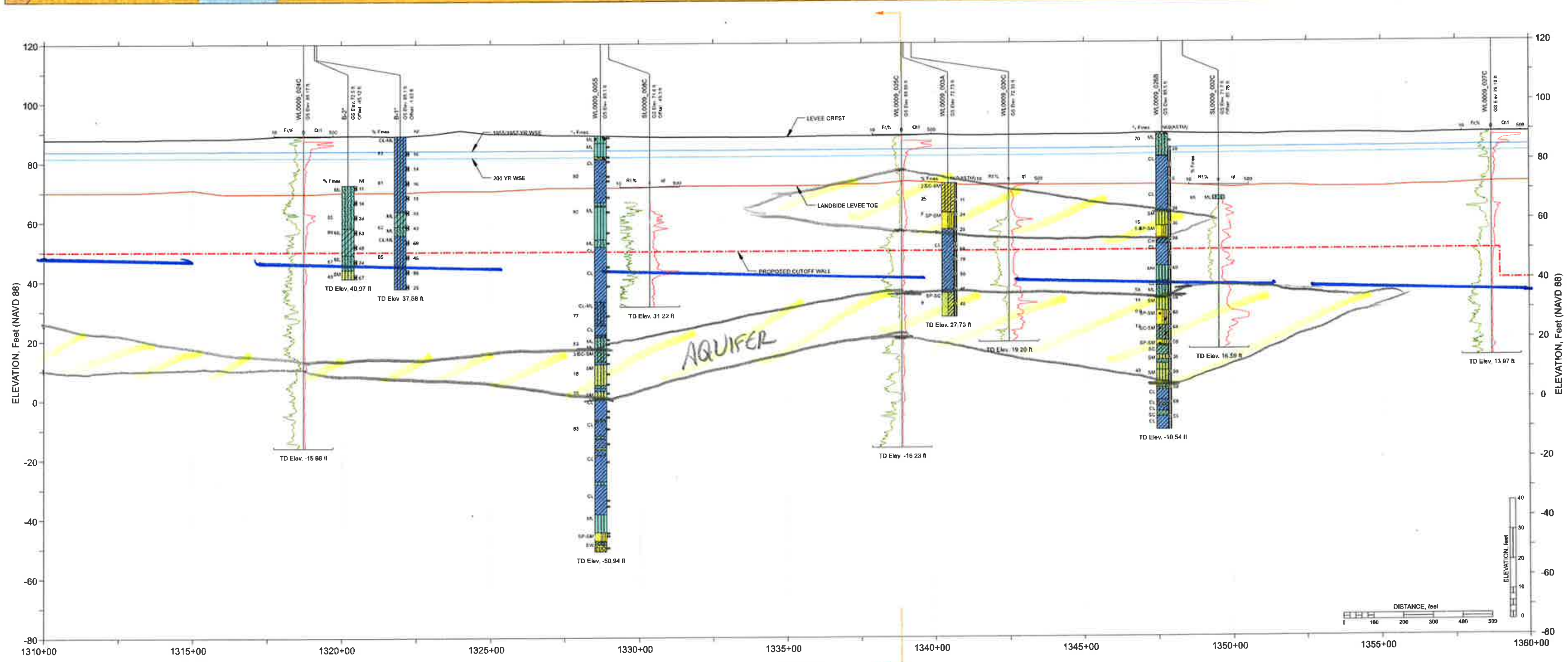
Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A28





0 100 200
Feet

NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LiDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
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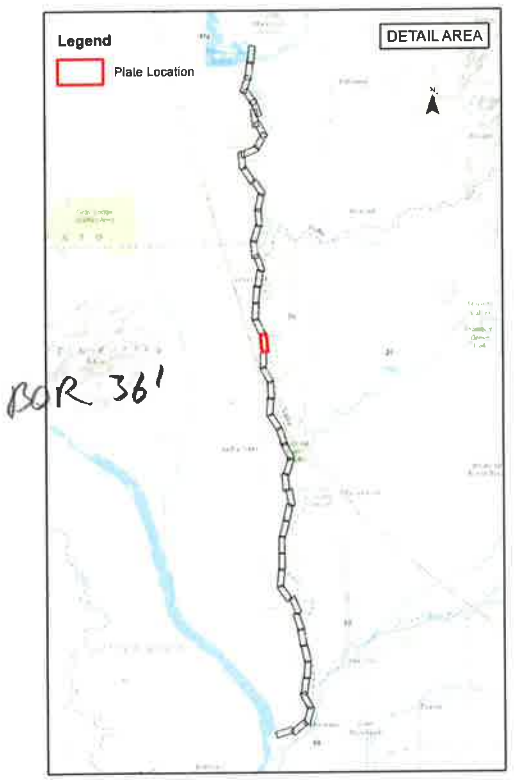

FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 1310+00 to Station 1360+00

URS — Geotechnical Design Recommendations Report

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FEATHER RIVER WEST LEVEE PROJECT

Appendix A29

NEW WALL CUTS OFF AQUIFER

0 100 200
Feet

NOTES:
1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LiDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
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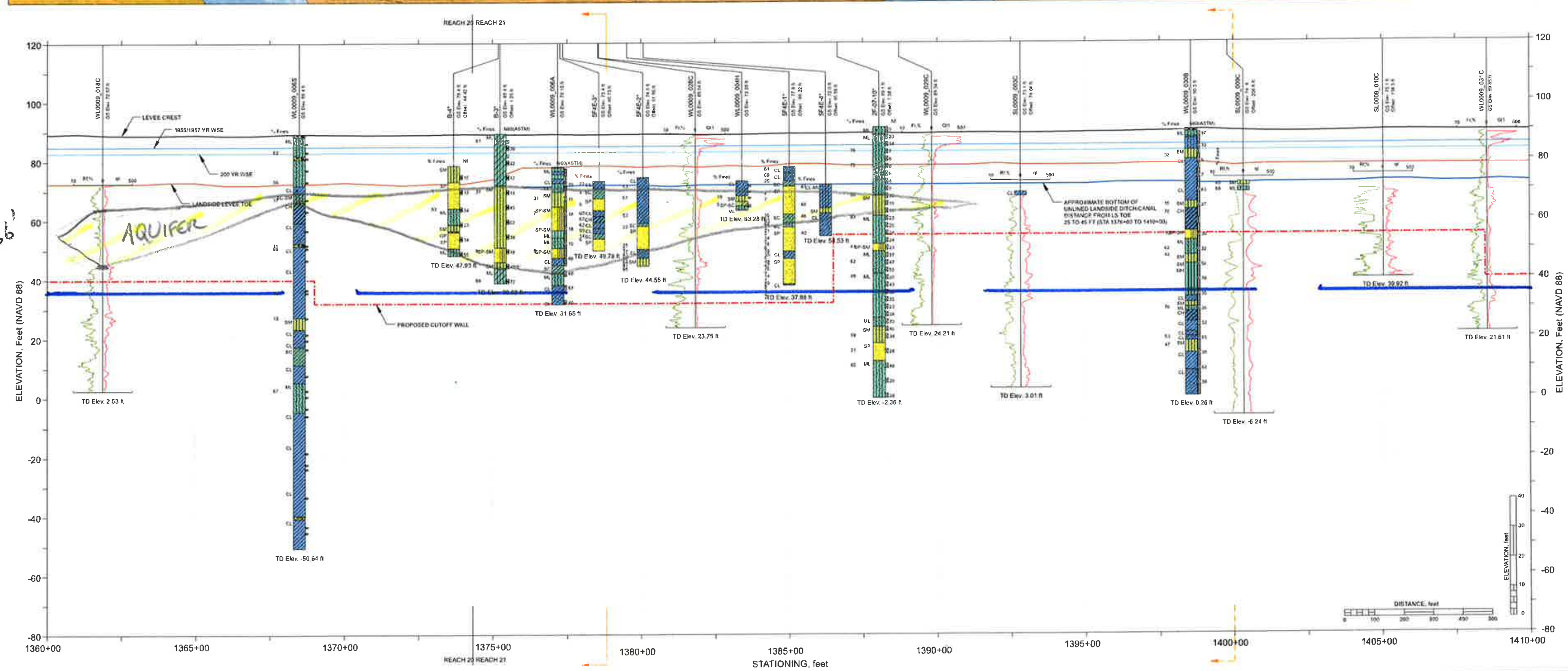
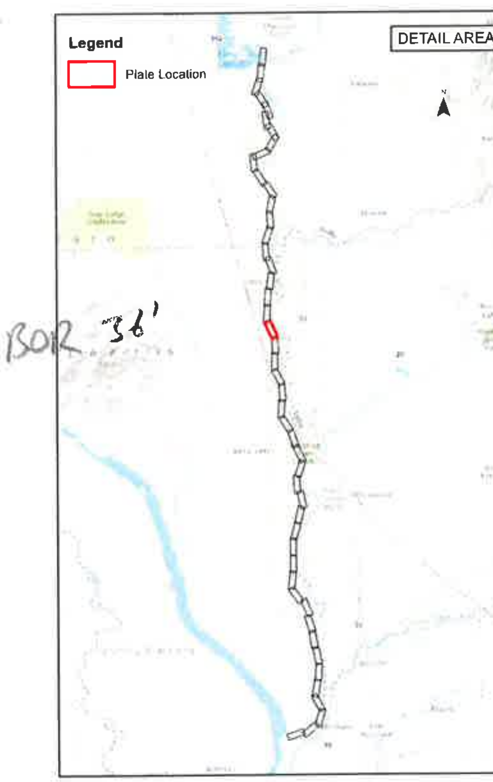




FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 1360+00 to Station 1410+00

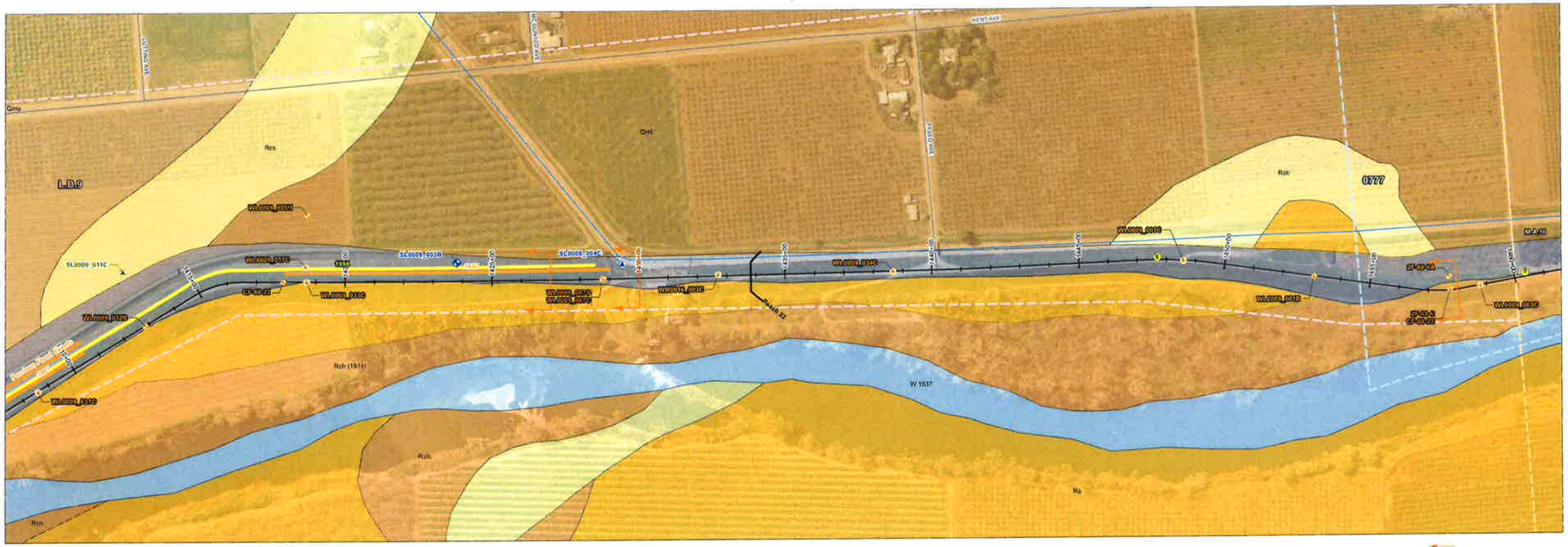
URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency

FEATHER RIVER WEST LEVEE PROJECT

Appendix A30

NEW WALL CUTS OFF UPPER AQUIFER



0 100 200
Feet

NOTES:

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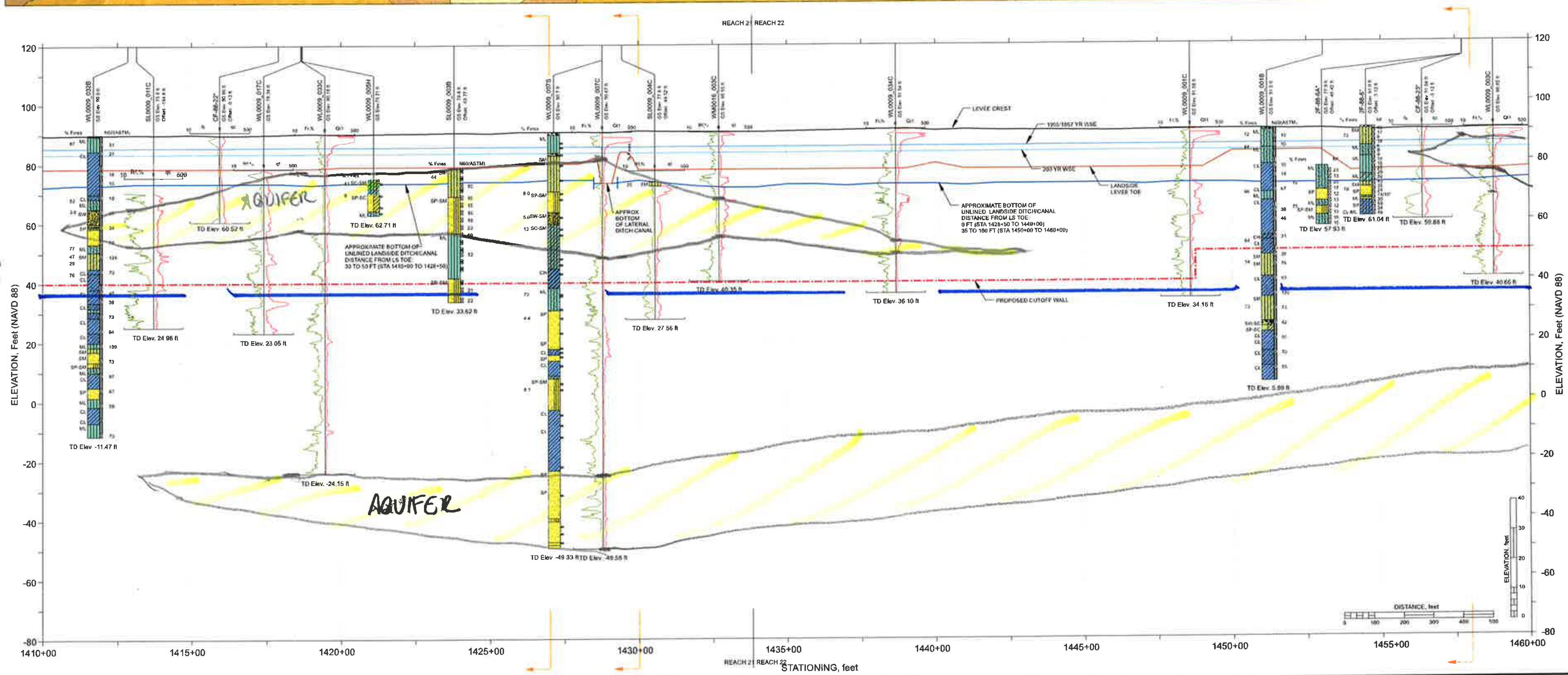


FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 1410+00 to Station 1460+00

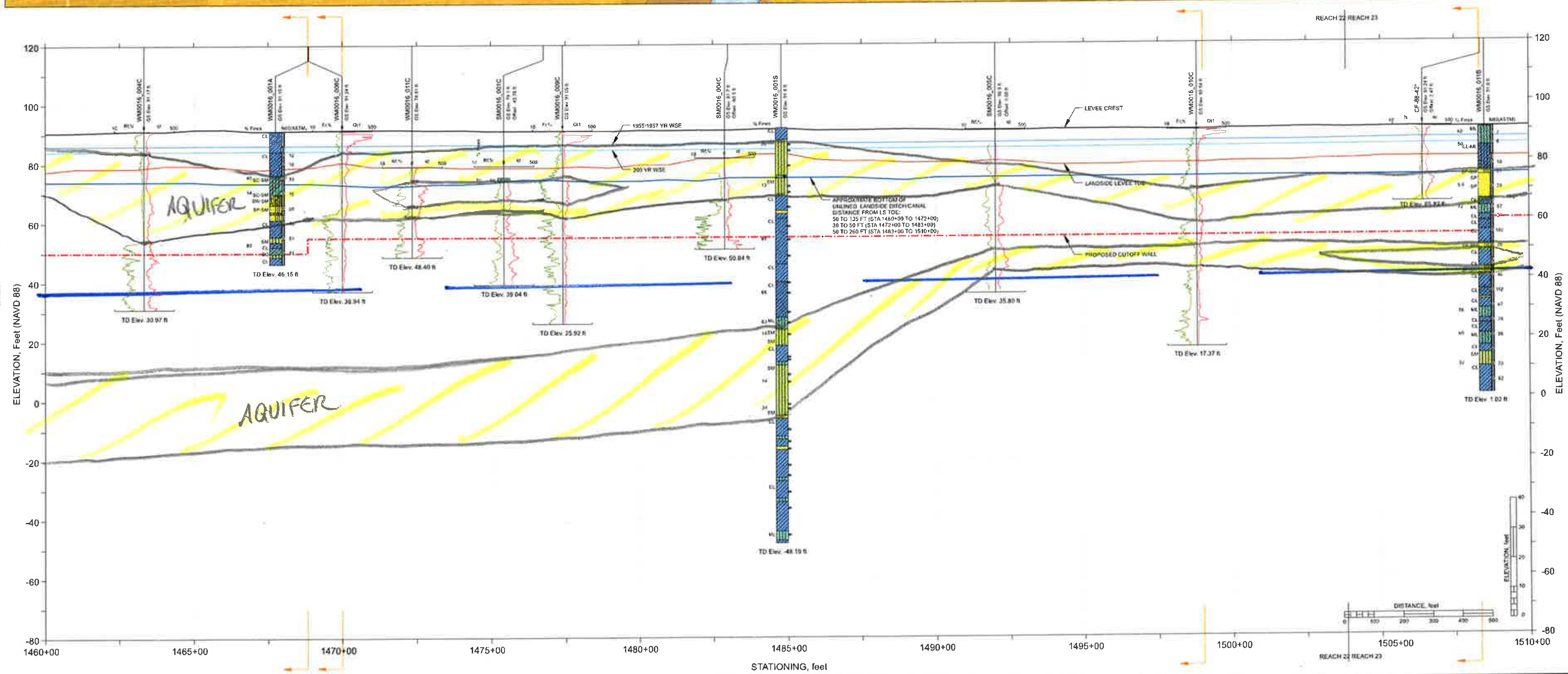
URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency

FEATHER RIVER WEST LEVEE PROJECT

Appendix A31

NEW WALL CUTS OFF UPPER AQUIFER



0 100 200

Feet

NOTES:

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6. USCS classification labels are not presented on the stick logs for soil lenses (thickness less than 1.5 feet).
7. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
9. Surficial geology was mapped at 1:20,000 scale. (Source: SGDR for DWR ULE Project, URS,2010).
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12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.

FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 1460+00 to Station 1510+00

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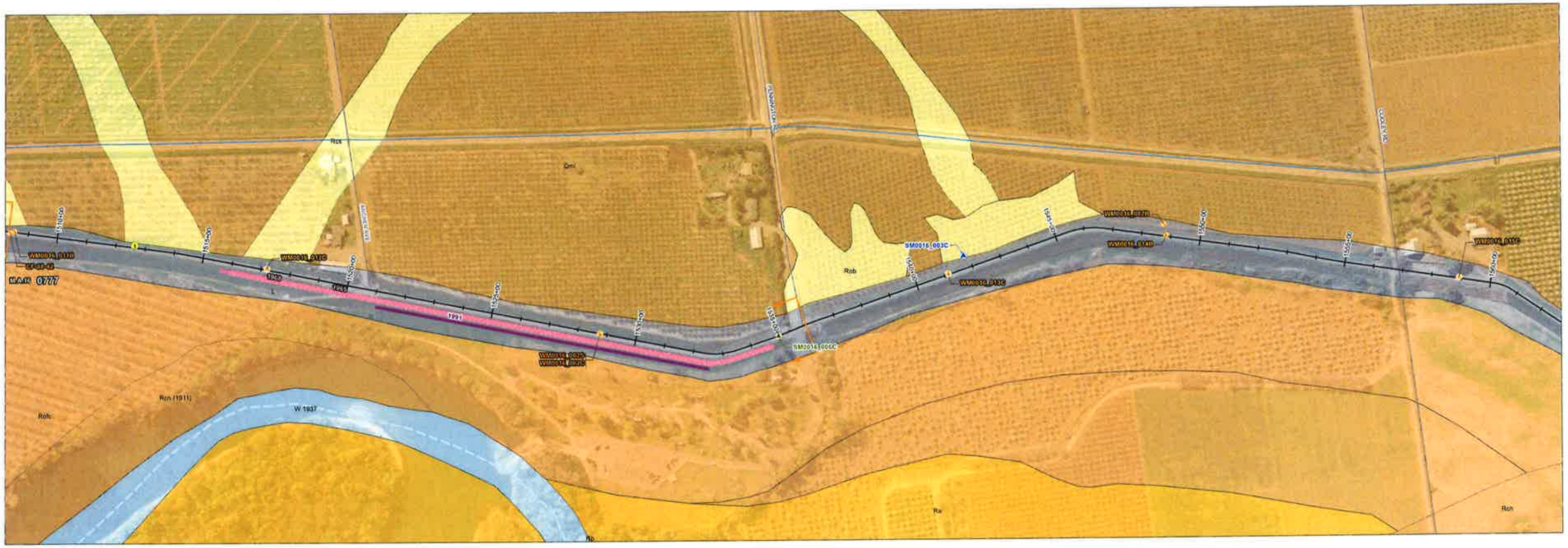
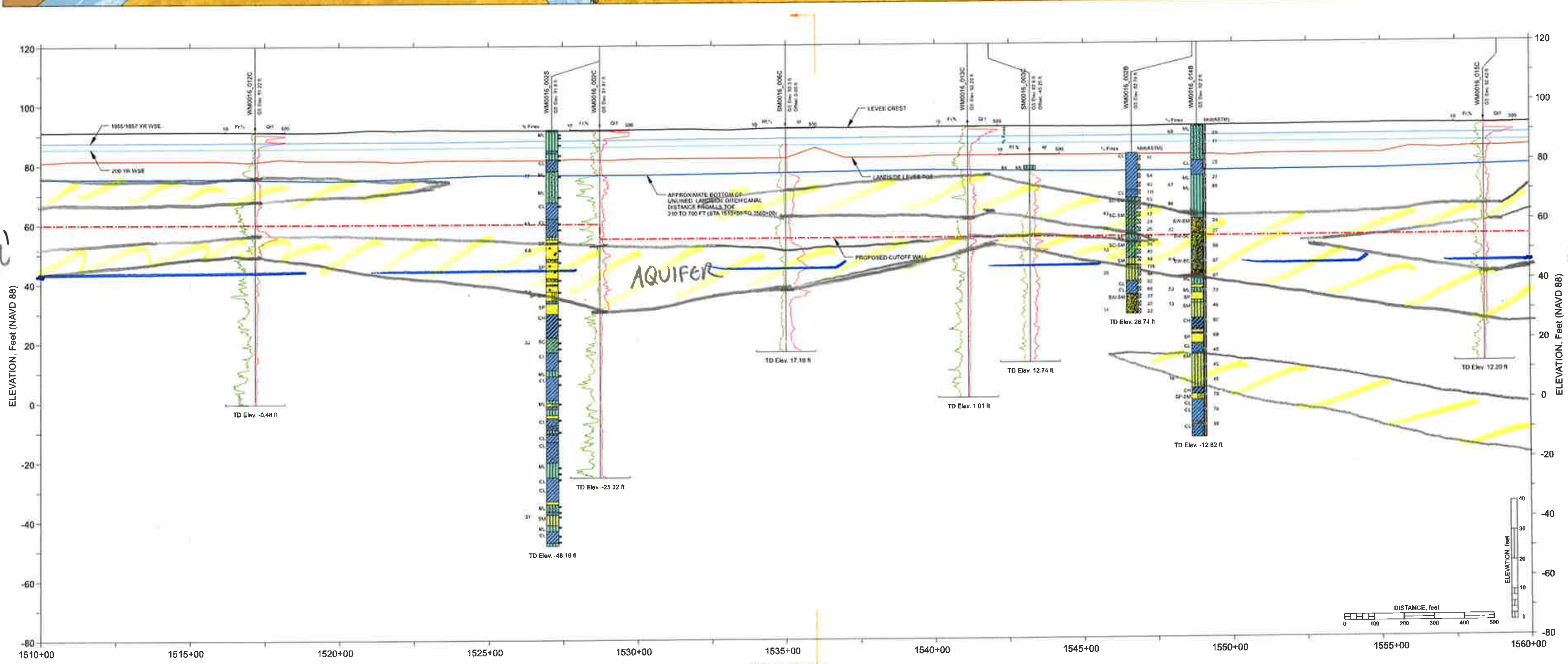
FEATHER RIVER WEST LEVEE PROJECT

Appendix A32





0 100 200

Feet

NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LIDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
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12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.

FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 1510+00 to Station 1560+00

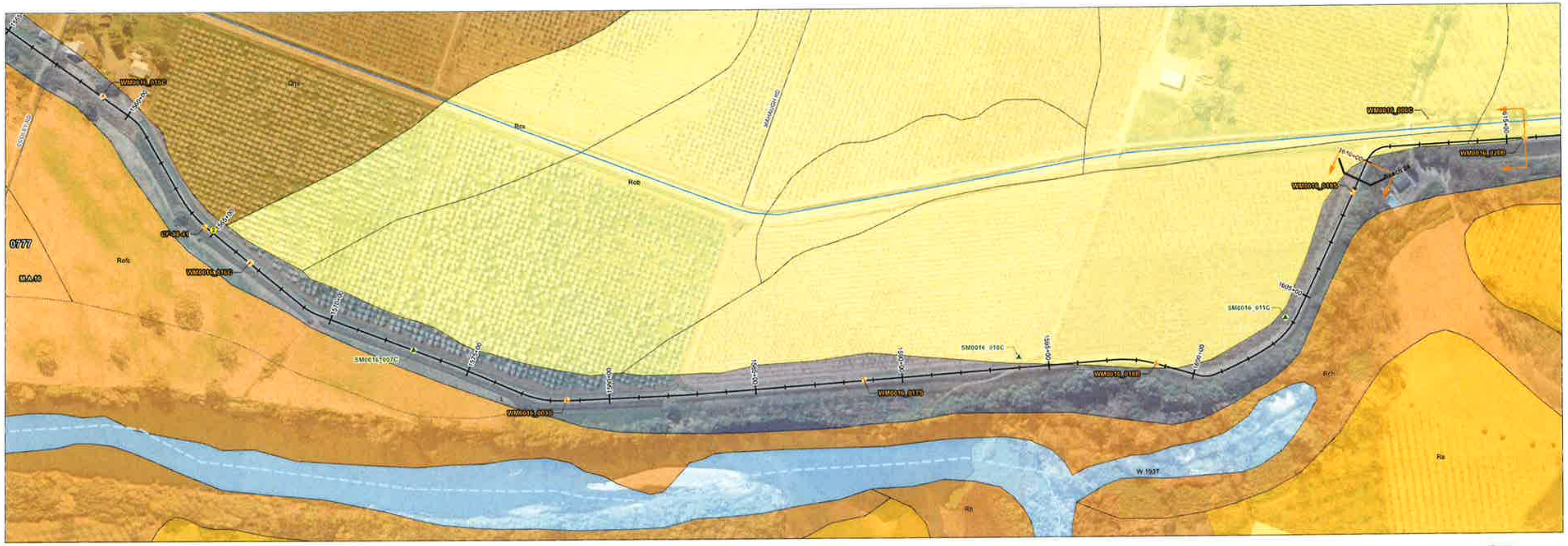
URS

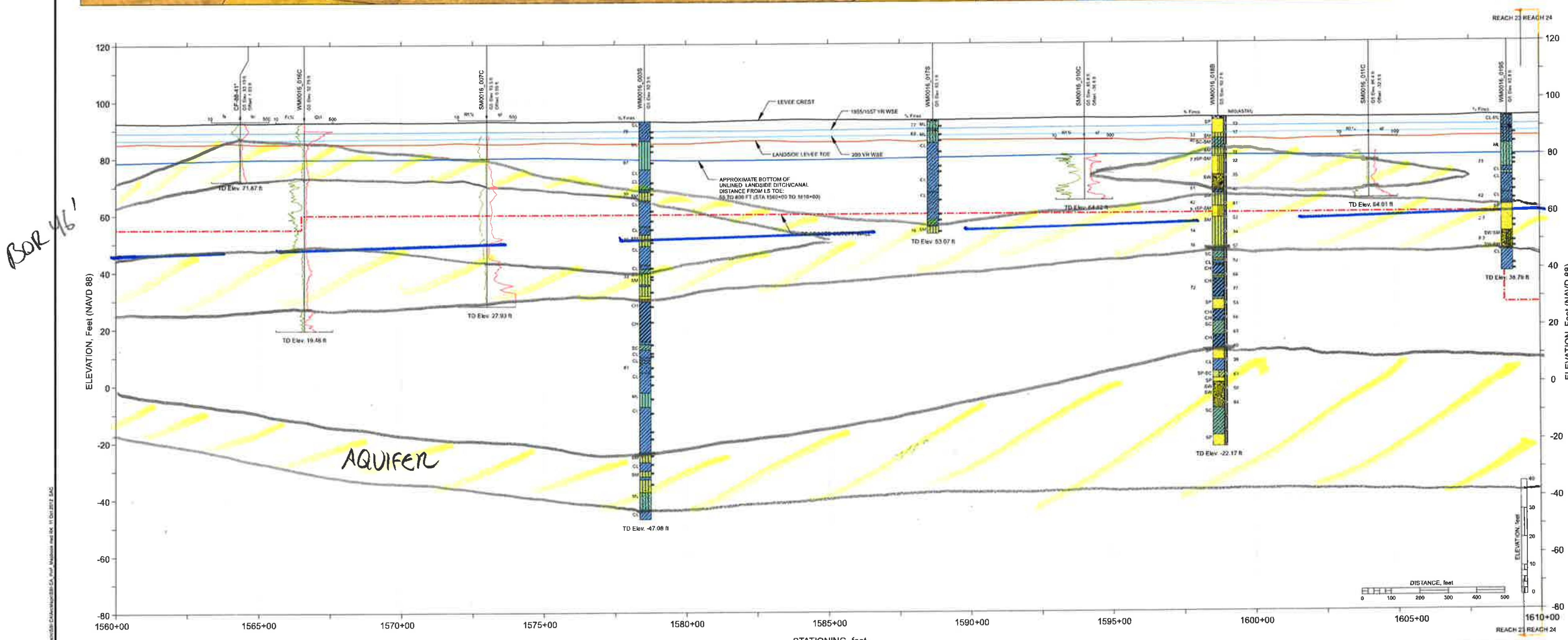
Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency

FEATHER RIVER WEST LEVEE PROJECT

Appendix A33





0 100 200
Feet

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12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.

Legend
Plate Location

DETAIL AREA

FRWL Project Plan Views and Stick Log Figures
FRWL Project: Station 1560+00 to Station 1610+00

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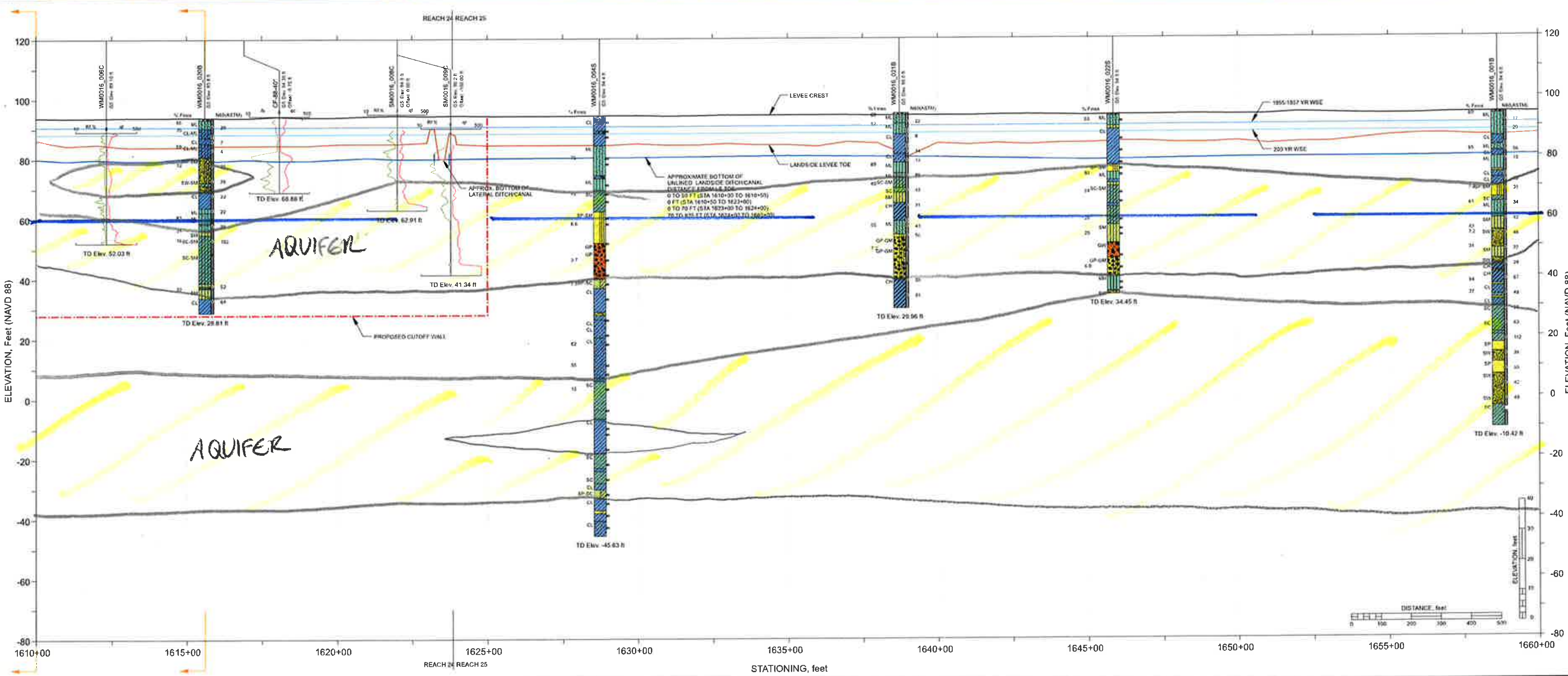
Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A34

NEW WALL CUTS OFF SMALL PORTION OF UPPER AQUIFER



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12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.

FRWL Project Plan Views and Stick Log Figures

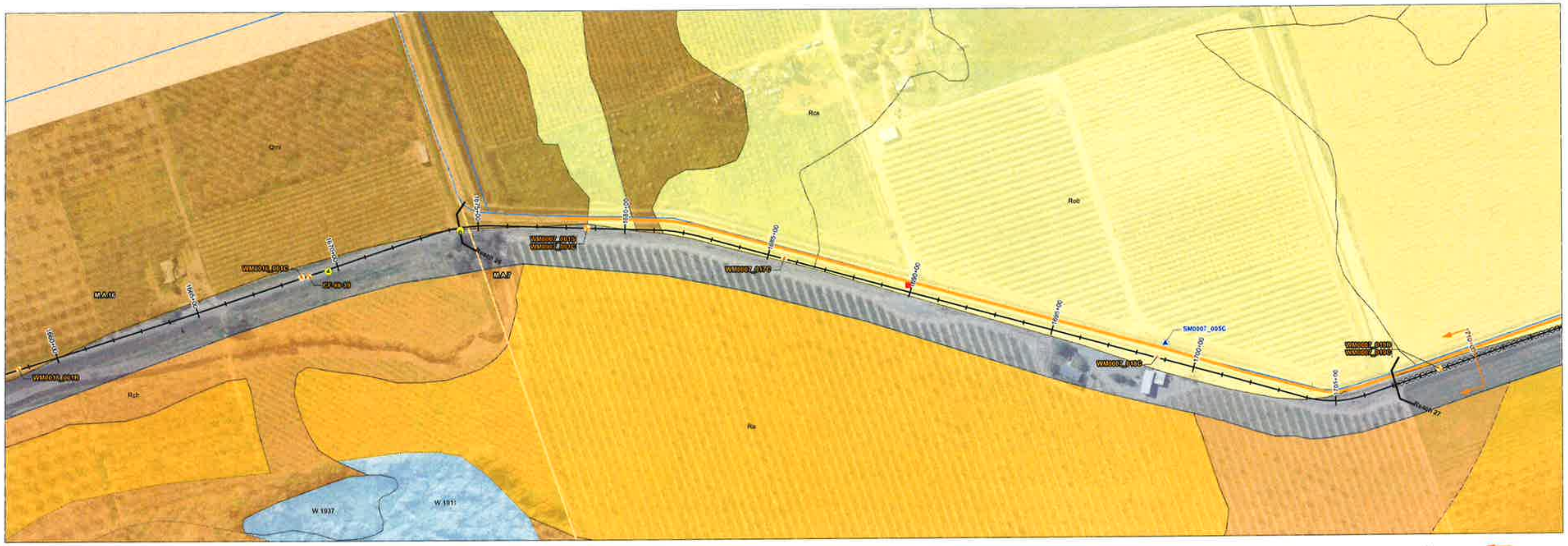
FRWL Project: Station 1610+00 to Station 1660+00

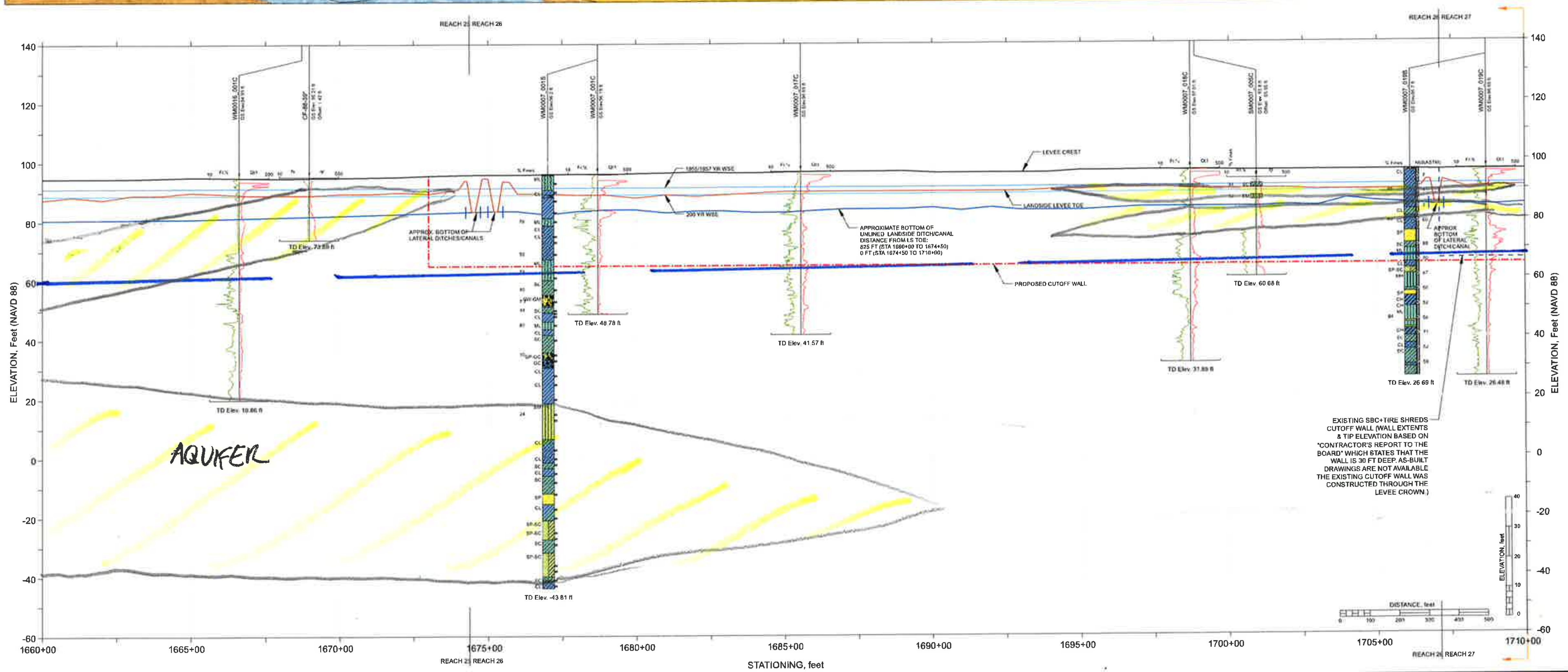
URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency — FEATHER RIVER WEST LEVEE PROJECT

Appendix A35

NEW WALL CUTS OFF SHALLOW AQUIFER FROM ~ STA. 1695+00 TO 1727+50





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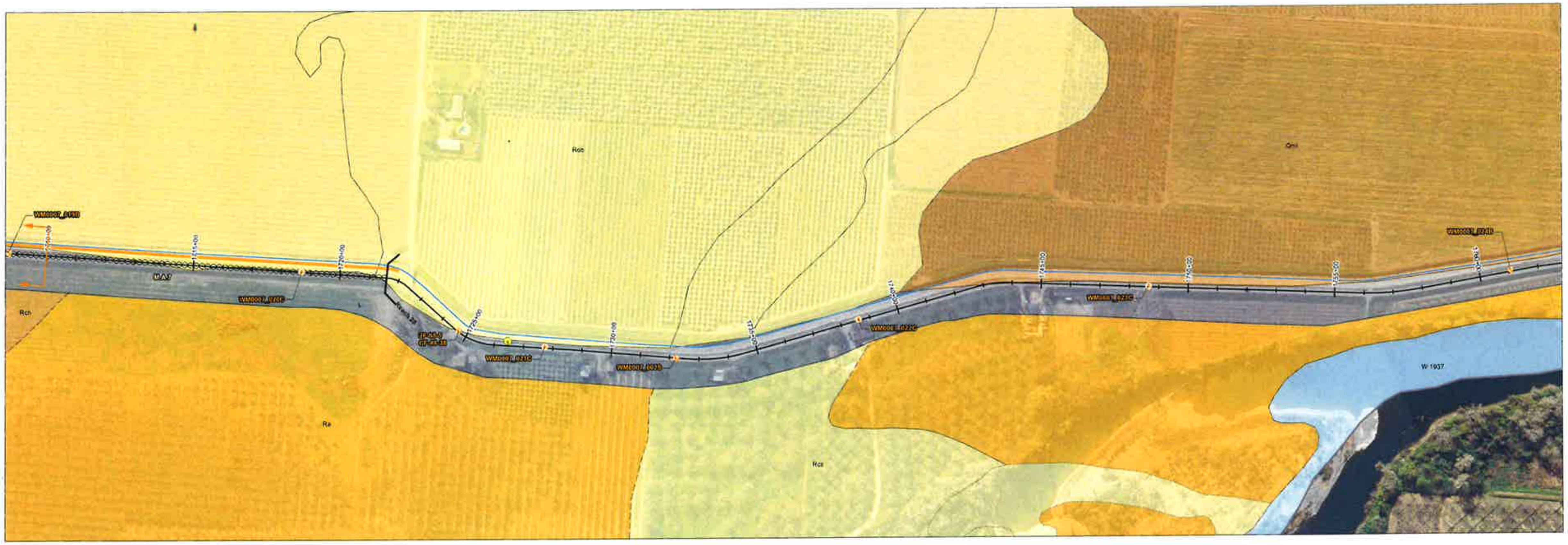
FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 1660+00 to Station 1710+00

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency — FEATHER RIVER WEST LEVEE PROJECT

Appendix A36



N

0 100 200
Feet

NOTES:

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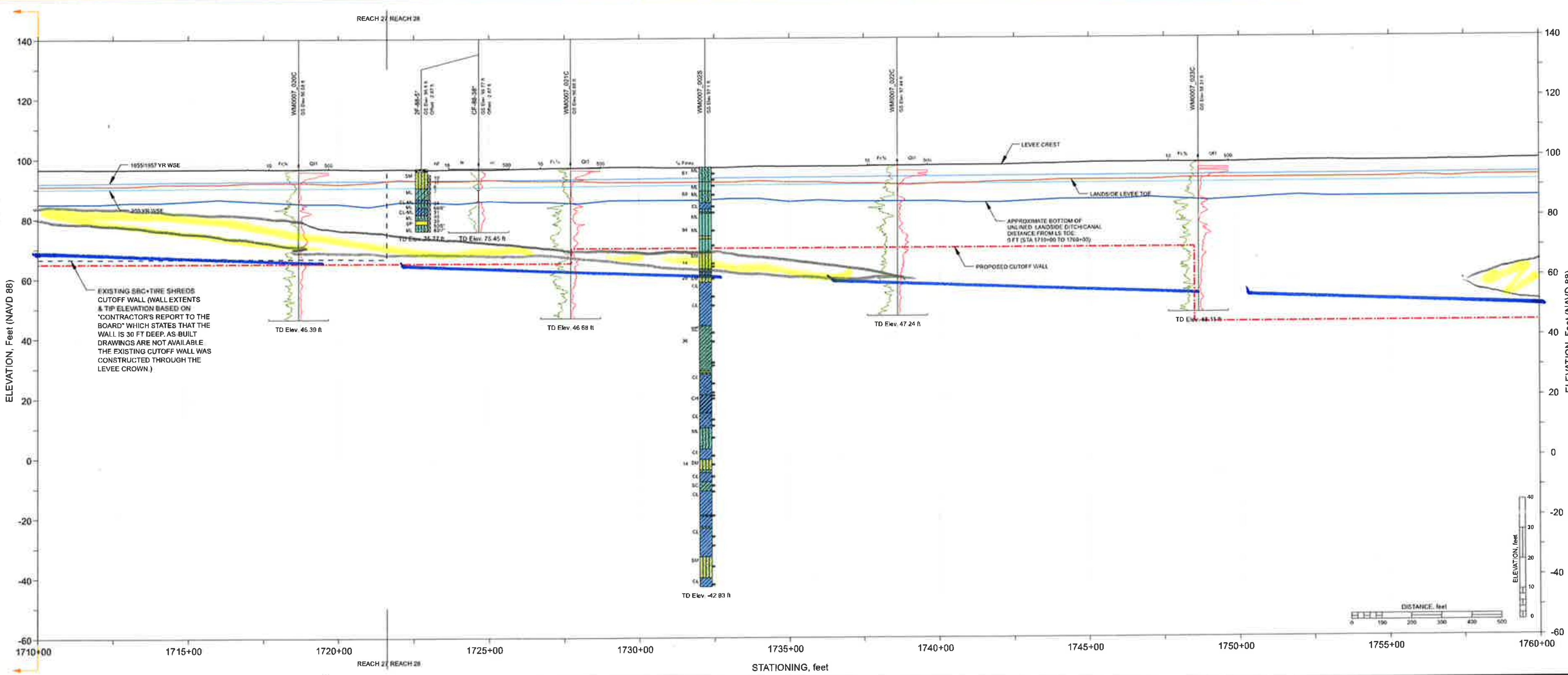


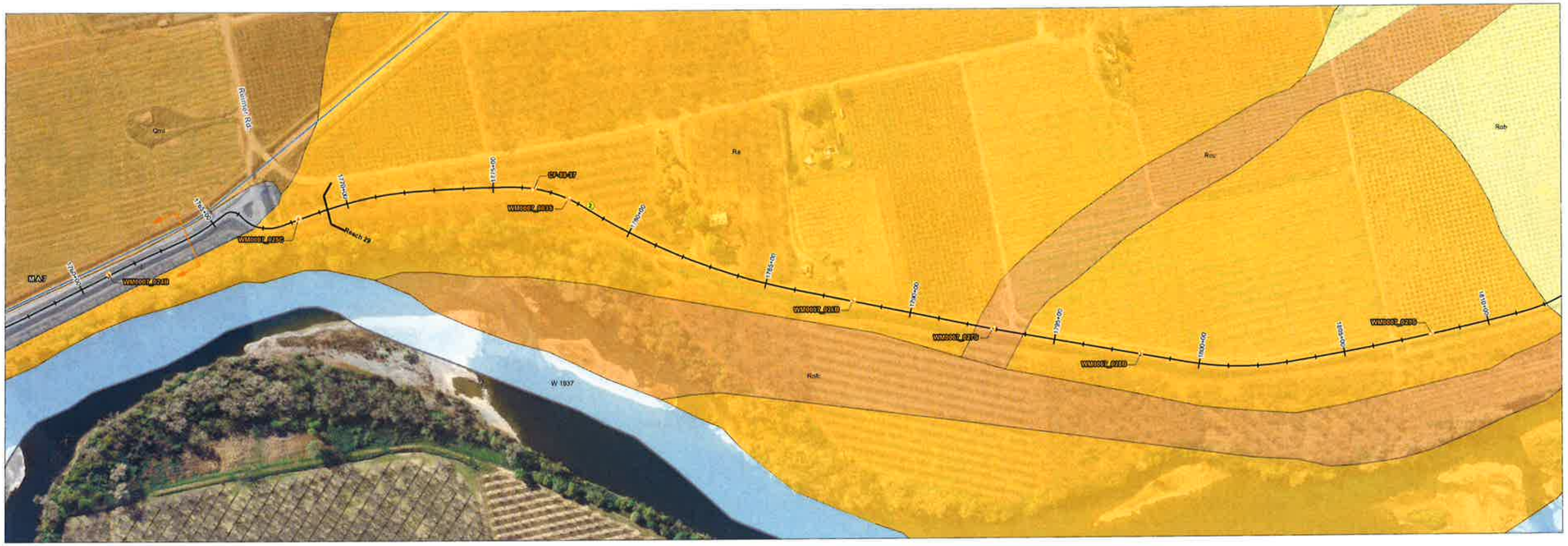
FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 1710+00 to Station 1760+00

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A37



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Feet

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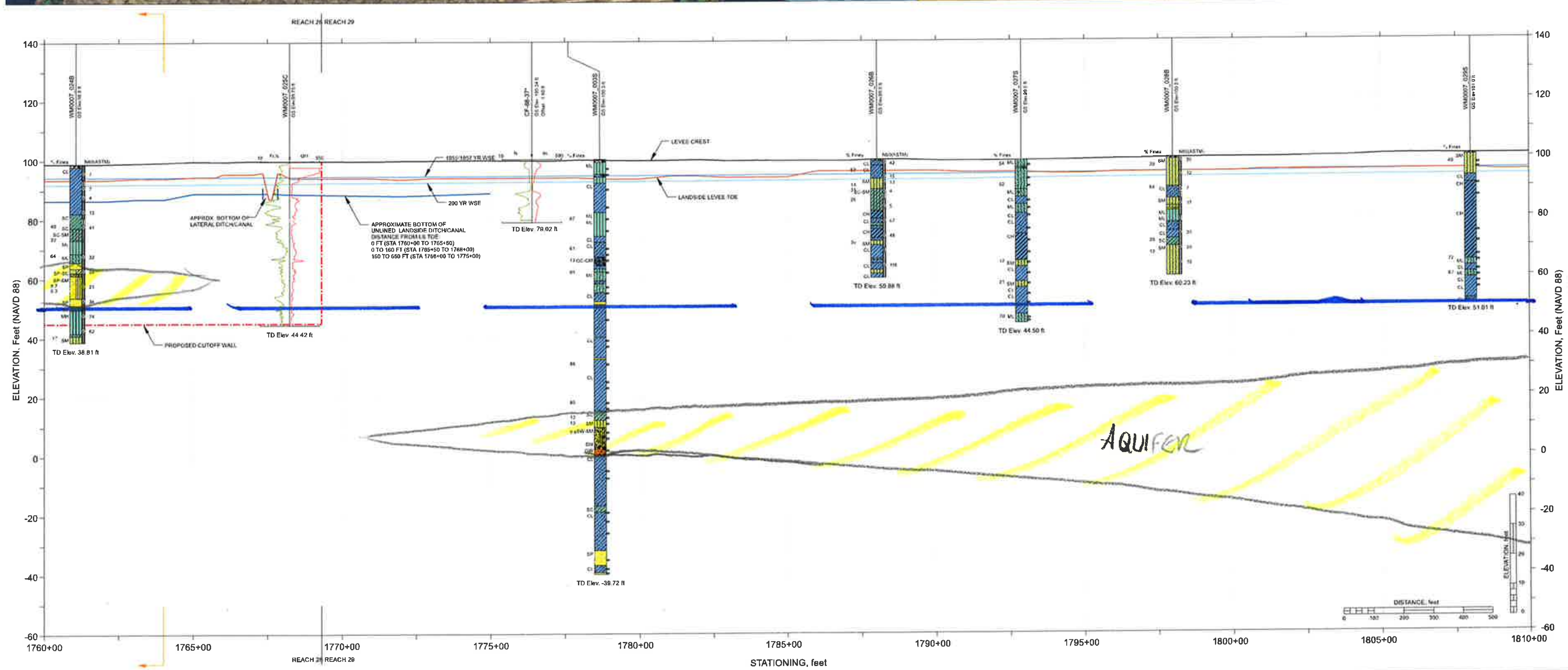
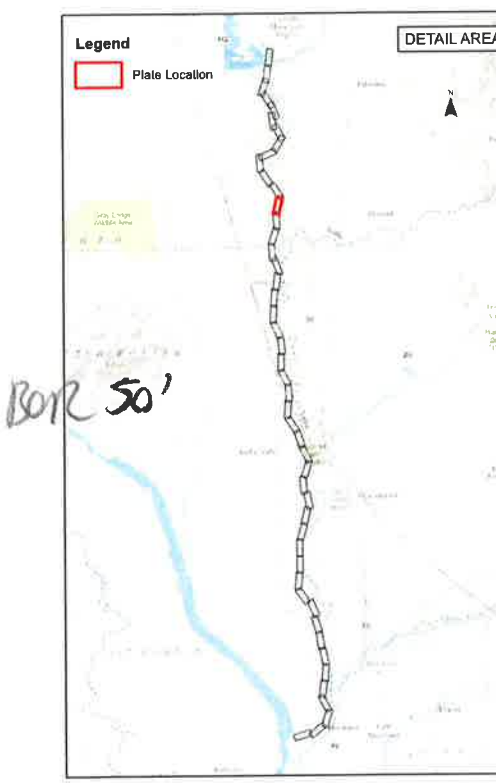




FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 1760+00 to Station 1810+00

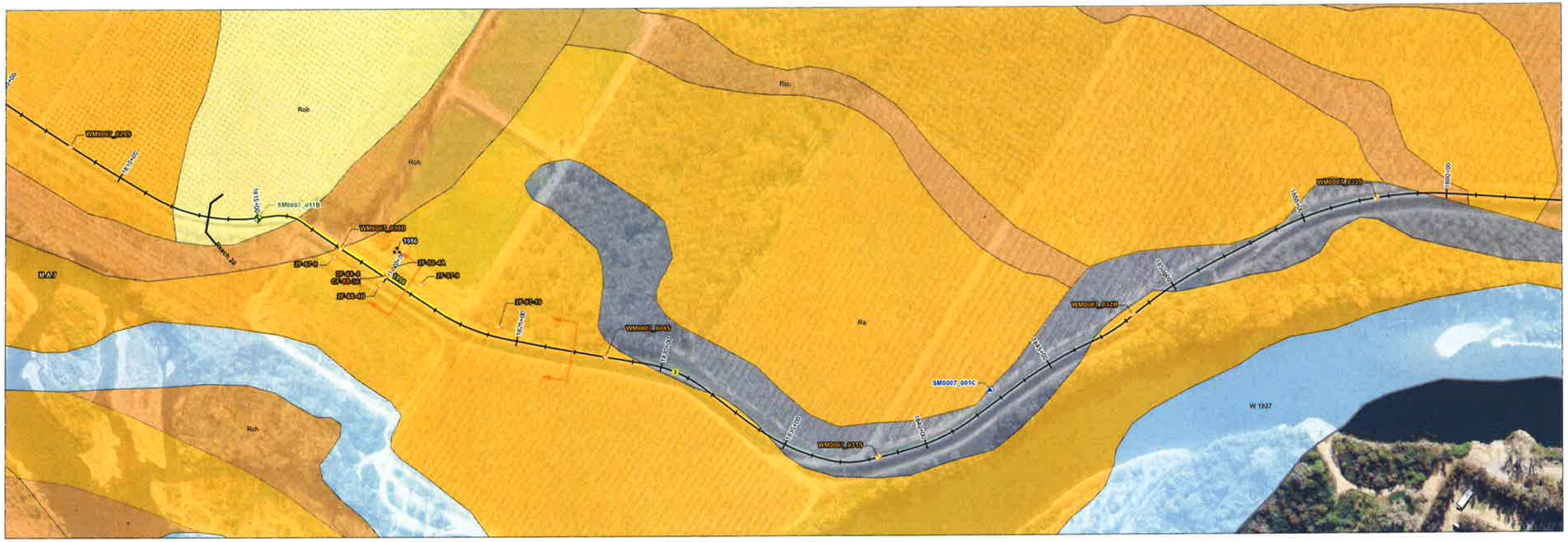
URS

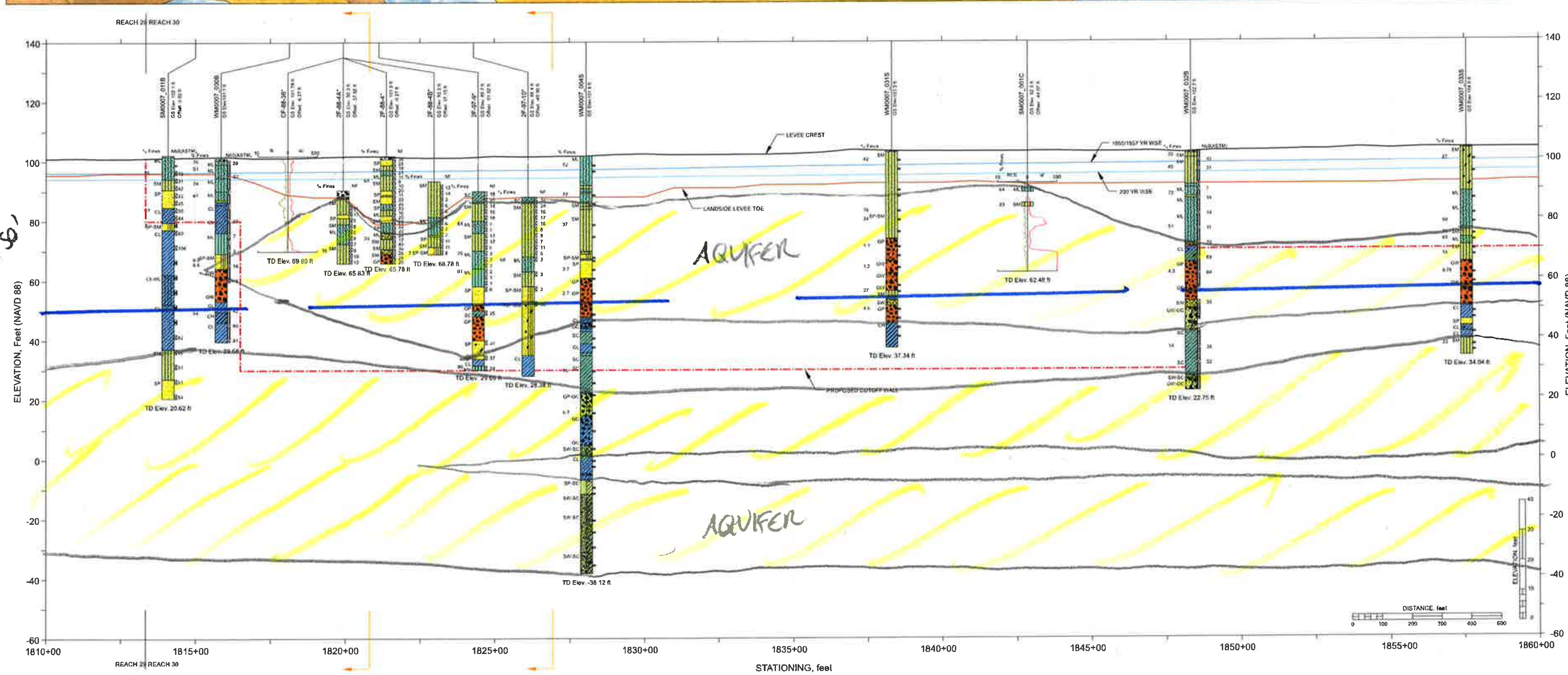
Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A38

NEW WALL CUTS OFF SHALLOW AQUIFER





0 100 200
Feet

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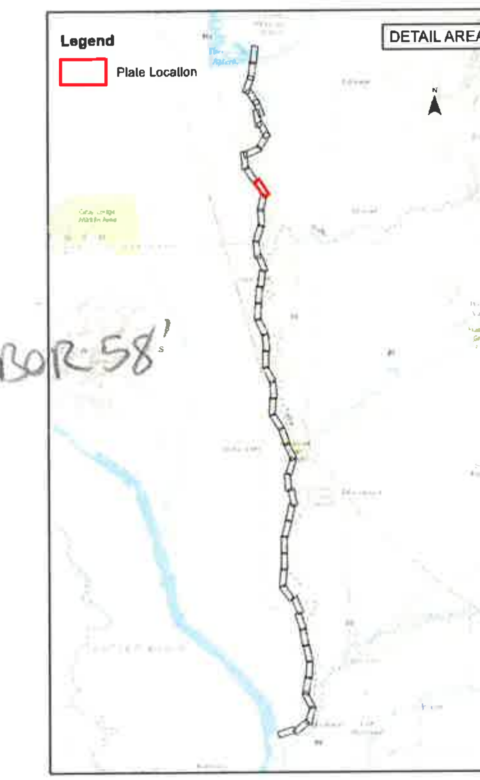
Legend

Plate Location

DETAIL AREA



FRWL Project Plan Views and Stick Log Figures

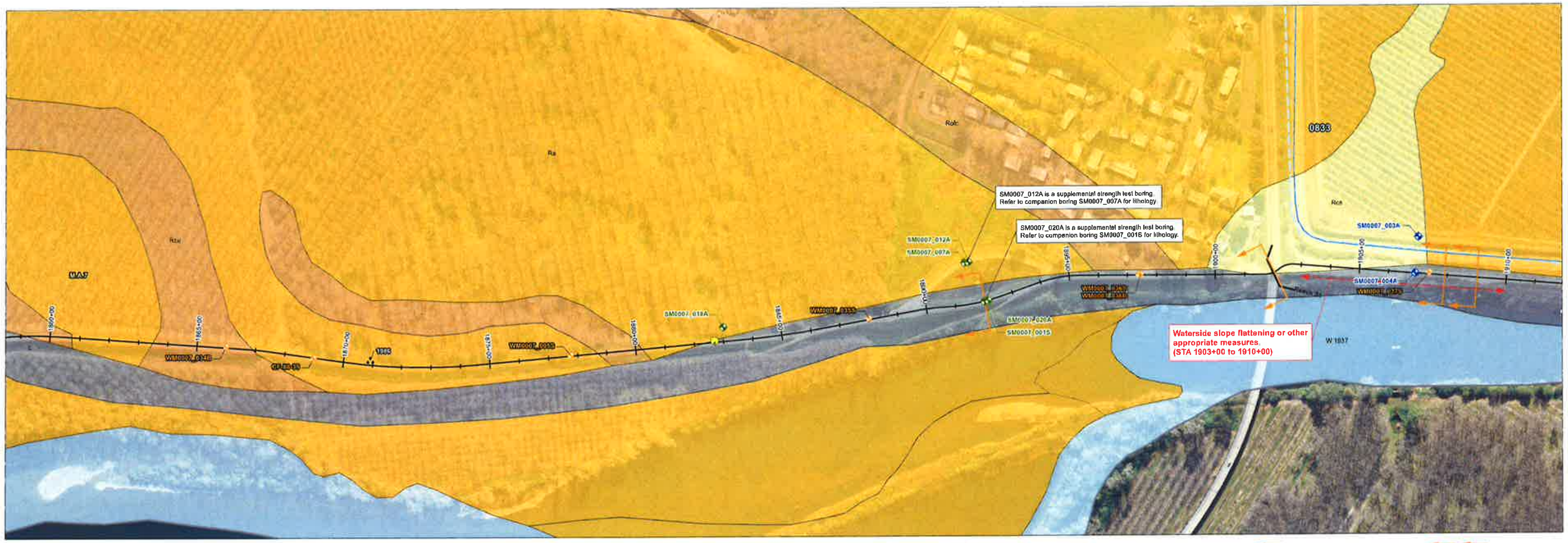
FRWL Project: Station 1810+00 to Station 1860+00

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A39

NEW WALL CUTS OFF UPPER AQUIFER



0 100 200
Feet

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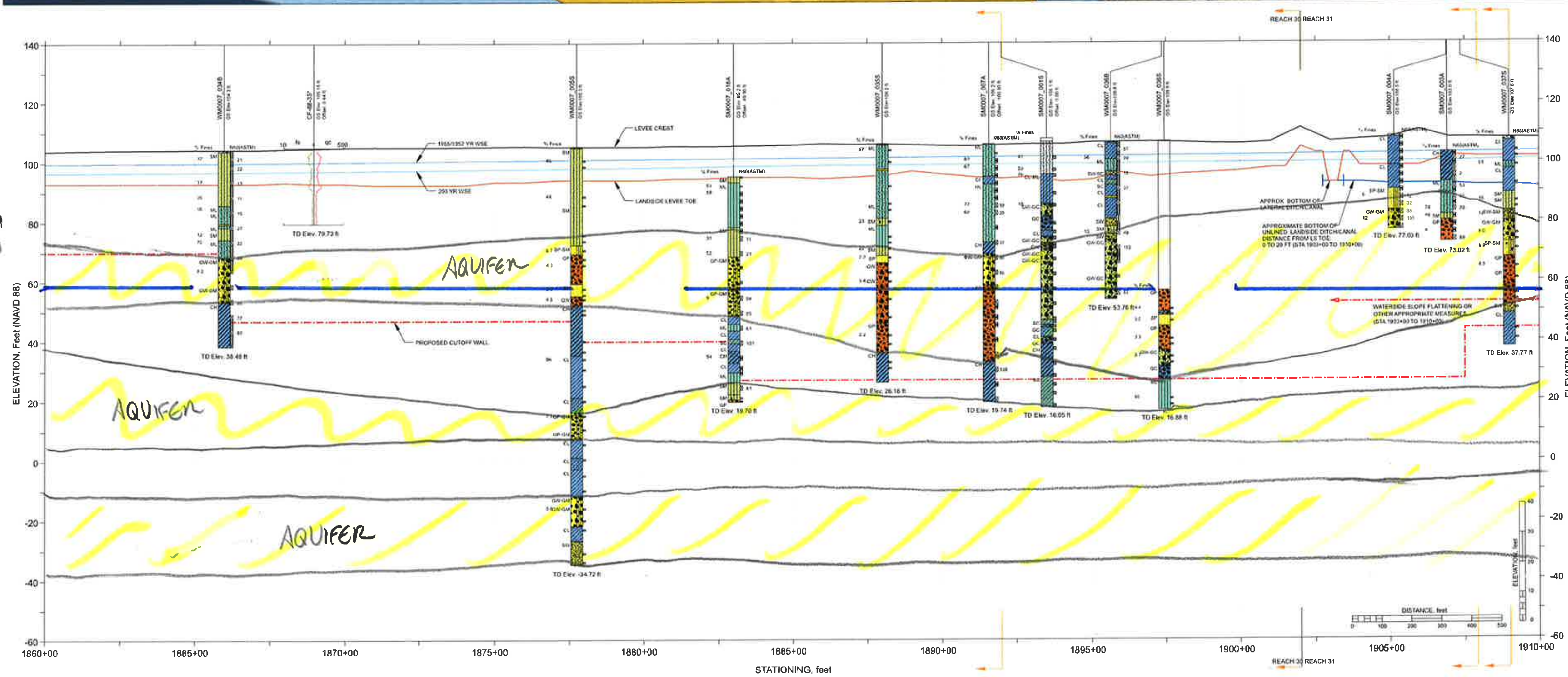


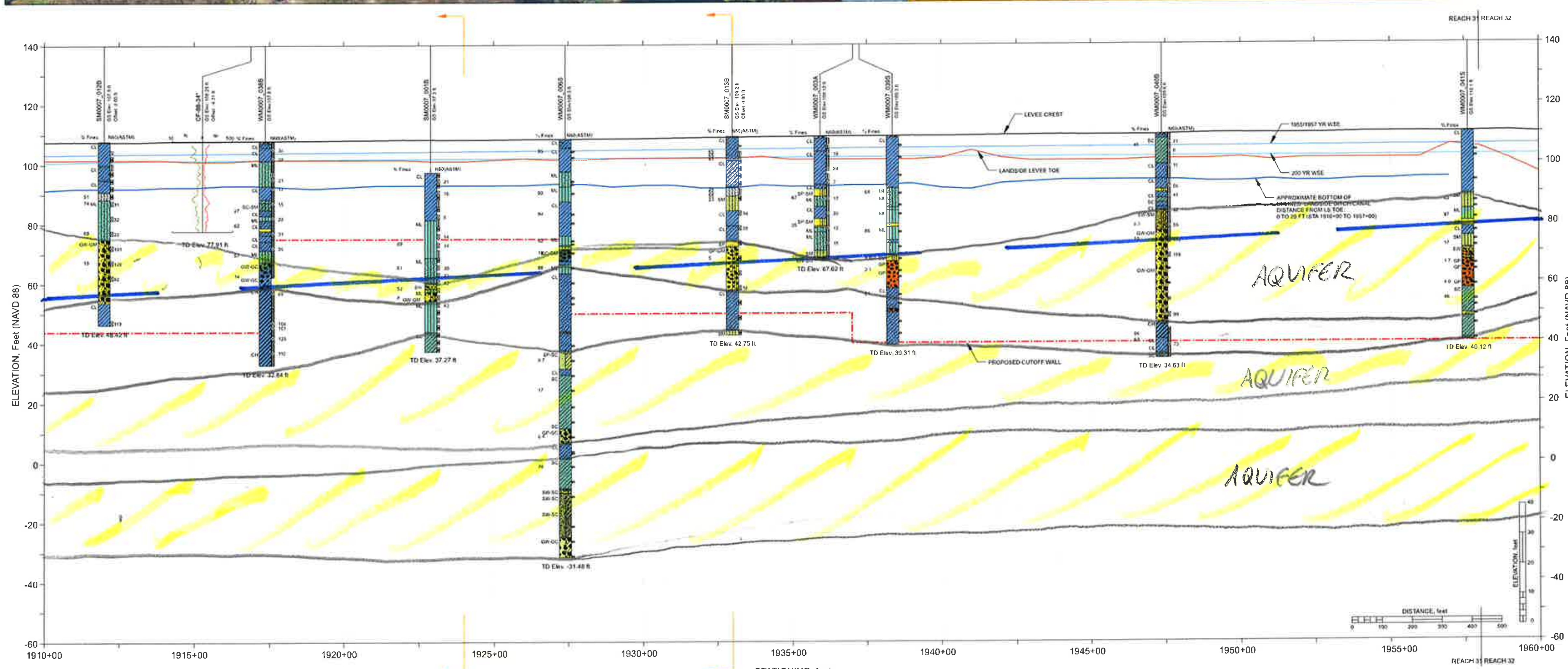
FRWL Project Plan Views and Stick Log Figures
FRWL Project: Station 1860+00 to Station 1910+00

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A40

NEW WALL CUTS OFF UPPER AQUIFER



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Feet

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3. Locations of explorations are approximate. Stick logs represent general soil conditions encountered at the time of exploration. For more detailed information on the materials encountered, refer to boring and CPT logs in the Geotechnical Data Report for the FRWL Project. No warranty is provided regarding the continuity of soil conditions between individual explorations.
4. When reported, N_{60}(ASTM), refers to N_{60}(ASTM) = N_{field} * Hammer Efficiency (%). See Geotechnical Data Report for the FRWL Project for hammer efficiency data for individual borings.
5. These drawings do not include all historical explorations on the profile view. Historical explorations from the DWR ULE project are shown; "other" historical explorations are identified by an asterisk (*) in the exploration ID. For these "other" historical borings, blow counts are field blow counts (Nf) and USCS classifications are visual classifications.
6. USCS classification labels are not presented on the stick logs for soil lenses (thickness less than 1.5 feet).
7. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
9. Surficial geology was mapped at 1:20,000 scale. (Source: SGDR for DWR ULE Project, URS,2010).
10. The information provided in these plans and stick-log plates has been compiled from a variety of sources. URS does not attest to the accuracy, completeness, or reliability of geotechnical exploration and other subsurface data by others that are included or referenced in these plates.
11. These plans and stick-log plates are for the use and benefit of HDR, SBFCA, and their consultants in connection with the execution of the FRWL Project. Use by any other party is at their own discretion and risk. These figures should not to be used as the sole basis for design, construction, remedial action, or major capital spending decisions.
12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.

FRWL Project Plan Views and Stick Log Figures

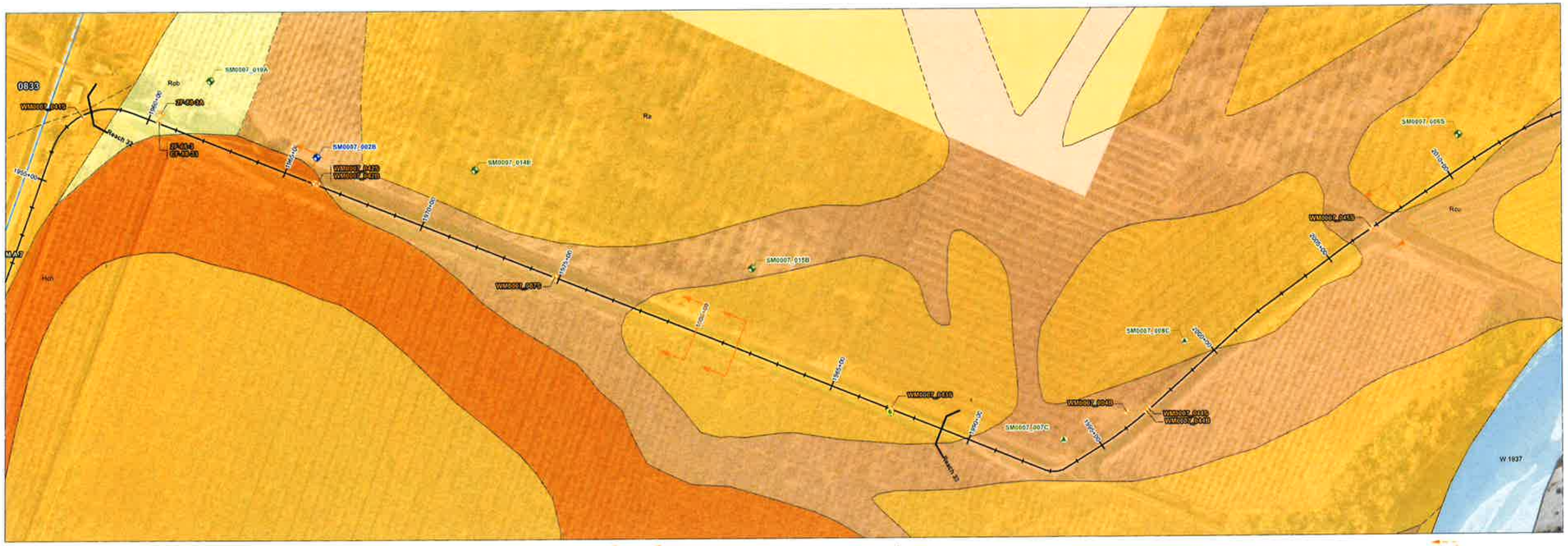
FRWL Project: Station 1910+00 to Station 1960+00

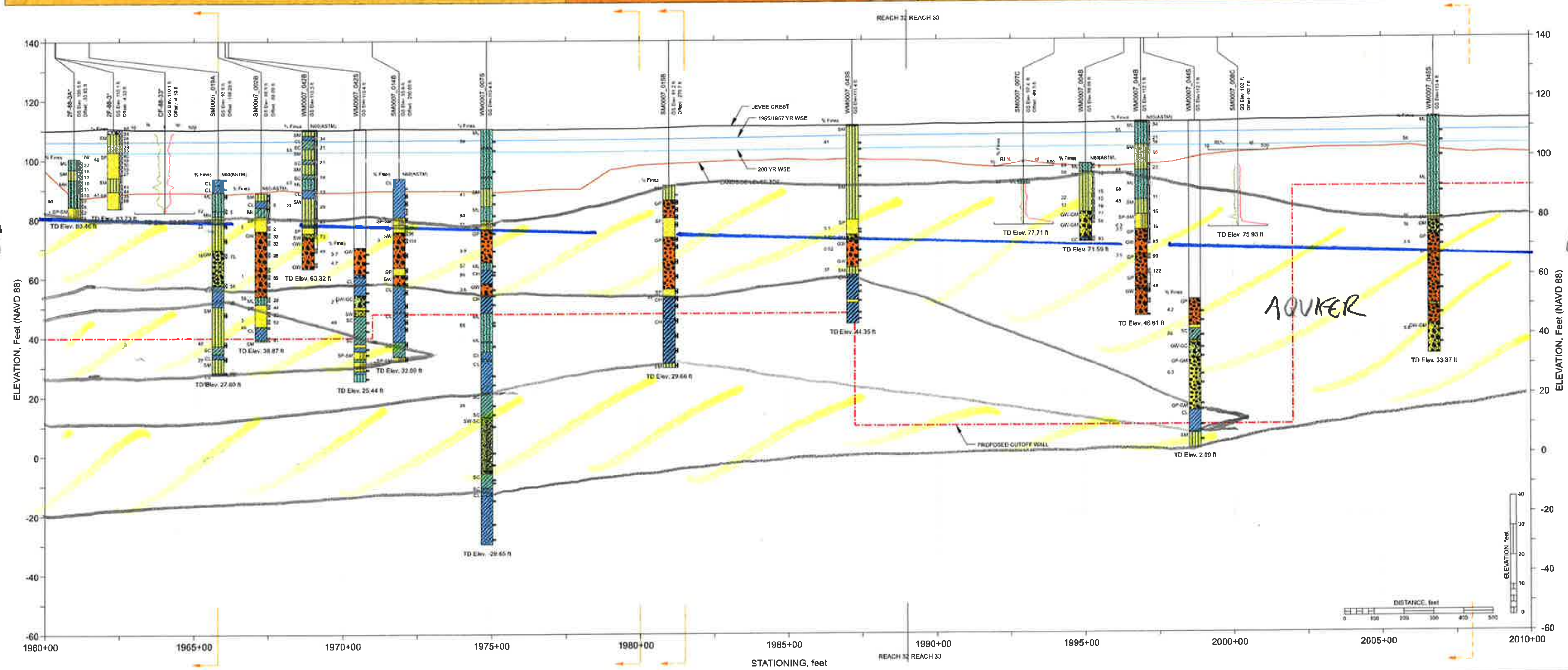
URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A41

NEW WALL CUTS OFF UPPER AQUIFER





0 100 200
Feet

NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LIDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
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6. USCS classification labels are not presented on the stick logs for soil lenses (thickness less than 1.5 feet).
7. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
9. Surficial geology was mapped at 1:20,000 scale. (Source: SGDR for DWR ULE Project, URS,2010).
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12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.

Legend

Plate Location

DETAIL AREA

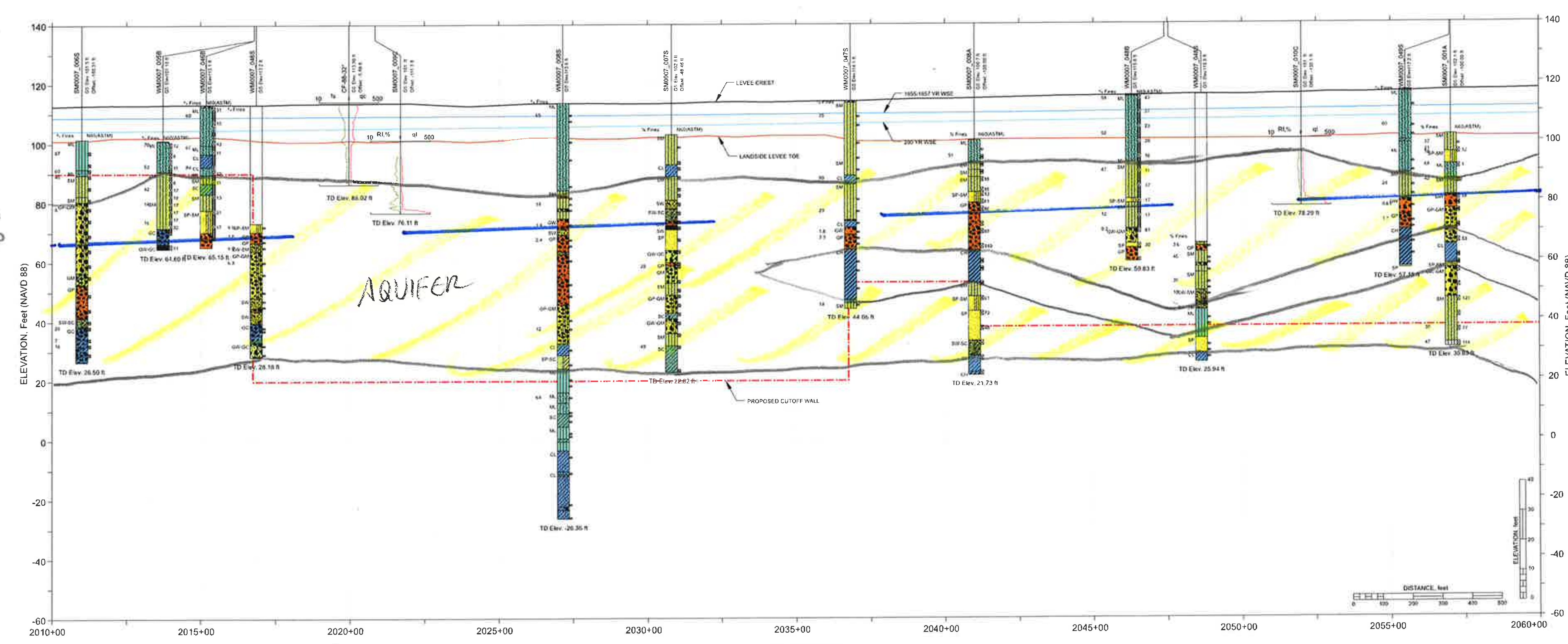
FRWL Project Plan Views and Stick Log Figures
FRWL Project: Station 1960+00 to Station 2010+00

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A42

NEW WALL CUTS OFF AQUIFER



0 100 200

Feet

NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LiDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
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12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.

FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 2010+00 to Station 2060+00

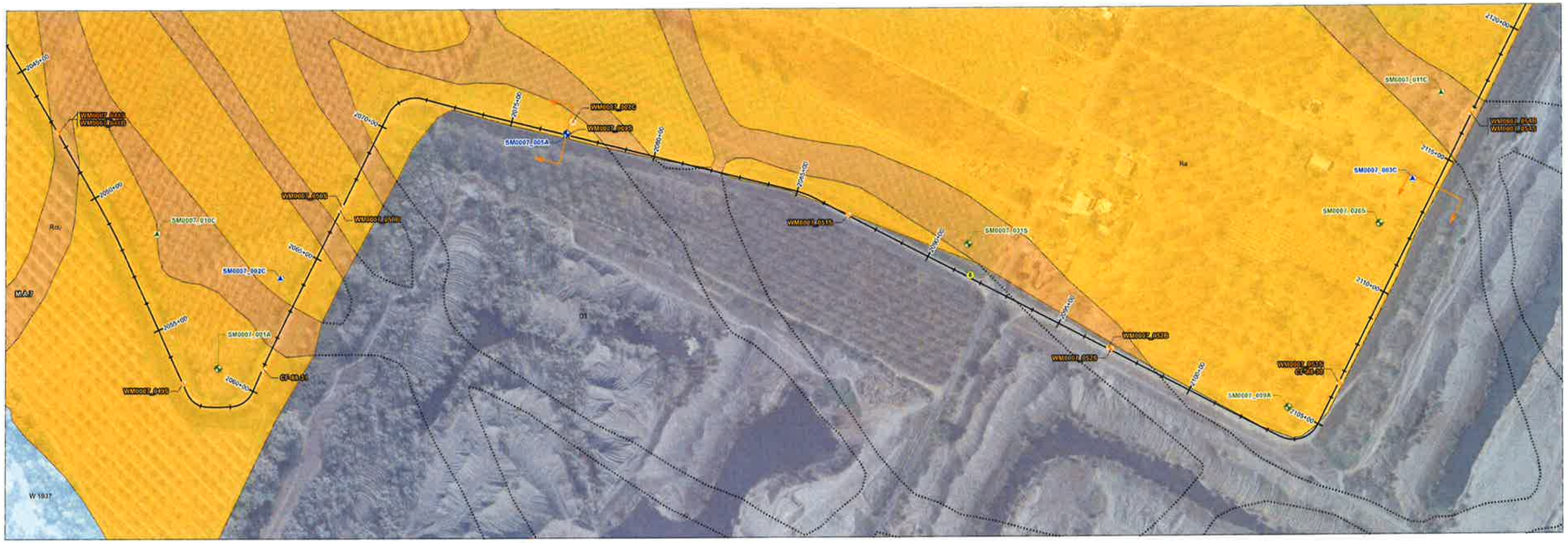
URS — Geotechnical Design Recommendations Report

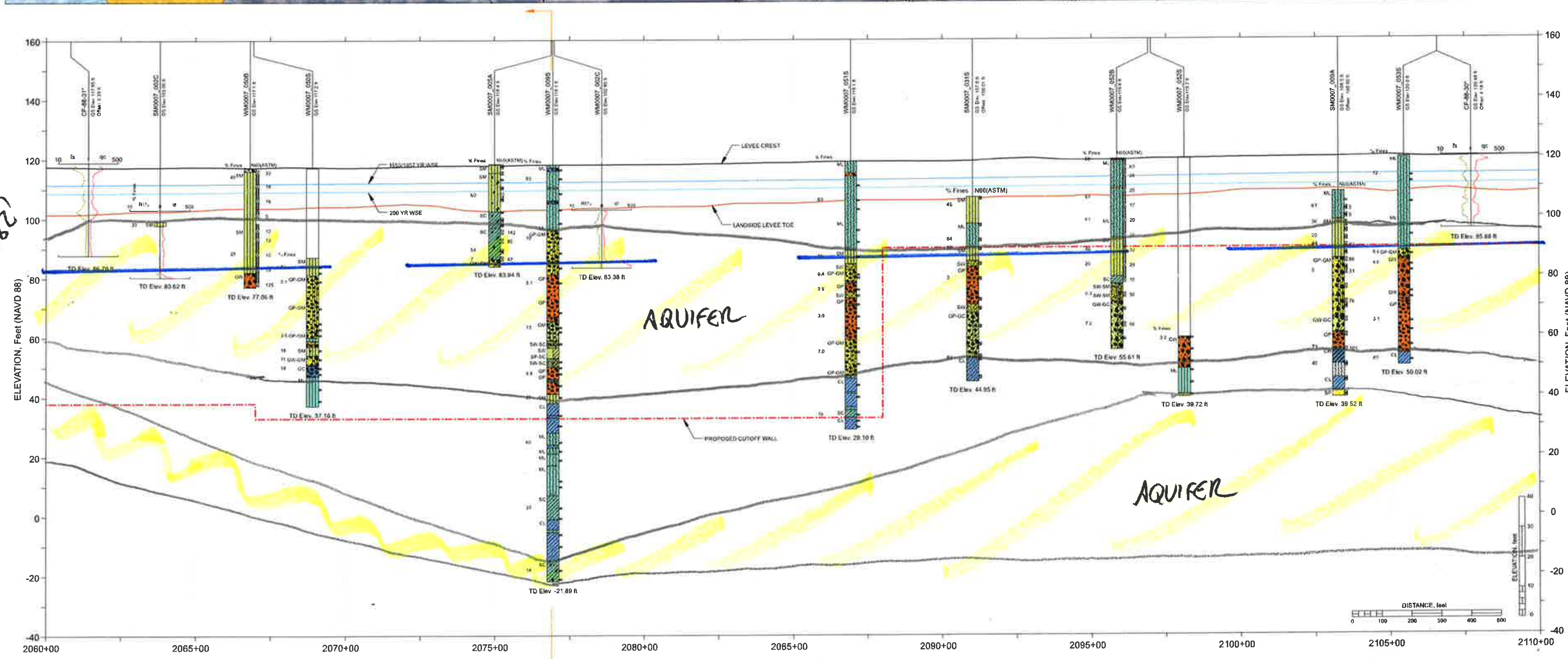
Sutter Butte Flood Control Agency

FEATHER RIVER WEST LEVEE PROJECT

Appendix A43

NEW WALL CUTS OFF UPPER AQUIFER





0 100 200
Feet

NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LIDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
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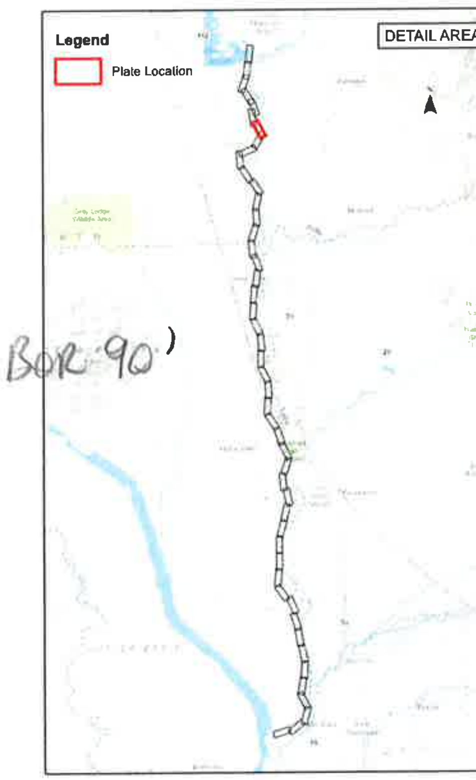
12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.



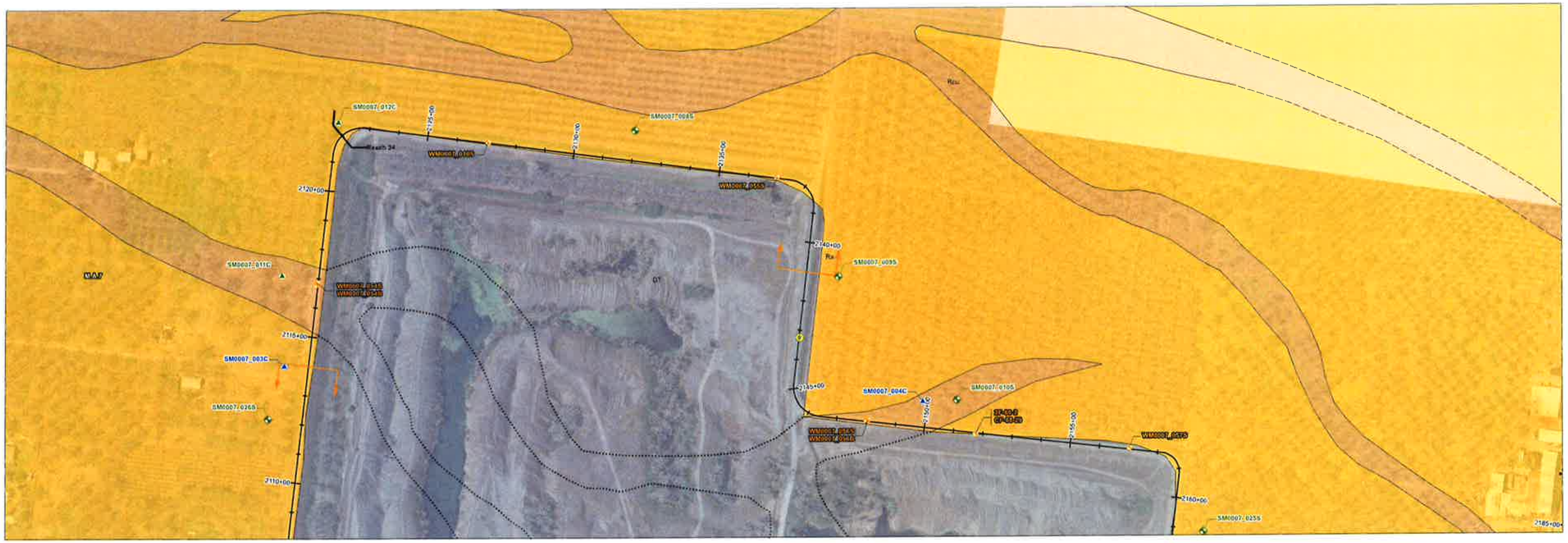
FRWL Project Plan Views and Stick Log Figures
FRWL Project: Station 2060+00 to Station 2110+00

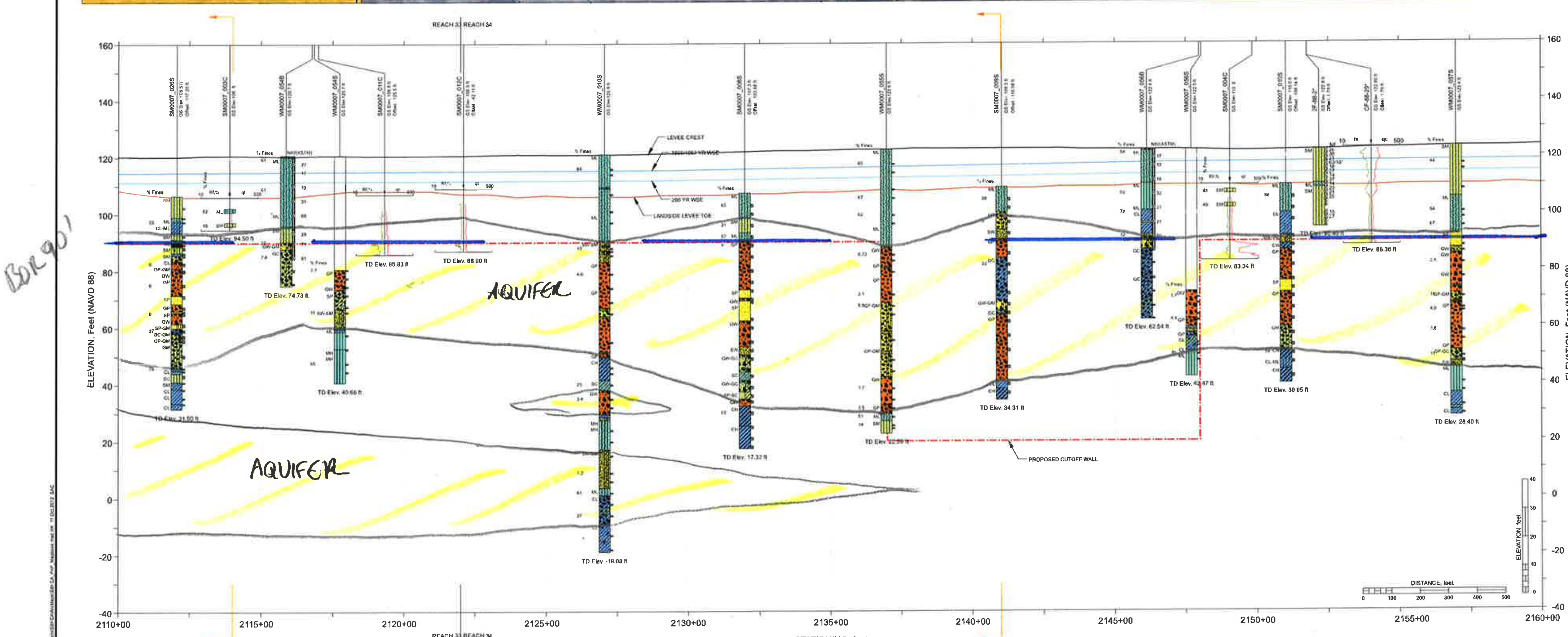
URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A44

NEW WALL CUTS OFF AQUIFER FROM ~STA. 2137+00 TO 2148+00





0 100 200
Feet

NOTES:
1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LiDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
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6. USCS classification labels are not presented on the stick logs for soil lenses (thickness less than 1.5 feet).
7. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
9. Surficial geology was mapped at 1:20,000 scale. (Source: SGDR for DWR ULE Project, URS,2010).
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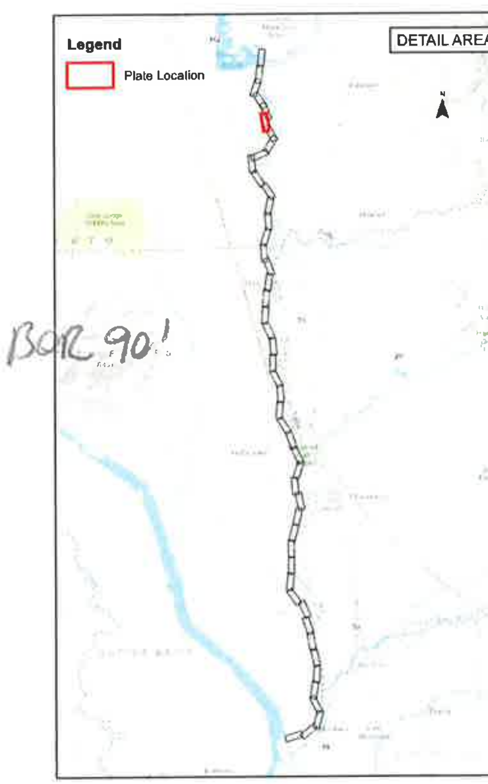
12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.



FRWL Project Plan Views and Stick Log Figures

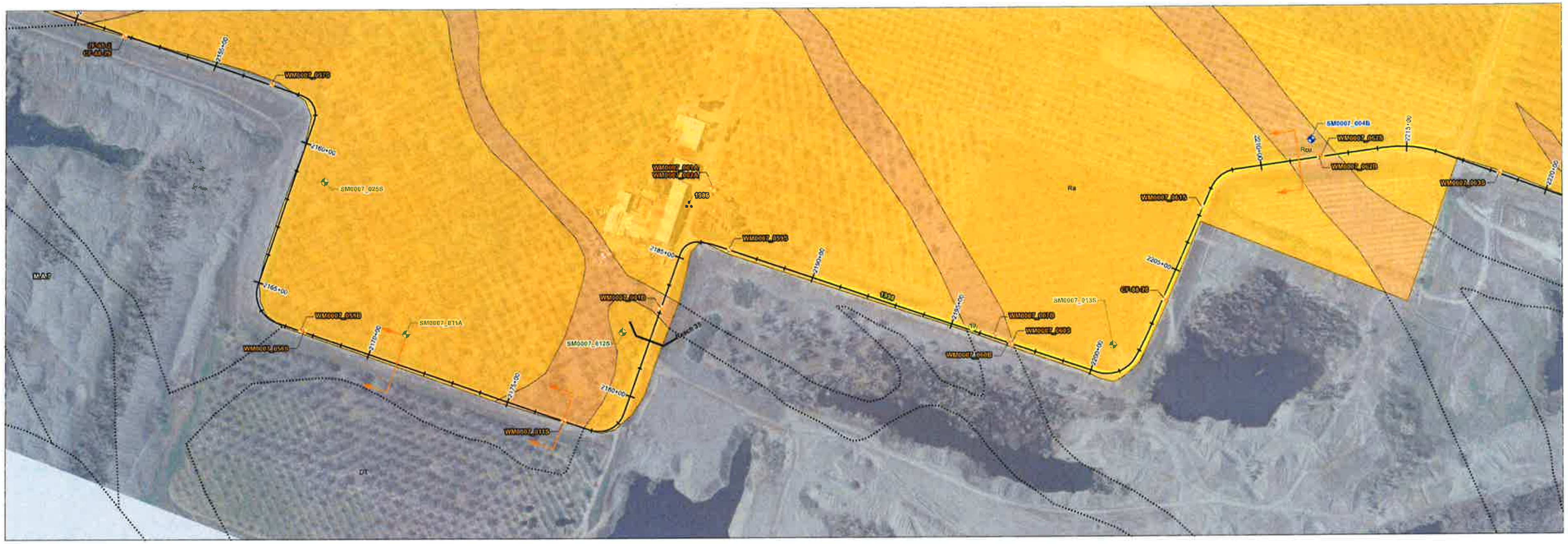
FRWL Project: Station 2110+00 to Station 2160+00

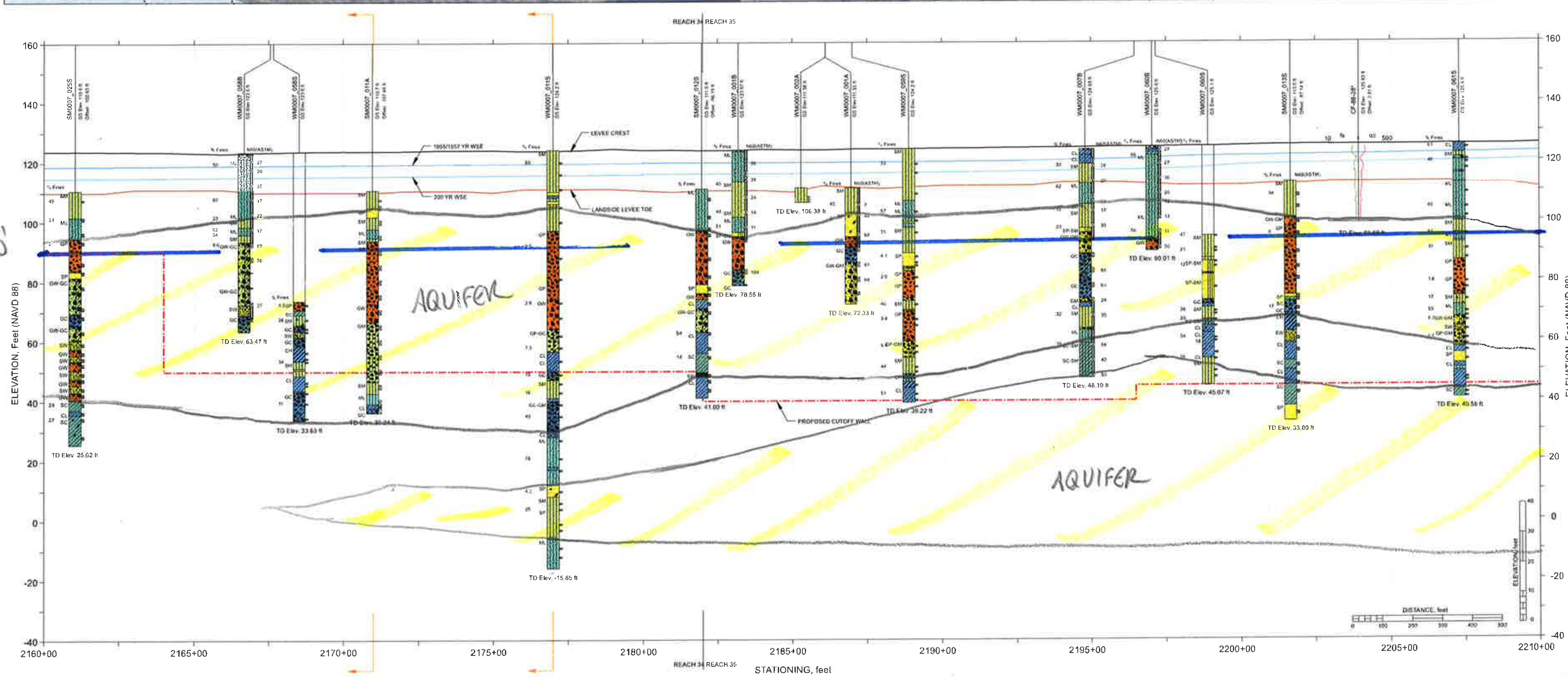
URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency — FEATHER RIVER WEST LEVEE PROJECT

Appendix A45

NEW WALL CUTS OFF UPPER AQUIFER





N

0 100 200
Feet

NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LiDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
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7. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
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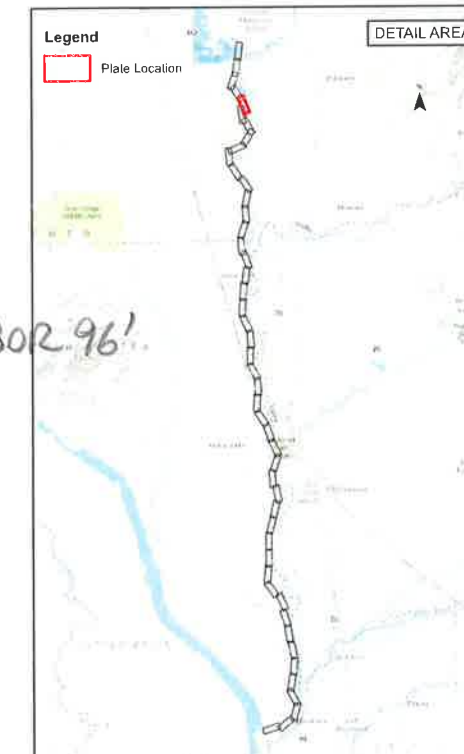
12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.

Legend

Plate Location

DETAIL AREA



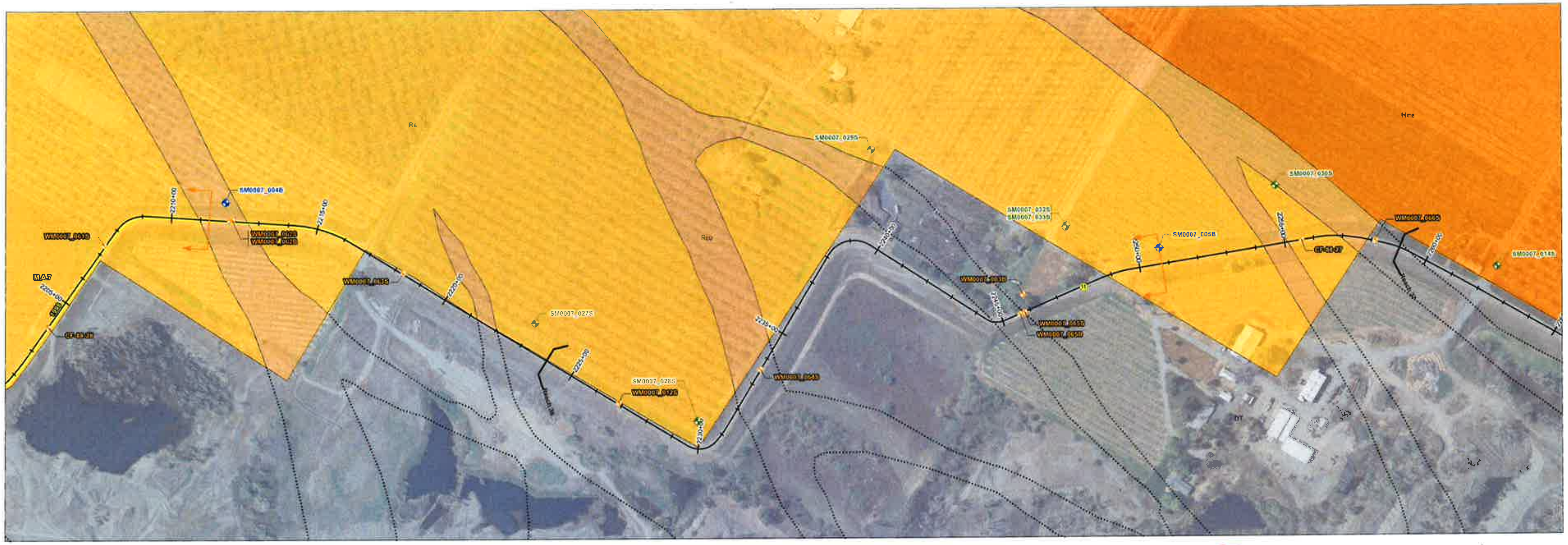
FRWL Project Plan Views and Stick Log Figures
FRWL Project: Station 2160+00 to Station 2210+00

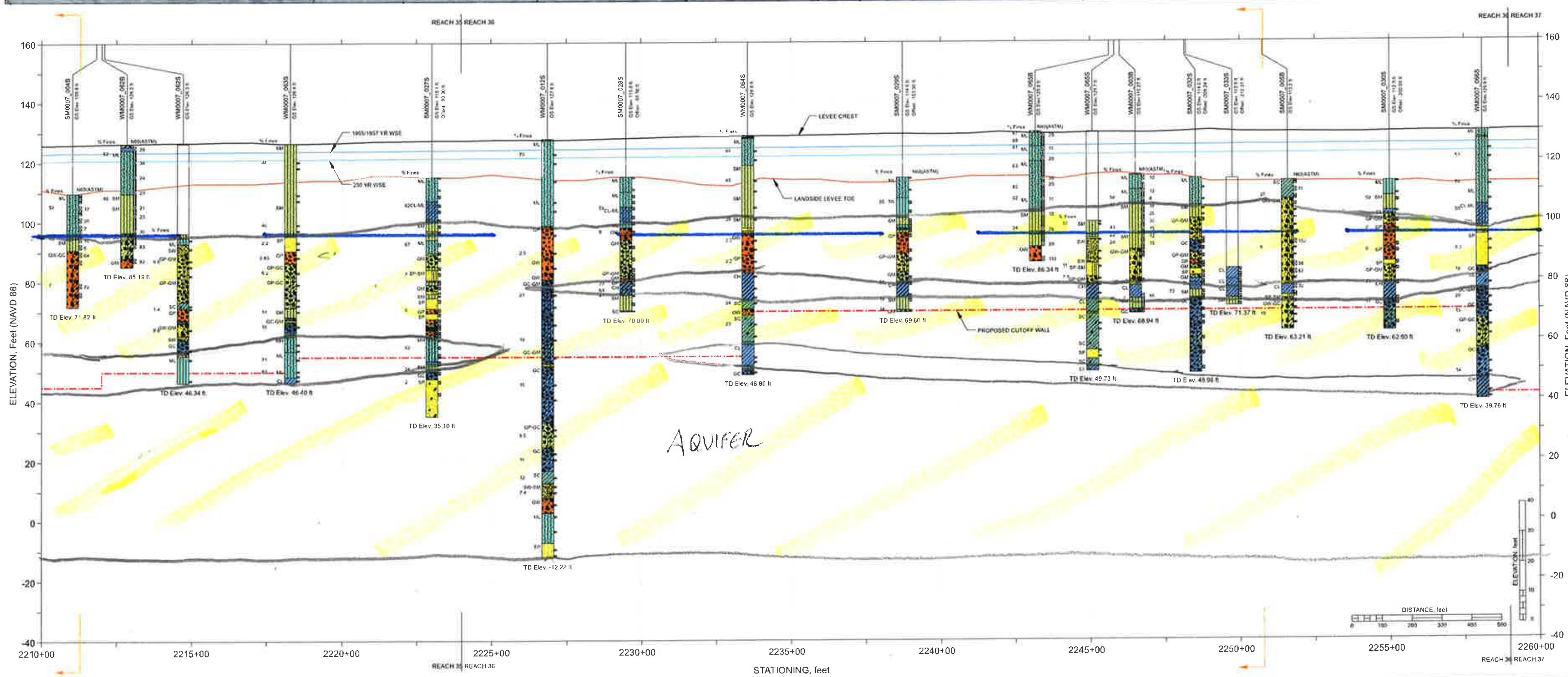
URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A46

NEW WALL CUTS OFF UPPER PORTION OF AQUIFER





0 100 200

Feet

NOTES:

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6. USCS classification labels are not presented on the stick logs for soil lenses (thickness less than 1.5 feet).
7. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
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12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.

Legend

Plate Location

DETAIL AREA

FRWL Project Plan Views and Stick Log Figures

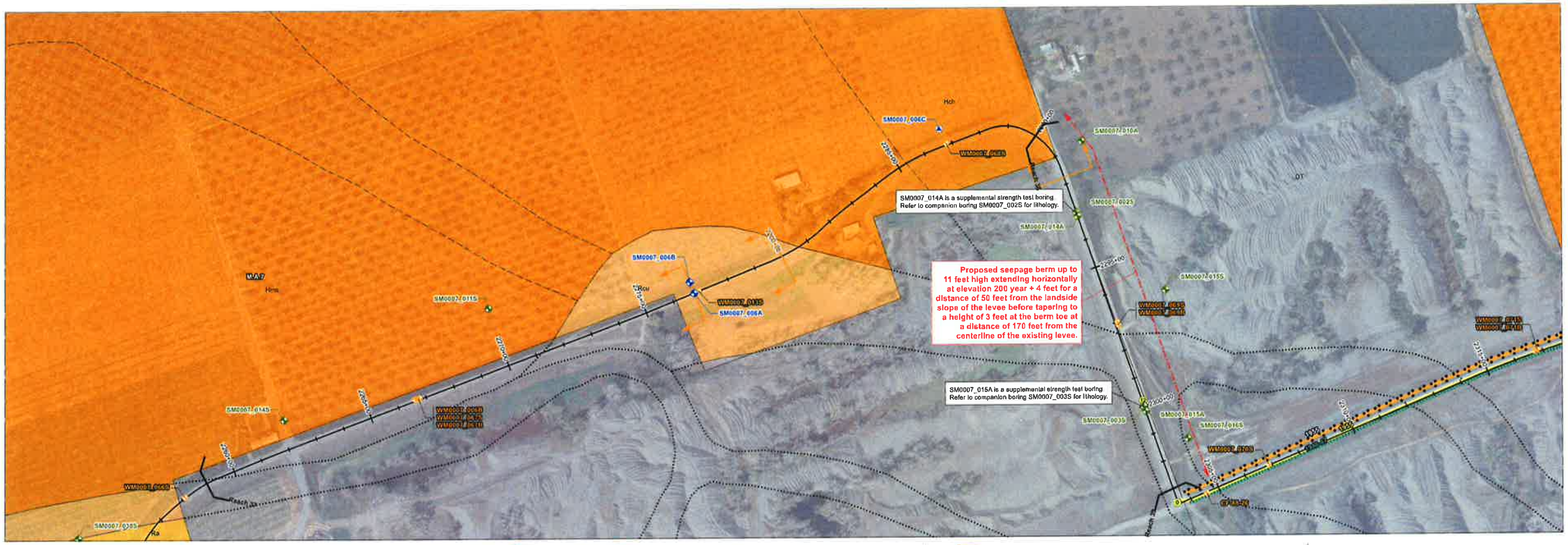
FRWL Project: Station 2210+00 to Station 2260+00

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency

FEATHER RIVER WEST LEVEE PROJECT

Appendix A47



0 100 200
Feet

NOTES:
1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LIDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
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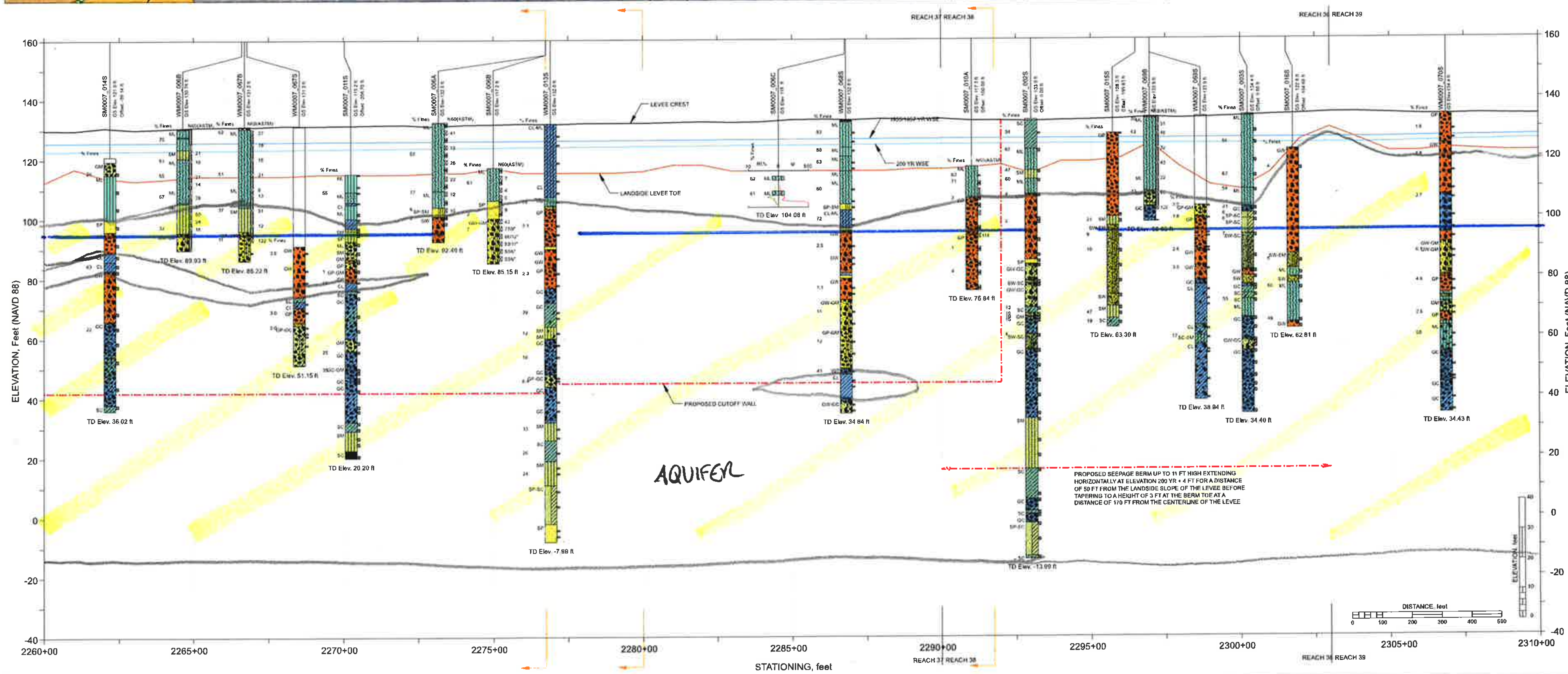
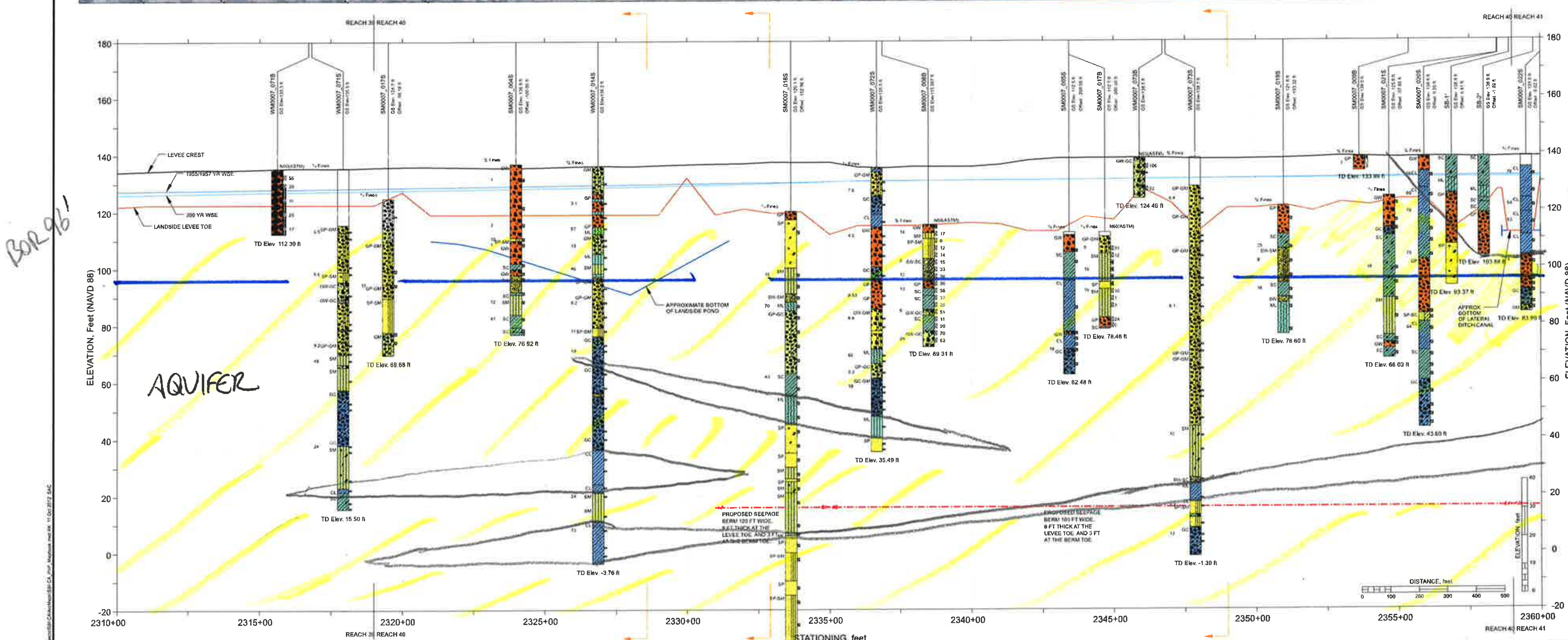


FRWL Project Plan Views and Stick Log Figures
FRWL Project: Station 2260+00 to Station 2310+00

URS
Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A48



0 100 200

Feet

NOTES:

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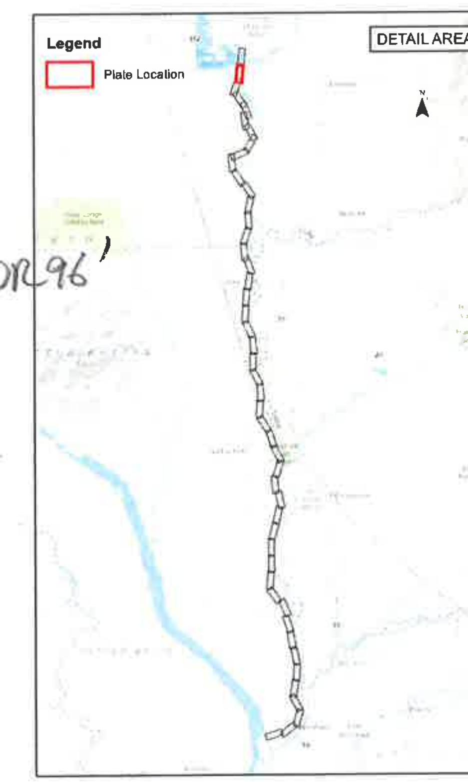


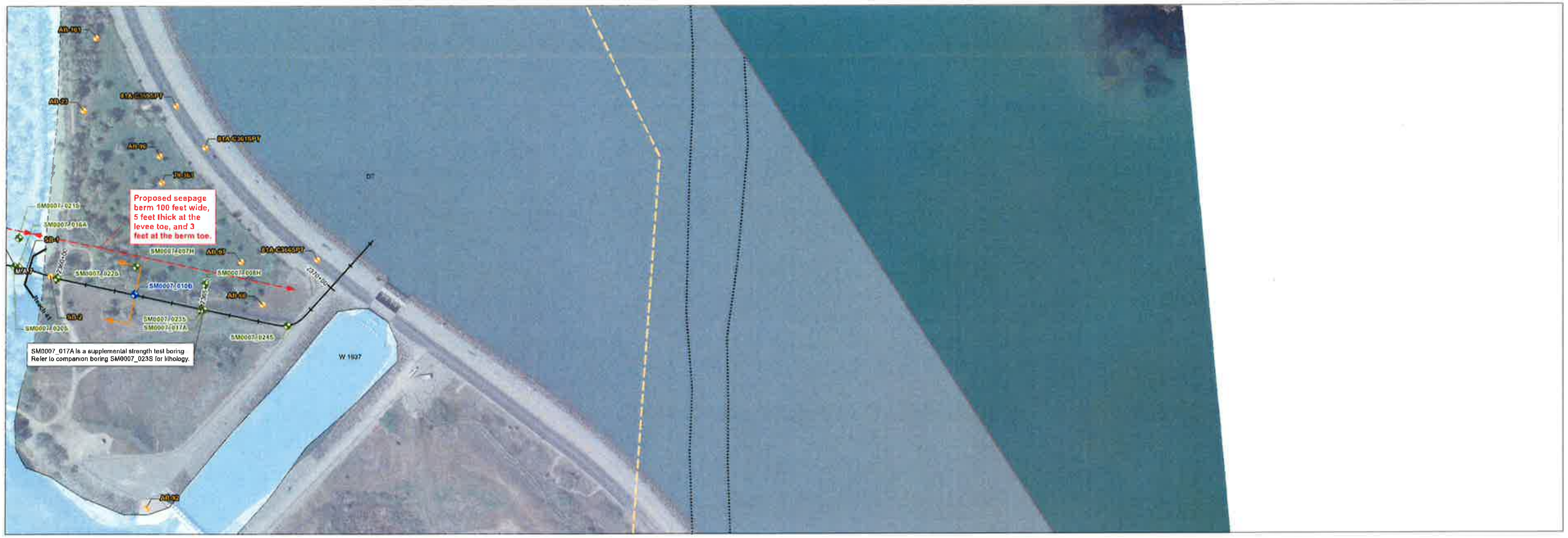
FRWL Project Plan Views and Stick Log Figures

FRWL Project: Station 2310+00 to Station 2360+00

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A49



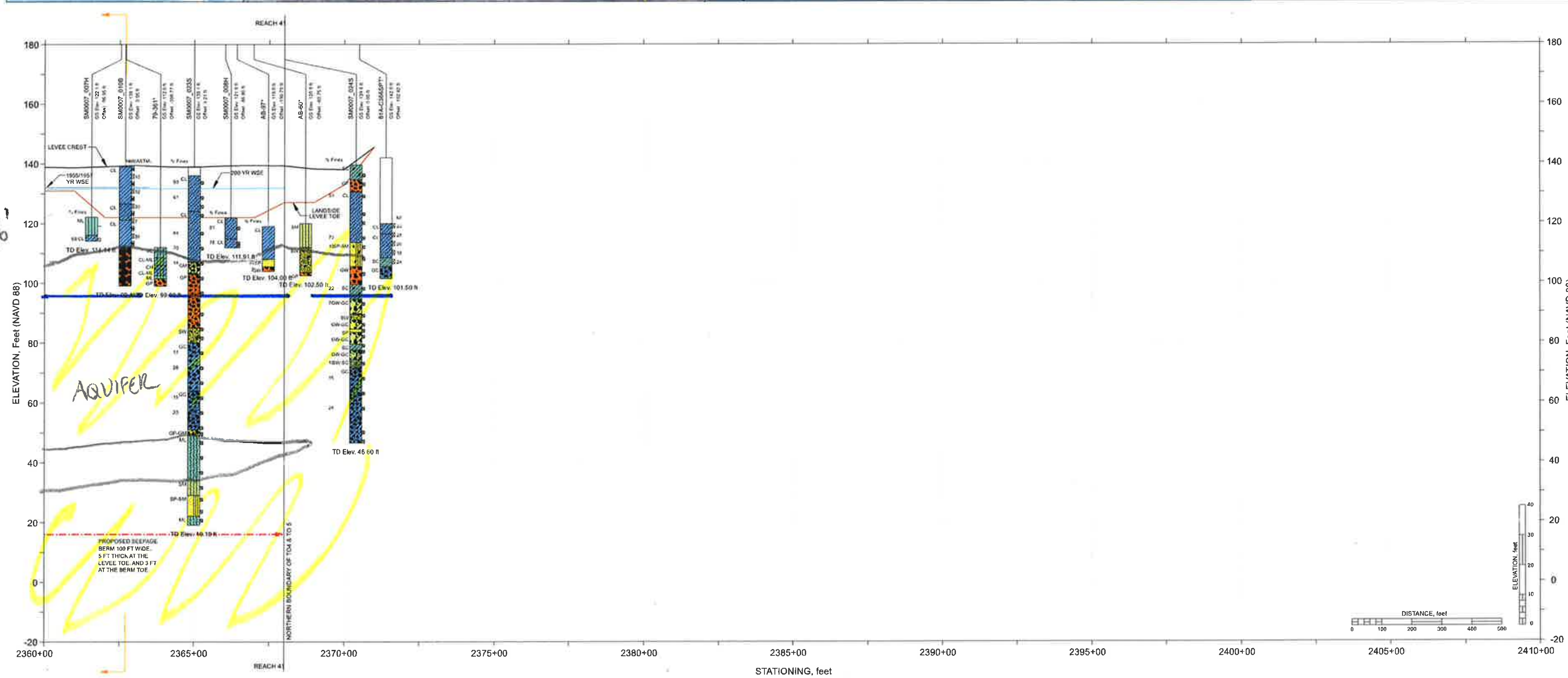
N

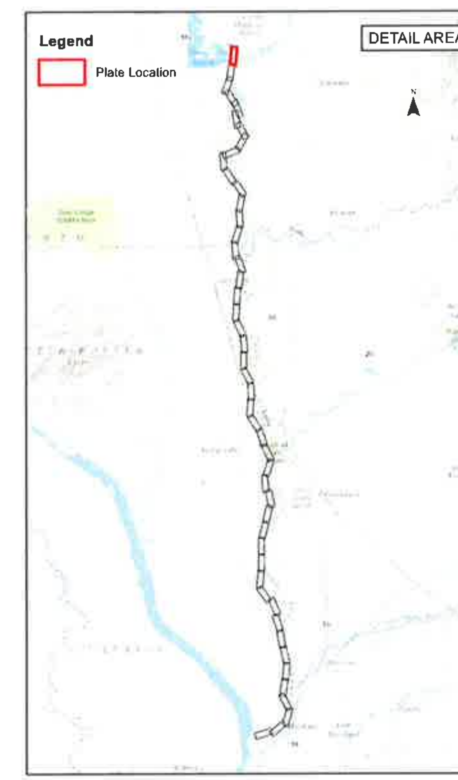
0 100 200

Feet

NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from DWR CVFED or ULE LiDAR data and used for geotechnical analyses and report purpose only. For detail crown elevation and landside toe information, please refer to the FRWL Project civil drawings.
2. The water surface elevations are based on information provided by Peterson Brustad, Inc. in their July 26, 2012 report entitled "Design Water Surface Profiles for the Feather River West Levee Rehabilitation Project Addendum #1".
3. Locations of explorations are approximate. Stick logs represent general soil conditions encountered at the time of exploration. For more detailed information on the materials encountered, refer to boring and CPT logs in the Geotechnical Data Report for the FRWL Project. No warranty is provided regarding the continuity of soil conditions between individual explorations.
4. When reported, N_{60}(ASTM), refers to N_{60}(ASTM) = N_{field} * Hammer Efficiency (%). See Geotechnical Data Report for the FRWL Project for hammer efficiency data for individual borings.
5. These drawings do not include all historical explorations on the profile view. Historical explorations from the DWR ULE project are shown; "other" historical explorations are identified by an asterisk (*) in the exploration ID. For these "other" historical borings, blow counts are field blow counts (Nf) and USCS classifications are visual classifications.
6. USCS classification labels are not presented on the stick logs for soil lenses (thickness less than 1.5 feet).
7. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
9. Surficial geology was mapped at 1:20,000 scale. (Source: SGDR for DWR ULE Project, URS,2010).
10. The Information provided in these plans and stick-log plates has been compiled from a variety of sources. URS does not attest to the accuracy, completeness, or reliability of geotechnical exploration and other subsurface data by others that are included or referenced in these plates.
11. These plans and stick-log plates are for the use and benefit of HDR, SBFCA, and their consultants in connection with the execution of the FRWL Project. Use by any other party is at their own discretion and risk. These figures should not to be used as the sole basis for design, construction, remedial action, or major capital spending decisions.
12. The canal/ditch elevations are approximate. These elevations were estimated from the topography.





FRWL Project Plan Views and Stick Log Figures

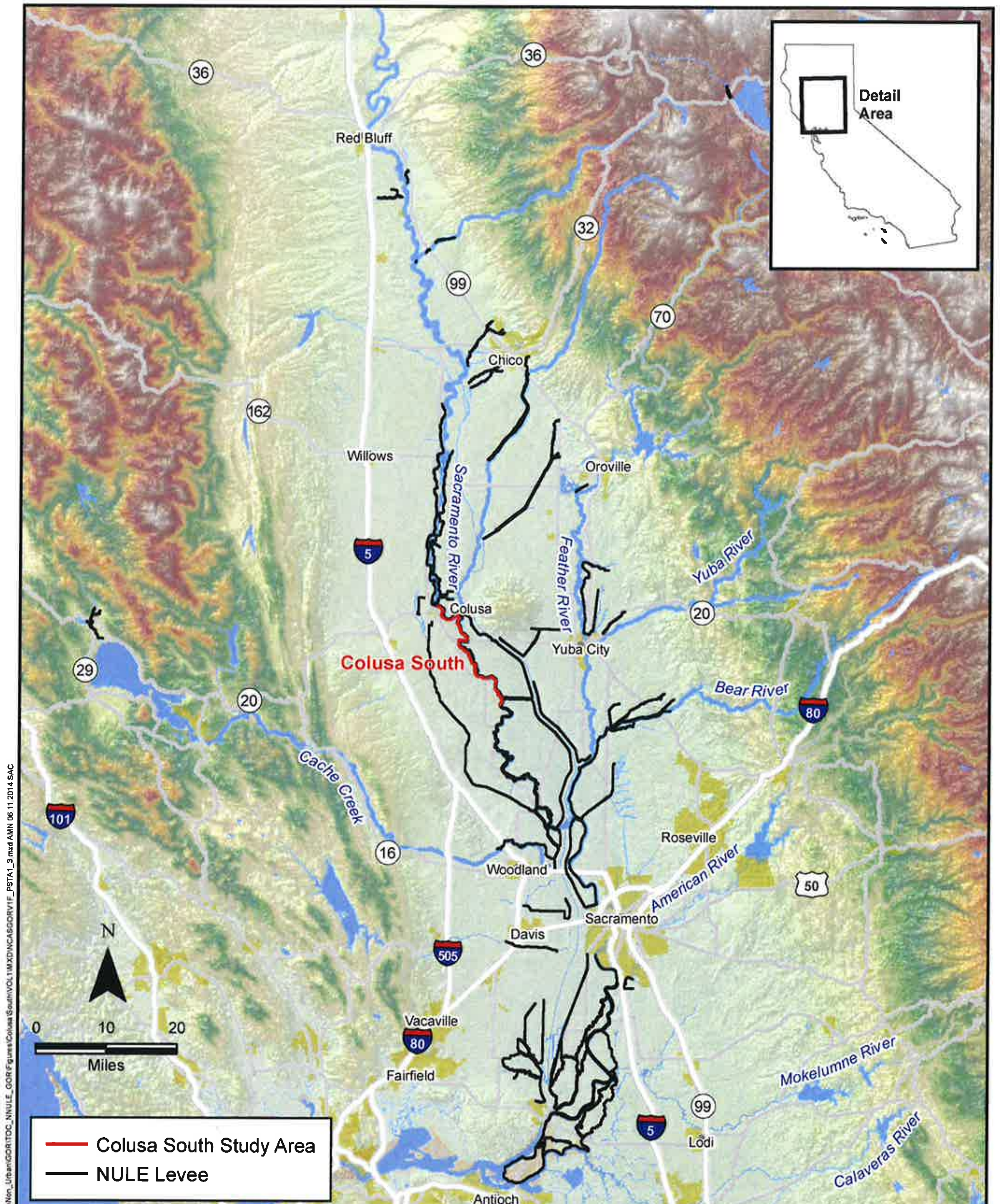
FRWL Project: Station 2360+00 to Station 2372+17

URS — Geotechnical Design Recommendations Report

Sutter Butte Flood Control Agency
FEATHER RIVER WEST LEVEE PROJECT

Appendix A50

APPENDIX D
GEOLOGIC SECTIONS
SACRAMENTO RIVER LEVEES



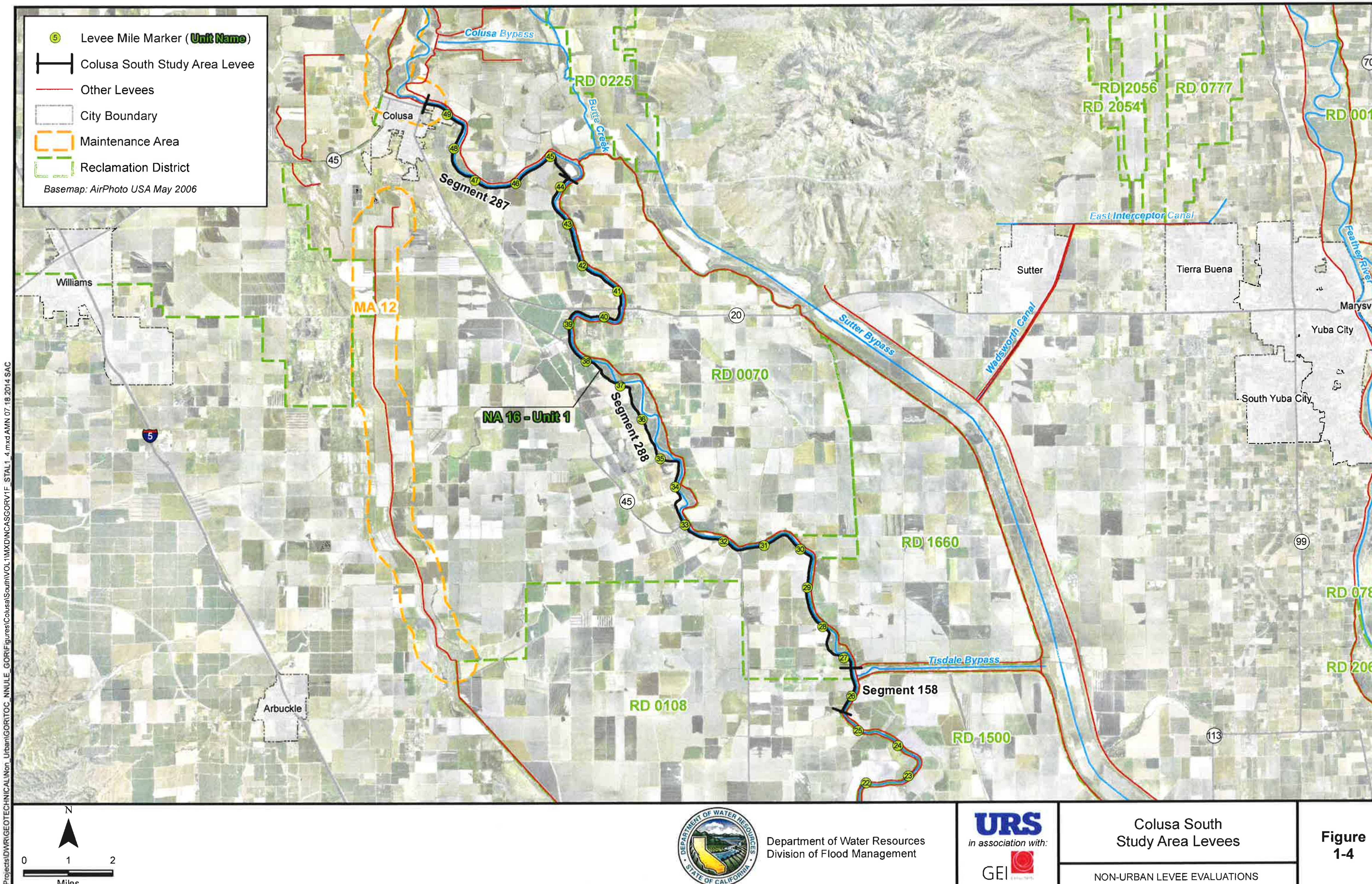
Department of Water Resources
Division of Flood Management

URS
in association with:
GEI

Colusa South Study Area

NON-URBAN LEVEE EVALUATIONS

Figure 1-3



L:\Projects\DWR\GEOTECHNICAL\Non_Urban\GORTOC_NNULE_GOR\Figures\Colusa\South\VOL1\MXD\NCASGORV1F_STAL1_4.mxd AMN 07.18.2014 SAC

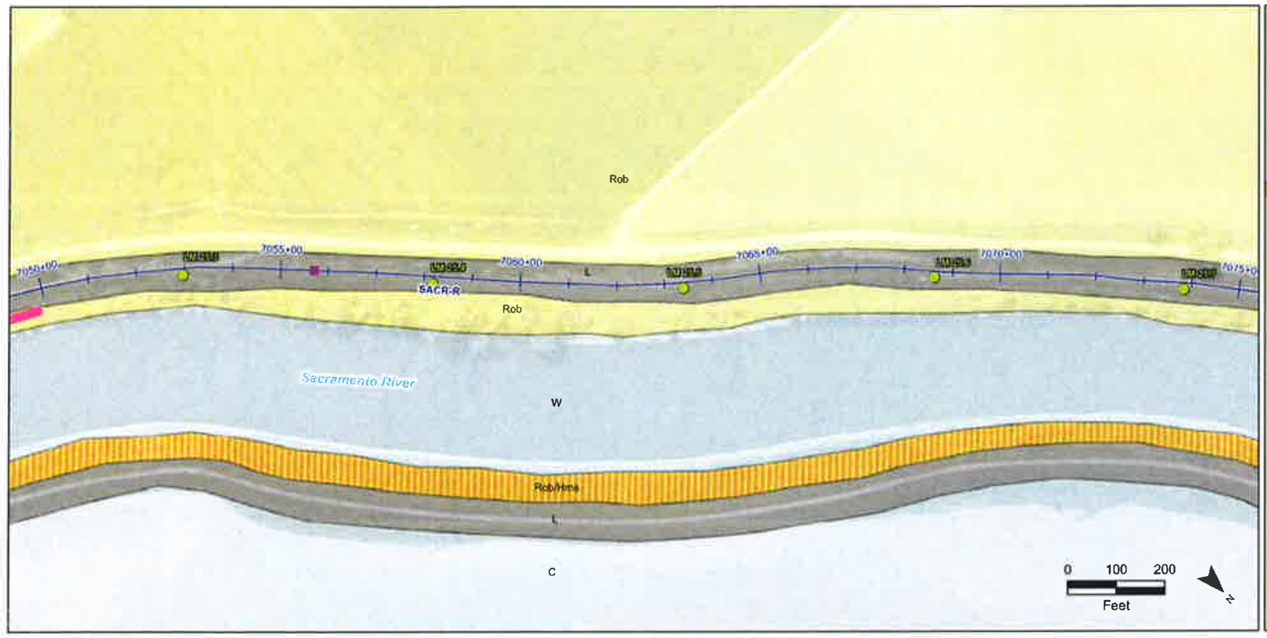
Department of Water Resources
Division of Flood Management

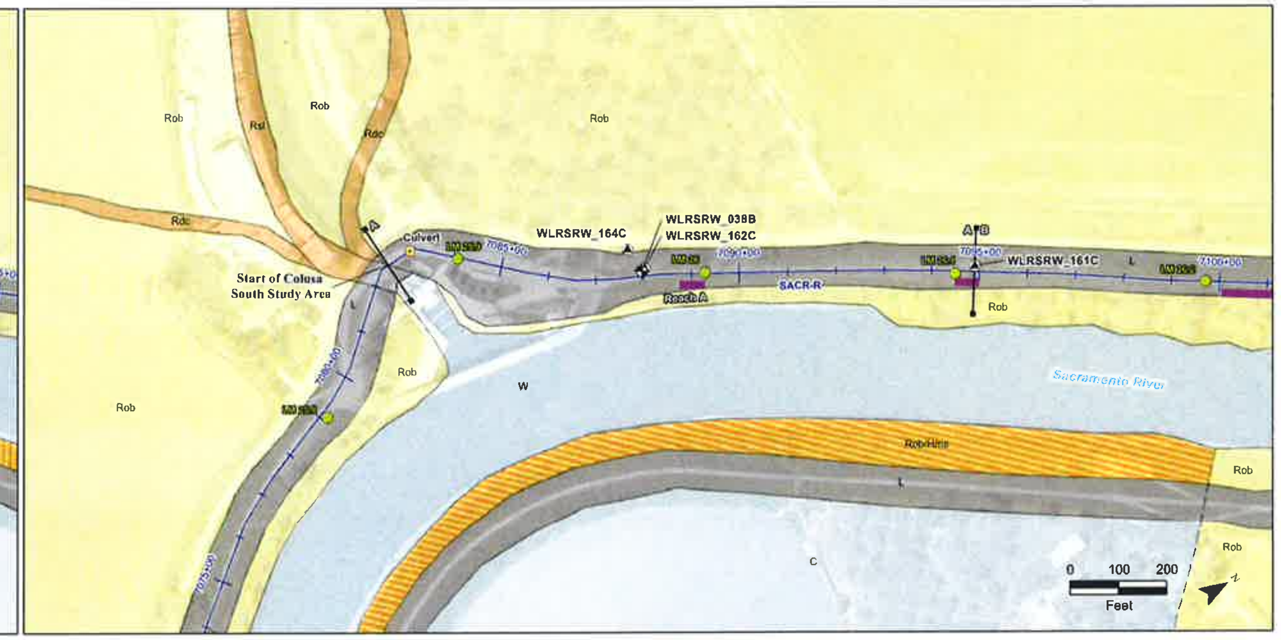
URS
in association with:
GEI

Colusa South
Study Area Levees

NON-URBAN LEVEE EVALUATIONS

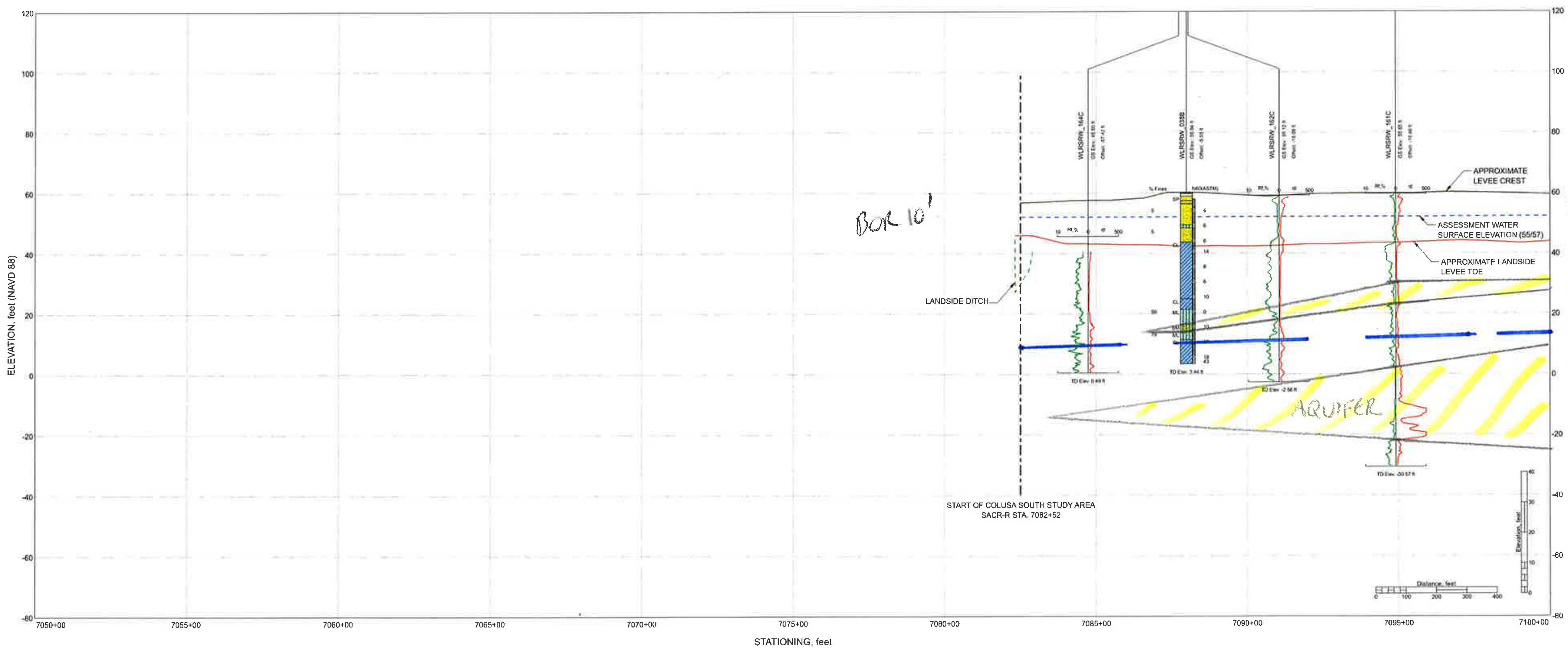
Figure 1-4





NOTES:

1. These plan and profile drawings support the Geotechnical Overview Report and are not intended for any other use or purpose. Please see accompanying report for details.
2. Elevations of levee crest and landside toe are approximate. Levee crest elevations are from the California Levee Database (CLD) levee centerline and landside toe elevations are based DWR-provided LiDAR data.
3. The assessment water surface elevations are based on information provided by DWR.
4. Where water was present in the ditch at the time LiDAR was flown, the ditch bottom elevation is the water surface elevation. For analyses purposes, the bottom elevation of the ditch was calculated based on a depth of water estimated from available data.
5. Locations of explorations are approximate. Stick logs represent general soil conditions encountered at the time of exploration. For more detailed information on the materials encountered, refer to boring and CPT logs in the Geotechnical Data Report for the NULE Colusa South study area. No warranty is provided regarding the continuity of soil conditions between individual explorations.
6. When reported, N_{60} (ASTM) = N field * [Hammer Efficiency(%)/60]. See Geotechnical Data Report for the NULE Colusa South study area for hammer efficiency data for individual borings.
7. USCS classification labels are not presented on the stick logs for soil layers less than 1.5 feet thick or historical borings with limited data.
8. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
9. To prevent scale distortion, this map should be printed on an ANSI "D" size sheet (22x34 inches).
10. Where past performance and mitigation line features are geographically coincident, symbols have been offset for display purposes.
11. Surficial geology was mapped at 1:24,000 scale. (Source: Level 2-II Geomorphic Assessment and Surficial Mapping of the Sacramento River below Colusa and Adjoining Areas for NULE Project, URS, 2010).
12. The information provided on these plates has been compiled from a variety of sources. The URS team does not attest to the accuracy, completeness, or reliability of plan or subsurface data (including geotechnical exploration) by others that are included or referenced in these plates.
13. These plan and profile drawings are for the use and benefit of DWR, and their consultants in connection with the execution of the NULE Colusa South study area. Use by any other party is at their own discretion and risk. These figures should not be used as the sole basis for design, construction, remedial action, or major capital spending decisions.



Department of Water Resources
Division of Flood Management

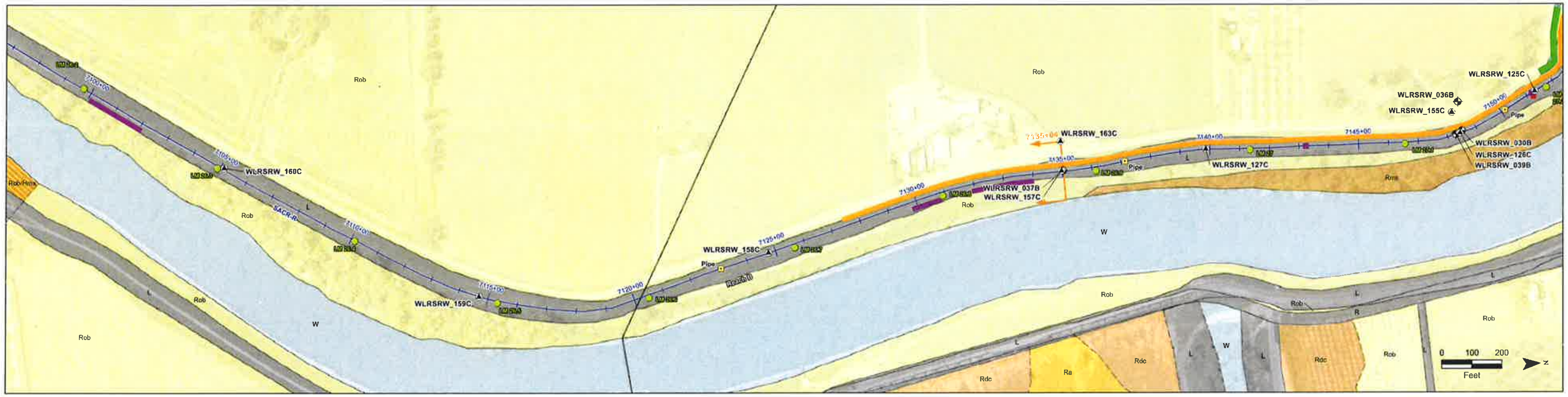
URS in association with: GEI

Colusa South Plan and Profiles
Sacramento River Right Bank Station 7082+52 to Station 7100+00

Non-Urban Levee Evaluations

Plate 3

Geotechnical Overview Report



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3. The assessment water surface elevations are based on information provided by DWR.
4. Where water was present in the ditch at the time LiDAR was flown, the ditch bottom elevation is the water surface elevation. For analyses purposes, the bottom elevation of the ditch was calculated based on a depth of water estimated from available data.
5. Locations of explorations are approximate. Stick logs represent general soil conditions encountered at the time of exploration. For more detailed information on the materials encountered, refer to boring and CPT logs in the Geotechnical Data Report for the NULE Colusa South study area. No warranty is provided regarding the continuity of soil conditions between individual explorations.
6. When reported, N_{60} (ASTM) = N field * [Hammer Efficiency(%)/60]. See Geotechnical Data Report for the NULE Colusa South study area for hammer efficiency data for individual borings.
7. USCS classification labels are not presented on the stick logs for soil layers less than 1.5 feet thick or historical borings with limited data.
8. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
9. To prevent scale distortion, this map should be printed on an ANSI "D" size sheet (22x34 inches).
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11. Surficial geology was mapped at 1:24,000 scale. (Source: Level 2-II Geomorphic Assessment and Surficial Mapping of the Sacramento River below Colusa and Adjoining Areas for NULE Project, URS, 2010).
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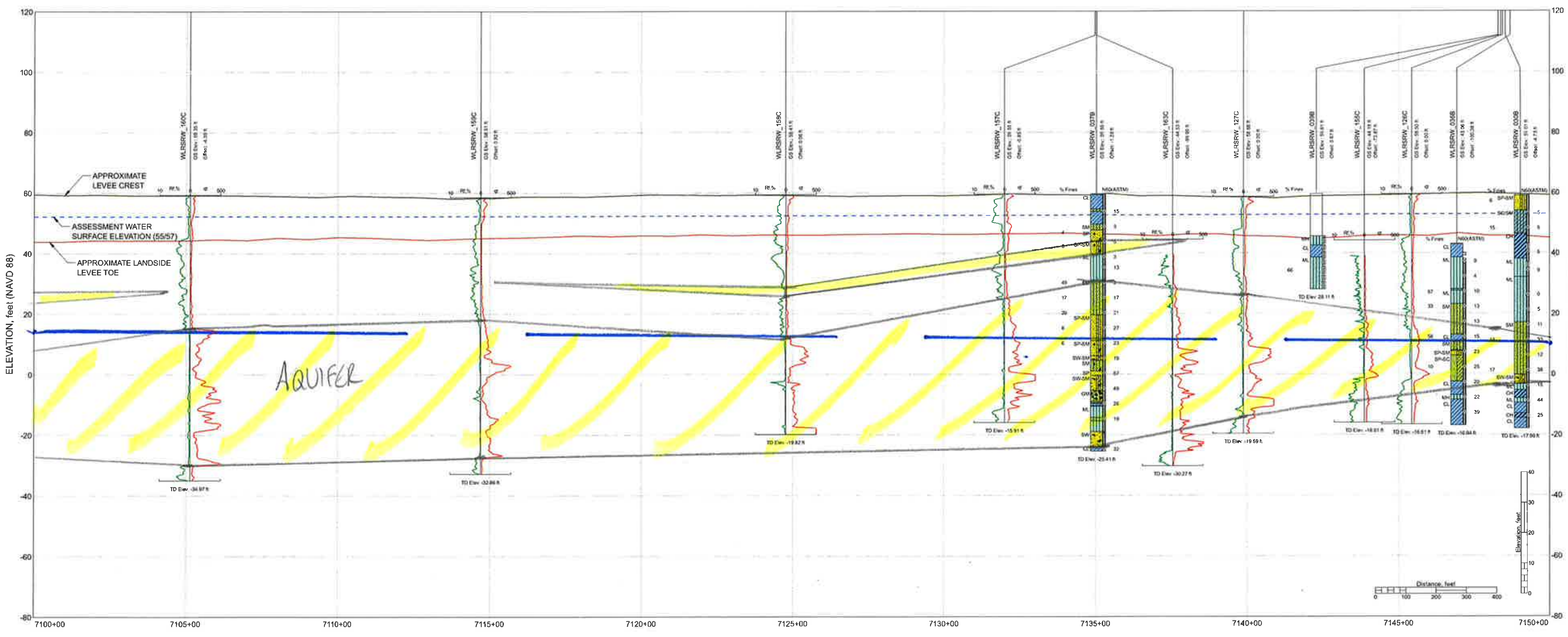
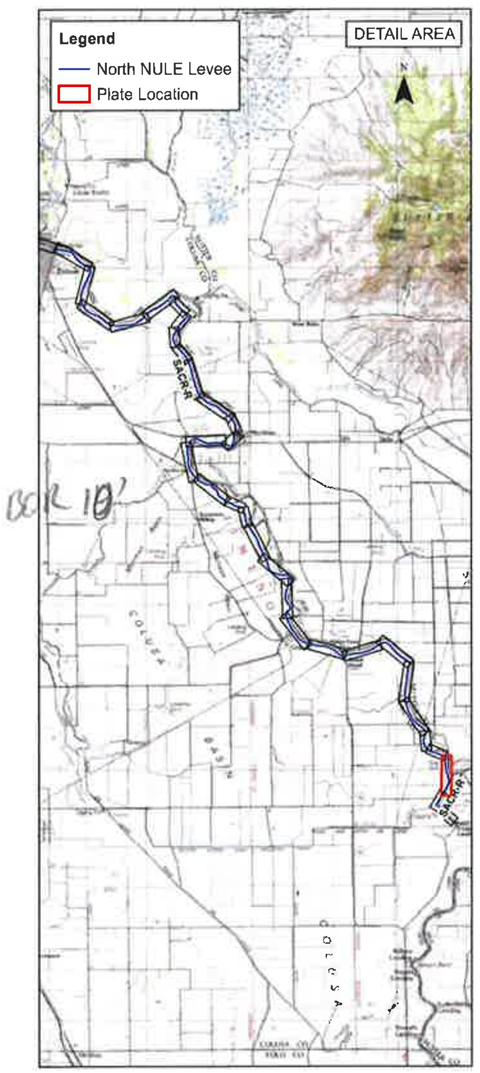




Department of Water Resources
Division of Flood Management

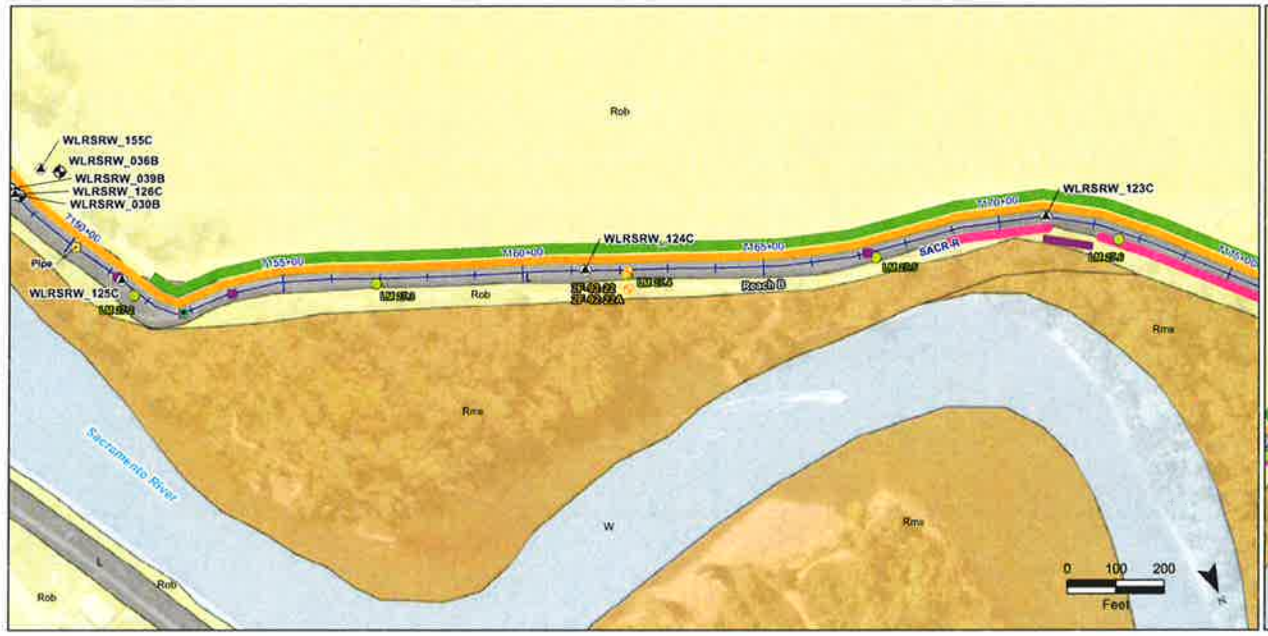
URS in association with: GEI

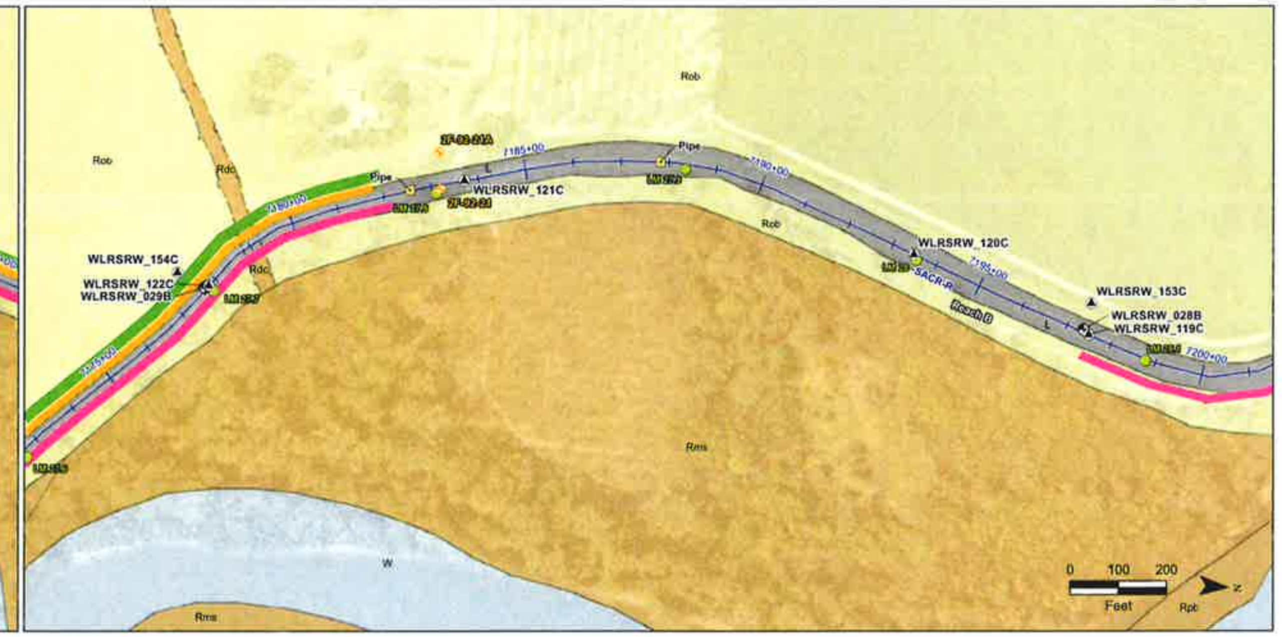
Colusa South Plan and Profiles

Sacramento River Right Bank Station 7100+00 to Station 7150+00

Non-Urban Levee Evaluations

Plate 4





NOTES:

1. These plan and profile drawings support the Geotechnical Overview Report and are not intended for any other use or purpose. Please see accompanying report for details.
2. Elevations of levee crest and landside toe are approximate. Levee crest elevations are from the California Levee Database (CLD) levee centerline and landside toe elevations are based DWR-provided LIDAR data.
3. The assessment water surface elevations are based on information provided by DWR.
4. Where water was present in the ditch at the time LIDAR was flown, the ditch bottom elevation is the water surface elevation. For analyses purposes, the bottom elevation of the ditch was calculated based on a depth of water estimated from available data.
5. Locations of explorations are approximate. Stick logs represent general soil conditions encountered at the time of exploration. For more detailed information on the materials encountered, refer to boring and CPT logs in the Geotechnical Data Report for the NULE Colusa South study area. No warranty is provided regarding the continuity of soil conditions between individual explorations.
6. When reported, N_{60} (ASTM) = N field * [Hammer Efficiency(%)/60]. See Geotechnical Data Report for the NULE Colusa South study area for hammer efficiency data for individual borings.
7. USCS classification labels are not presented on the stick logs for soil layers less than 1.5 feet thick or historical borings with limited data.
8. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
9. To prevent scale distortion, this map should be printed on an ANSI "D" size sheet (22x34 Inches).
10. Where past performance and mitigation line features are geographically coincident, symbols have been offset for display purposes.
11. Surficial geology was mapped at 1:24,000 scale. (Source: Level 2-II Geomorphic Assessment and Surficial Mapping of the Sacramento River below Colusa and Adjoining Areas for NULE Project, URS, 2010).
12. The information provided on these plates has been compiled from a variety of sources. The URS team does not attest to the accuracy, completeness, or reliability of plan or subsurface data (including geotechnical exploration) by others that are included or referenced in these plates.
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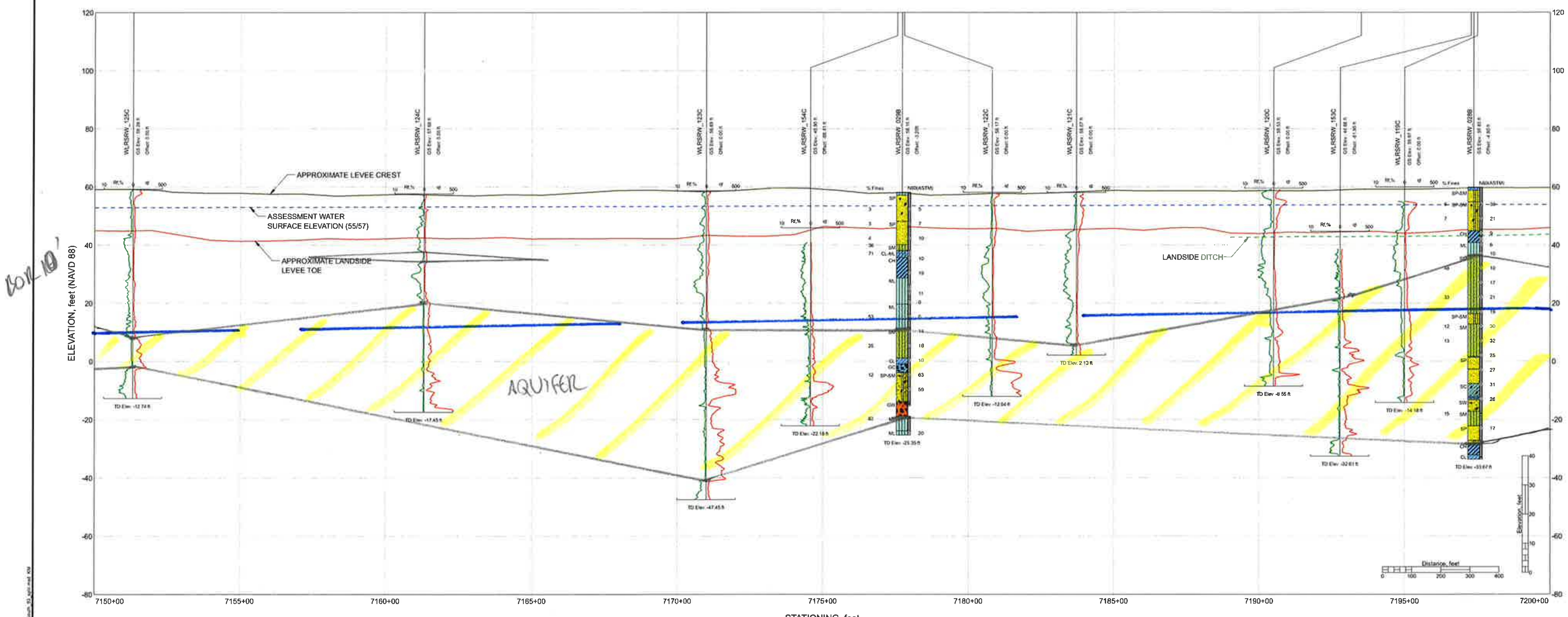
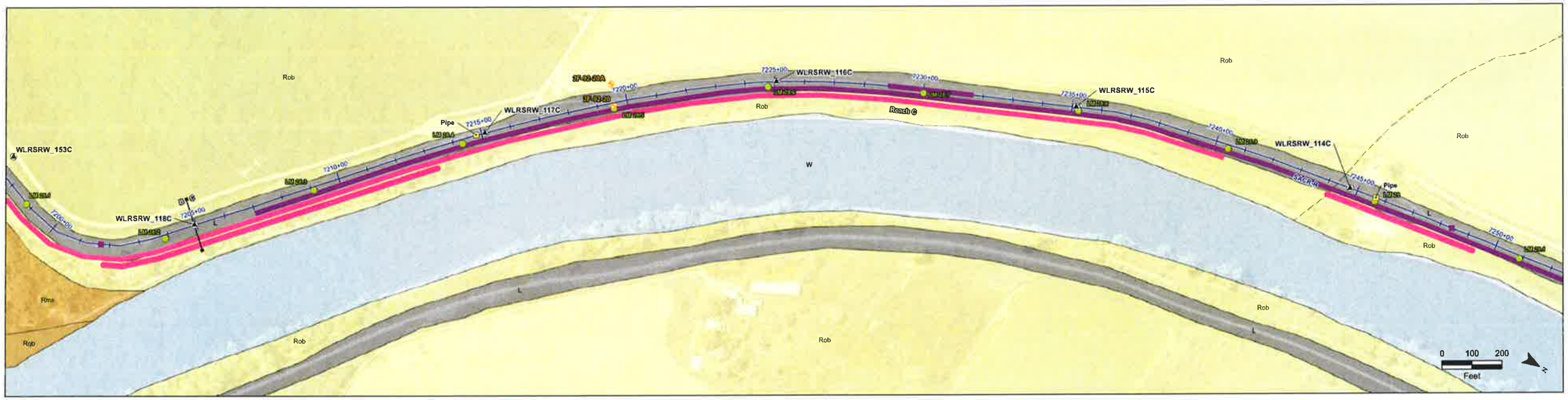


Department of Water Resources Division of Flood Management	URS in association with GEI	**Colusa South Plan and Profiles** **Sacramento River Right Bank Station 7150+00 to Station 7200+00** Non-Urban Levee Evaluations	Plate 5

Geotechnical Overview Report



NOTES:

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3. The assessment water surface elevations are based on information provided by DWR.
4. Where water was present in the ditch at the time LiDAR was flown, the ditch bottom elevation is the water surface elevation. For analyses purposes, the bottom elevation of the ditch was calculated based on a depth of water estimated from available data.
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6. When reported, N_{60} (ASTM) = N field * [Hammer Efficiency(%)/60]. See Geotechnical Data Report for the NULE Colusa South study area for hammer efficiency data for individual borings.
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9. To prevent scale distortion, this map should be printed on an ANSI "D" size sheet (22x34 inches).
10. Where past performance and mitigation line features are geographically coincident, symbols have been offset for display purposes.
11. Surficial geology was mapped at 1:24,000 scale. (Source: Level 2-II Geomorphic Assessment and Surficial Mapping of the Sacramento River below Colusa and Adjoining Areas for NULE Project, URS, 2010)
12. The information provided on these plates has been compiled from a variety of sources. The URS team does not attest to the accuracy, completeness, or reliability of plan or subsurface data (including geotechnical exploration) by others that are included or referenced in these plates.
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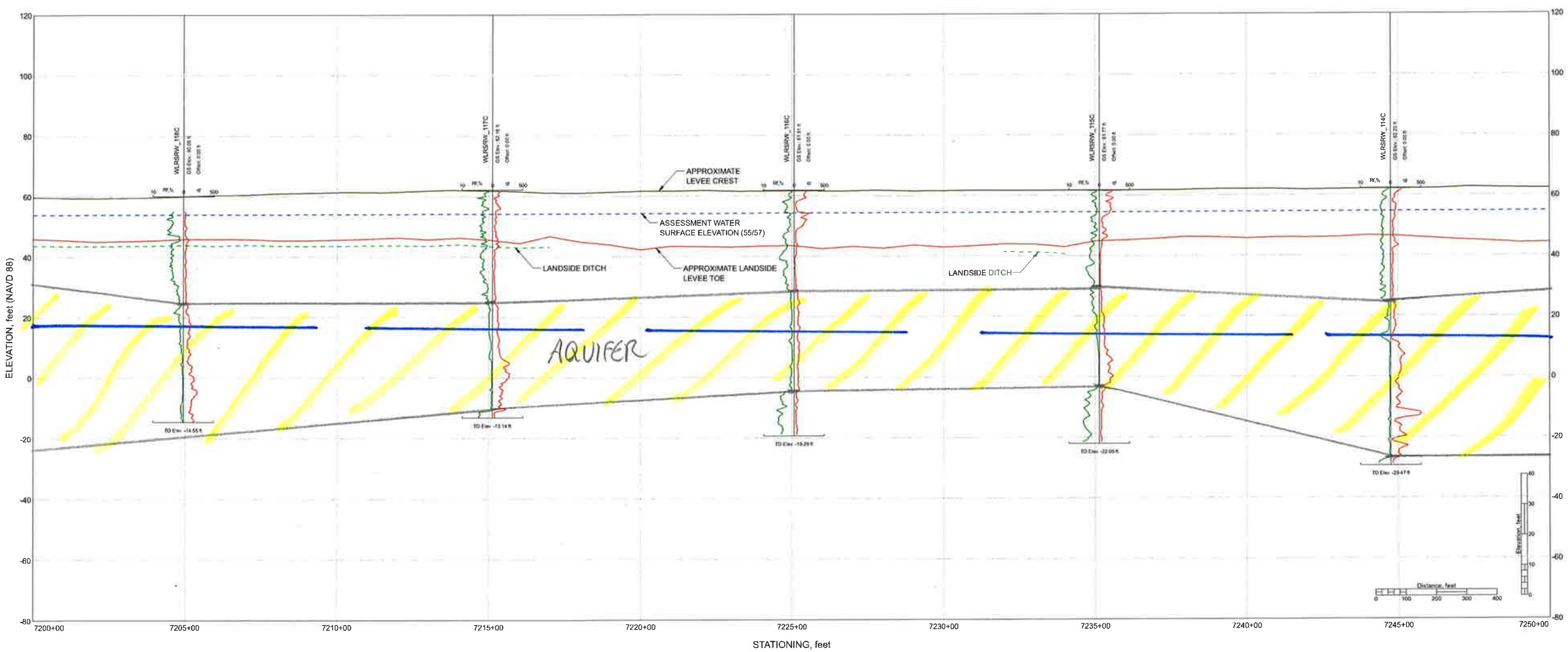
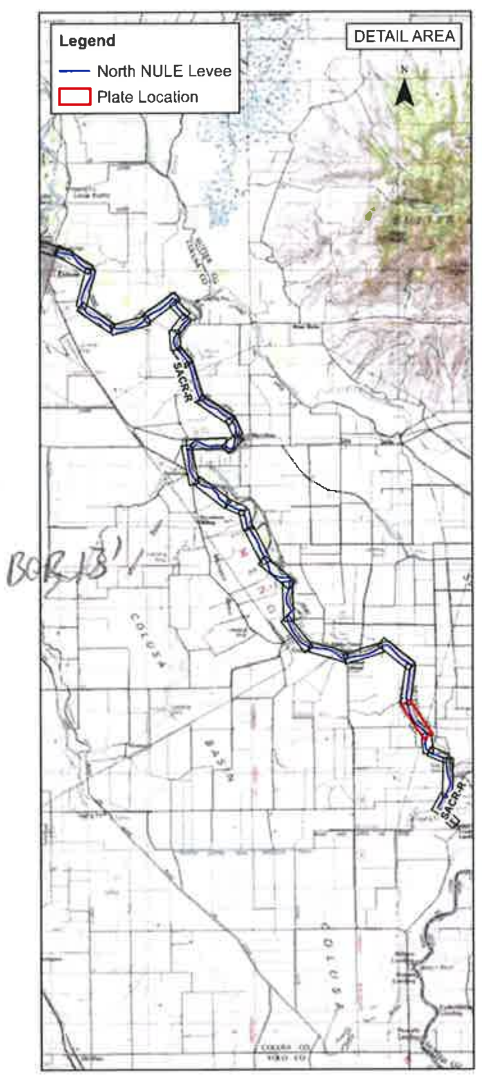




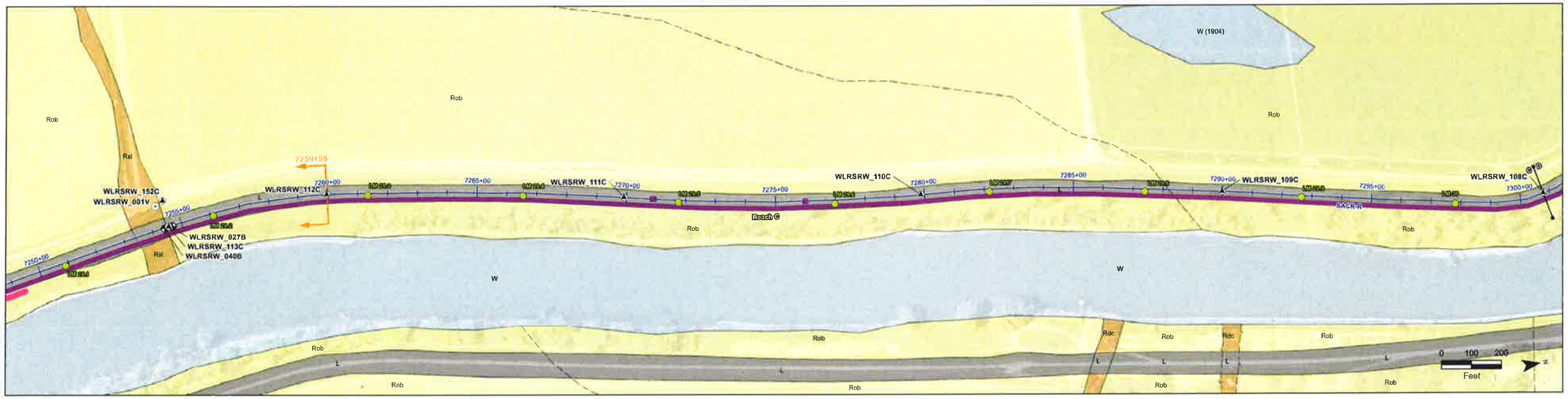
Department of Water Resources
Division of Flood Management

URS in association with: GEI

Colusa South Plan and Profiles
Sacramento River Right Bank Station 7200+00 to Station 7250+00
Non-Urban Levee Evaluations

Plate 6

Geotechnical Overview Report



NOTES:

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3. The assessment water surface elevations are based on information provided by DWR.
4. Where water was present in the ditch at the time LiDAR was flown, the ditch bottom elevation is the water surface elevation. For analyses purposes, the bottom elevation of the ditch was calculated based on a depth of water estimated from available data.
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8. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
9. To prevent scale distortion, this map should be printed on an ANSI "D" size sheet (22x34 inches).
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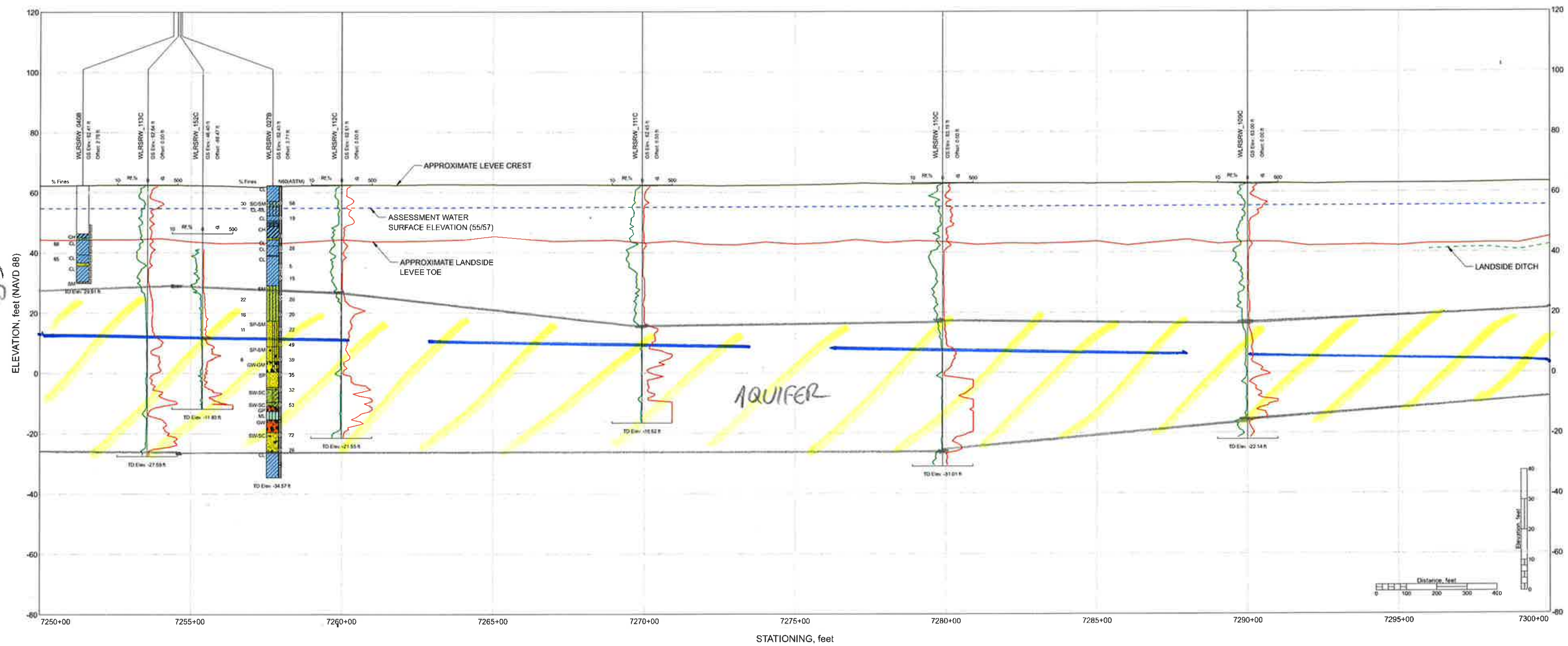


Department of Water Resources
Division of Flood Management

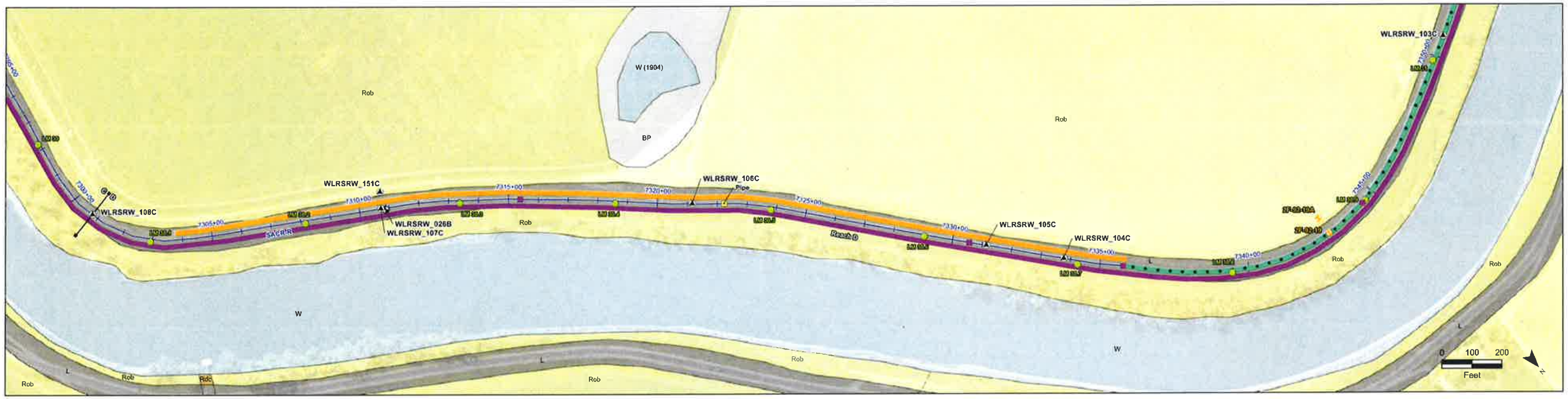
URS
in association with:
GEI

Colusa South Plan and Profiles
Sacramento River Right Bank Station 7250+00 to Station 7300+00

Non-Urban Levee Evaluations

Plate 7

Geotechnical Overview Report



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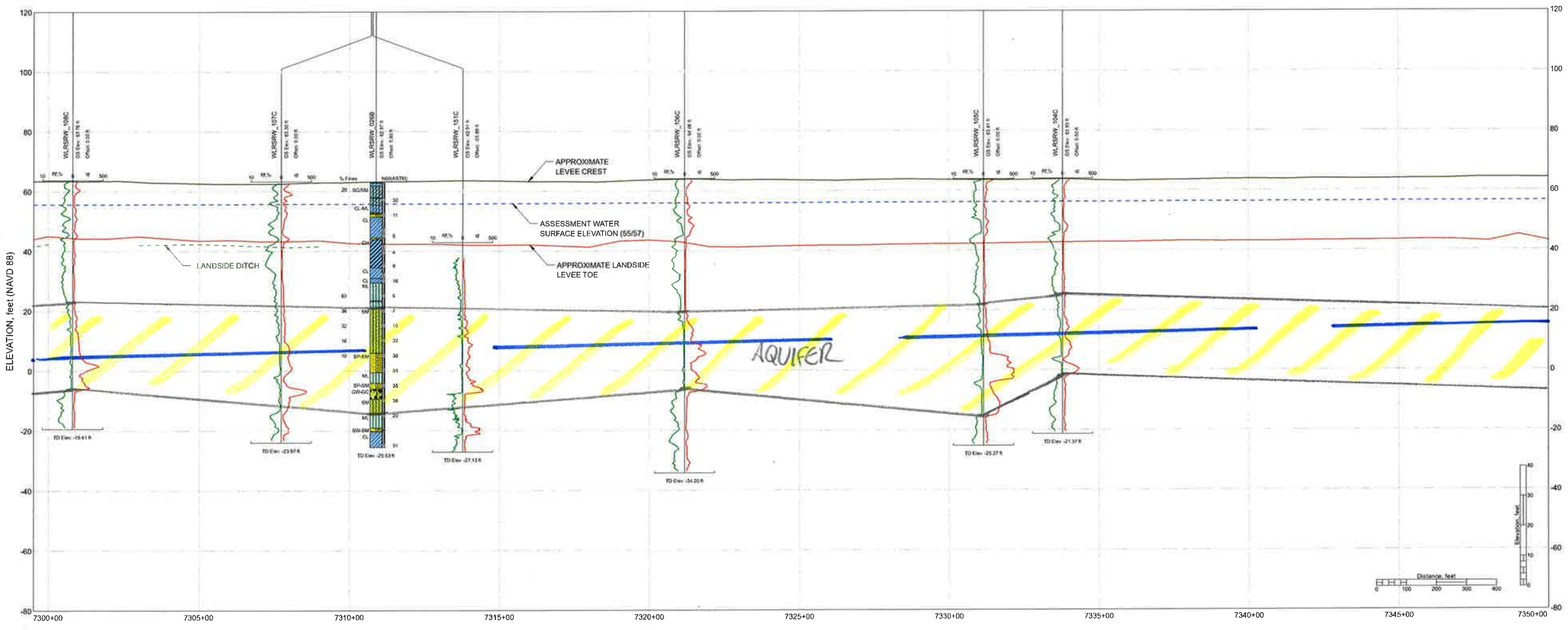
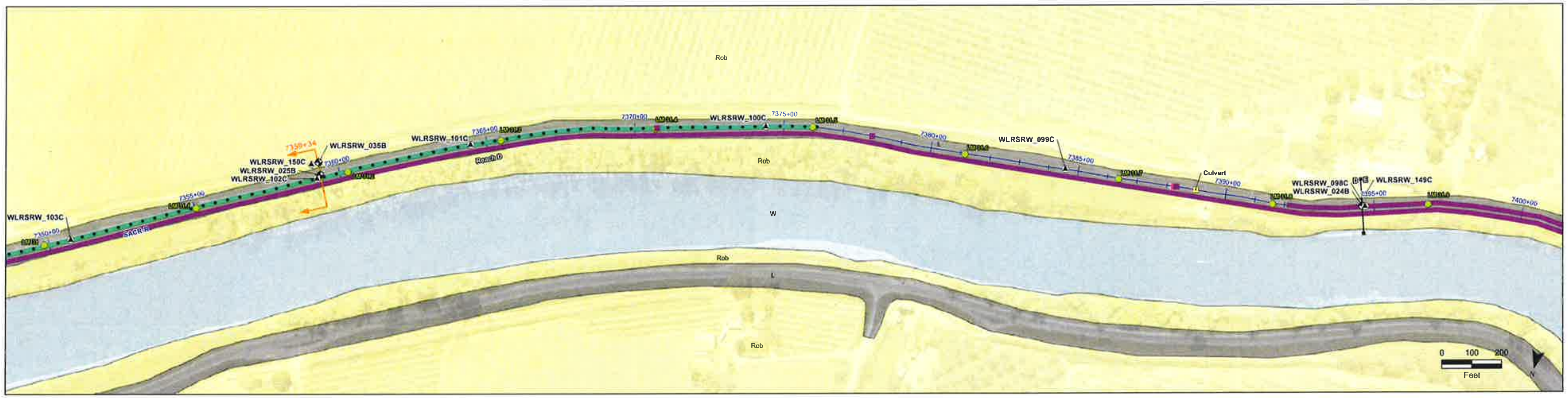


Department of Water Resources Division of Flood Management	URS in association with: GEI	Colusa South Plan and Profiles Sacramento River Right Bank Station 7300+00 to Station 7350+00 Non-Urban Levee Evaluations	Plate 8

Geotechnical Overview Report



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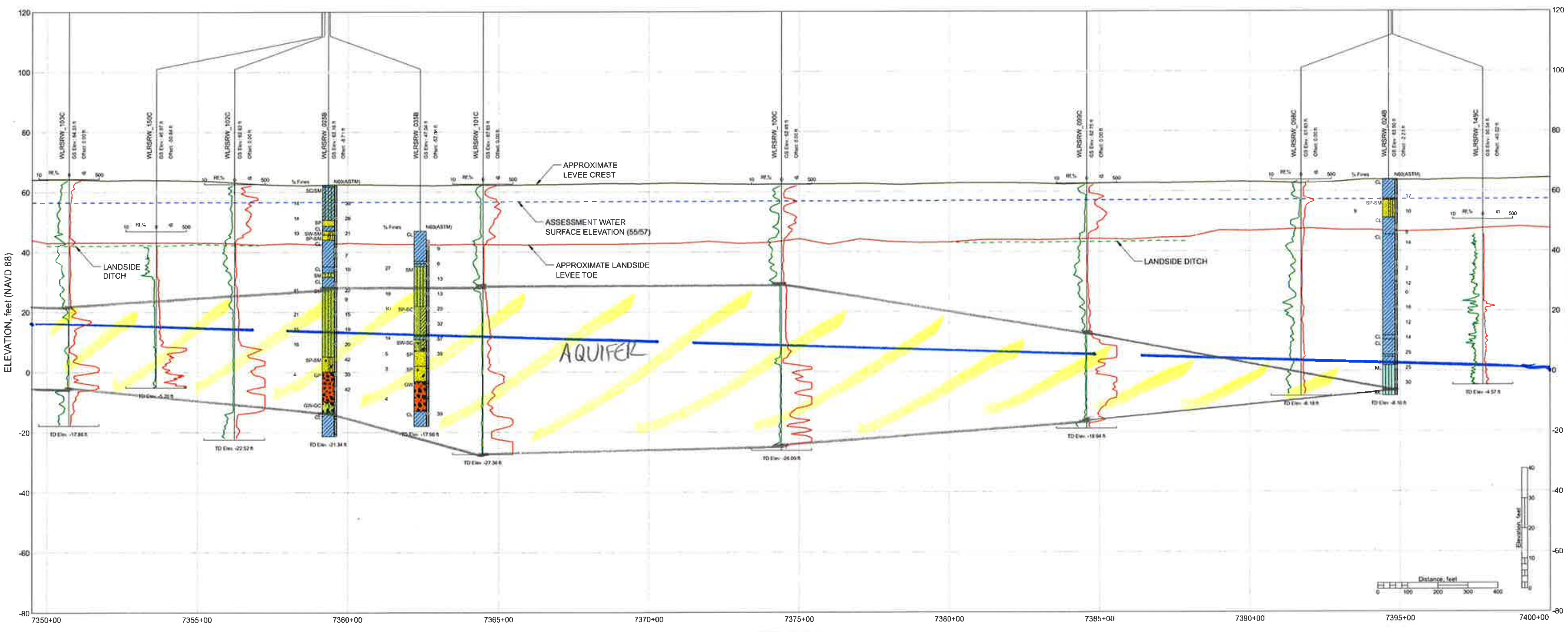
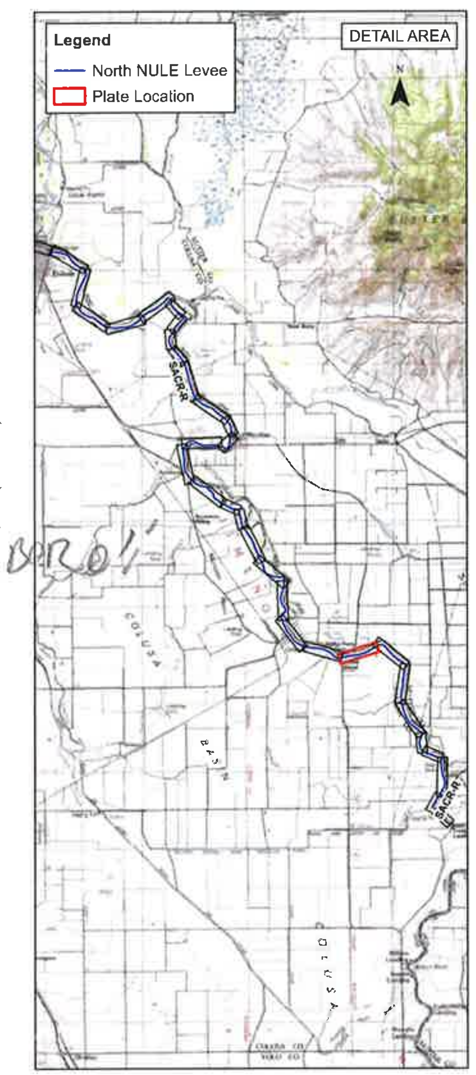
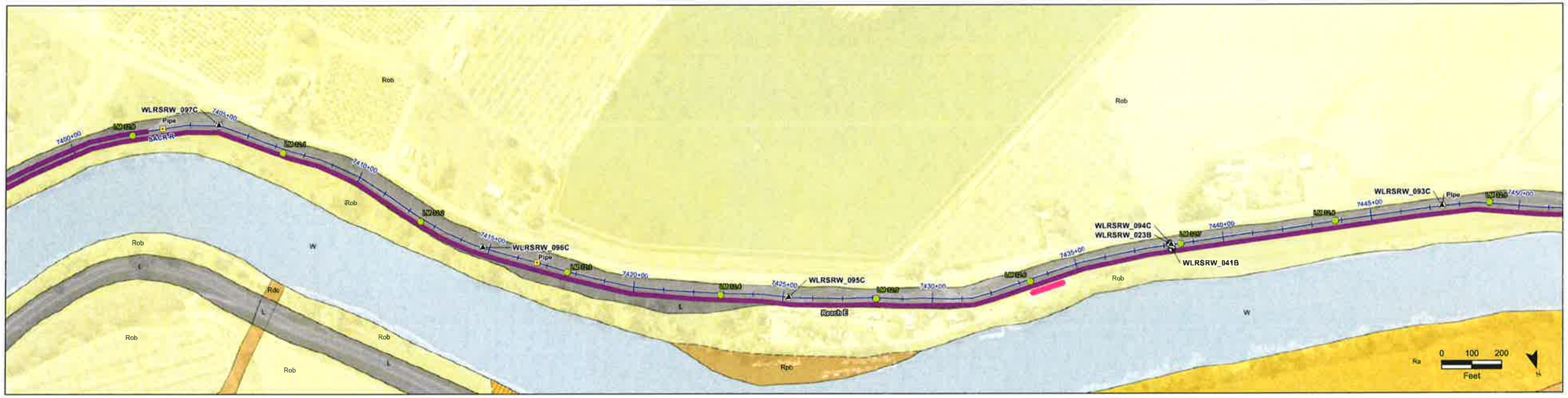




Department of Water Resources Division of Flood Management	URS in association with: GEI	Colusa South Plan and Profiles Sacramento River Right Bank Station 7350+00 to Station 7400+00 Non-Urban Levee Evaluations	Plate 9

Geotechnical Overview Report



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8. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
9. To prevent scale distortion, this map should be printed on an ANSI "D" size sheet (22x34 inches).
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11. Surficial geology was mapped at 1:24,000 scale. (Source: Level 2-II Geomorphic Assessment and Surficial Mapping of the Sacramento River below Colusa and Adjoining Areas for NULE Project, URS, 2010)
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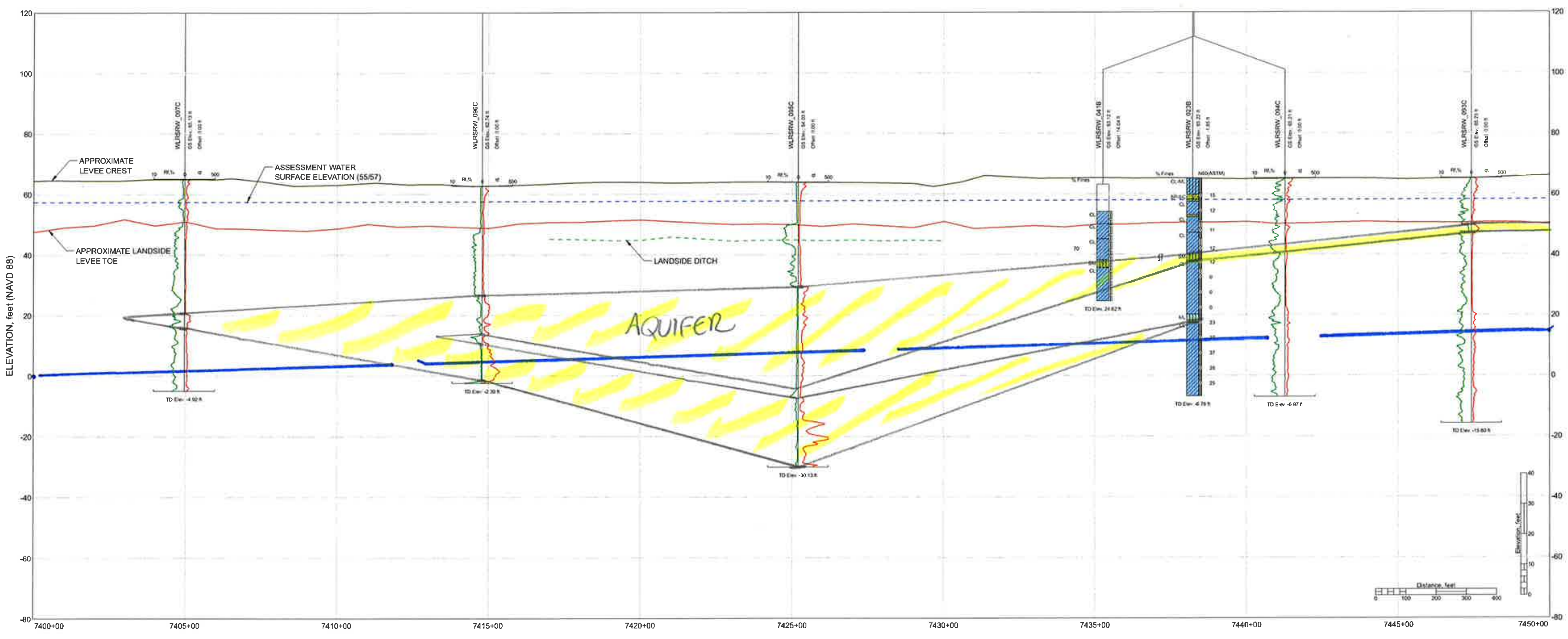
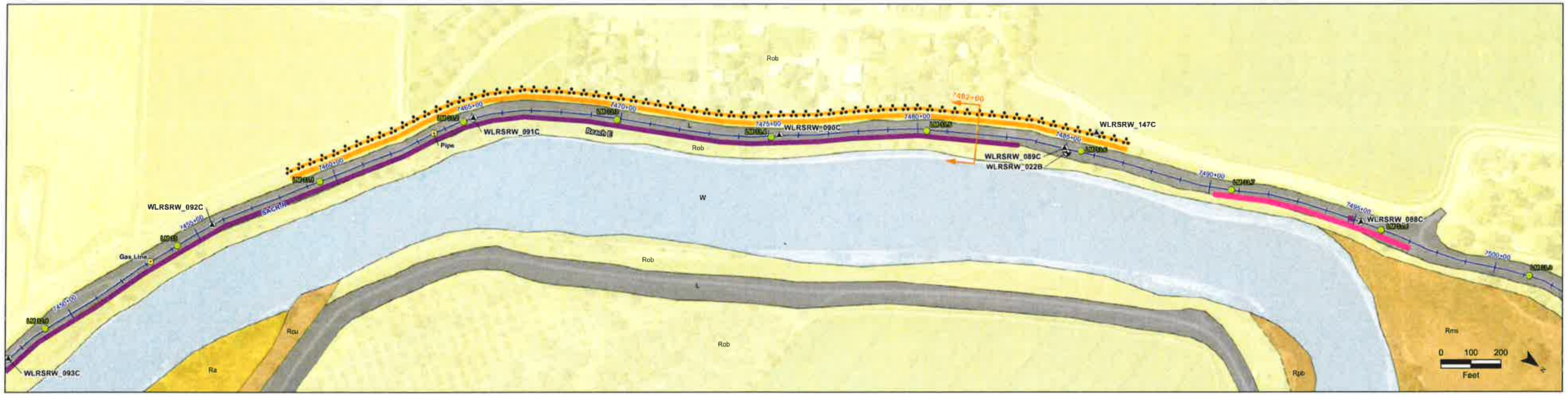


Department of Water Resources Division of Flood Management	URS in association with GEI	Colusa South Plan and Profiles Sacramento River Right Bank Station 7400+00 to Station 7450+00 Non-Urban Levee Evaluations	Plate 10

Geotechnical Overview Report



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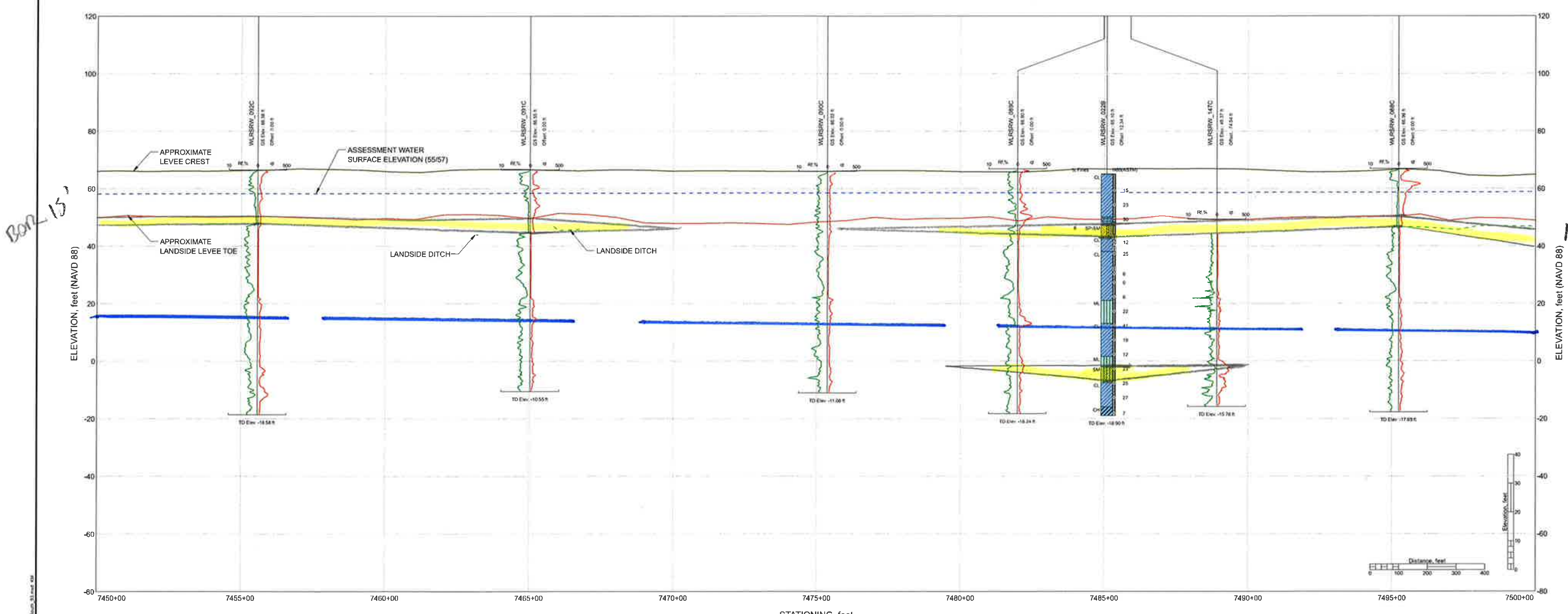


Department of Water Resources
Division of Flood Management

URS
in association with:
GEI

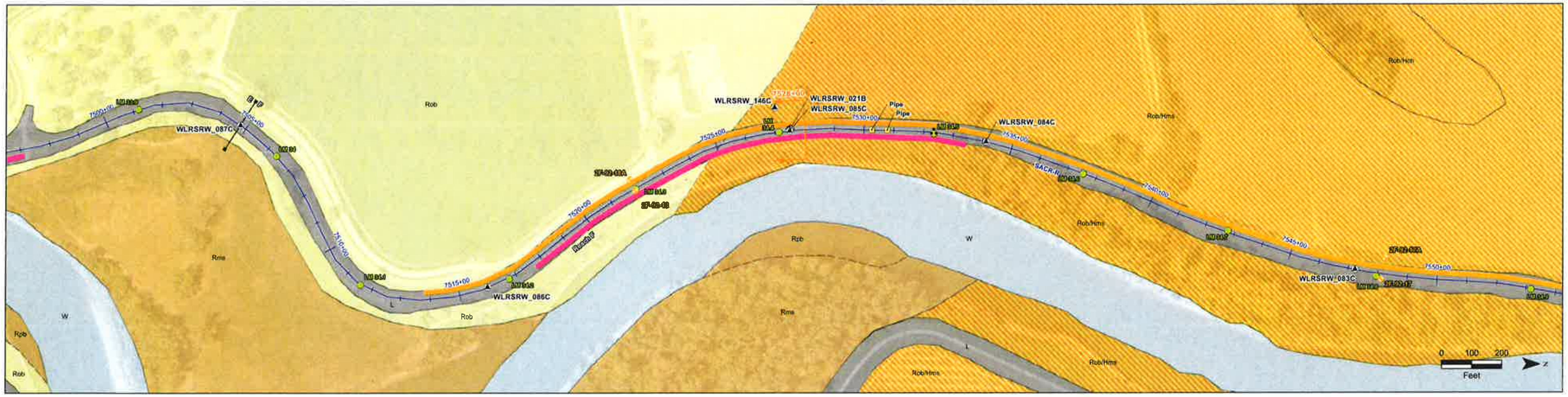
Colusa South Plan and Profiles

Sacramento River Right Bank Station 7450+00 to Station 7500+00

Non-Urban Levee Evaluations

Plate 11

Geotechnical Overview Report



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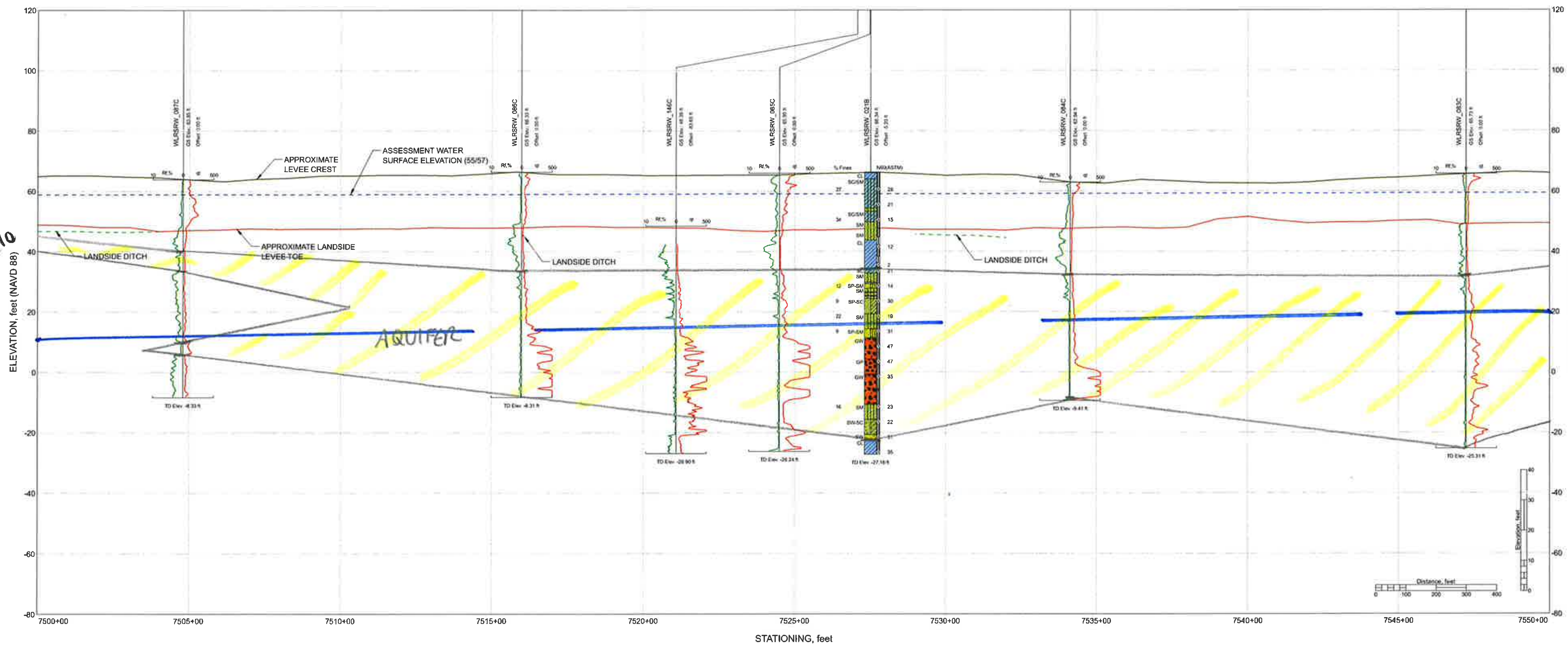
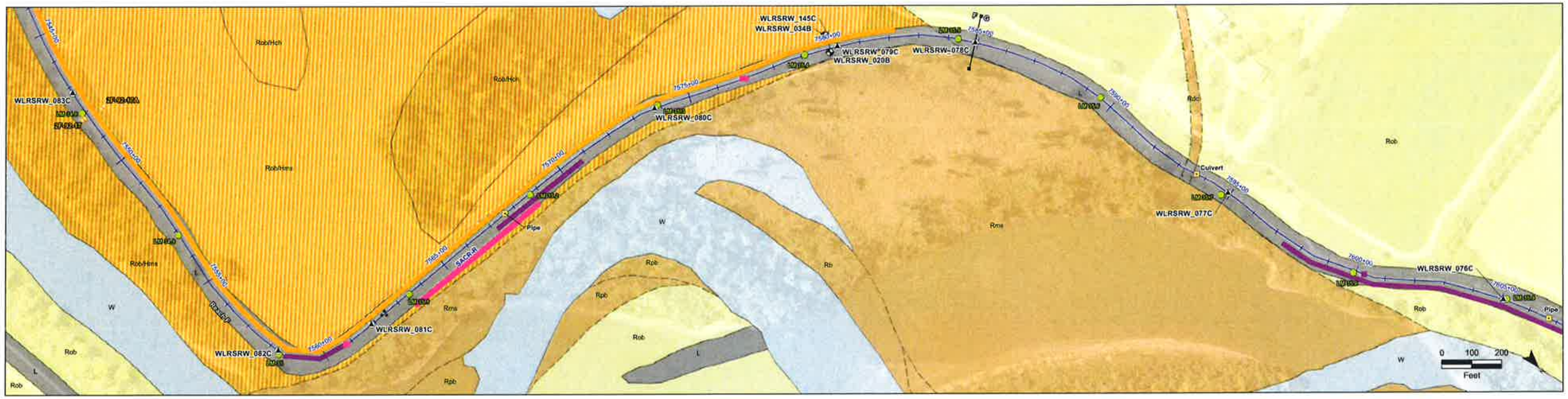


Department of Water Resources Division of Flood Management	URS in association with: GEI	Colusa South Plan and Profiles Sacramento River Right Bank Station 7500+00 to Station 7550+00 Non-Urban Levee Evaluations	Plate 12

Geotechnical Overview Report



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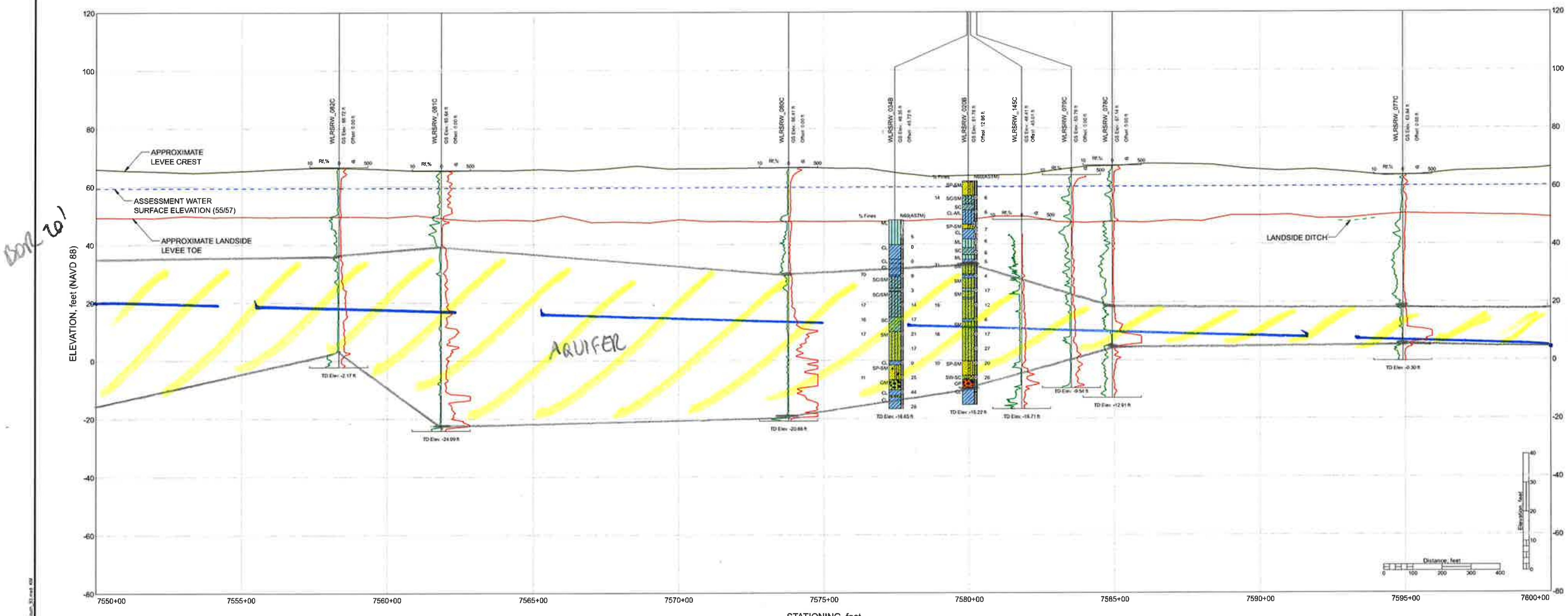

Department of Water Resources
Division of Flood Management

URS
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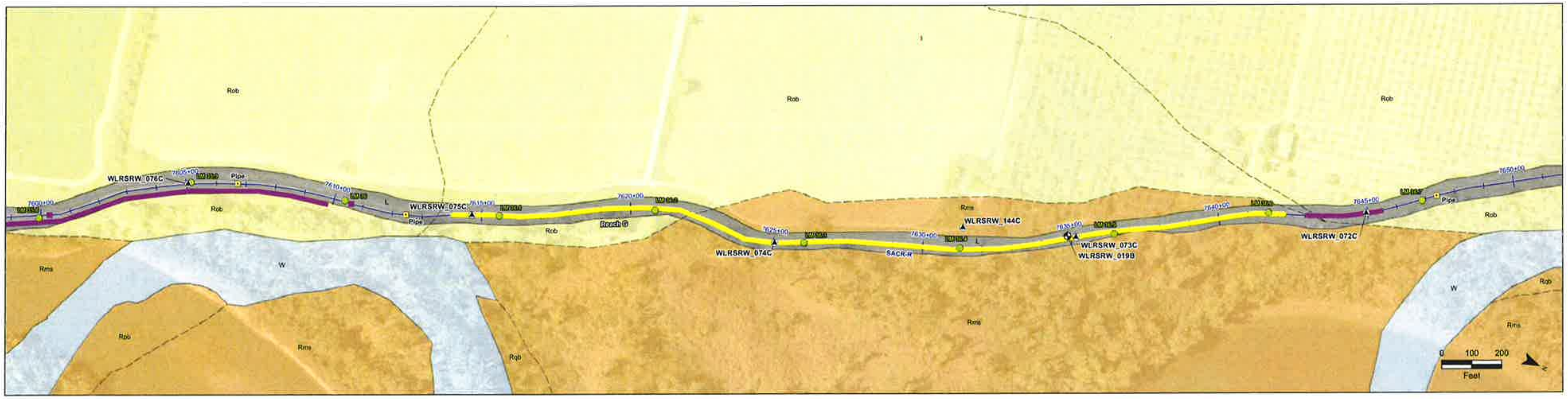
Colusa South Plan and Profiles
Sacramento River Right Bank Station 7550+00 to Station 7600+00

Non-Urban Levee Evaluations

Plate 13

Geotechnical Overview Report



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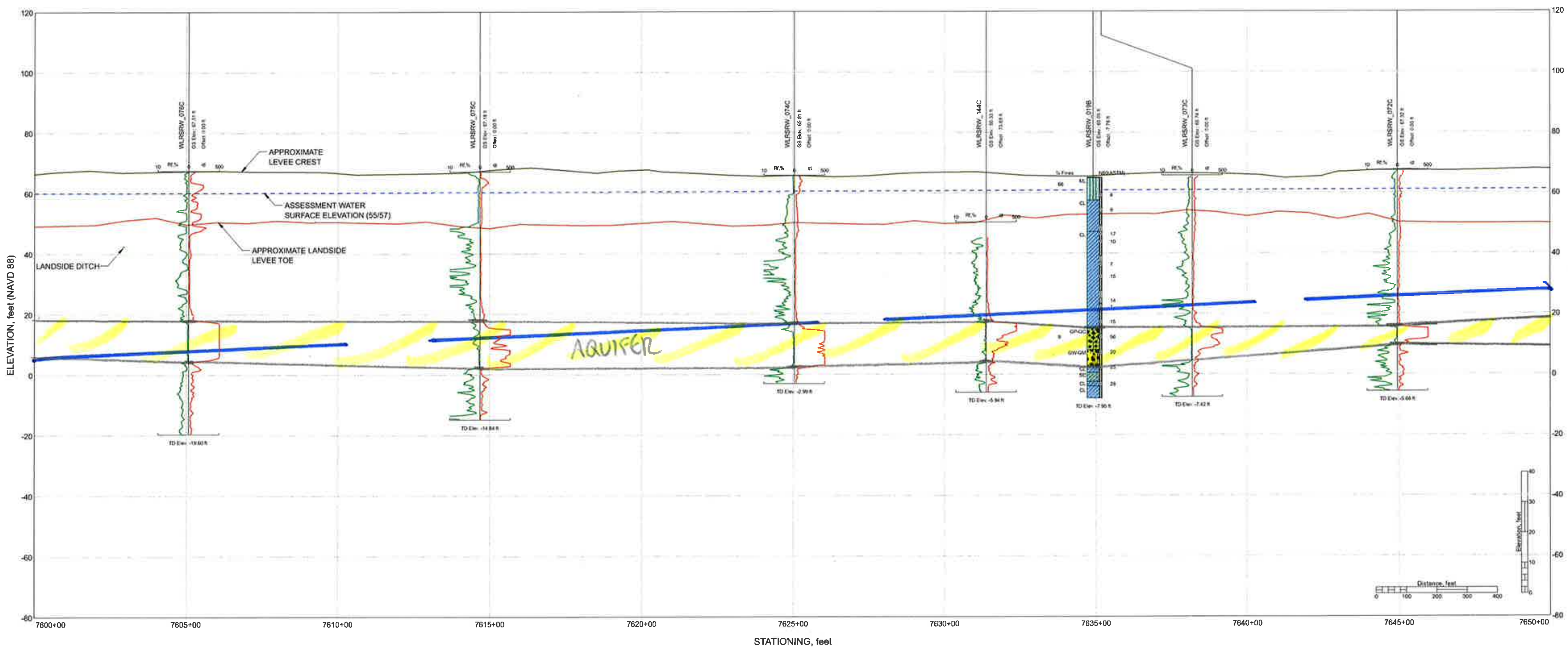

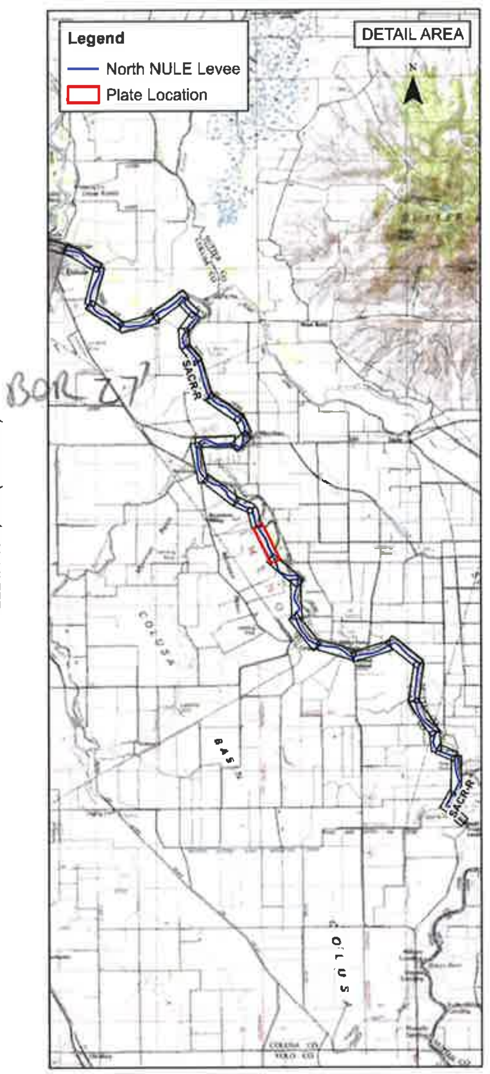

Department of Water Resources
Division of Flood Management

URS
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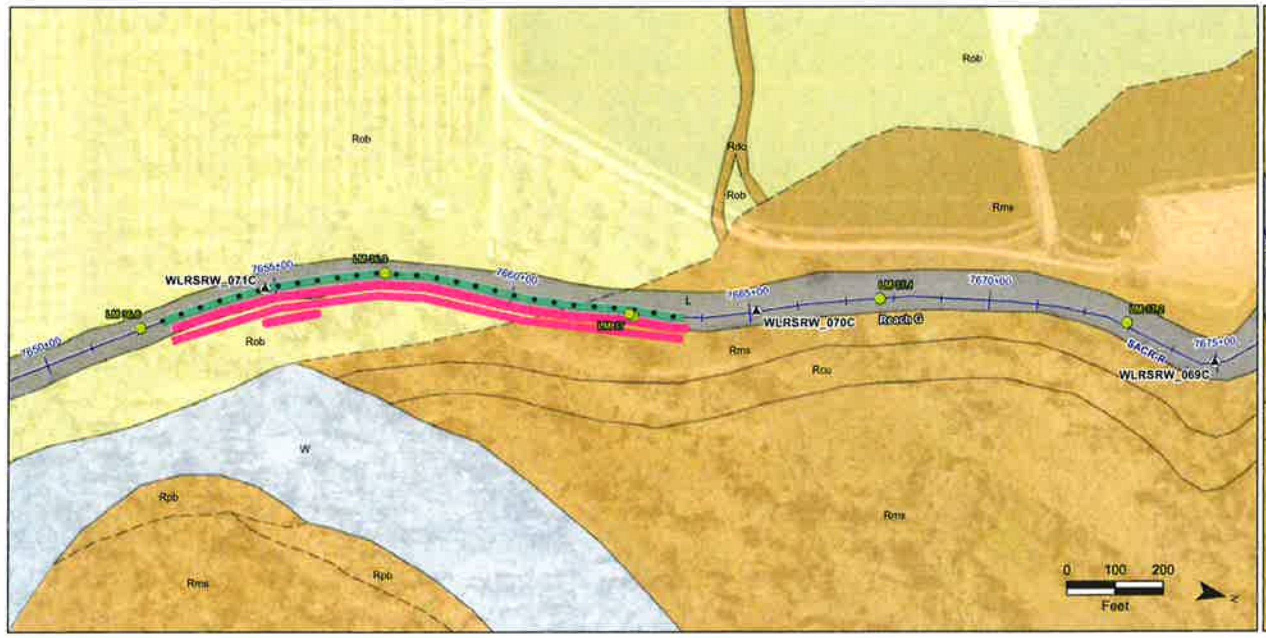
Colusa South Plan and Profiles

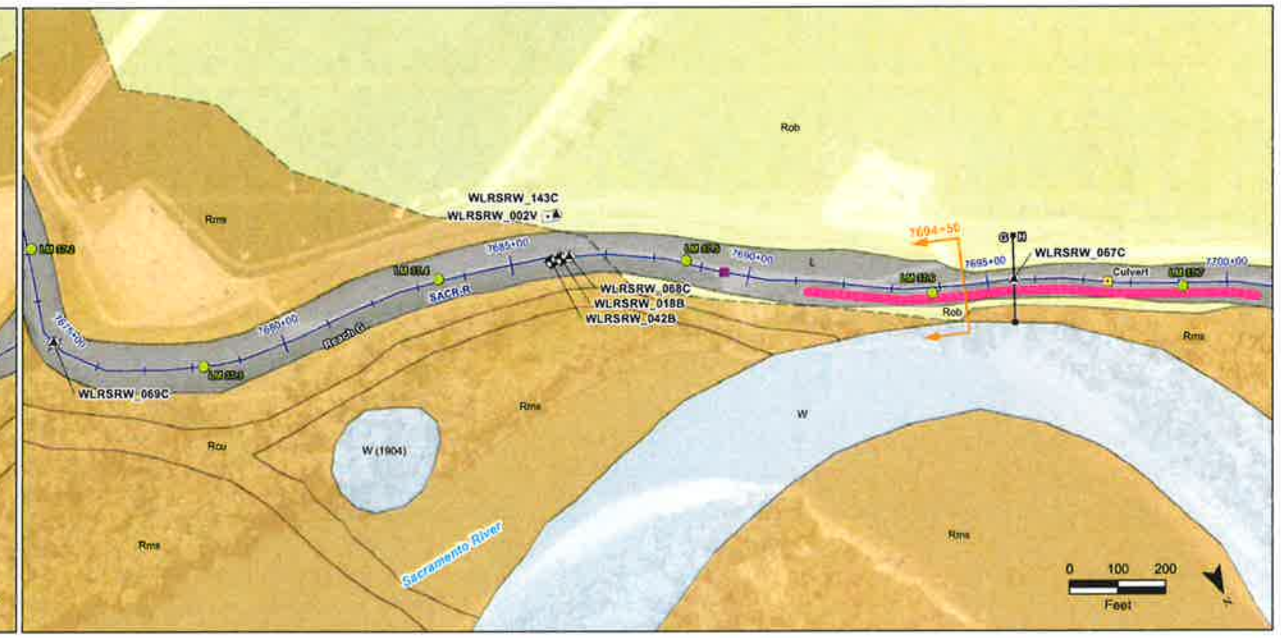
Sacramento River Right Bank Station 7600+00 to Station 7650+00

Non-Urban Levee Evaluations

Plate 14

Geotechnical Overview Report





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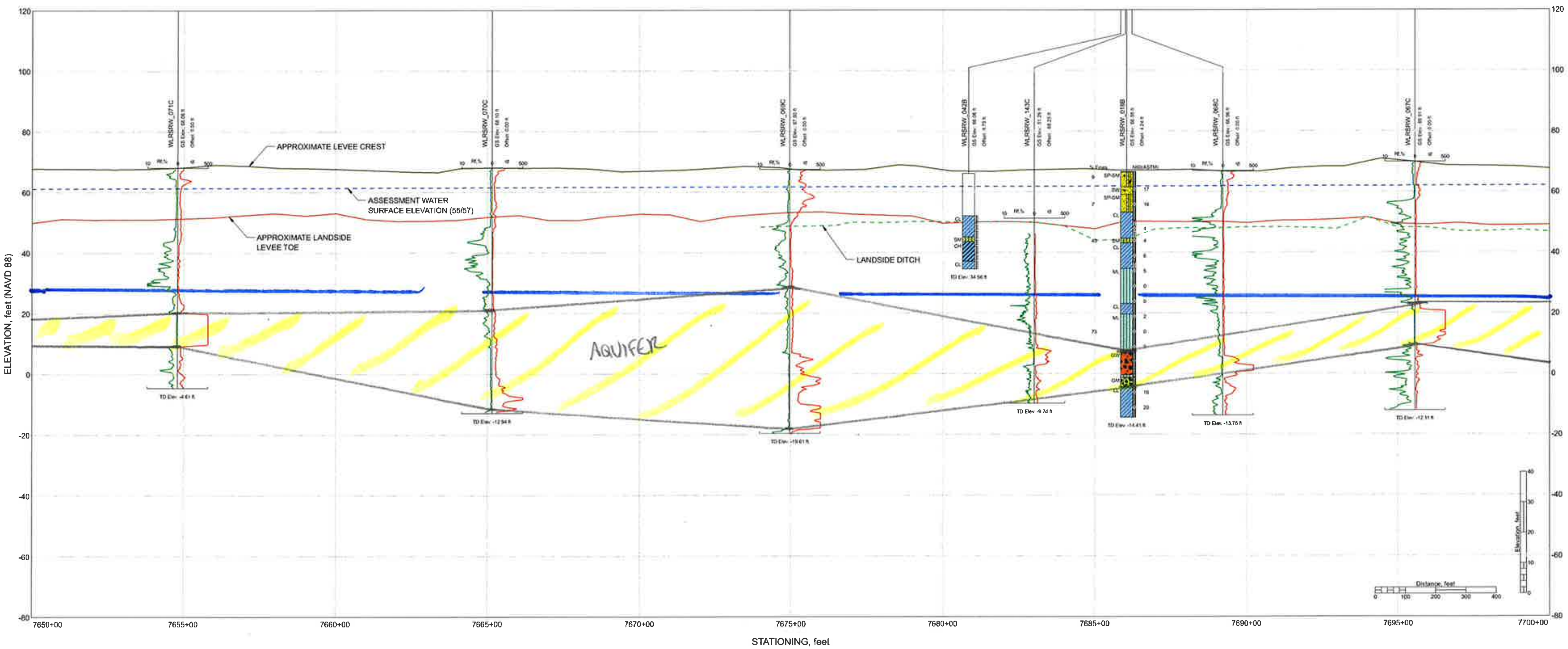


Department of Water Resources
Division of Flood Management

URS
in association with
GEI

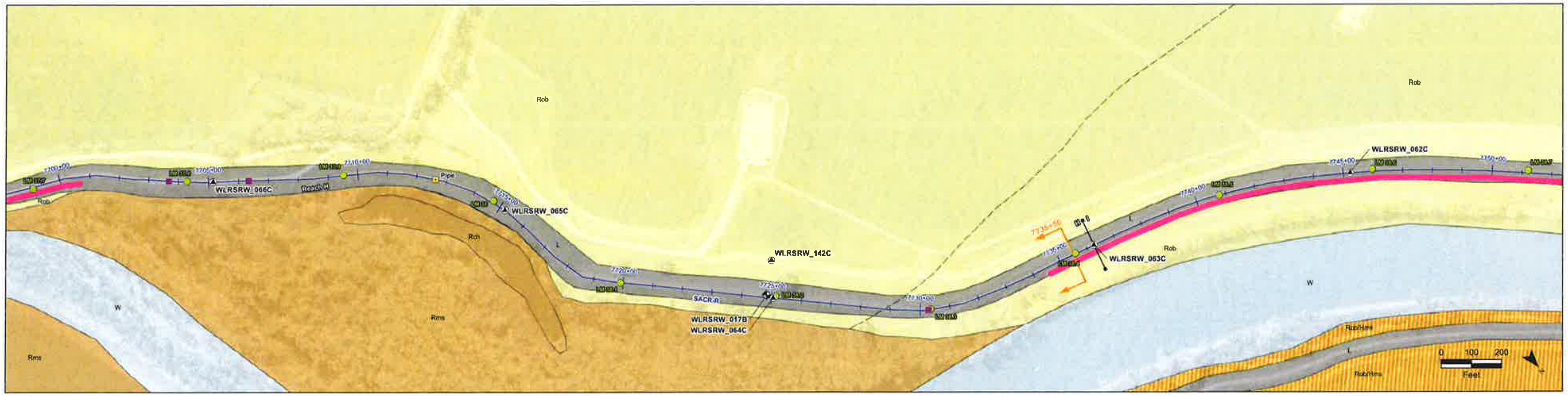
Colusa South Plan and Profiles

Sacramento River Right Bank Station 7650+00 to Station 7700+00

Non-Urban Levee Evaluations

Plate 15

Geotechnical Overview Report



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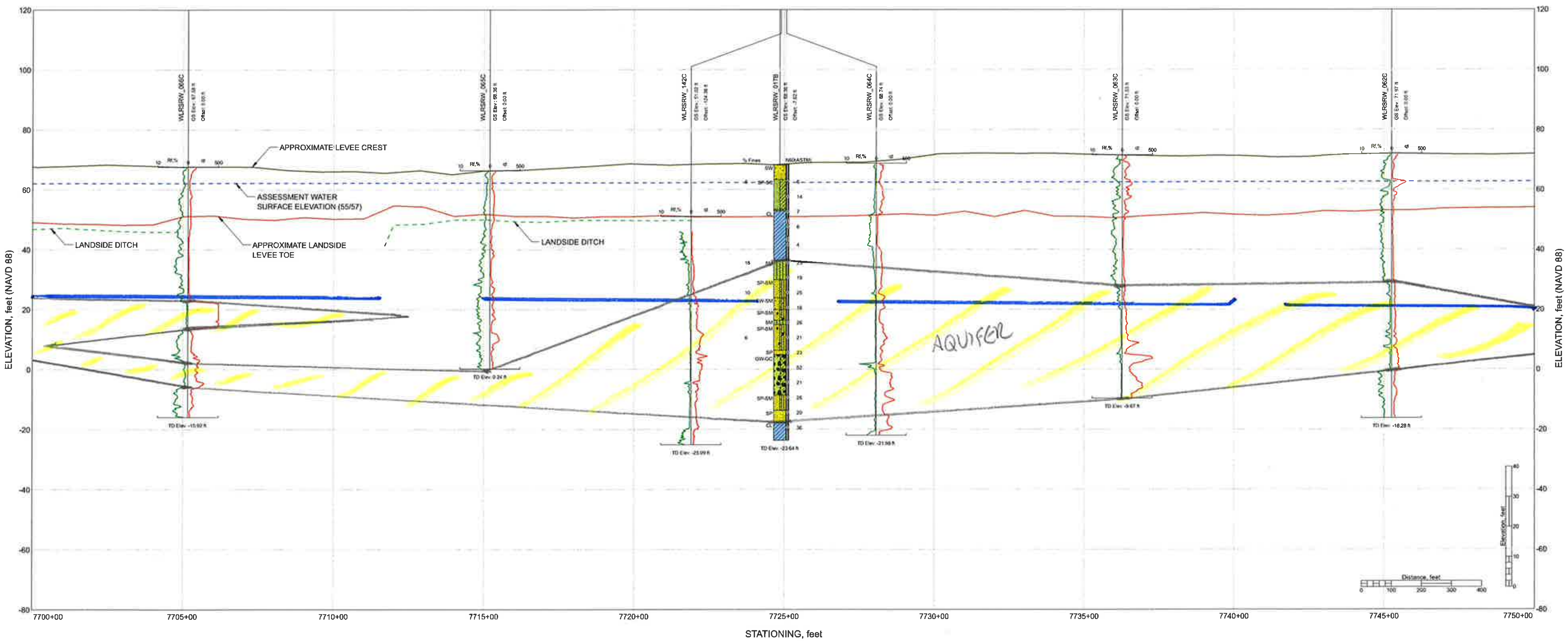

Department of Water Resources
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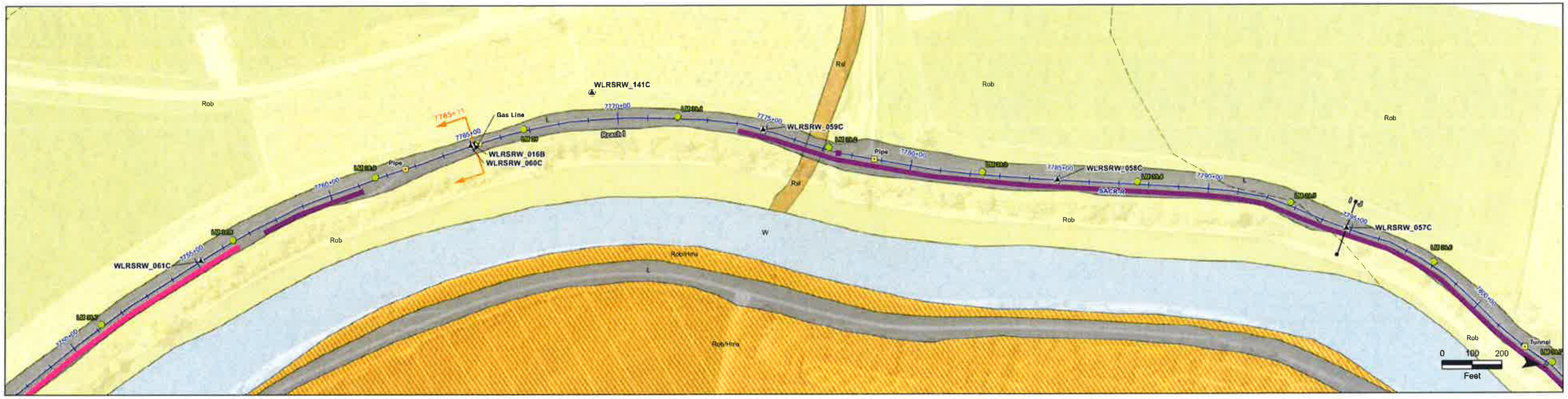
Colusa South Plan and Profiles
Sacramento River Right Bank Station 7700+00 to Station 7750+00

Non-Urban Levee Evaluations

Plate 16

Geotechnical Overview Report



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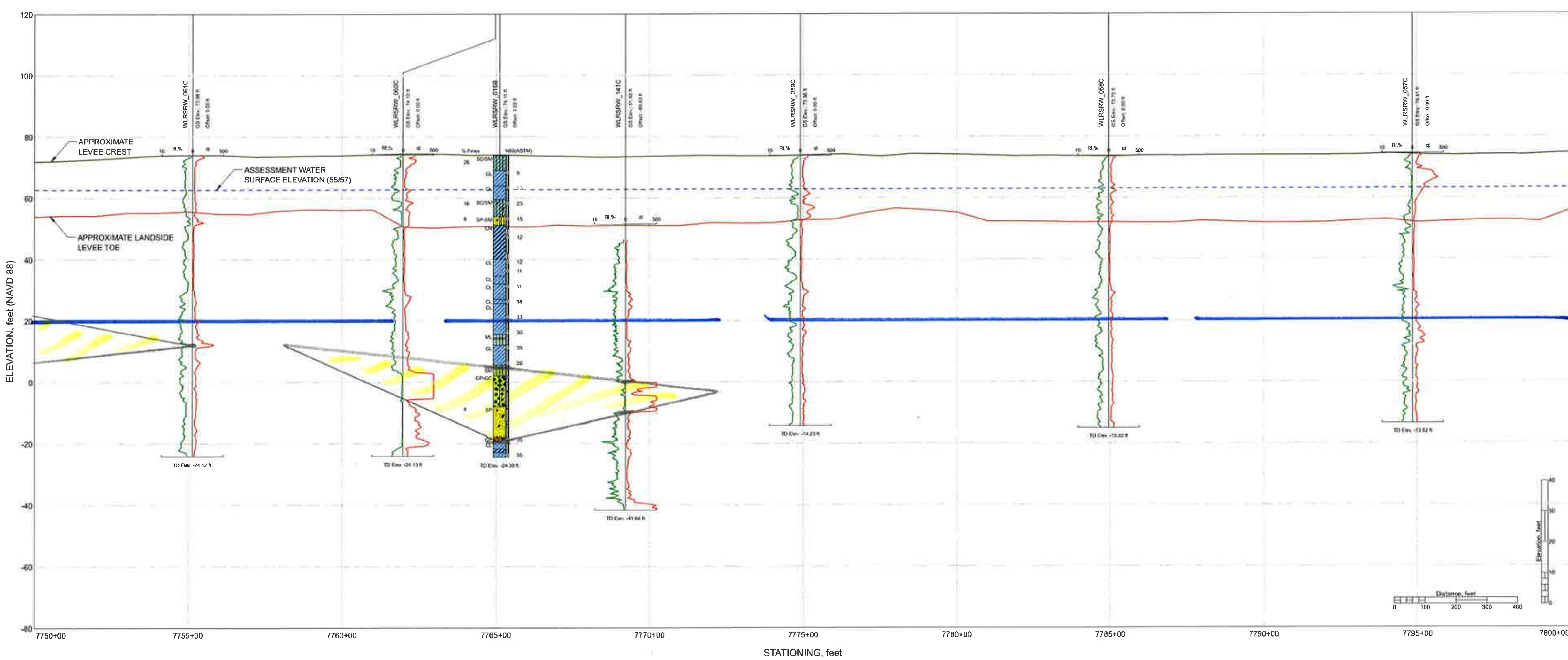


Department of Water Resources
Division of Flood Management

URS in association with GEI

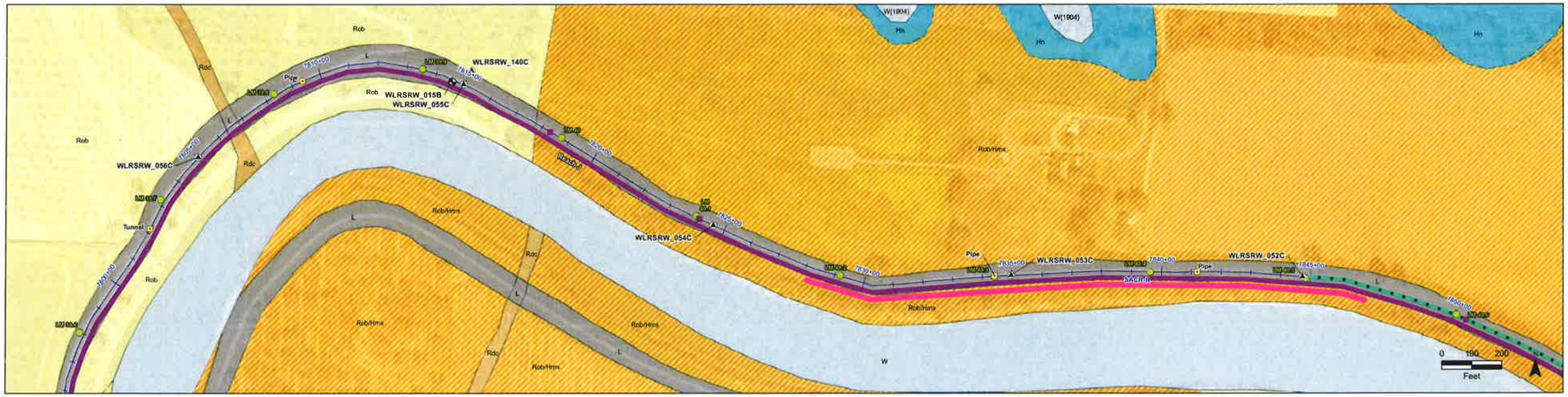
Colusa South Plan and Profiles

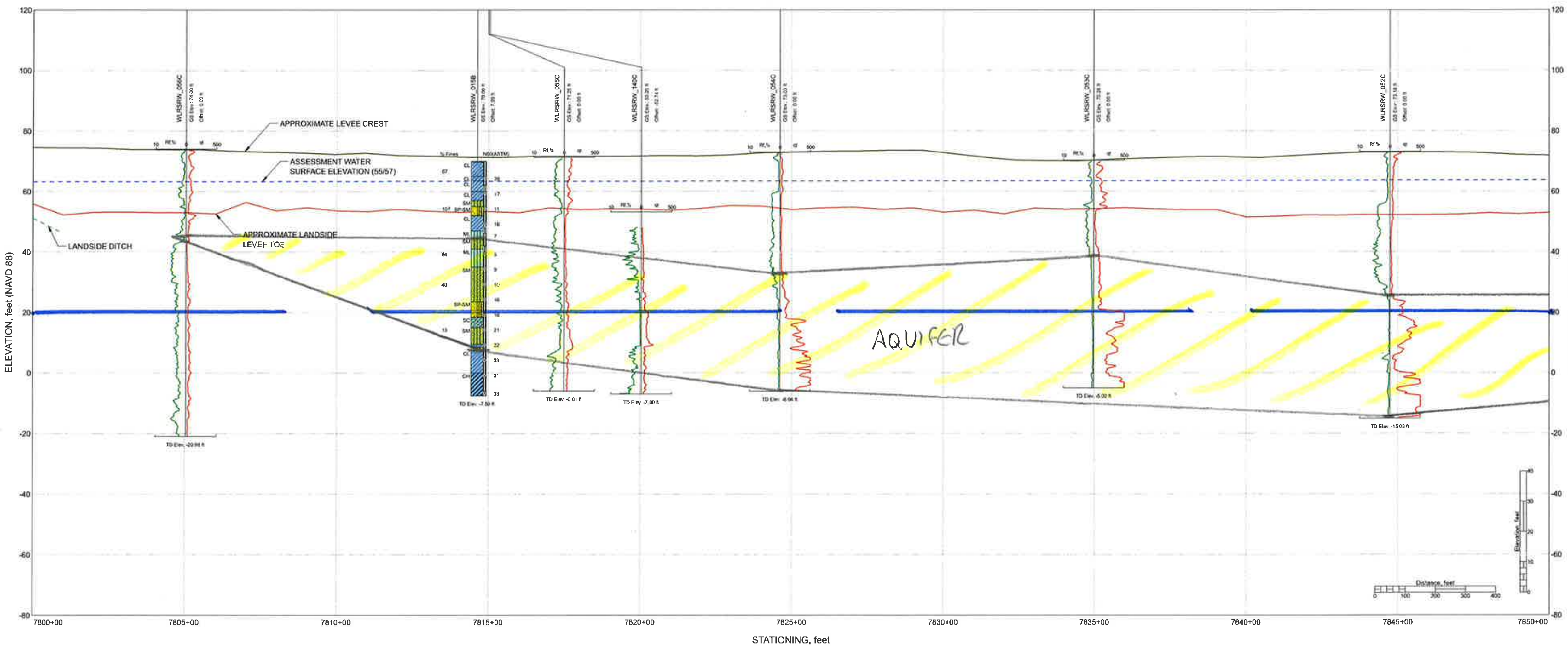
Sacramento River Right Bank Station 7750+00 to Station 7800+00

Non-Urban Levee Evaluations

Plate 17

Geotechnical Overview Report





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Department of Water Resources
Division of Flood Management

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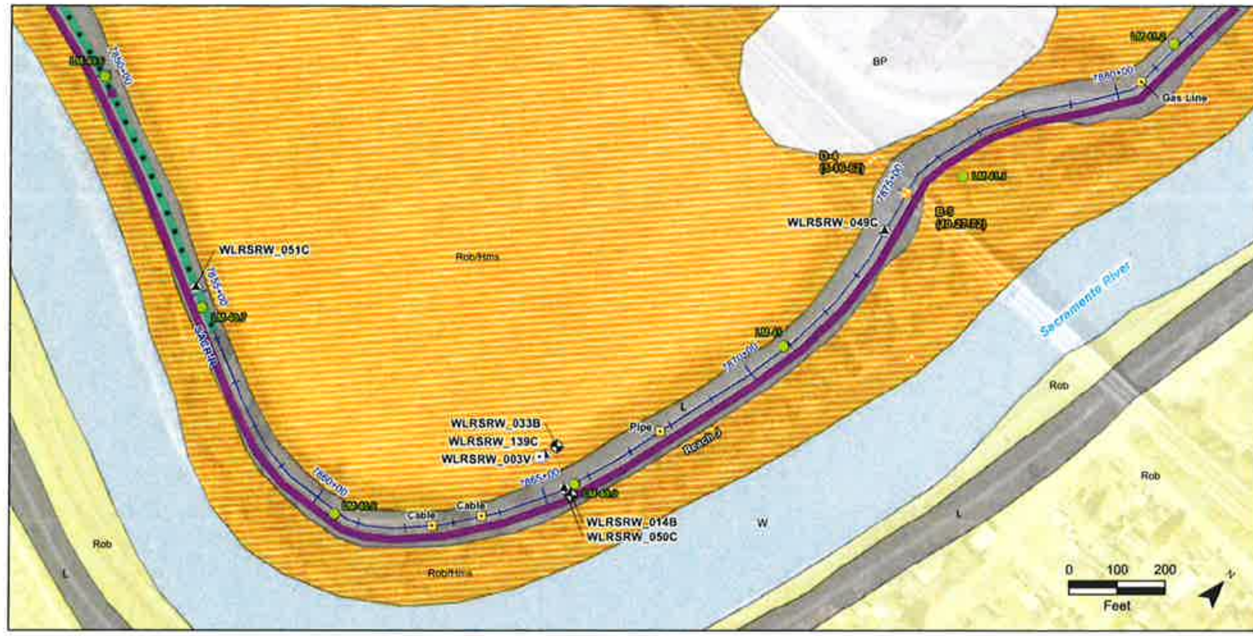
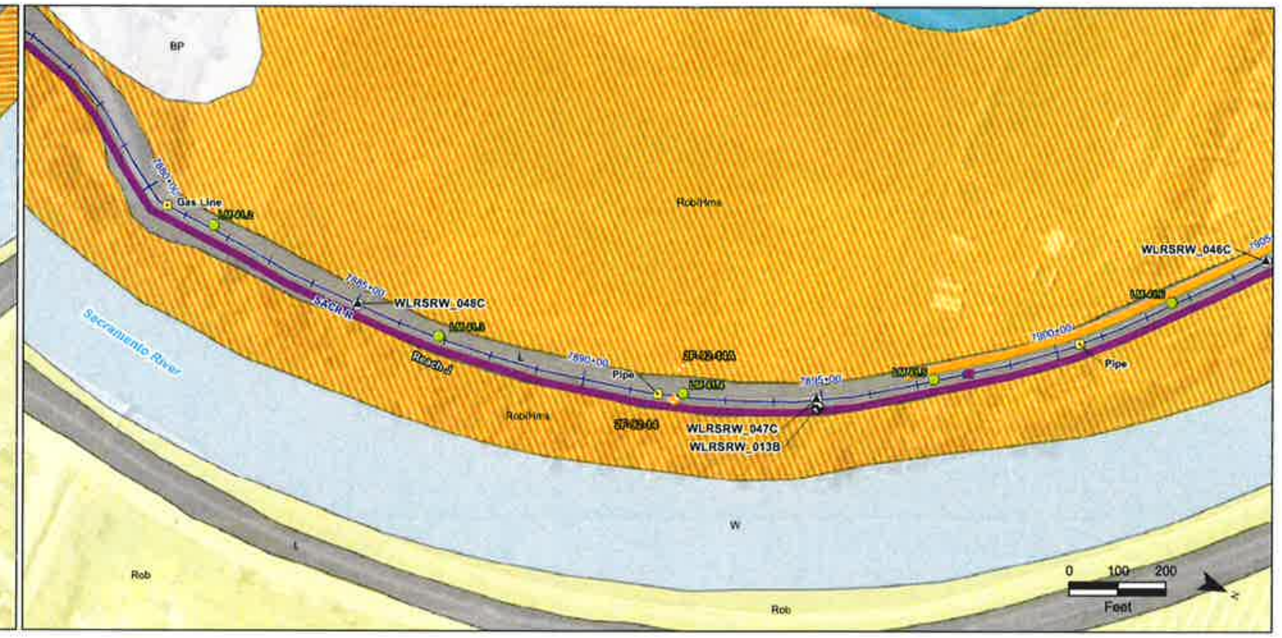
Colusa South Plan and Profiles
Sacramento River Right Bank Station 7800+00 to Station 7850+00
Non-Urban Levee Evaluations

Plate 18

Geotechnical Overview Report





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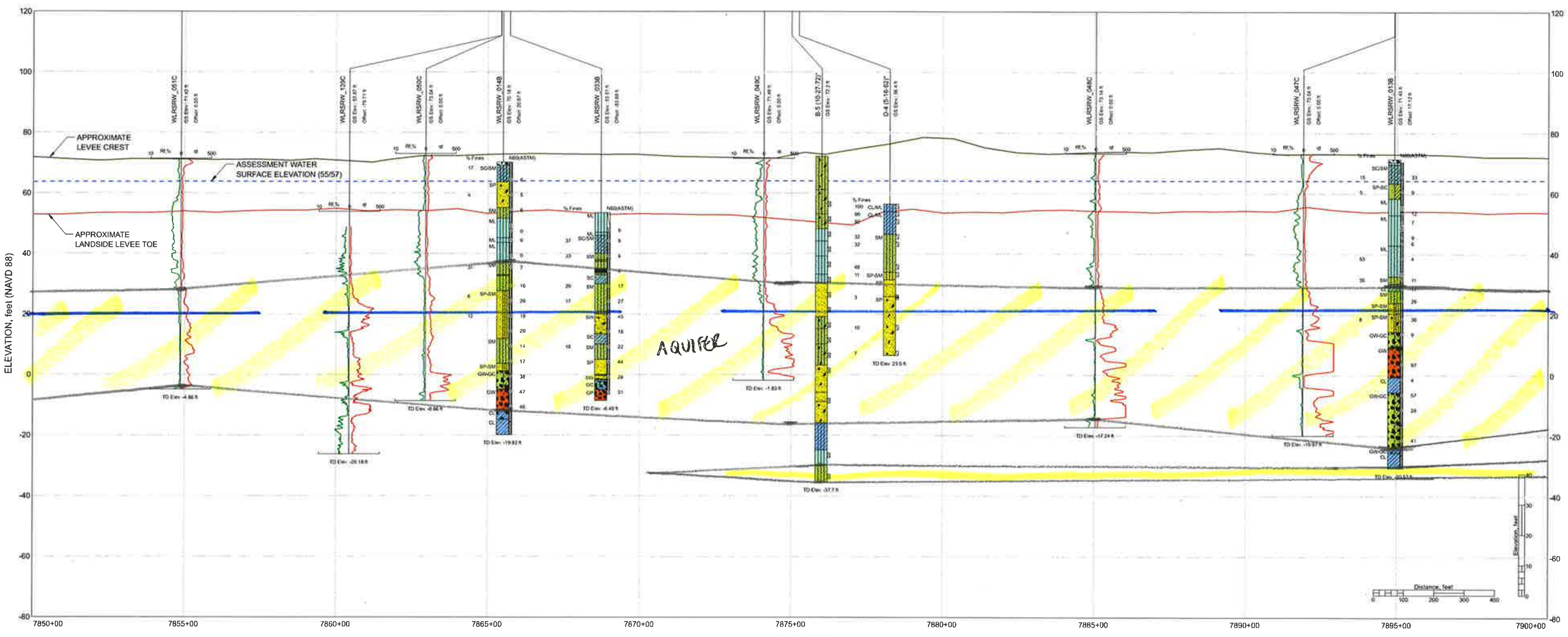

Department of Water Resources
Division of Flood Management

URS
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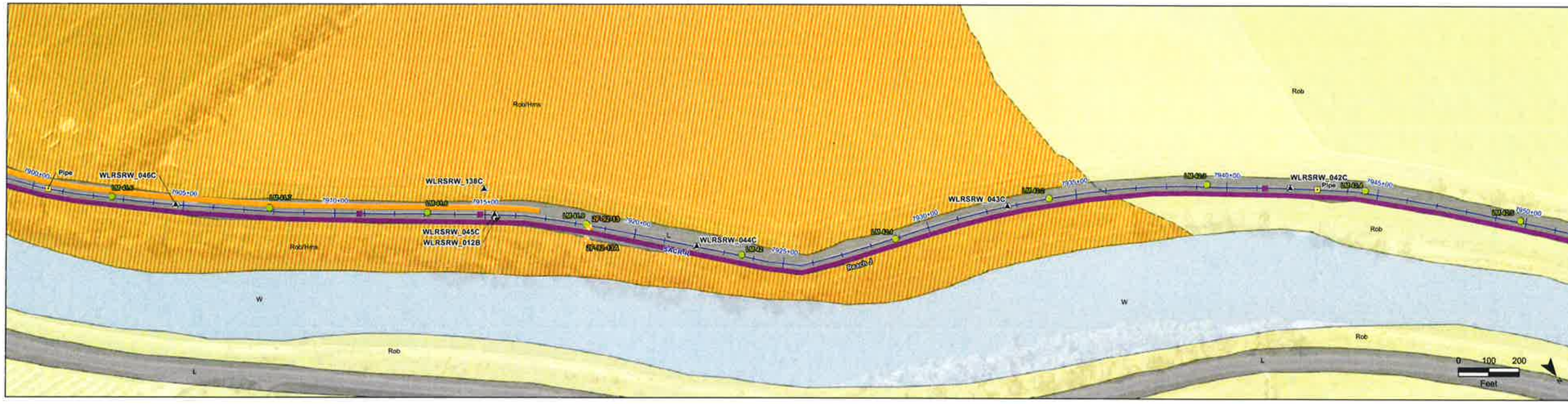
GEI

Colusa South Plan and Profiles
Sacramento River Right Bank Station 7850+00 to Station 7900+00
Non-Urban Levee Evaluations

Plate
19

Geotechnical Overview Report



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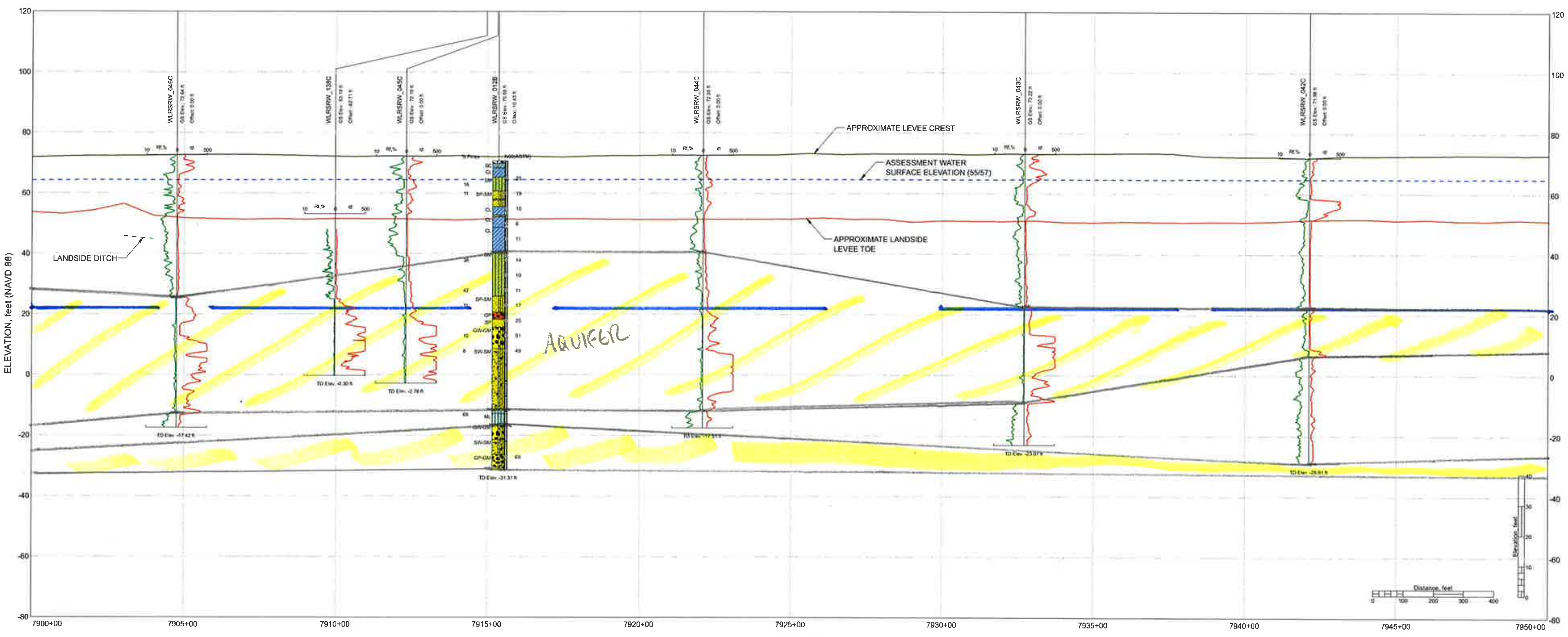

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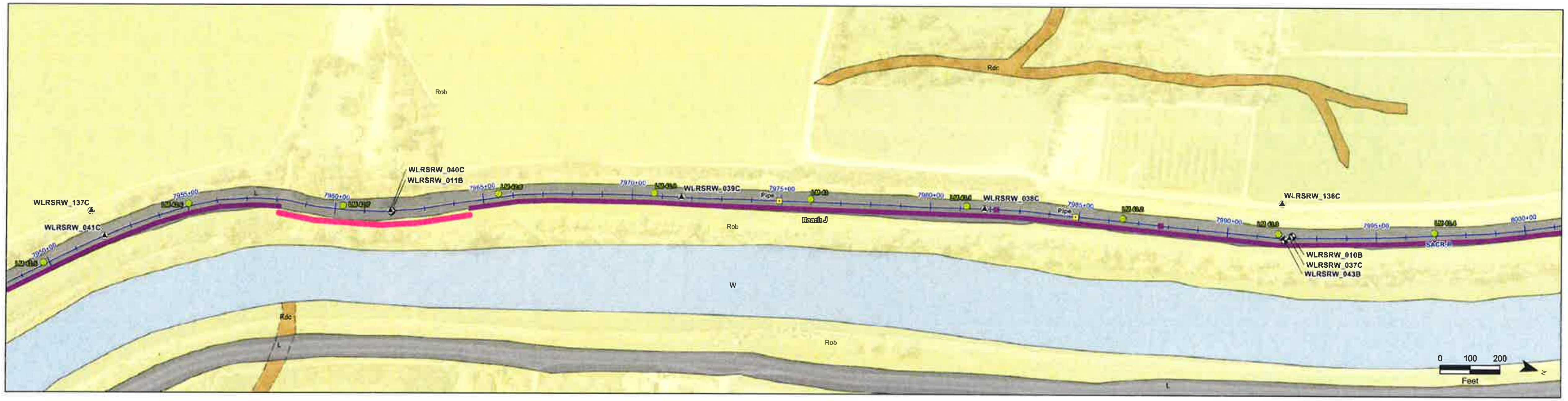
Colusa South Plan and Profiles

Sacramento River Right Bank Station 7900+00 to Station 7950+00

Non-Urban Levee Evaluations

Plate 20

Geotechnical Overview Report



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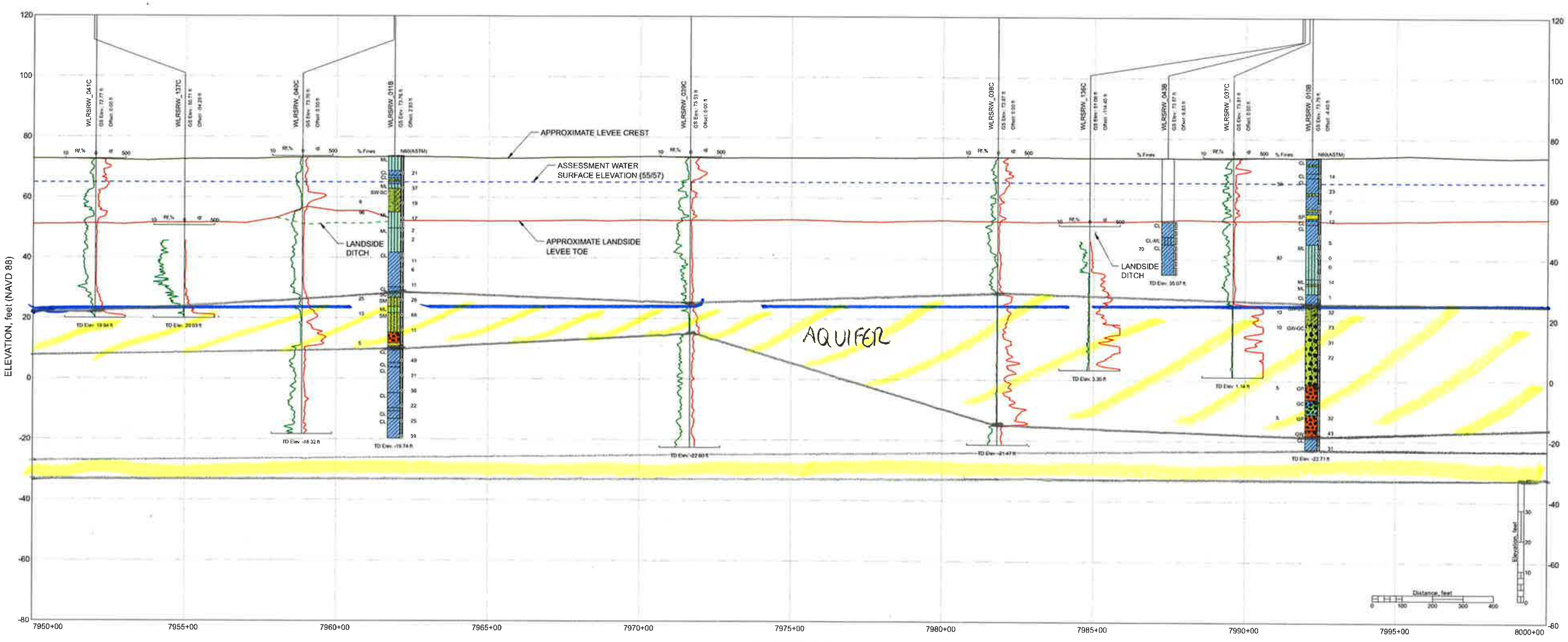

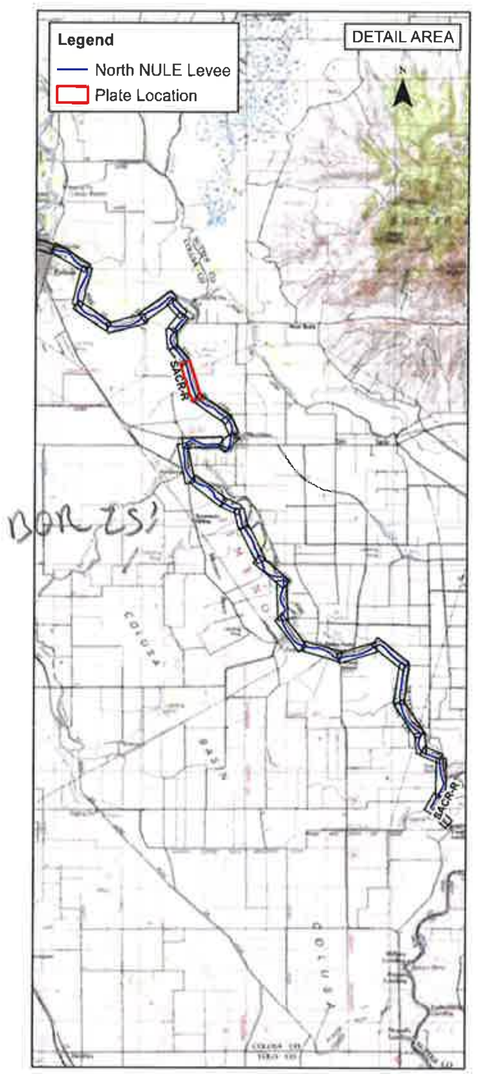

Department of Water Resources
Division of Flood Management

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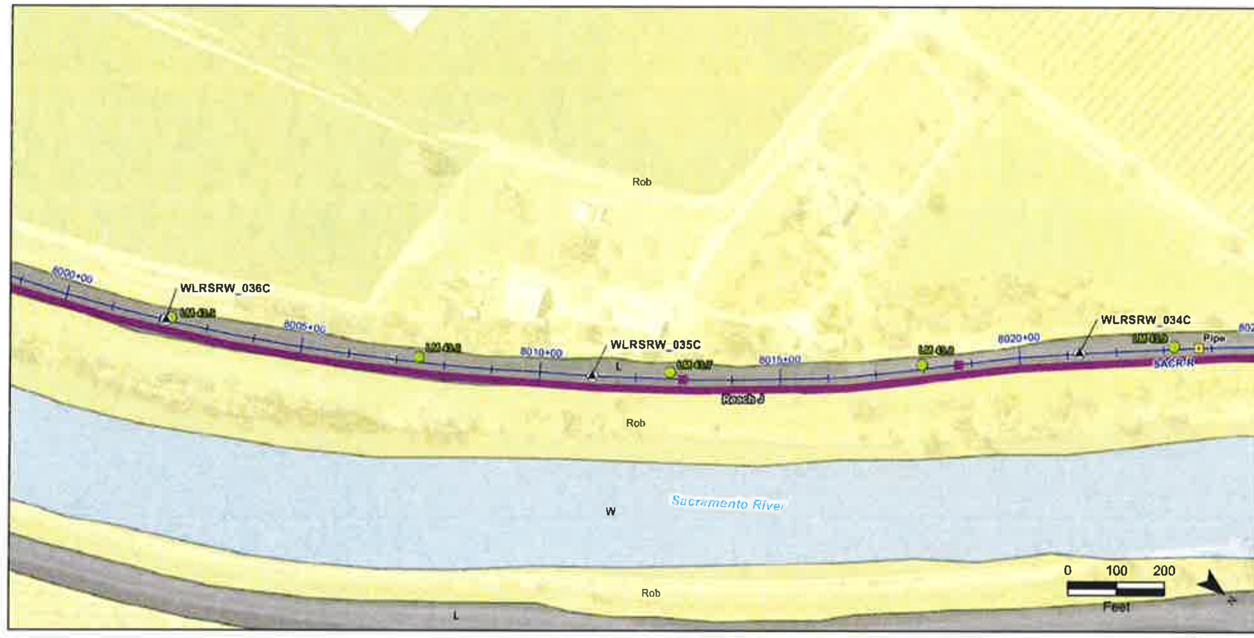
Colusa South Plan and Profiles

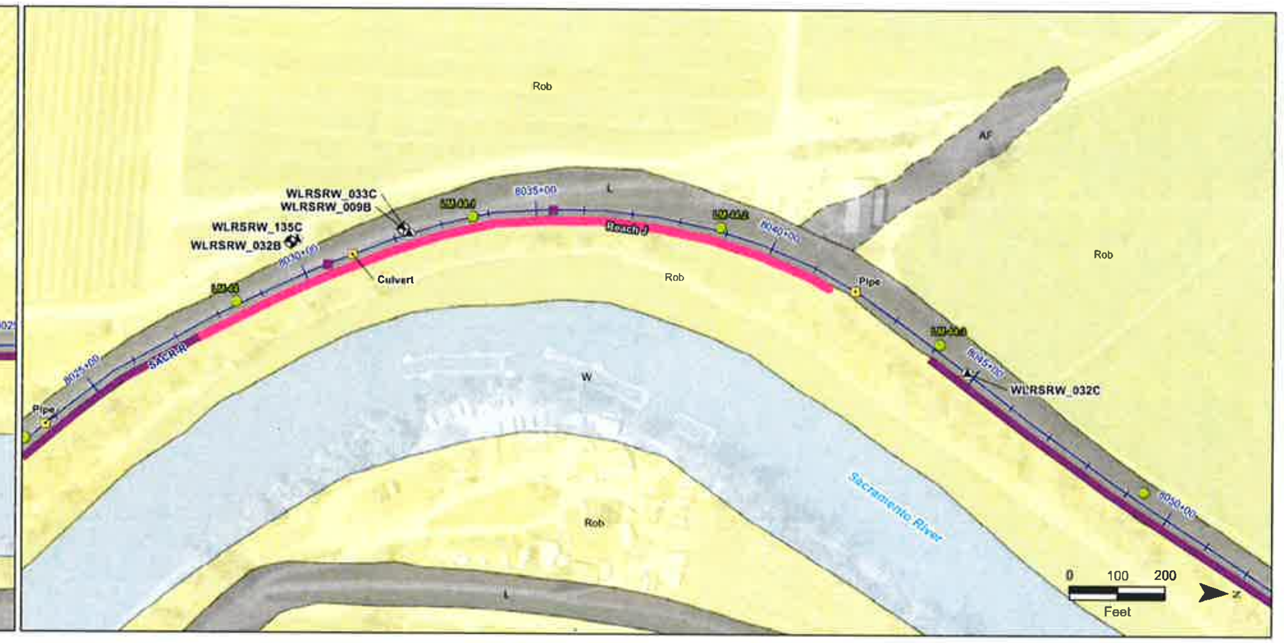
Sacramento River Right Bank Station 7950+00 to Station 8000+00

Non-Urban Levee Evaluations

Plate 21

Geotechnical Overview Report





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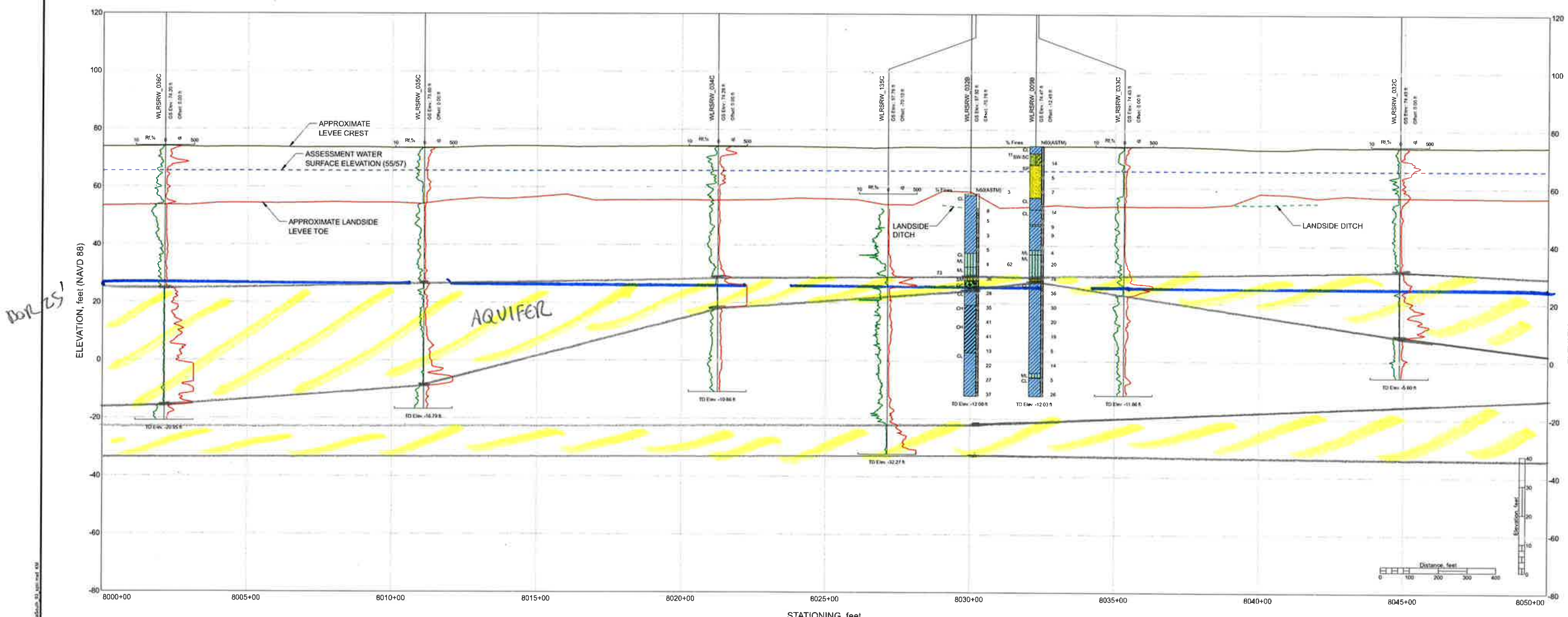

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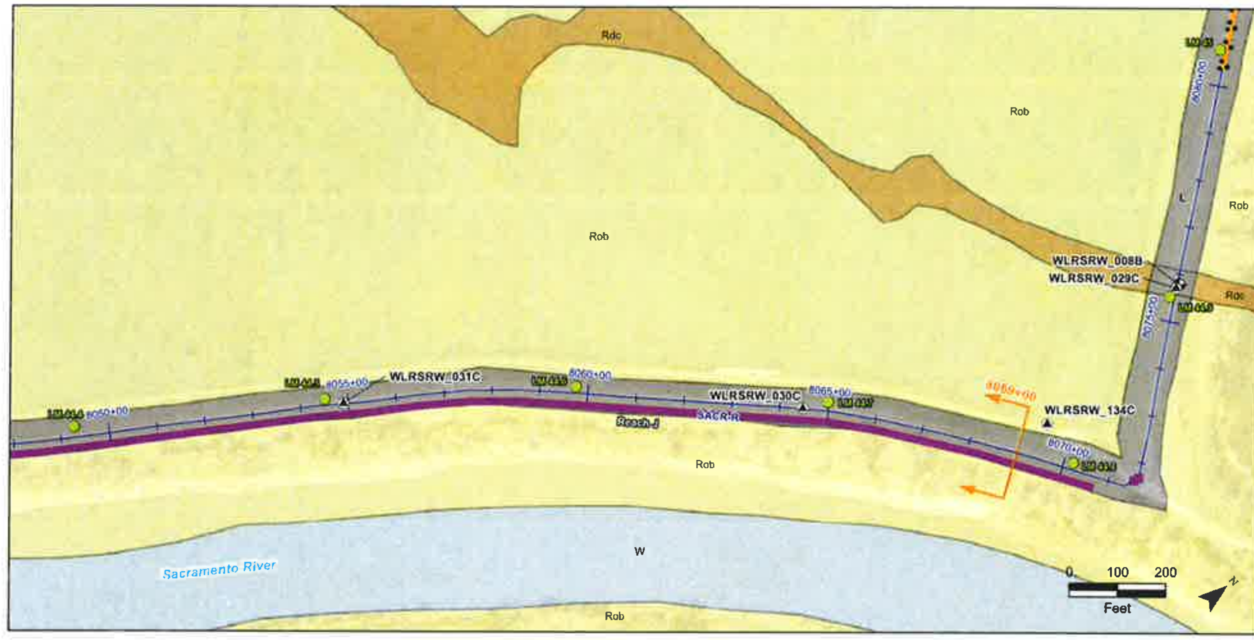
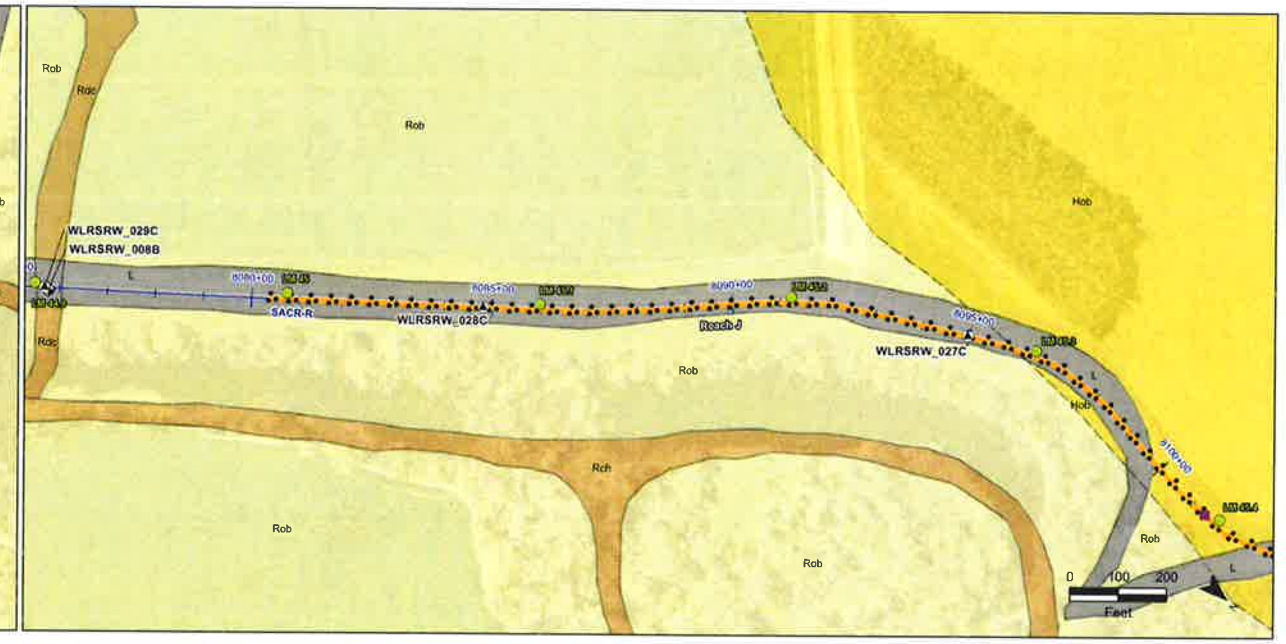
Colusa South Plan and Profiles
Sacramento River Right Bank Station 8000+00 to Station 8050+00
Non-Urban Levee Evaluations

Plate 22

Geotechnical Overview Report





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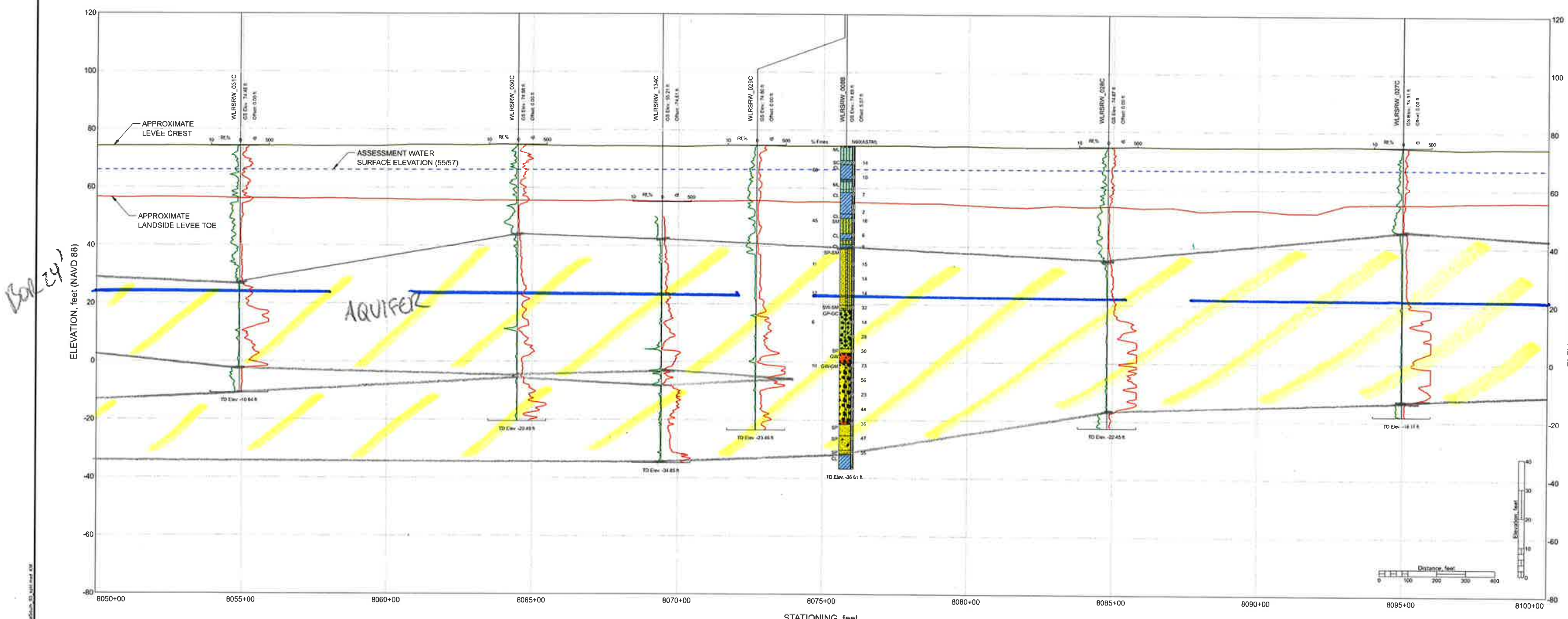

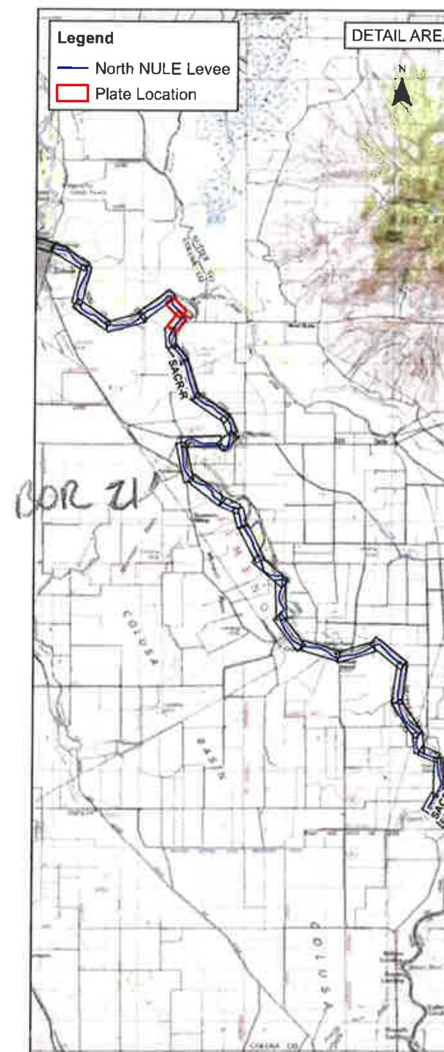

Department of Water Resources
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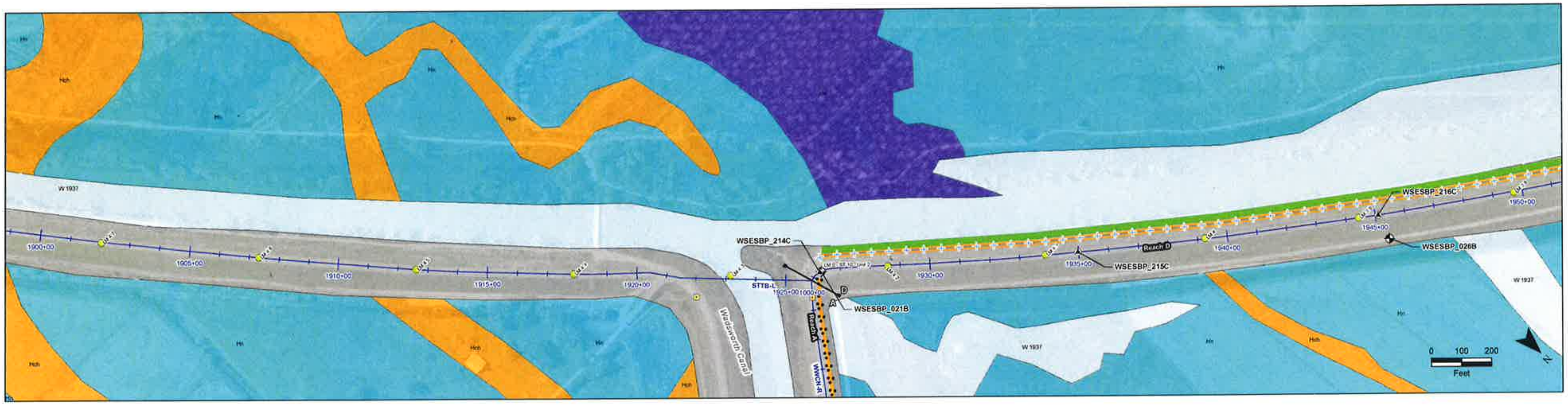
Colusa South Plan and Profiles
Sacramento River Right Bank Station 8050+00 to Station 8100+00
Non-Urban Levee Evaluations

Plate
23

Geotechnical Overview Report

APPENDIX E
GEOLOGIC SECTIONS
SUTTER BYPASS
AND WADSWORTH CANAL



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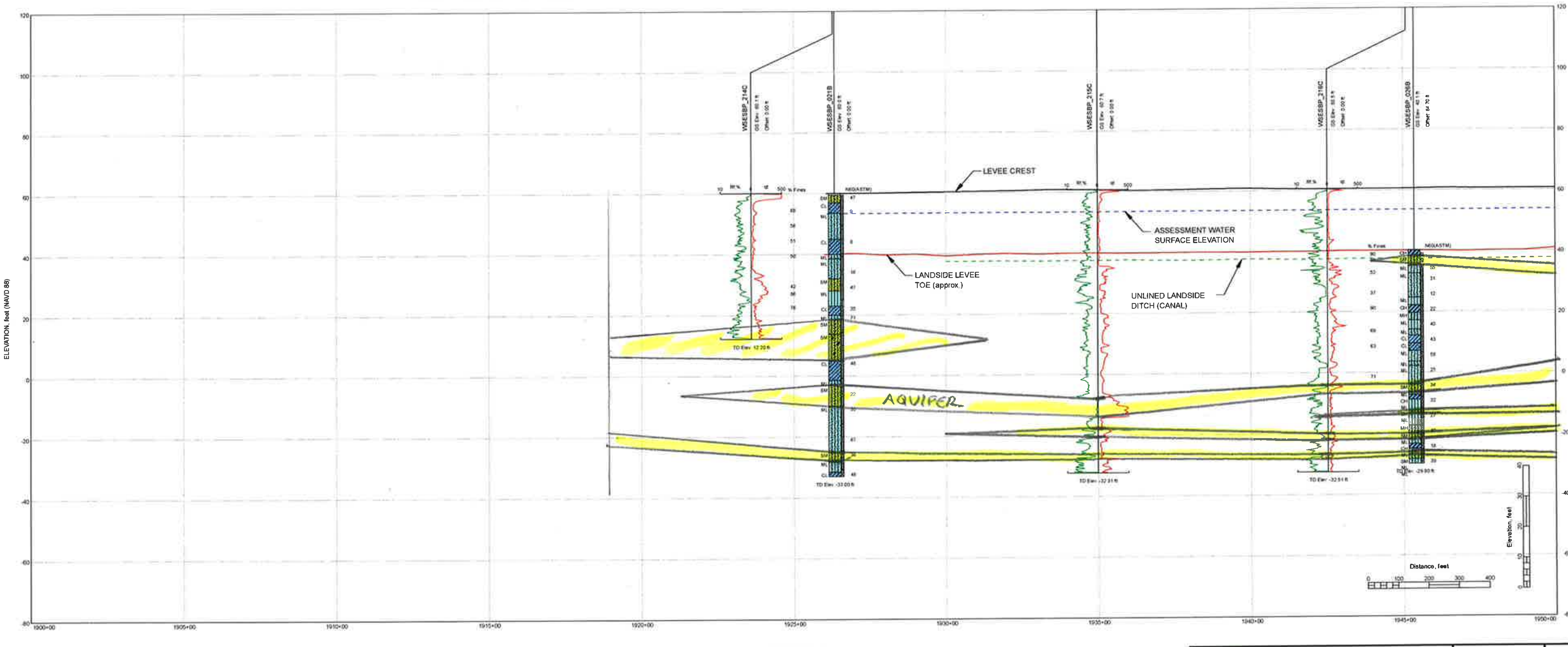
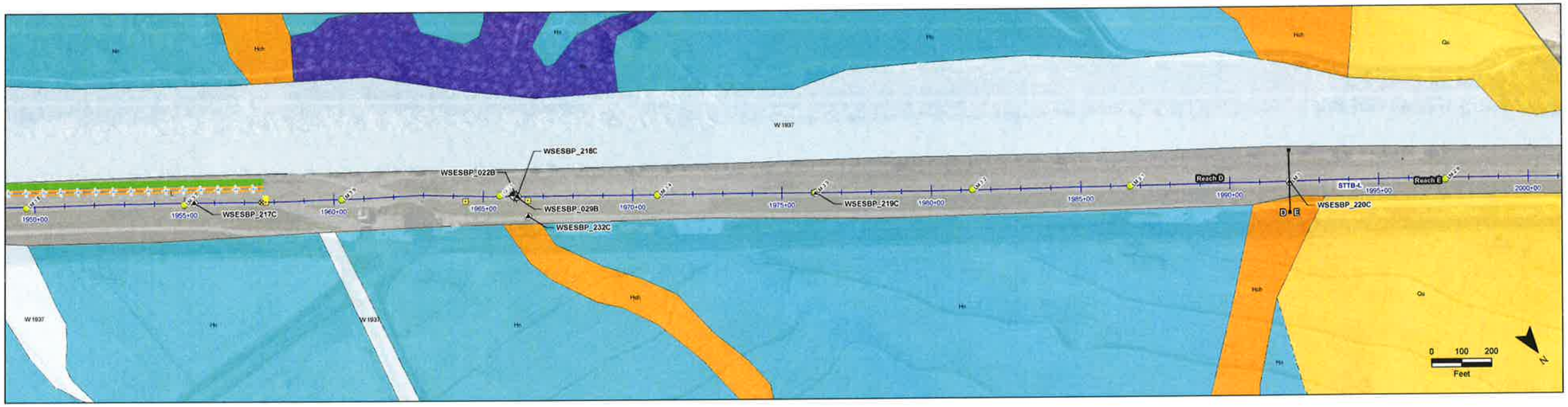
NO BATHYMETRY



Department of Water Resources Division of Flood Management	URS	Sutter Plan and Profile Sutter Bypass Left Bank Station 1925+89 to Station 1950+00 Non-Urban Levee Evaluations	Plate 8

Geotechnical Overview Report



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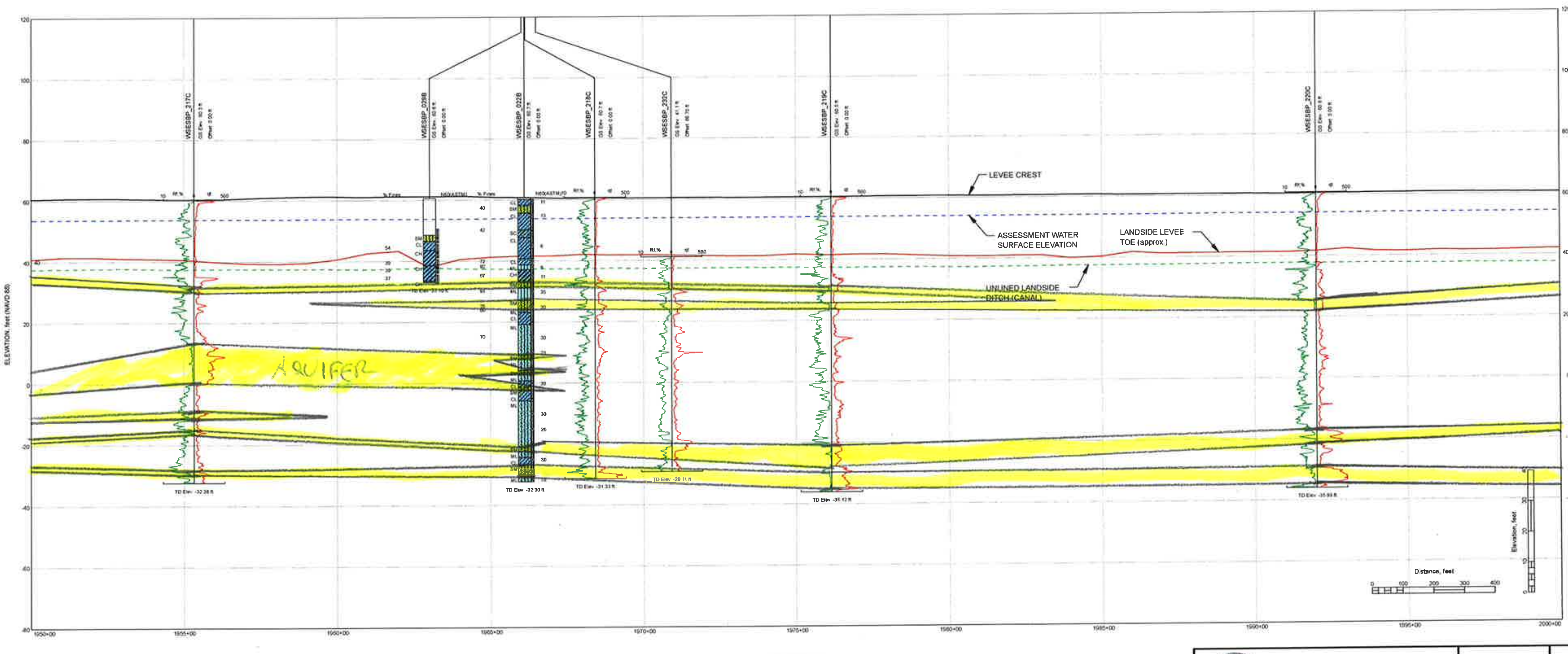
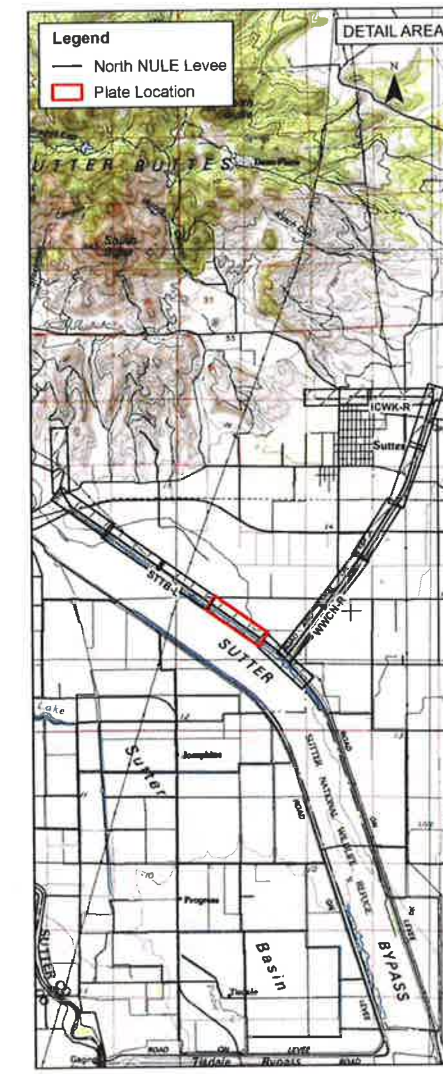




Department of Water Resources
Division of Flood Management

URS

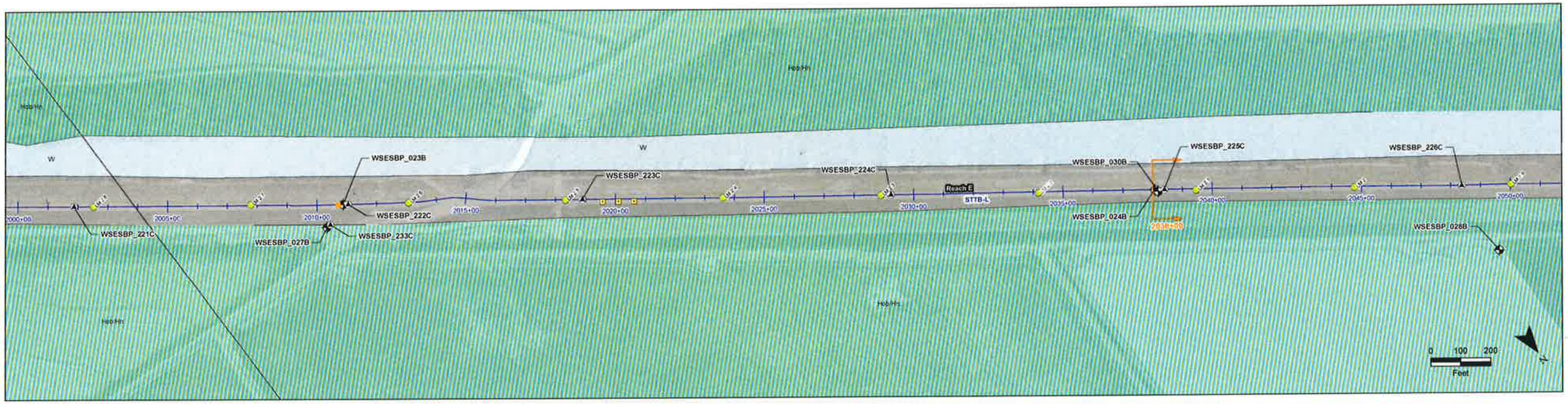
Sutter Plan and Profile

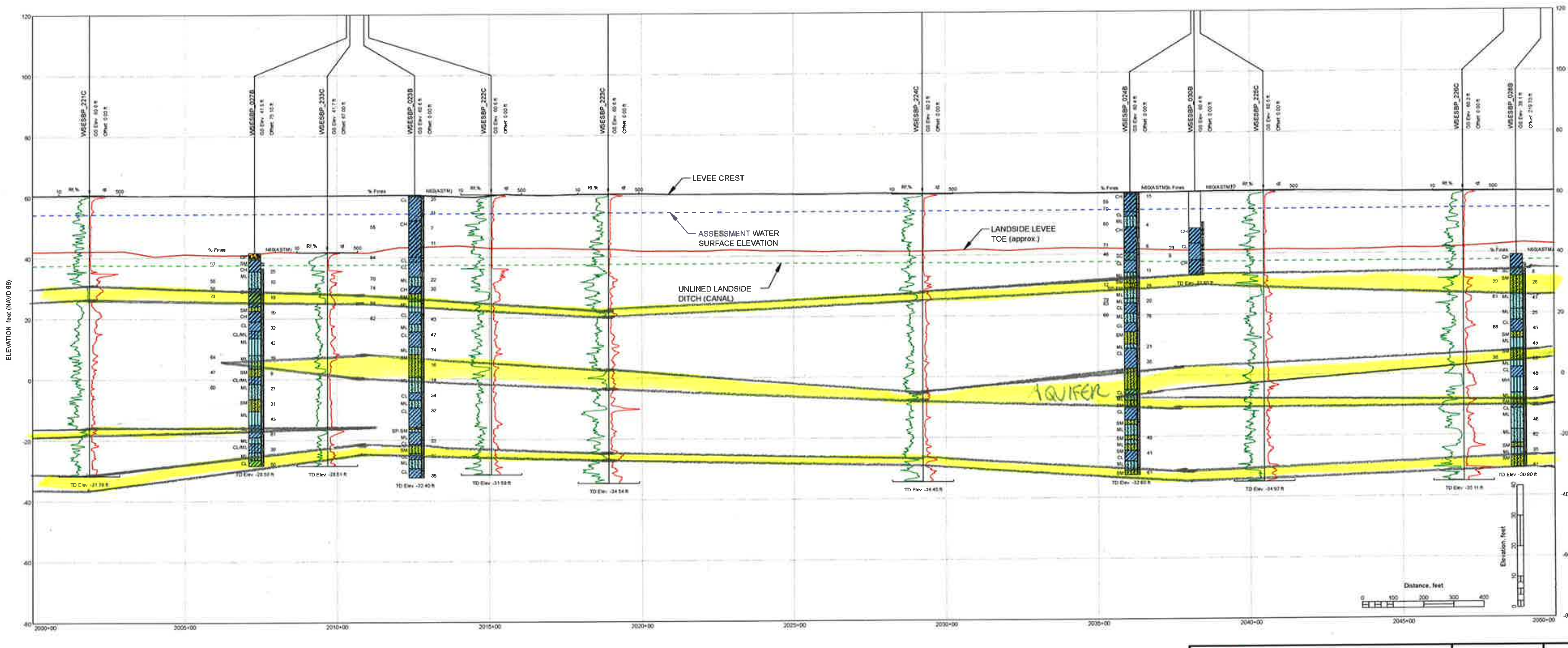
Sutter Bypass Left Bank Station 1950+00 to Station 2000+00

Non-Urban Levee Evaluations

Plate 9

Geotechnical Overview Report





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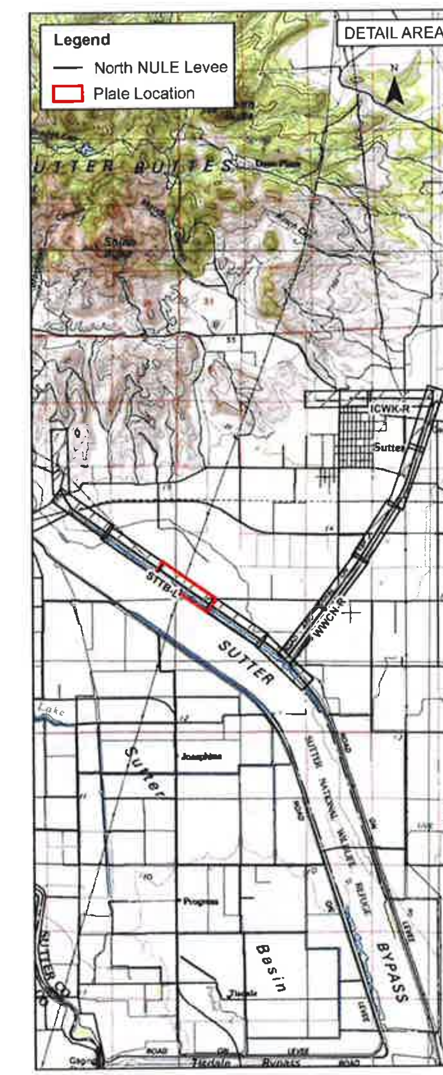


Department of Water Resources
Division of Flood Management

URS

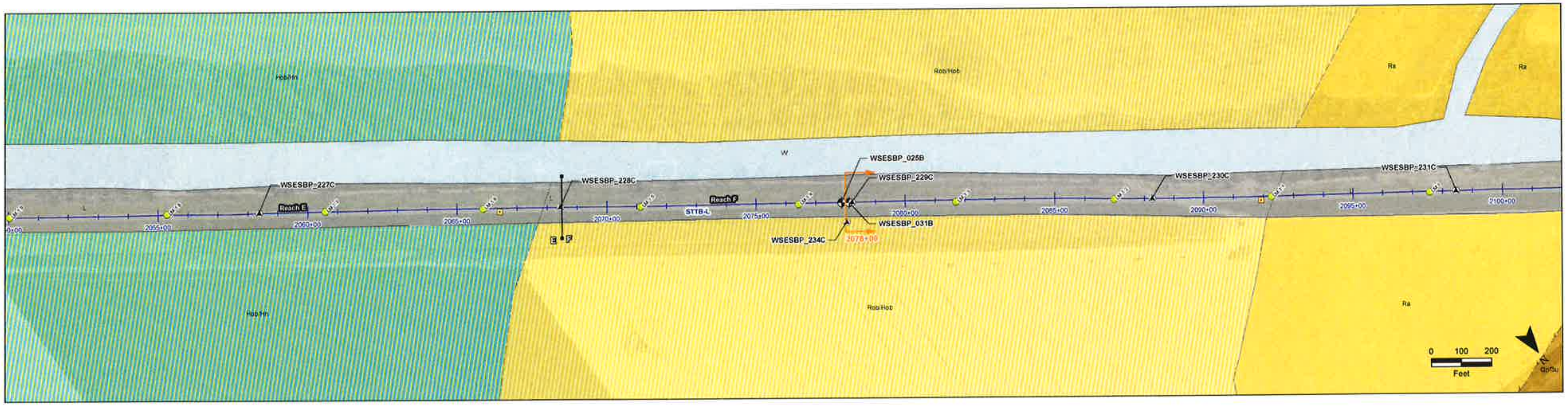
Sutter Plan and Profile

Sutter Bypass Left Bank Station 2000+00 to Station 2050+00

Non-Urban Levee Evaluations

Plate 10

Geotechnical Overview Report



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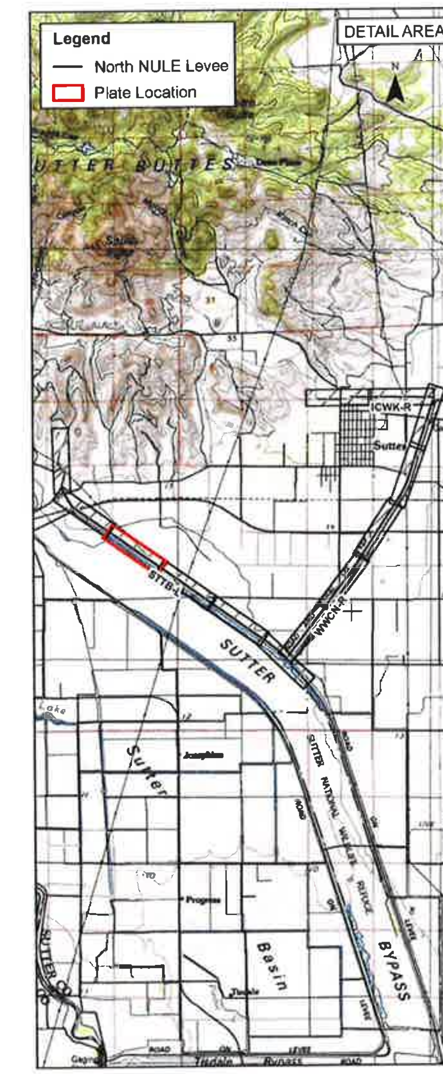
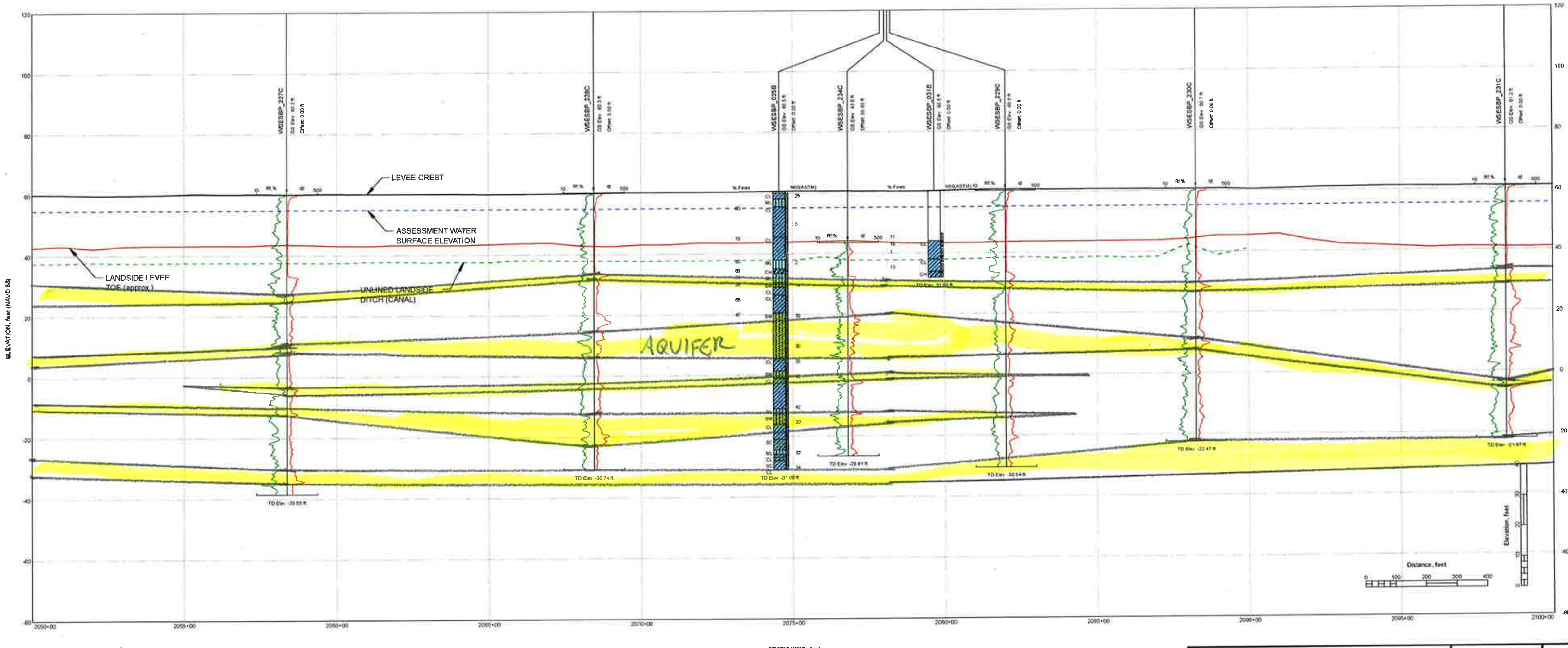
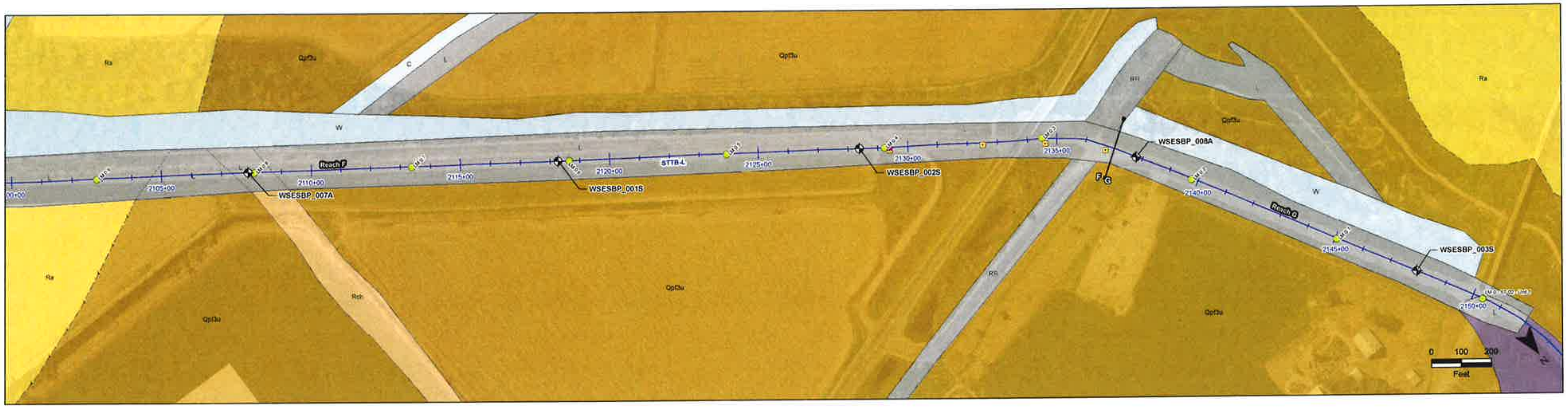




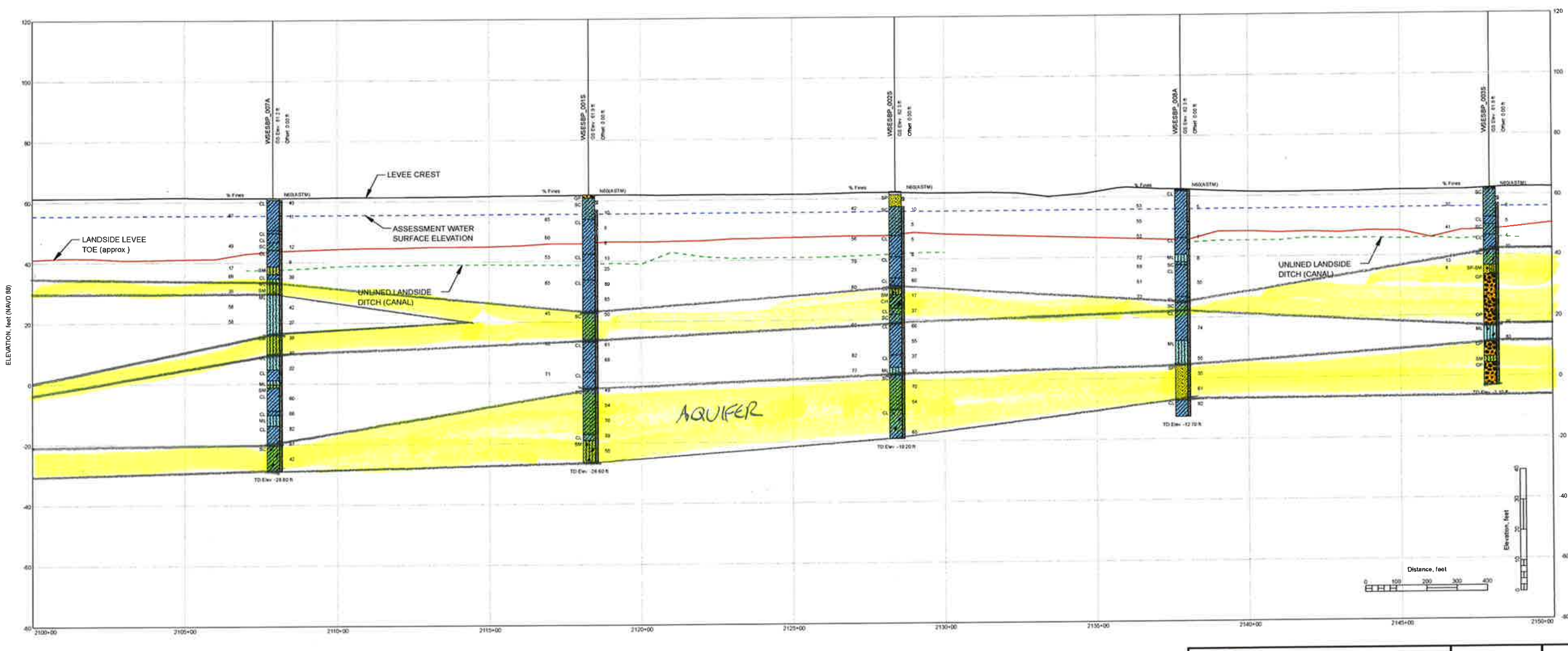
Department of Water Resources Division of Flood Management	URS	**Sutter Plan and Profile** Sutter Bypass Left Bank Station 2050+00 to Station 2100+00 Non-Urban Levee Evaluations	Plate 11

Geotechnical Overview Report



NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from NULE LiDAR data and used for geotechnical analyses and report purpose only.
2. AWSEs are not available due to the 2- to 3-foot levee height, and no available 1955/57 design WSE.
3. Ditch bottom are shown from LiDAR data which reflects some areas of ditches were dry and other areas were filled with water when data was taken. See GOR for more information.
4. Locations of explorations are approximate. Stick logs represent general soil conditions encountered at the time of exploration. For more detailed information on the materials encountered, refer to boring and CPT logs in the Geotechnical Data Report for the Sutter Project. No warranty is provided regarding the continuity of soil conditions between individual explorations.
5. When reported, N_{60} (ASTM), refers to N_{60} (ASTM) = N field * Hammer Efficiency (%). See Geotechnical Data Report for the Sutter GOR Project for hammer efficiency data for individual borings.
6. USCS classification labels are not presented on the stick logs for soil lenses (thickness less than 1.5 feet).
7. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
9. Surficial geology was mapped at 1:24000 scale. (Source: SGDR for DWR ULE Project, URS,2010)
10. The information provided in these plans and stick-log plates has been compiled from a variety of sources. URS does not attest to the accuracy, completeness, or reliability of geotechnical exploration and other subsurface data by others that are included or referenced in these plates.
11. These plans and stick-log plates are for the use and benefit of DWR, and their consultants in connection with the execution of the Sutter Project. Use by any other party is at their own discretion and risk. These figures should not to be used as the sole basis for design, construction, remedial action, or major capital spending decisions.



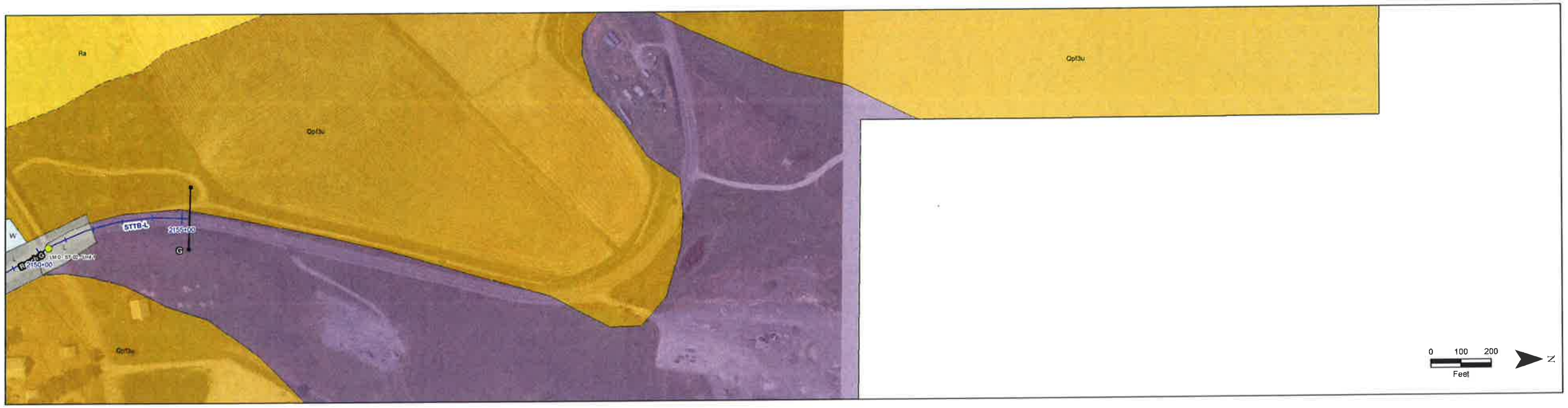
Department of Water Resources
Division of Flood Management

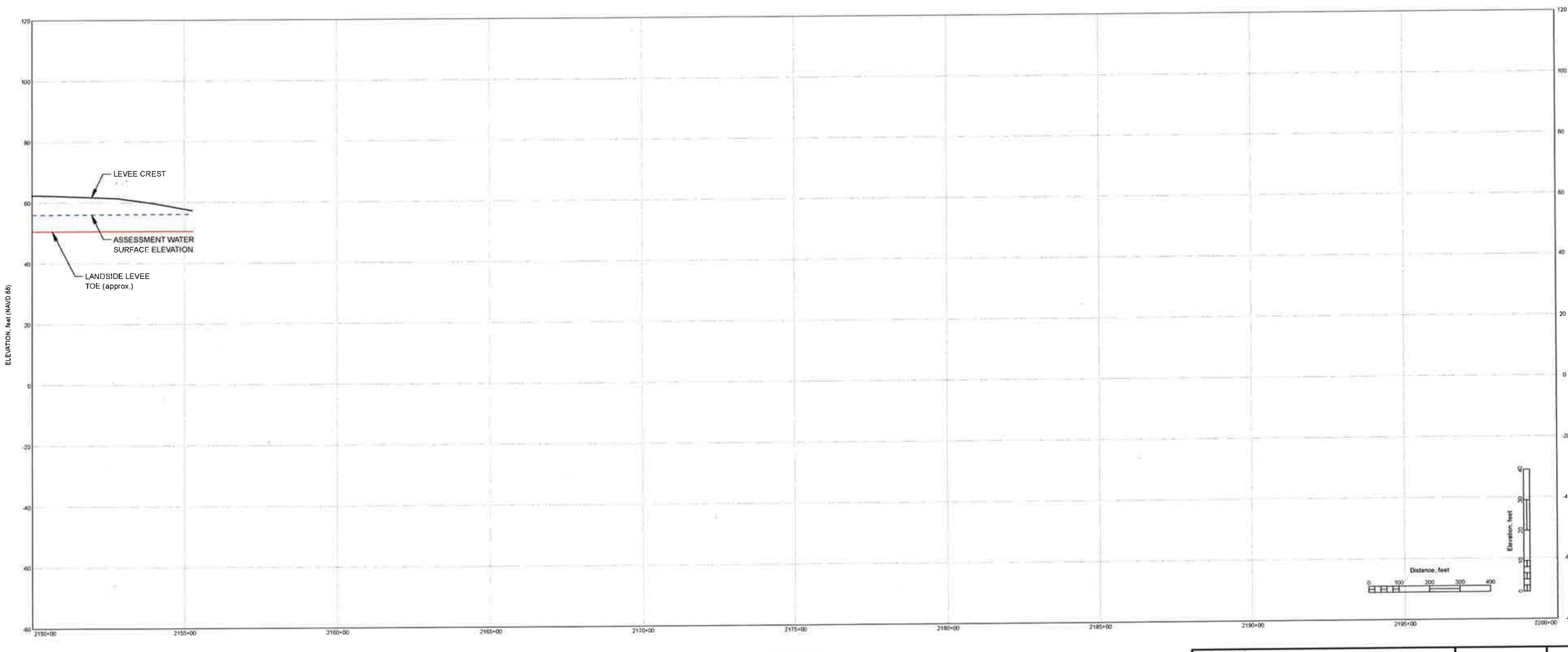
URS

Sutter Plan and Profile
Sutter Bypass Left Bank Station 2100+00 to Station 2150+00
Non-Urban Levee Evaluations

Plate 12

Geotechnical Overview Report





NOTES:

1. Elevations of levee crown and landside toe are approximate. These elevations were obtained from NULE LiDAR data and used for geotechnical analyses and report purpose only.
2. AWSEs are not available due to the 2- to 3-foot levee height, and no available 1955/57 design WSE.
3. Ditch bottom are shown from LiDAR data which reflects some areas of ditches were dry and other areas were filled with water when data was taken. See GOR for more information.
4. Locations of explorations are approximate. Stick logs represent general soil conditions encountered at the time of exploration. For more detailed information on the materials encountered, refer to boring and CPT logs in the Geotechnical Data Report for the Sutter Project. No warranty is provided regarding the continuity of soil conditions between individual explorations.
5. When reported, N_{60} (ASTM), refers to N_{60} (ASTM) = N field * Hammer Efficiency (%). See Geotechnical Data Report for the Sutter GOR Project for hammer efficiency data for individual borings.
6. USCS classification labels are not presented on the stick logs for soil lenses (thickness less than 1.5 feet).
7. This is a color figure. Black and white reproduction should not be relied upon as data will be lost.
8. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
9. Surficial geology was mapped at 1:24000 scale. (Source: SGDR for DWR ULE Project, URS,2010).
10. The information provided in these plans and stick-log plates has been compiled from a variety of sources. URS does not attest to the accuracy, completeness, or reliability of geotechnical exploration and other subsurface data by others that are included or referenced in these plates.
11. These plans and stick-log plates are for the use and benefit of DWR, and their consultants in connection with the execution of the Sutter Project. Use by any other party is at their own discretion and risk. These figures should not to be used as the sole basis for design, construction, remedial action, or major capital spending decisions.

Department of Water Resources
Division of Flood Management

URS

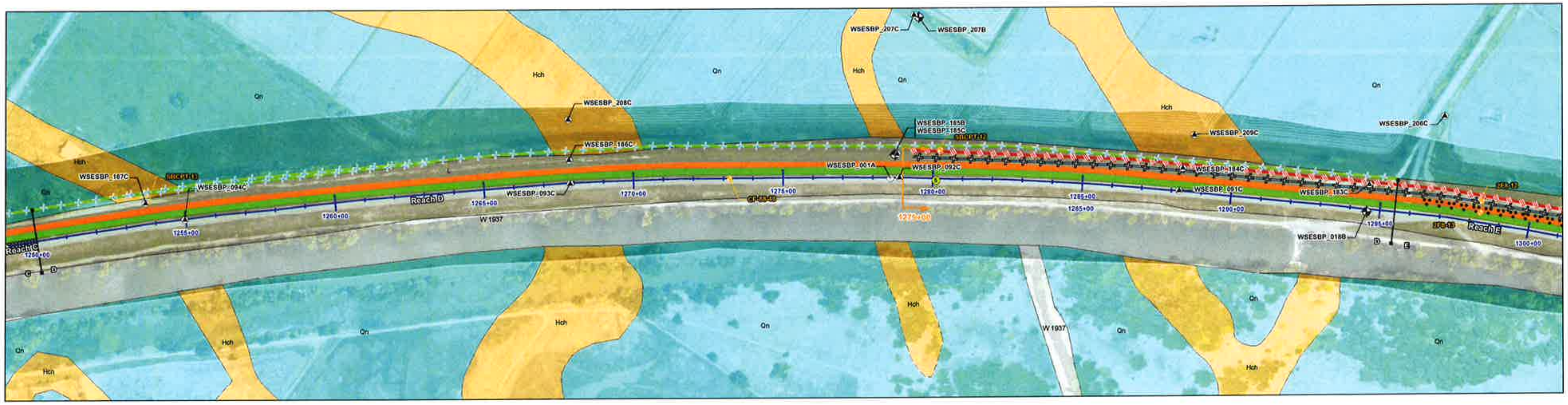
Sutter Plan and Profile

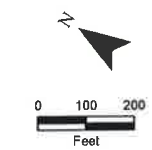
Sutter Bypass Left Bank Station 2150+00 to Station 2155+26

Non-Urban Levee Evaluations

Plate 13

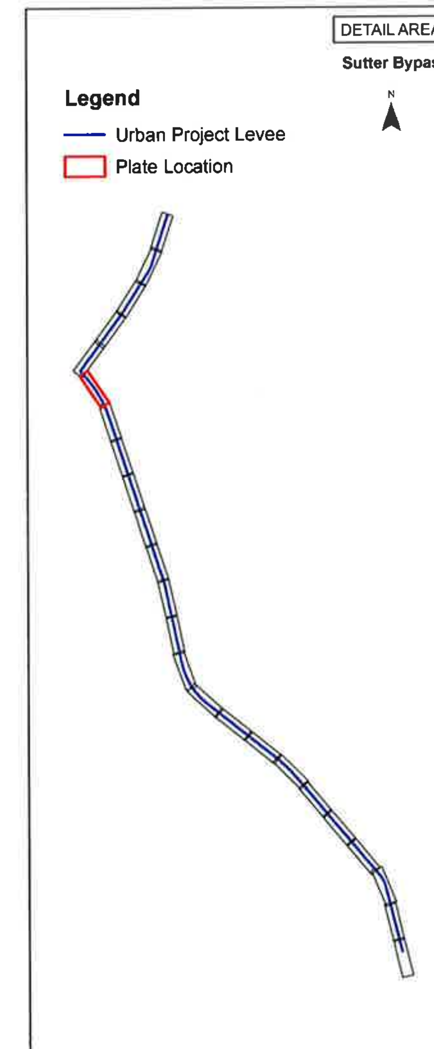
Geotechnical Overview Report





NOTES:

1. Elevations of levee crown, landside toe, and landside depression/ditch are approximate.
2. Stratigraphy between explorations may differ from that shown at exploration locations.
3. Only explorations through the levee crown are shown on the profile.
4. Historical borings on the profile are denoted by an asterisk (*) after the boring name. Historical boring locations and profiles are based on available information. Some historical explorations are shown on the plan but not in the profile if the log was not available or was close to a new exploration.
5. USCS classification labels are not presented on the profiles for soil lenses (thickness less than 1.5 ft).
6. This is a color figure. Black and white reproductions should not be relied upon as data will be lost.
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
8. Surficial geology was mapped at 1:20,000



Department of Water Resources
Division of Flood Management

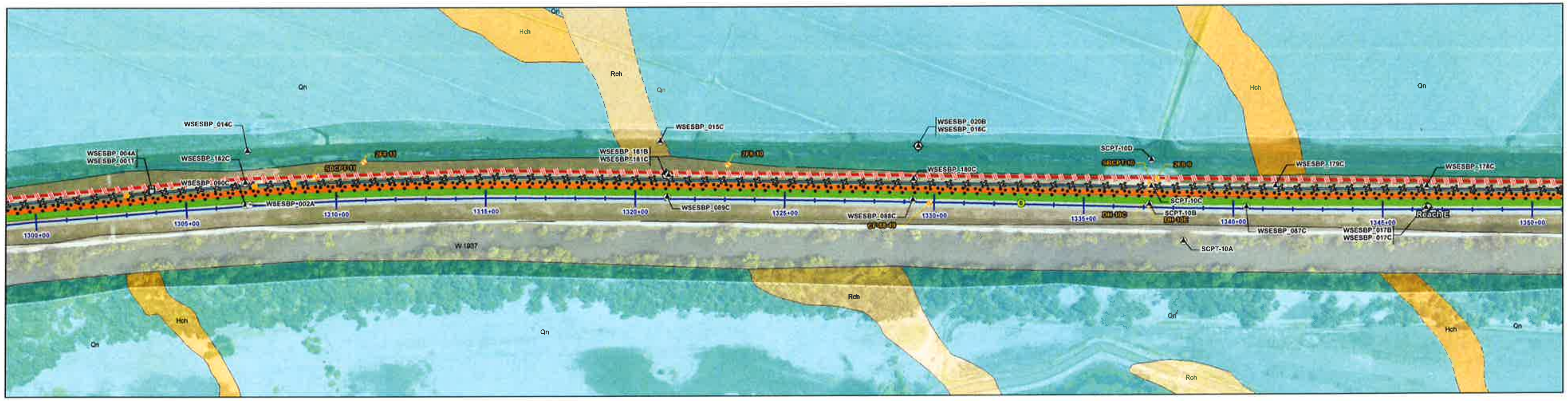
URS

Sutter Bypass-Wadsworth Canal Plan and Profile
Station 1250+00 to Station 1300+00
Sutter Bypass

URBAN LEVEE EVALUATIONS

Plate 8

Geotechnical Evaluation Report



N

0 100 200
Feet

NOTES:

1. Elevations of levee crown, landside toe, and landside depression/ditch are approximate.
2. Stratigraphy between explorations may differ from that shown at exploration locations.
3. Only explorations through the levee crown are shown on the profile.
4. Historical borings on the profile are denoted by an asterisk (*) after the boring name. Historical boring locations and profiles are based on available information. Some historical explorations are shown on the plan but not in the profile if the log was not available or was close to a new exploration.
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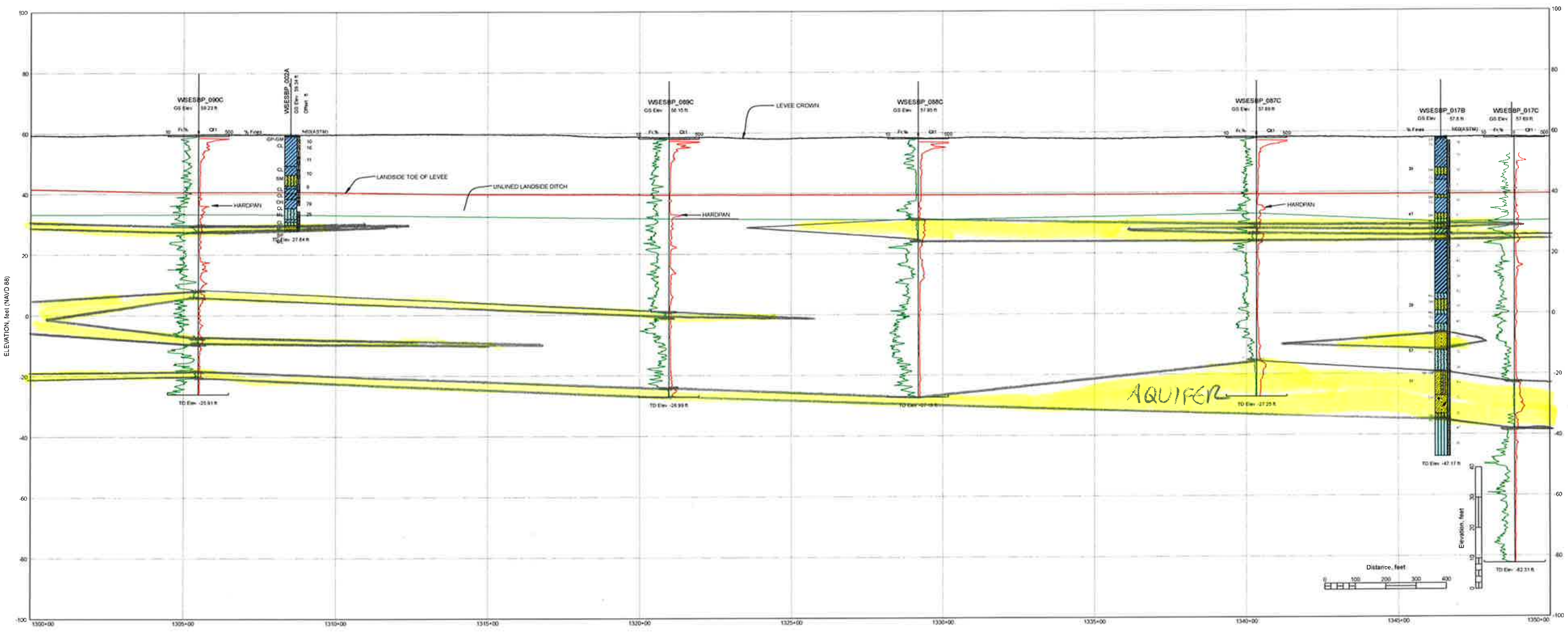
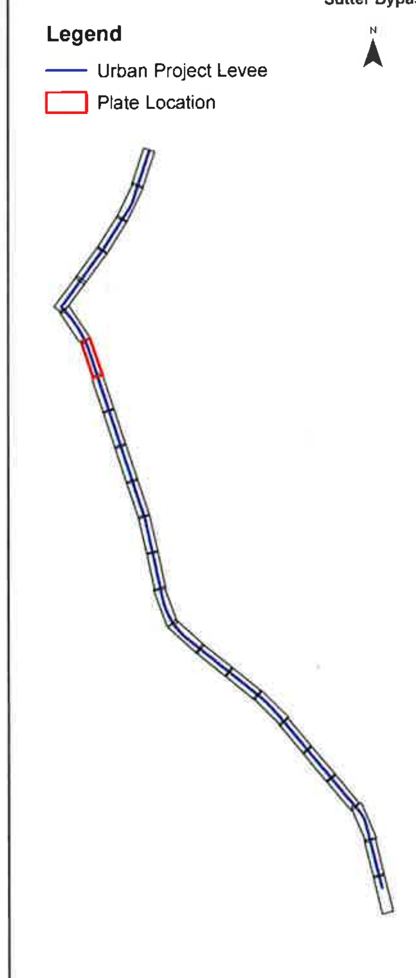
6. This is a color figure. Black and white reproductions should not be relied upon as data will be lost.
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
8. Surficial geology was mapped at 1:20,000



DETAIL AREA

Sutter Bypass



Department of Water Resources
Division of Flood Management

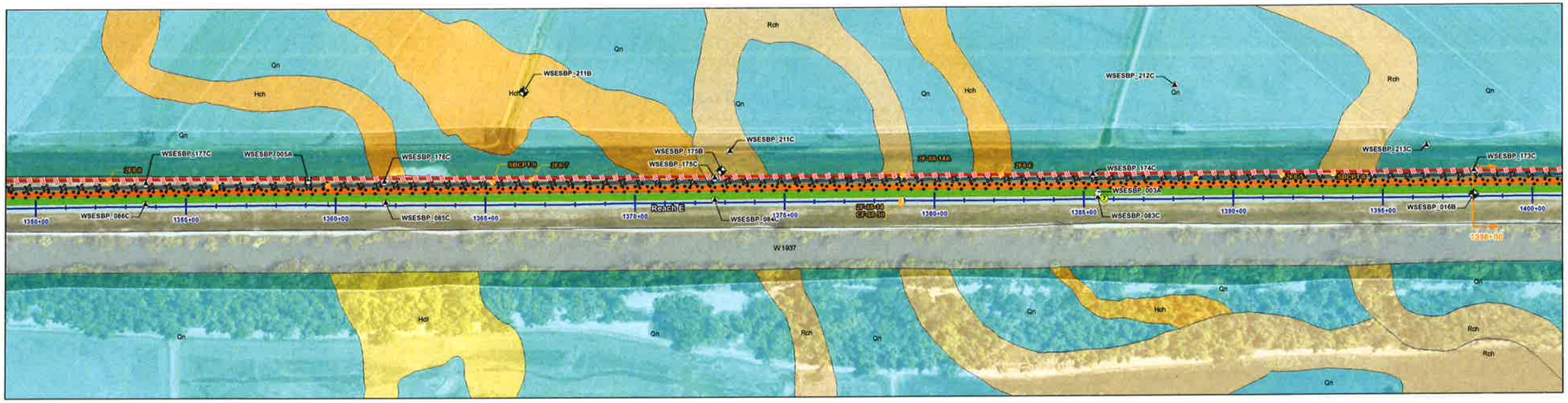
URS

Sutter Bypass-Wadsworth Canal Plan and Profile
Station 1300+00 to Station 1350+00
Sutter Bypass

URBAN LEVEE EVALUATIONS

Plate
9

Geotechnical Evaluation Report



0 100 200
Feet

NOTES:

1. Elevations of levee crown, landside toe, and landside depression/ditch are approximate.
2. Stratigraphy between explorations may differ from that shown at exploration locations.
3. Only explorations through the levee crown are shown on the profile.
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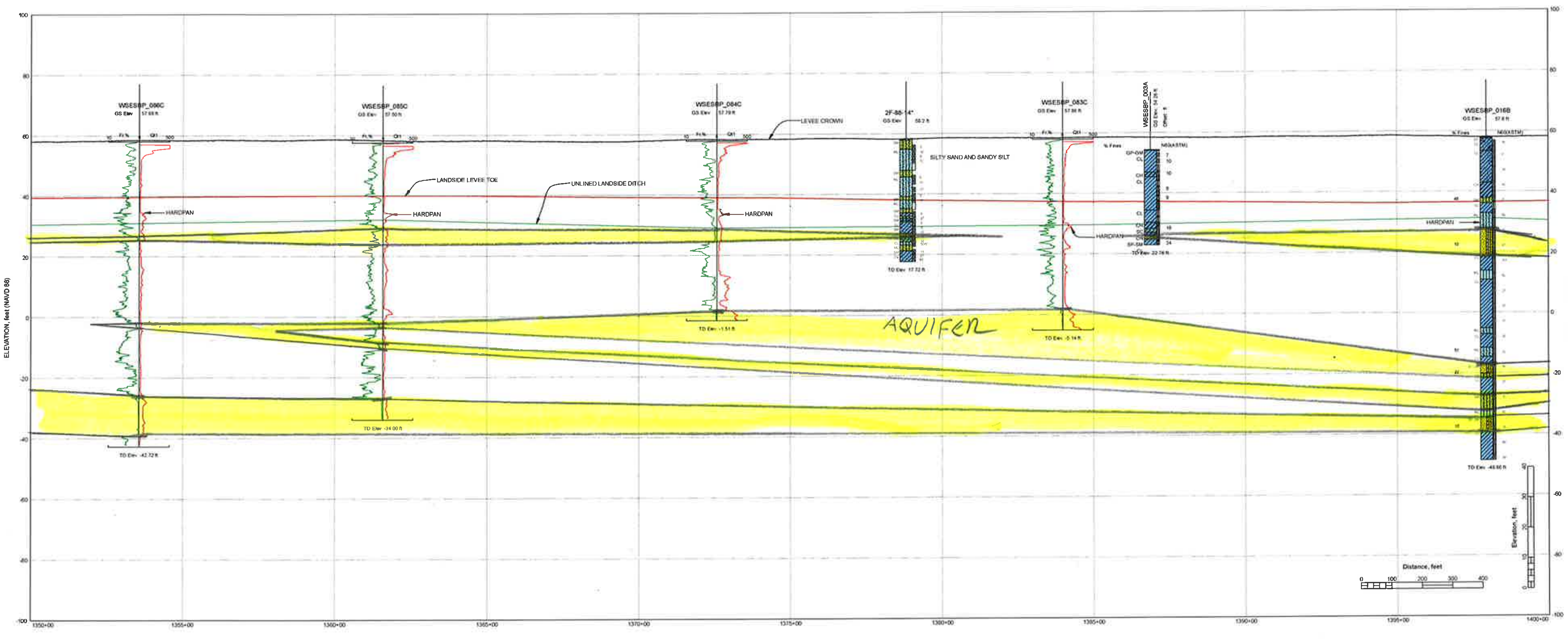
5. USCS classification labels are not presented on the profiles for soil lenses (thickness less than 1.5 ft).
6. This is a color figure. Black and white reproductions should not be relied upon as data will be lost.
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
8. Surficial geology was mapped at 1:20,000



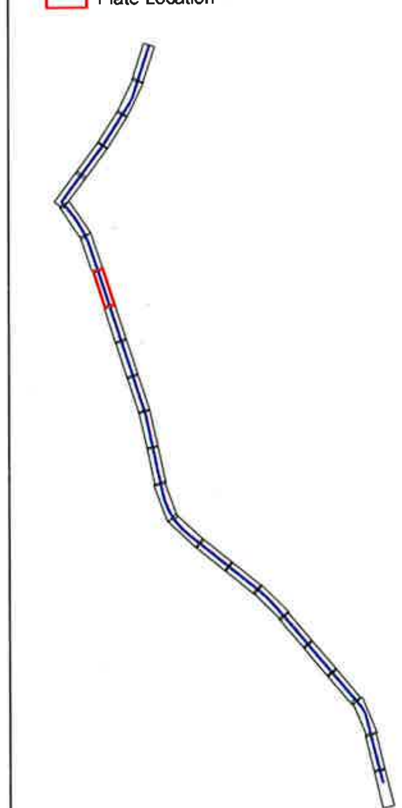
DETAIL AREA

Sutter Bypass

Legend

Urban Project Levee

Plate Location



Department of Water Resources
Division of Flood Management

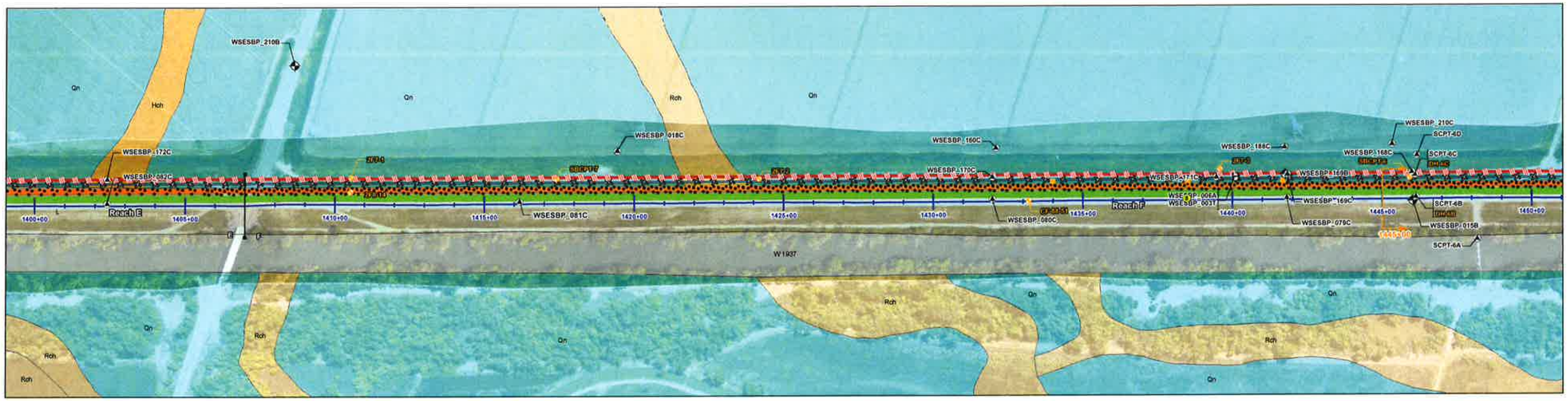
URS

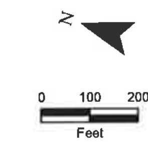
Sutter Bypass-Wadsworth Canal Plan and Profile
Station 1350+00 to Station 1400+00
Sutter Bypass

URBAN LEVEE EVALUATIONS

Plate 10

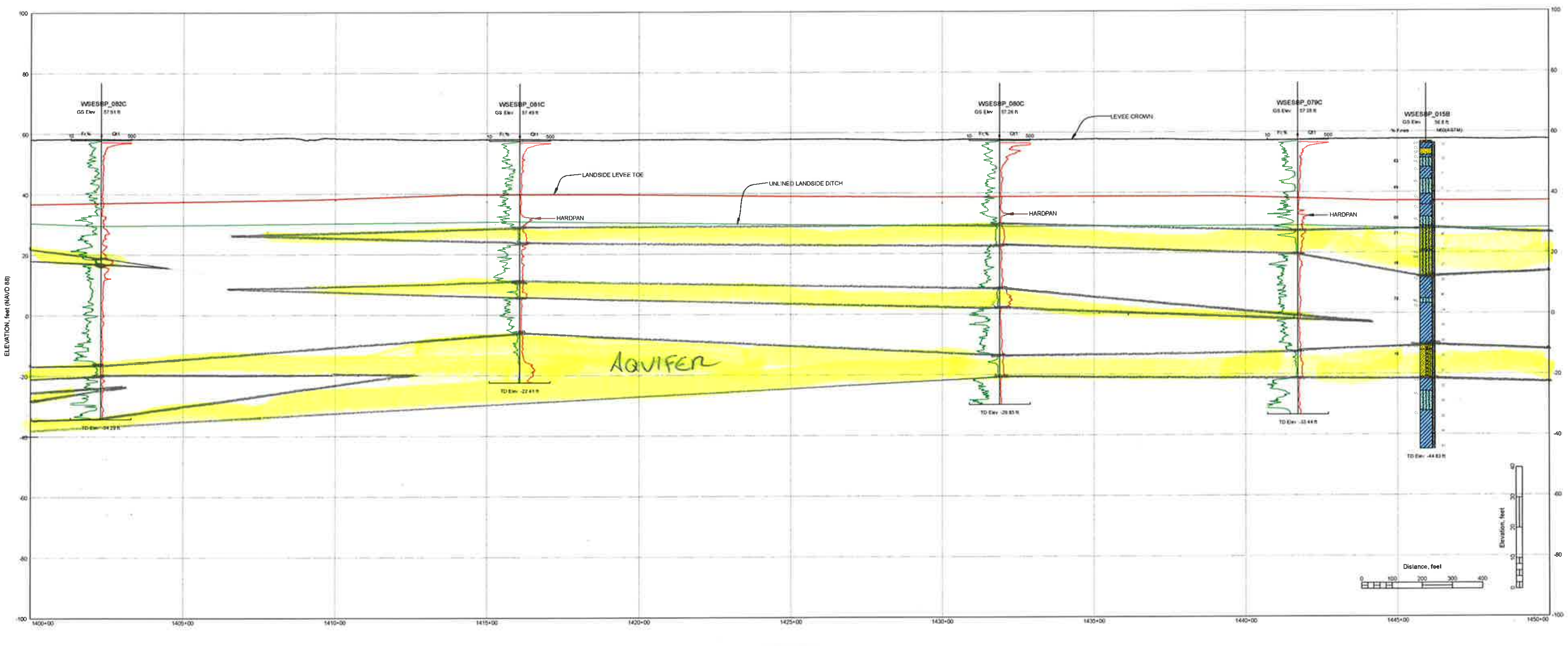
Geotechnical Evaluation Report





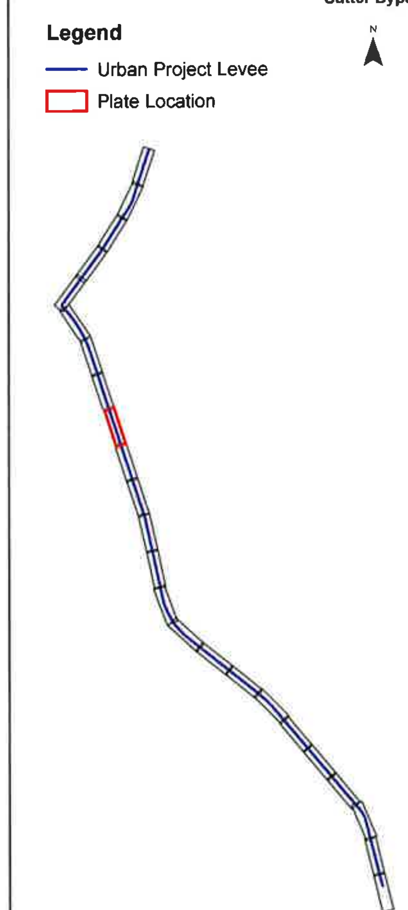
NOTES:

1. Elevations of levee crown, landside toe, and landside depression/ditch are approximate.
2. Stratigraphy between explorations may differ from that shown at exploration locations.
3. Only explorations through the levee crown are shown on the profile.
4. Historical borings on the profile are denoted by an asterisk (*) after the boring name. Historical boring locations and profiles are based on available information. Some historical explorations are shown on the plan but not in the profile if the log was not available or was close to a new exploration.
5. USCS classification labels are not presented on the profiles for soil lenses (thickness less than 1.5 ft).
6. This is a color figure. Black and white reproductions should not be relied upon as data will be lost.
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
8. Surficial geology was mapped at 1:20,000



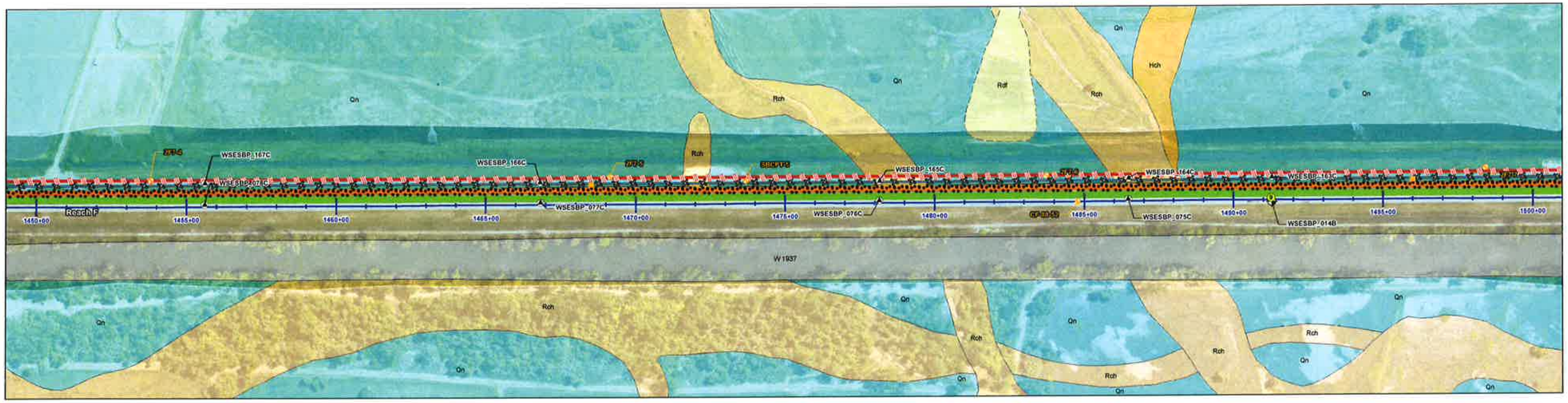
DETAIL AREA

Sutter Bypass



Department of Water Resources Division of Flood Management	URS	**Sutter Bypass-Wadsworth Canal Plan and Profile** **Station 1400+00 to Station 1450+00** Sutter Bypass URBAN LEVEE EVALUATIONS	Plate 11

Geotechnical Evaluation Report



N

0 100 200
Feet

NOTES:

1. Elevations of levee crown, landside toe, and landside depression/ditch are approximate.
2. Stratigraphy between explorations may differ from that shown at exploration locations.
3. Only explorations through the levee crown are shown on the profile.
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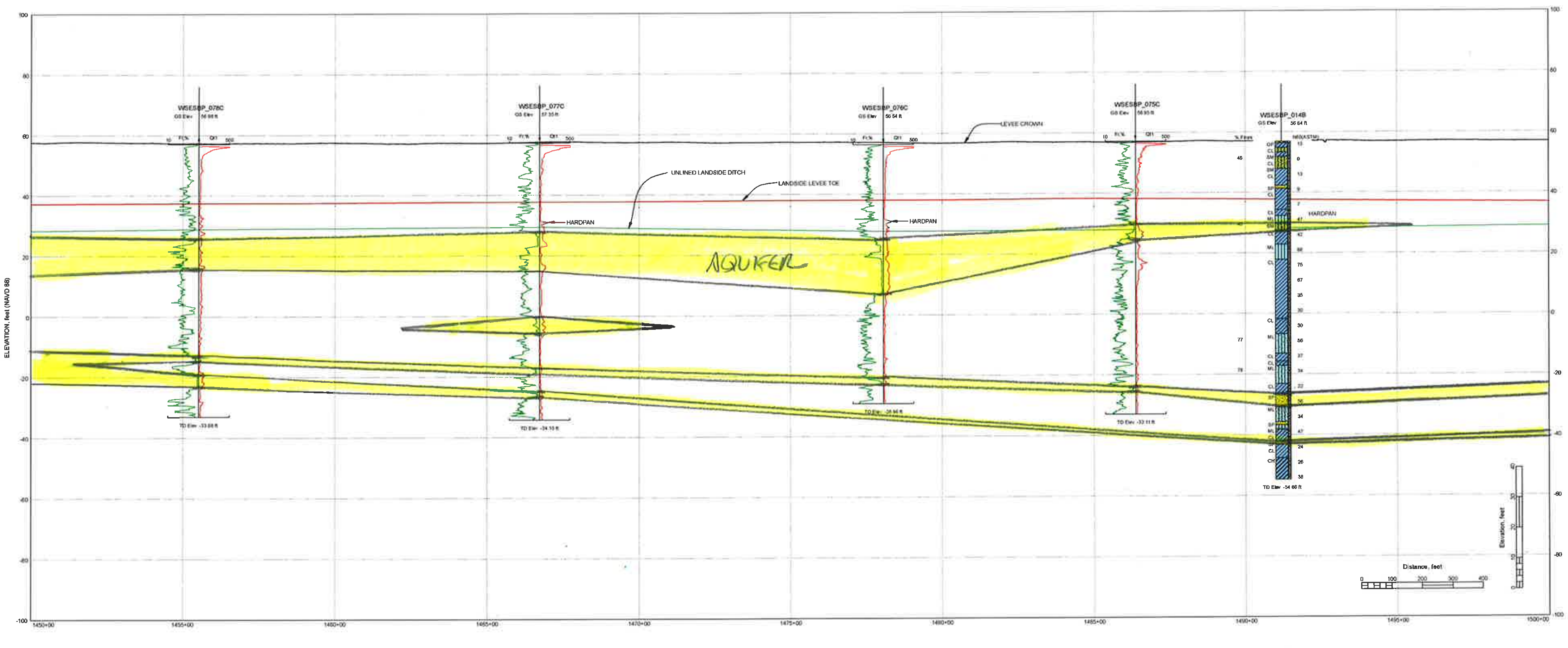
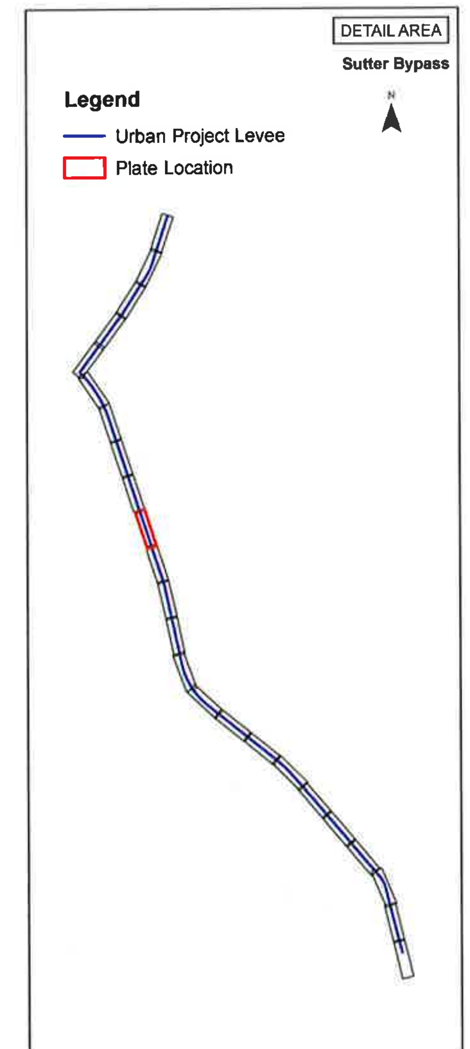
6. This is a color figure. Black and white reproductions should not be relied upon as data will be lost.
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
8. Surficial geology was mapped at 1:20,000





Department of Water Resources
Division of Flood Management

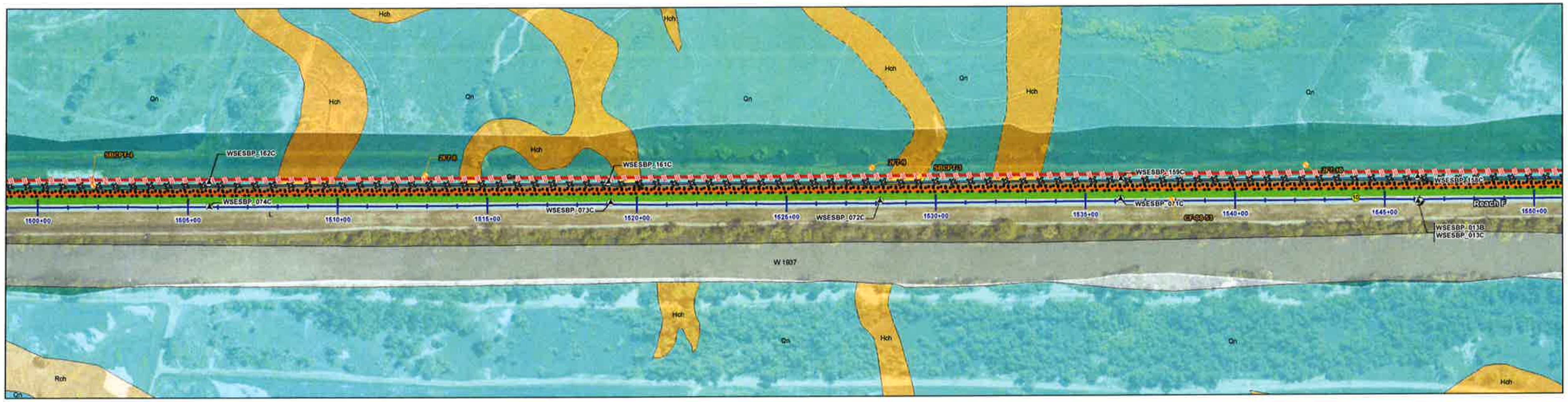
URS

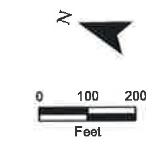
Sutter Bypass-Wadsworth Canal Plan and Profile
Station 1450+00 to Station 1500+00
Sutter Bypass

URBAN LEVEE EVALUATIONS

Plate 12

Geotechnical Evaluation Report





NOTES:

1. Elevations of levee crown, landside toe, and landside depression/ditch are approximate.
2. Stratigraphy between explorations may differ from that shown at exploration locations.
3. Only explorations through the levee crown are shown on the profile.
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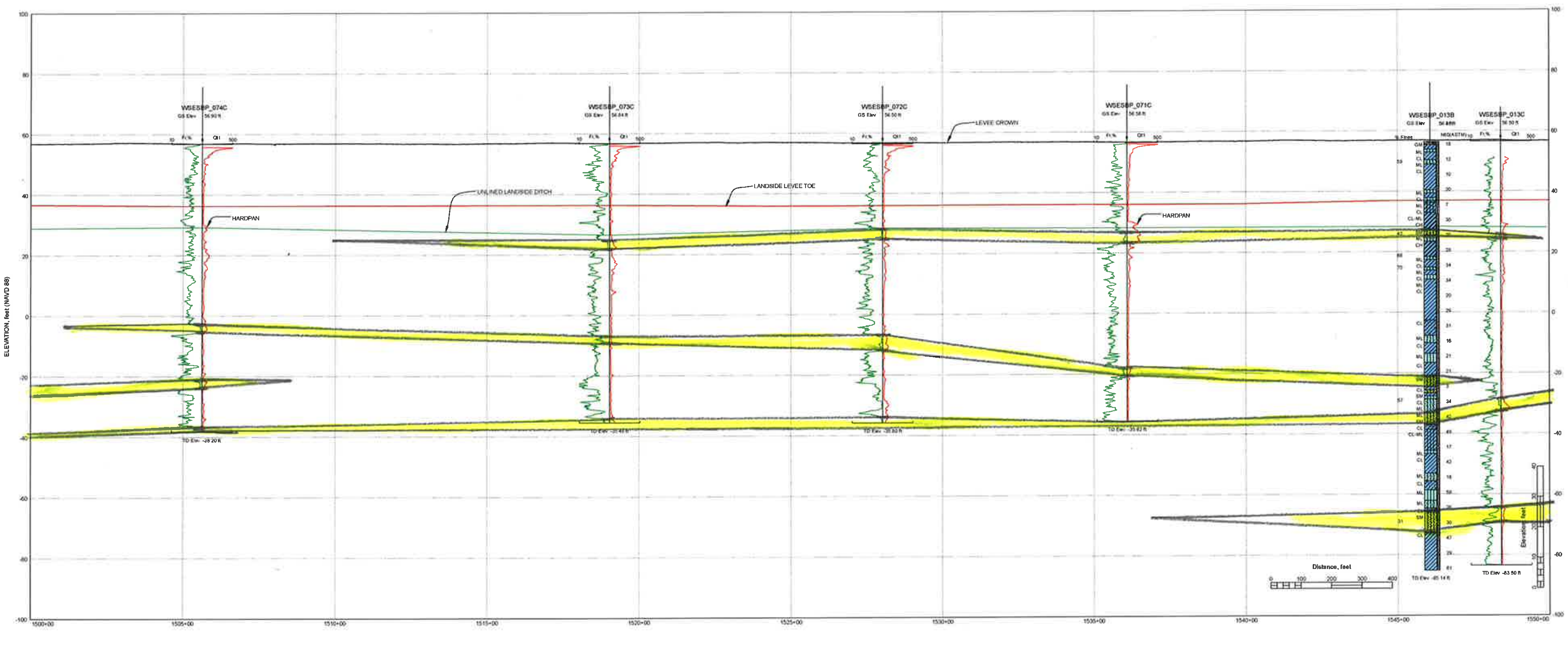
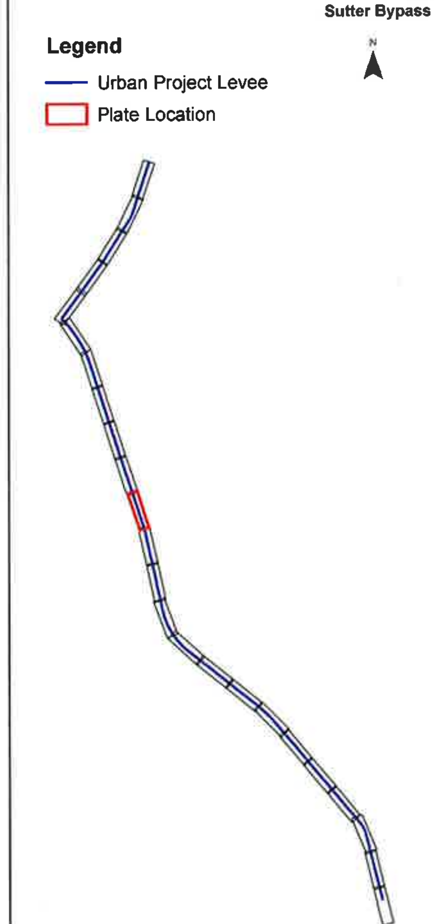
5. USCS classification labels are not presented on the profiles for soil lenses (thickness less than 1.5 ft).
6. This is a color figure. Black and white reproductions should not be relied upon as data will be lost.
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
8. Surficial geology was mapped at 1:20,000



DETAIL AREA

Sutter Bypass



Department of Water Resources
Division of Flood Management

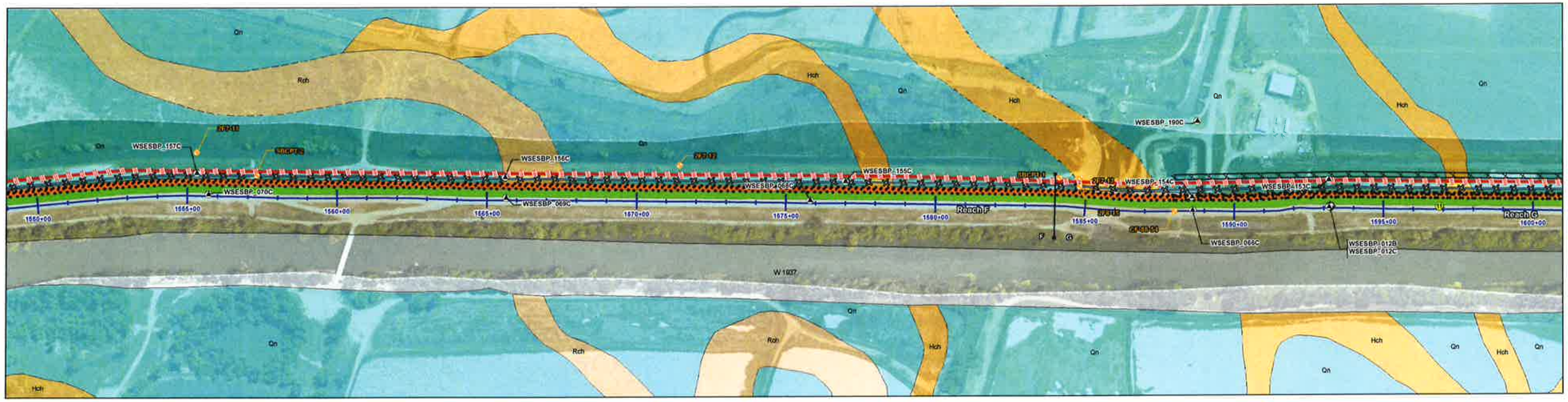
URS

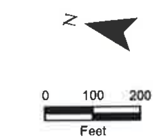
Sutter Bypass-Wadsworth Canal Plan and Profile
Station 1500+00 to Station 1550+00
Sutter Bypass

URBAN LEVEE EVALUATIONS

Plate
13

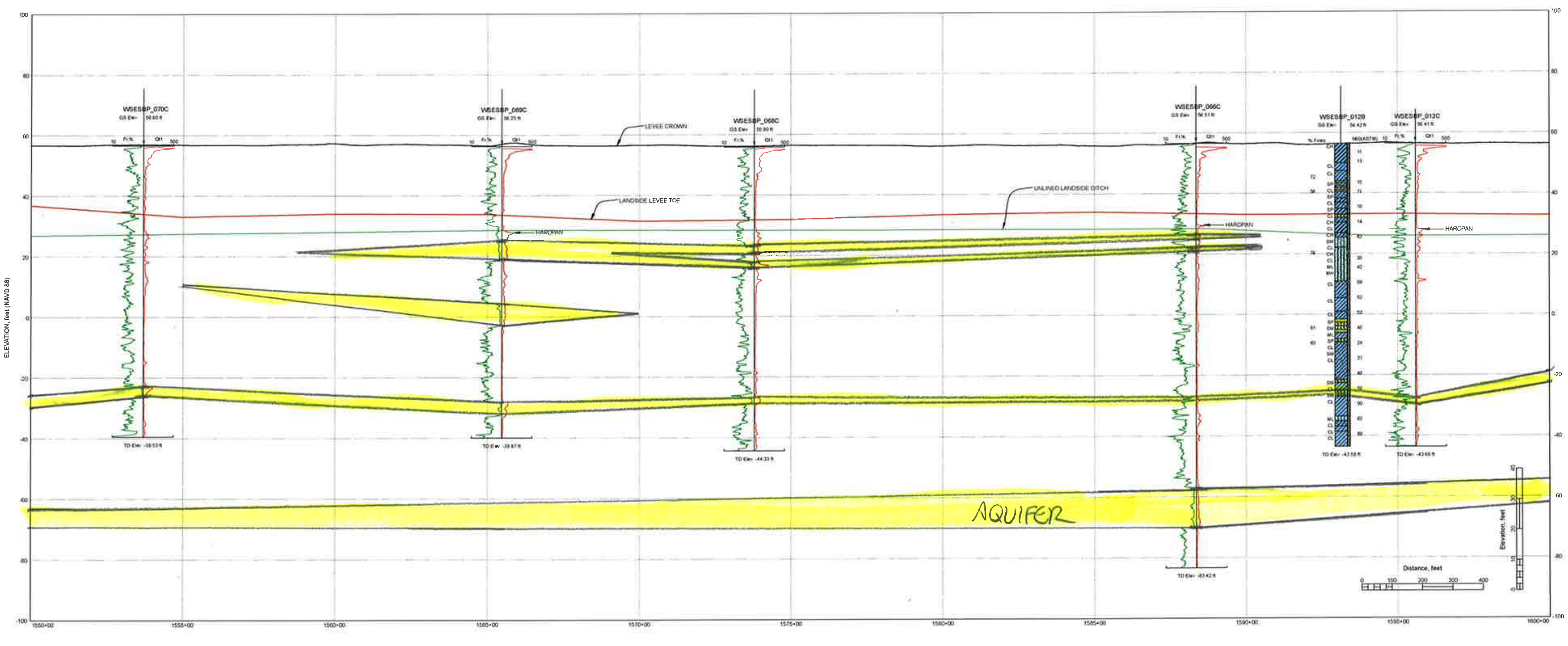
Geotechnical Evaluation Report





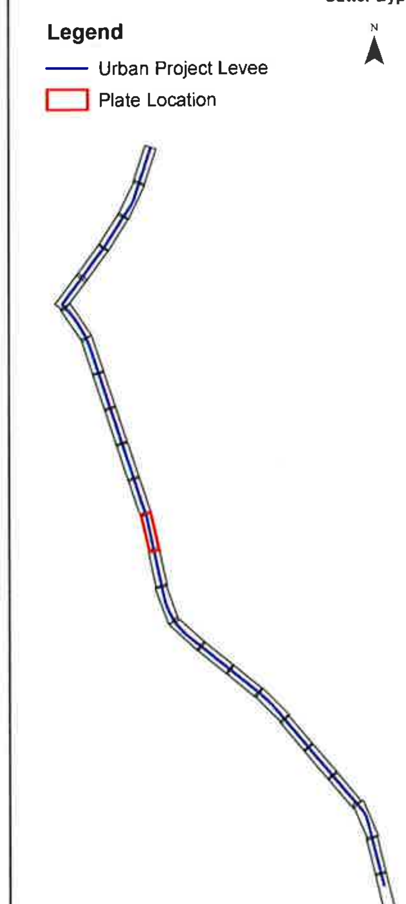
NOTES:

1. Elevations of levee crown, landside toe, and landside depression/ditch are approximate.
2. Stratigraphy between explorations may differ from that shown at exploration locations.
3. Only explorations through the levee crown are shown on the profile.
4. Historical borings on the profile are denoted by an asterisk (*) after the boring name. Historical boring locations and profiles are based on available information. Some historical explorations are shown on the plan but not in the profile if the log was not available or was close to a new exploration.
5. USCS classification labels are not presented on the profiles for soil lenses (thickness less than 1.5 ft).
6. This is a color figure. Black and white reproductions should not be relied upon as data will be lost.
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
8. Surficial geology was mapped at 1:20,000



DETAIL AREA

Sutter Bypass



Department of Water Resources
Division of Flood Management

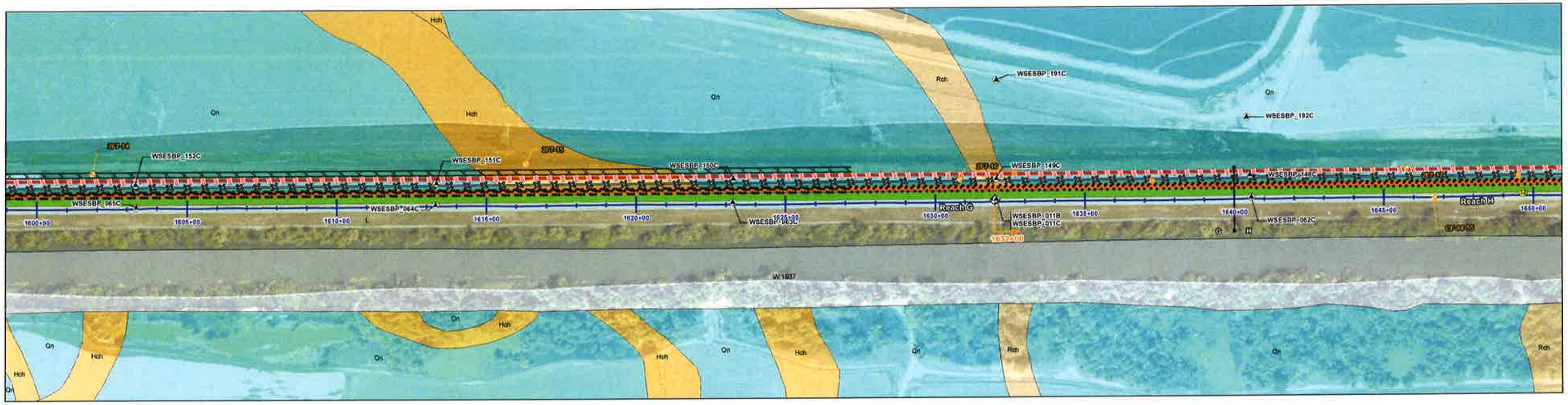
URS

Sutter Bypass-Wadsworth Canal Plan and Profile
Station 1550+00 to Station 1600+00
Sutter Bypass

URBAN LEVEE EVALUATIONS

Plate 14

Geotechnical Evaluation Report

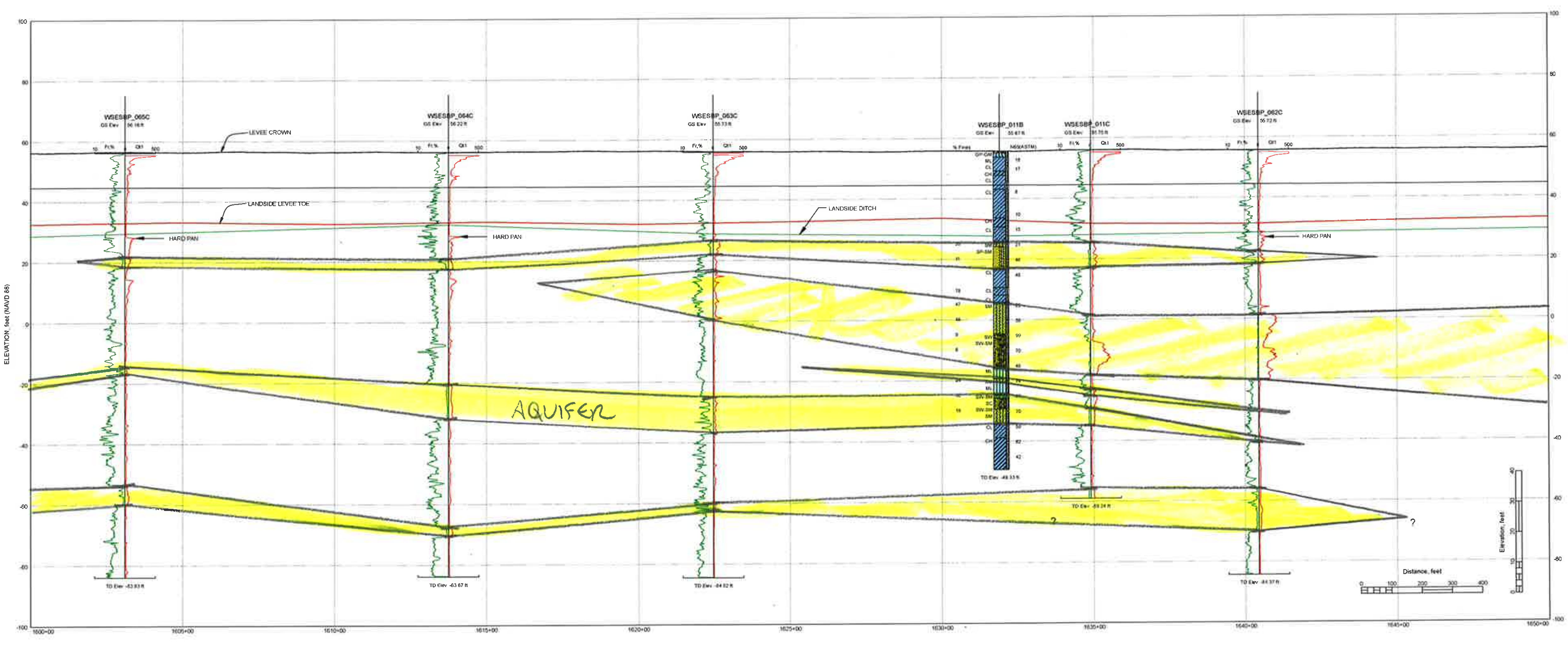


N

0 100 200
Feet

NOTES:

1. Elevations of levee crown, landside toe, and landside depression/ditch are approximate.
2. Stratigraphy between explorations may differ from that shown at exploration locations.
3. Only explorations through the levee crown are shown on the profile.
4. Historical borings on the profile are denoted by an asterisk (*) after the boring name. Historical boring locations and profiles are based on available information. Some historical explorations are shown on the plan but not in the profile if the log was not available or was close to a new exploration.
5. USCS classification labels are not presented on the profiles for soil lenses (thickness less than 1.5 ft).
6. This is a color figure. Black and white reproductions should not be relied upon as data will be lost.
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
8. Surficial geology was mapped at 1:20,000



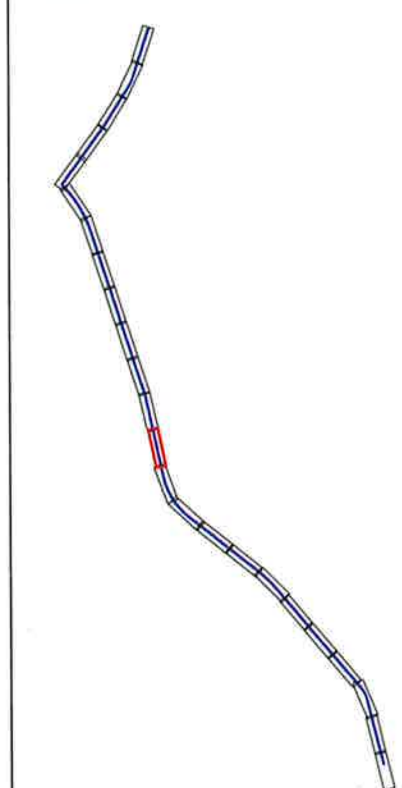
DETAIL AREA

Sutter Bypass

Legend

Urban Project Levee

Plate Location



Department of Water Resources
Division of Flood Management

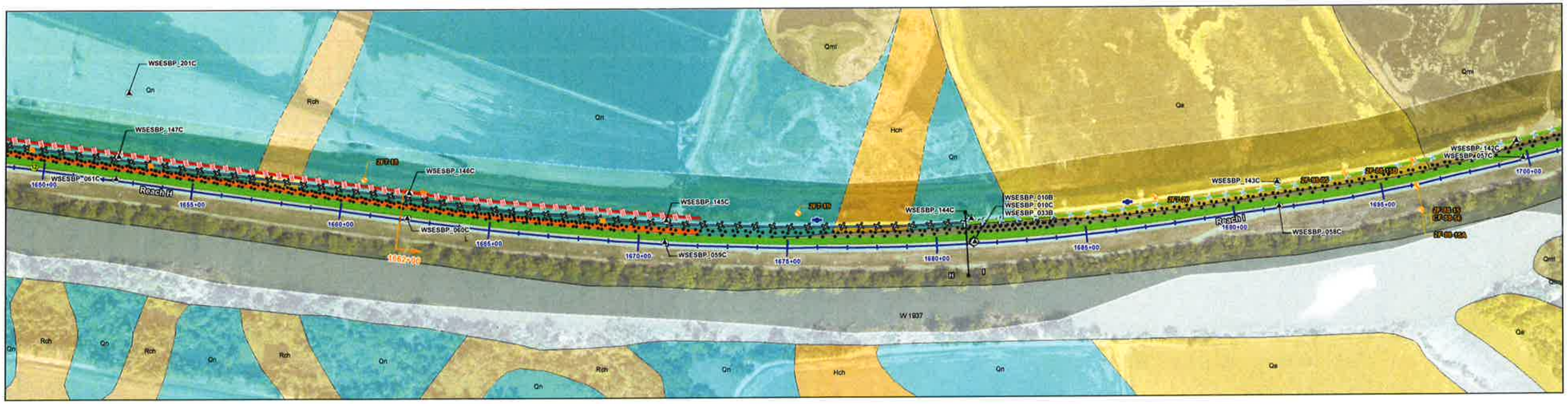
URS

Sutter Bypass-Wadsworth Canal Plan and Profile
Station 1600+00 to Station 1650+00
Sutter Bypass

URBAN LEVEE EVALUATIONS

Plate
15

Geotechnical Evaluation Report



NOTES:

1. Elevations of levee crown, landside toe, and landside depression/ditch are approximate.
2. Stratigraphy between explorations may differ from that shown at exploration locations.
3. Only explorations through the levee crown are shown on the profile.
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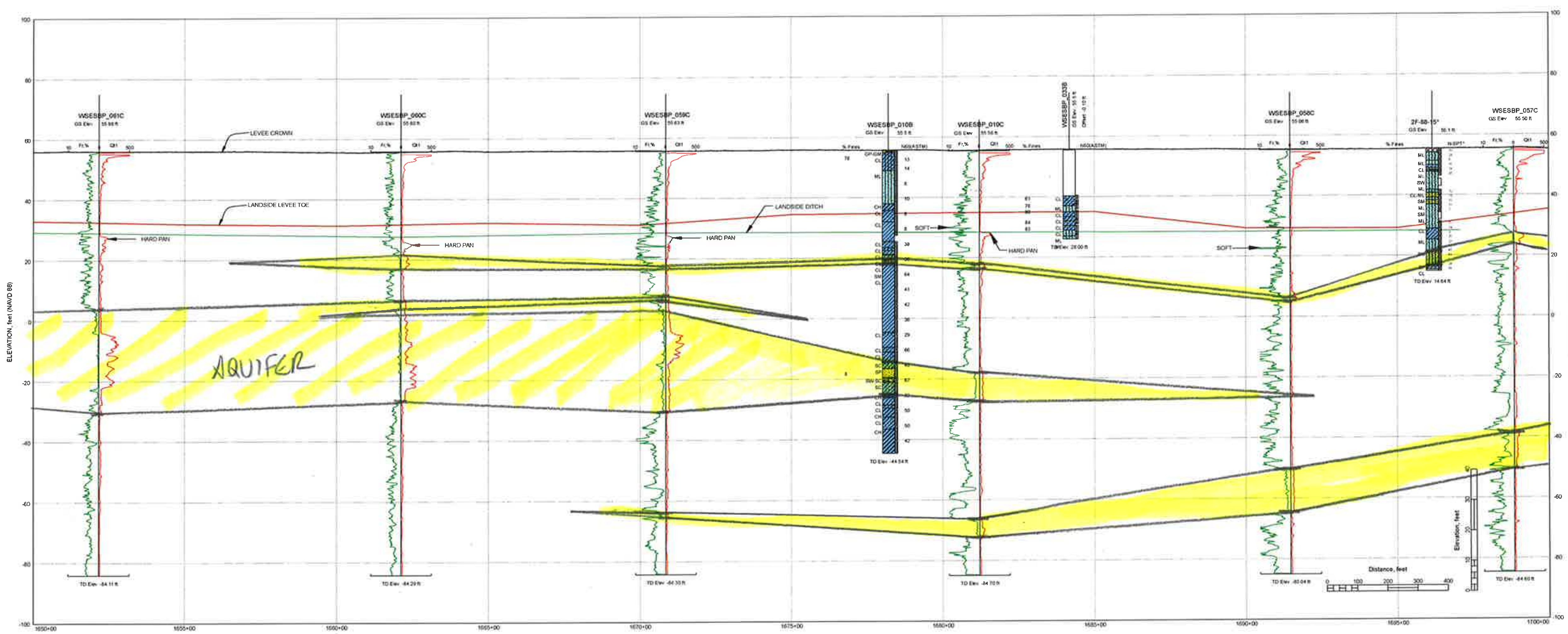
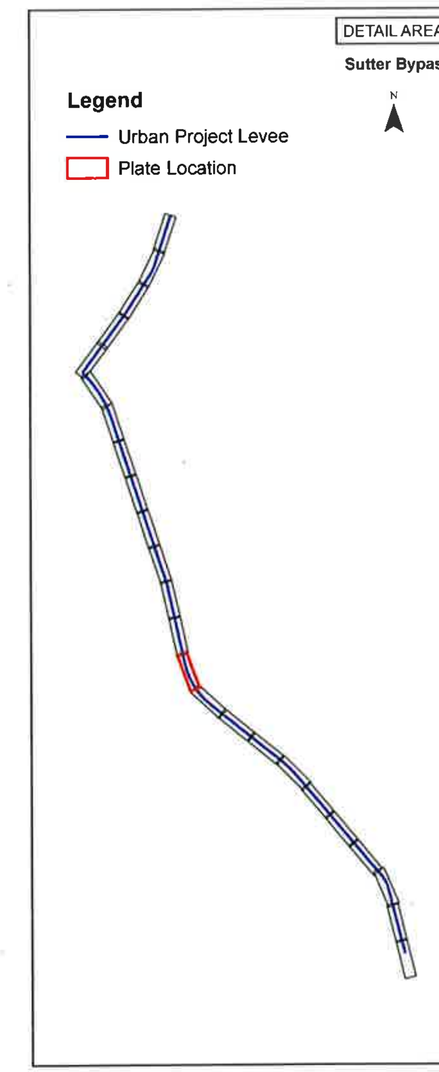
6. This is a color figure. Black and white reproductions should not be relied upon as data will be lost.
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
8. Surficial geology was mapped at 1:20,000



STATIONING, Feet



Department of Water Resources
Division of Flood Management

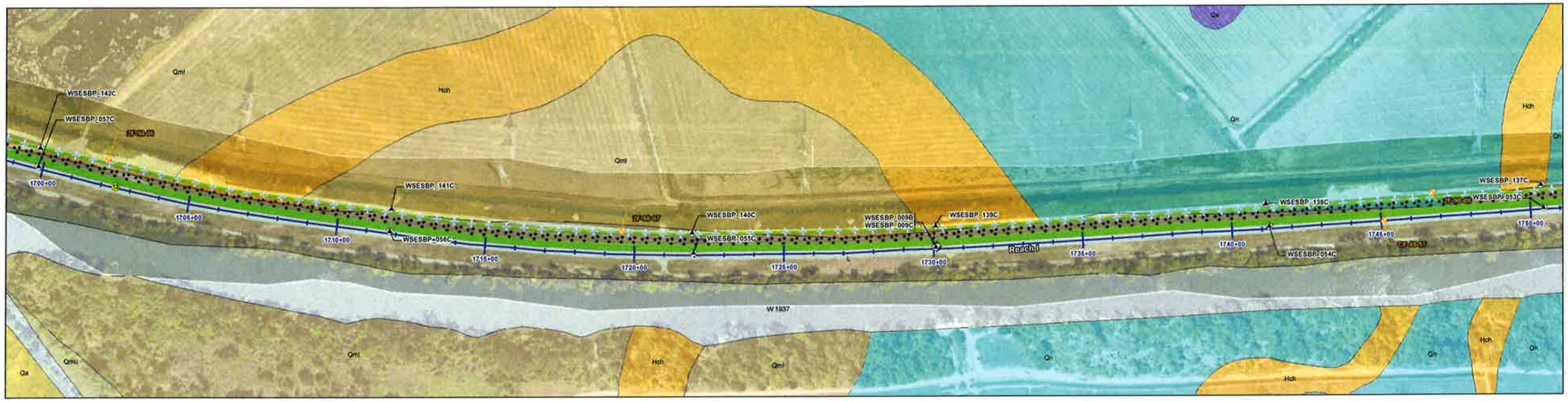
URS

Sutter Bypass-Wadsworth Canal Plan and Profile
Station 1650+00 to Station 1700+00
Sutter Bypass

URBAN LEVEE EVALUATIONS

Plate 16

Geotechnical Evaluation Report

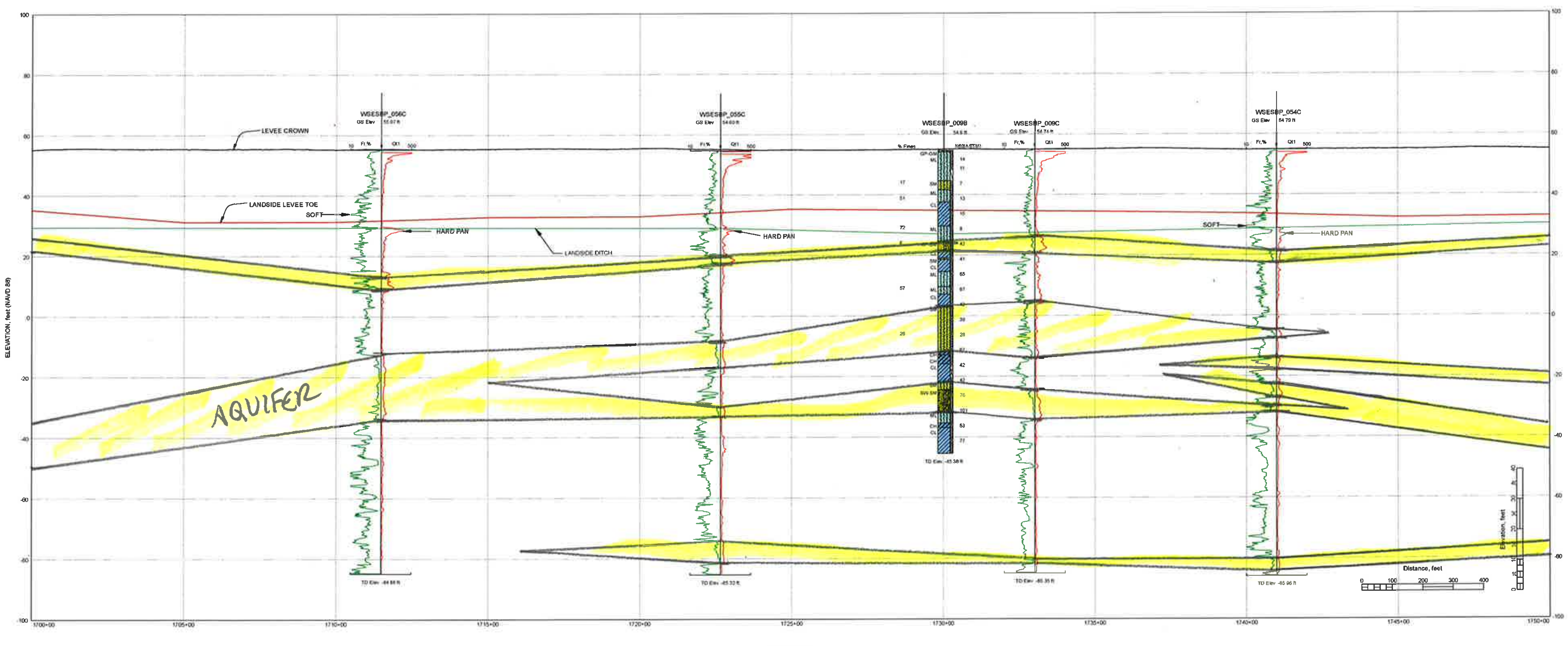


N

0 100 200
Feet

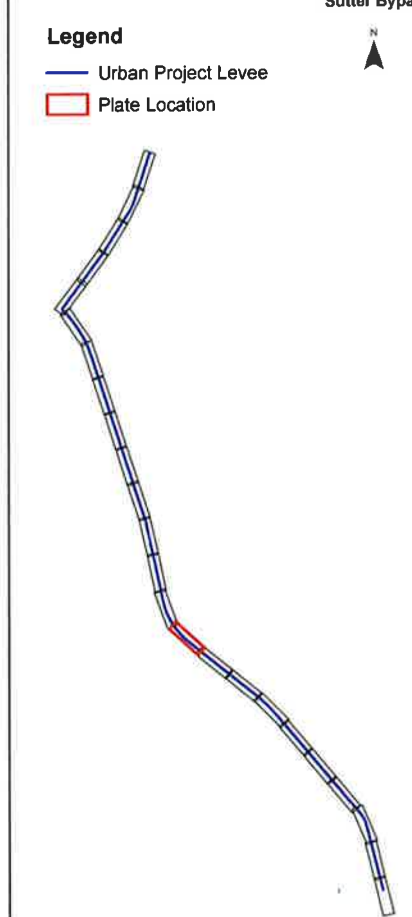
NOTES:

1. Elevations of levee crown, landside toe, and landside depression/ditch are approximate.
2. Stratigraphy between explorations may differ from that shown at exploration locations.
3. Only explorations through the levee crown are shown on the profile.
4. Historical borings on the profile are denoted by an asterisk (*) after the boring name. Historical boring locations and profiles are based on available information. Some historical explorations are shown on the plan but not in the profile if the log was not available or was close to a new exploration.
5. USCS classification labels are not presented on the profiles for soil lenses (thickness less than 1.5 ft).
6. This is a color figure. Black and white reproductions should not be relied upon as data will be lost.
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
8. Surficial geology was mapped at 1:20,000



DETAIL AREA

Sutter Bypass



Department of Water Resources
Division of Flood Management

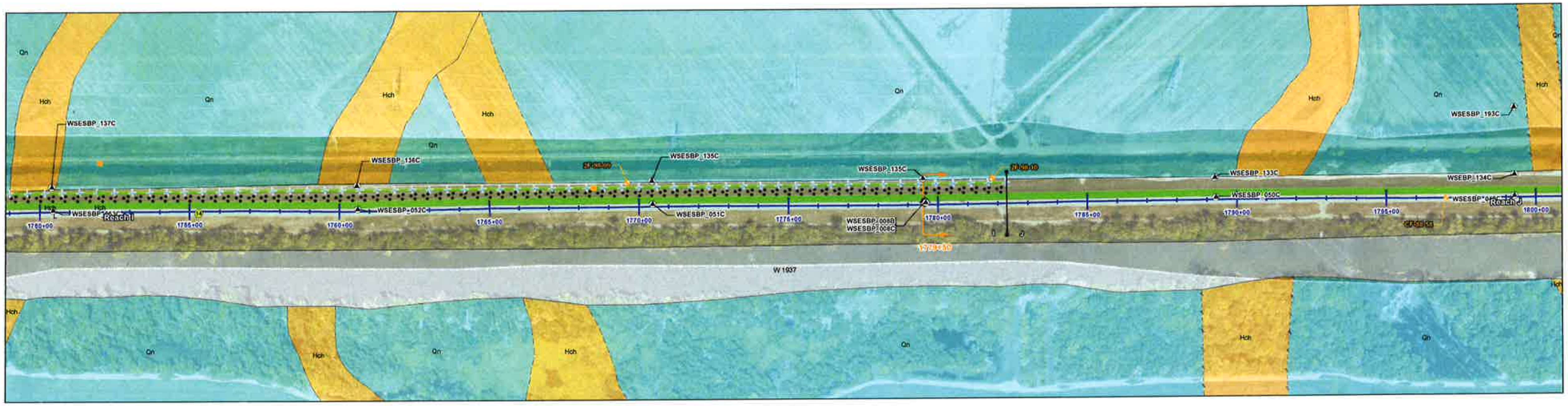
URS

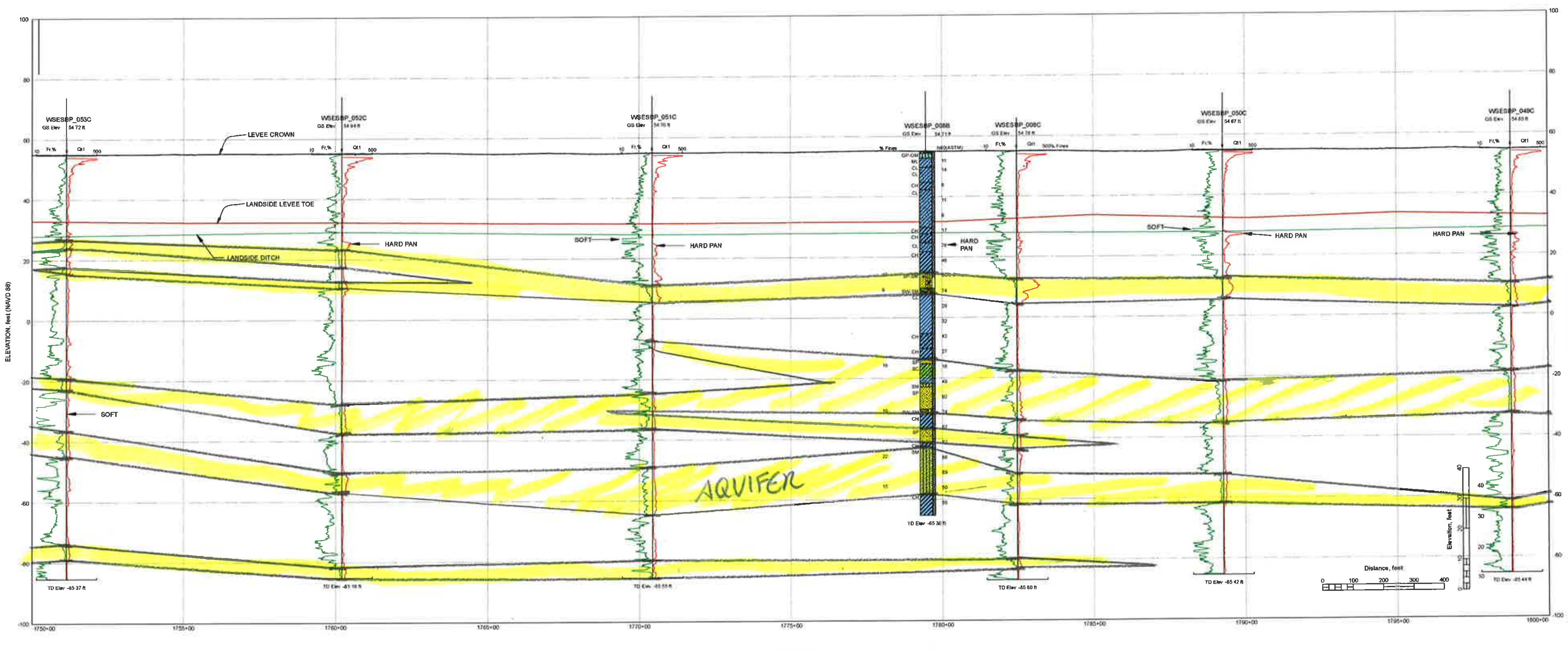
Sutter Bypass-Wadsworth Canal Plan and Profile
Station 1700+00 to Station 1750+00
Sutter Bypass

URBAN LEVEE EVALUATIONS

Plate
17

Geotechnical Evaluation Report



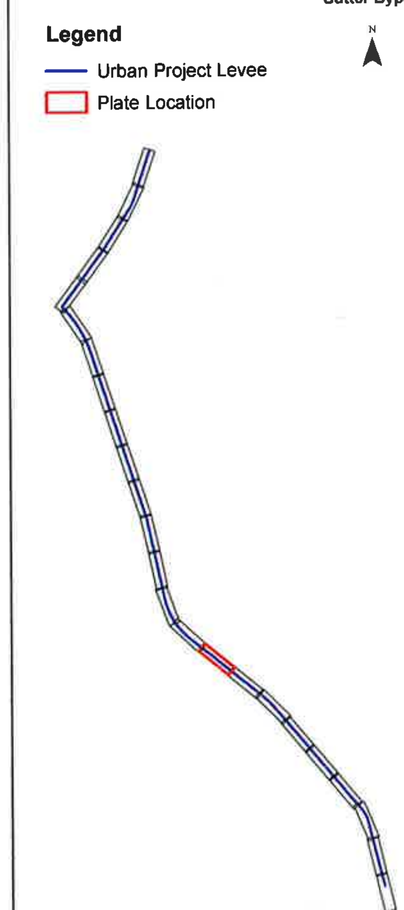


NOTES:

1. Elevations of levee crown, landside toe, and landside depression/ditch are approximate.
2. Stratigraphy between explorations may differ from that shown at exploration locations.
3. Only explorations through the levee crown are shown on the profile.
4. Historical borings on the profile are denoted by an asterisk (*) after the boring name. Historical boring locations and profiles are based on available information. Some historical explorations are shown on the plan but not in the profile if the log was not available or was close to a new exploration.
5. USCS classification labels are not presented on the profiles for soil lenses (thickness less than 1.5 ft).
6. This is a color figure. Black and white reproductions should not be relied upon as data will be lost.
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
8. Surficial geology was mapped at 1:20,000

DETAIL AREA

Sutter Bypass



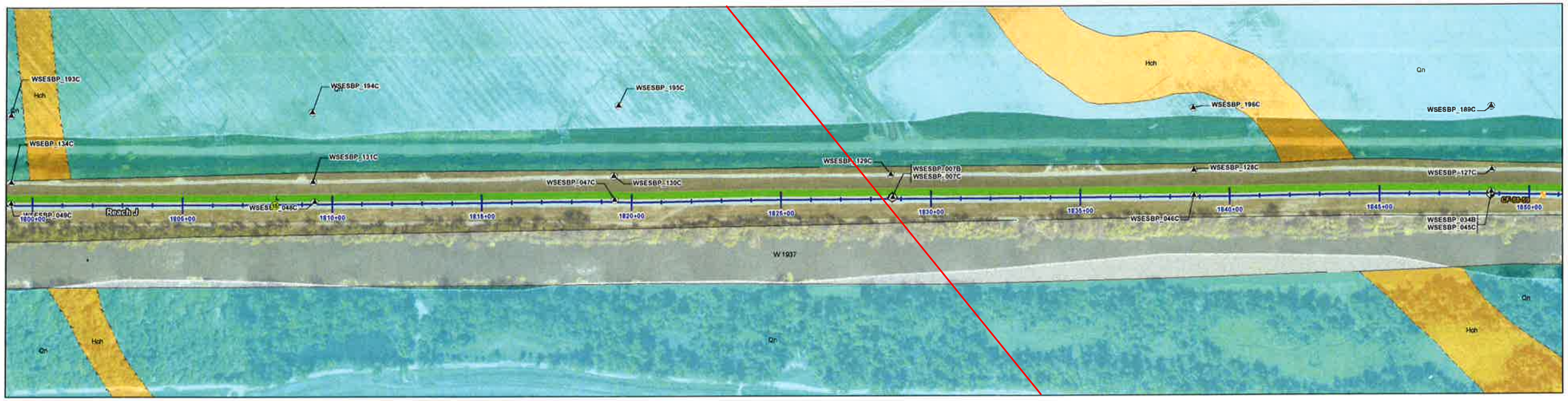
Department of Water Resources
Division of Flood Management

URS

Sutter Bypass-Wadsworth Canal Plan and Profile
Station 1750+00 to Station 1800+00
Sutter Bypass

URBAN LEVEE EVALUATIONS

Plate 18



NOTES:

1. Elevations of levee crown, landside toe, and landside depression/ditch are approximate.
2. Stratigraphy between explorations may differ from that shown at exploration locations.
3. Only explorations through the levee crown are shown on the profile.
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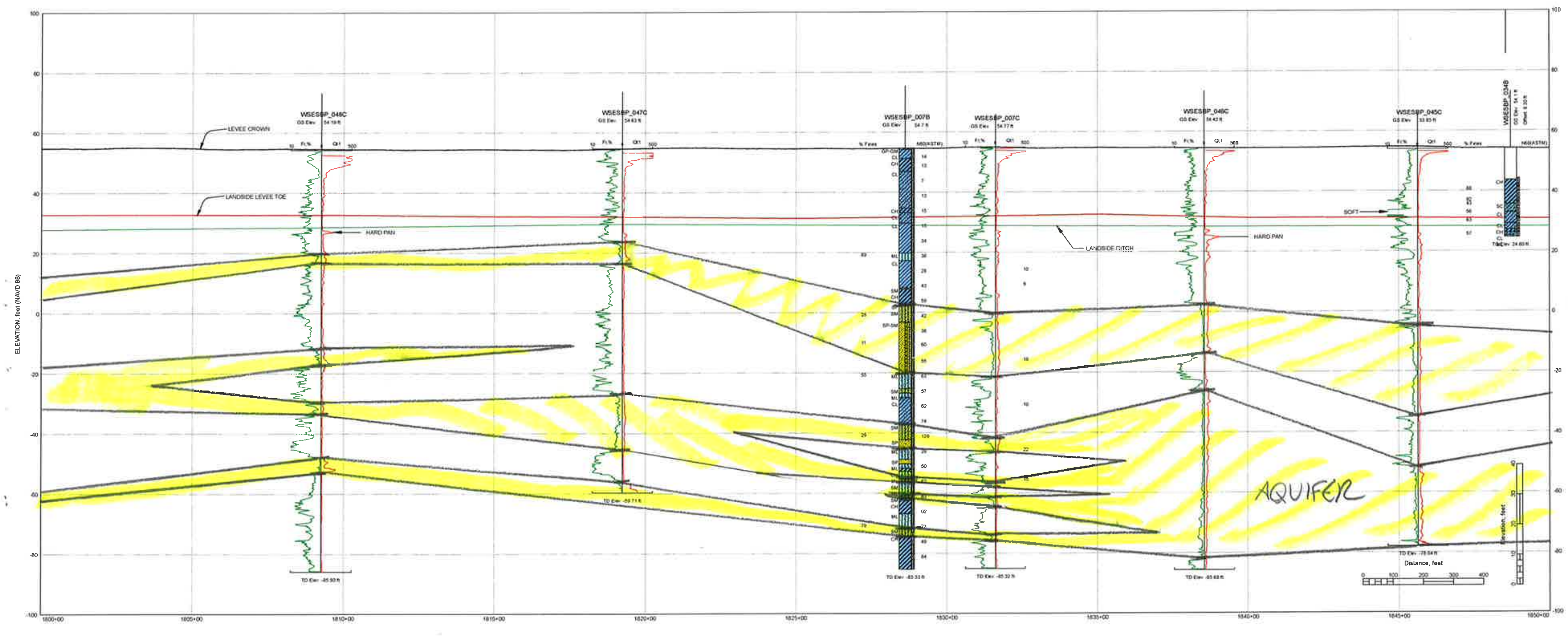
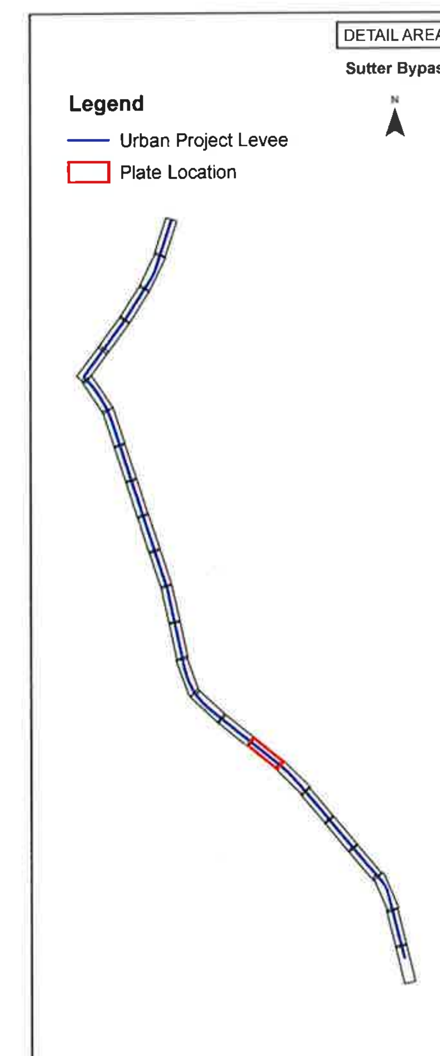
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
8. Surficial geology was mapped at 1:20,000





Department of Water Resources
Division of Flood Management

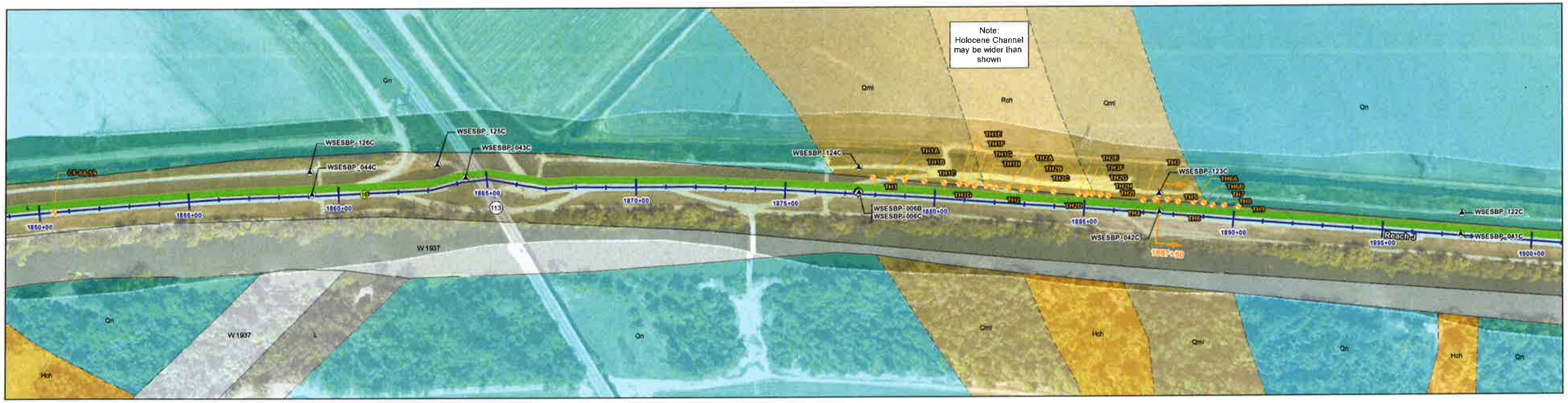
URS

Sutter Bypass-Wadsworth Canal Plan and Profile
Station 1800+00 to Station 1850+00
Sutter Bypass

URBAN LEVEE EVALUATIONS

Plate 19

Geotechnical Evaluation Report



0 100 200
Feet

NOTES:

1. Elevations of levee crown, landside toe, and landside depression/ditch are approximate.
2. Stratigraphy between explorations may differ from that shown at exploration locations.
3. Only explorations through the levee crown are shown on the profile.
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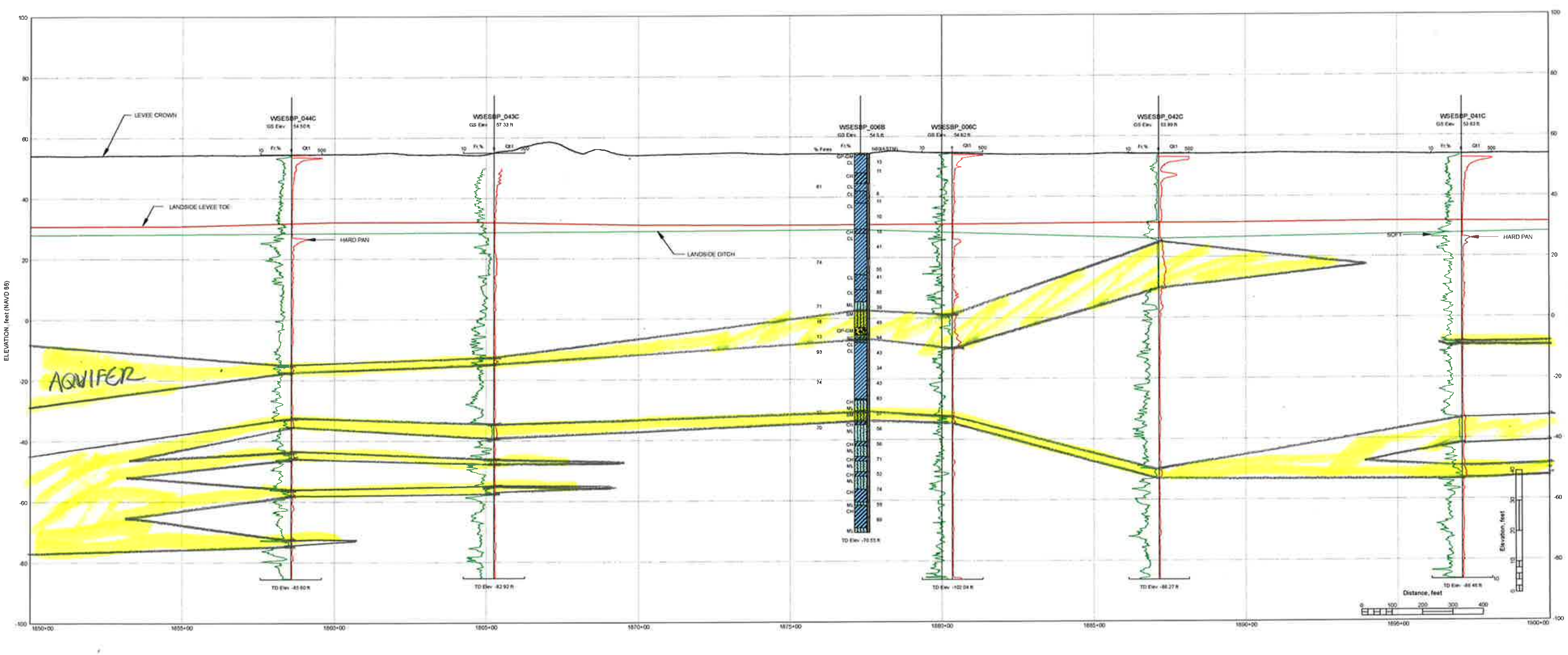
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
8. Surficial geology was mapped at 1:20,000



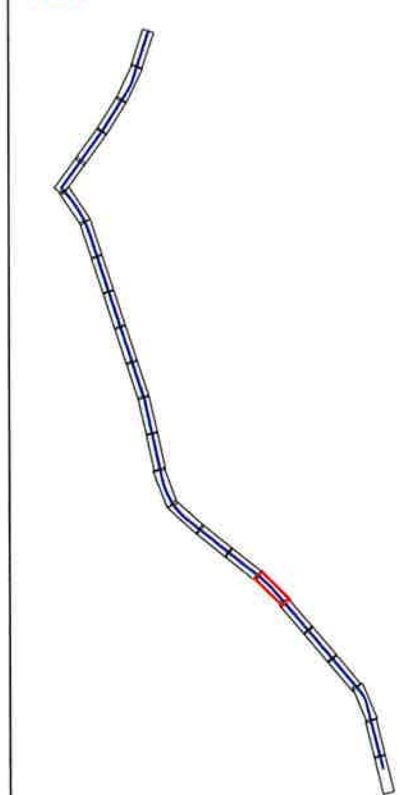
DETAIL AREA

Sutter Bypass

Legend

Urban Project Levee

Plate Location



Department of Water Resources
Division of Flood Management

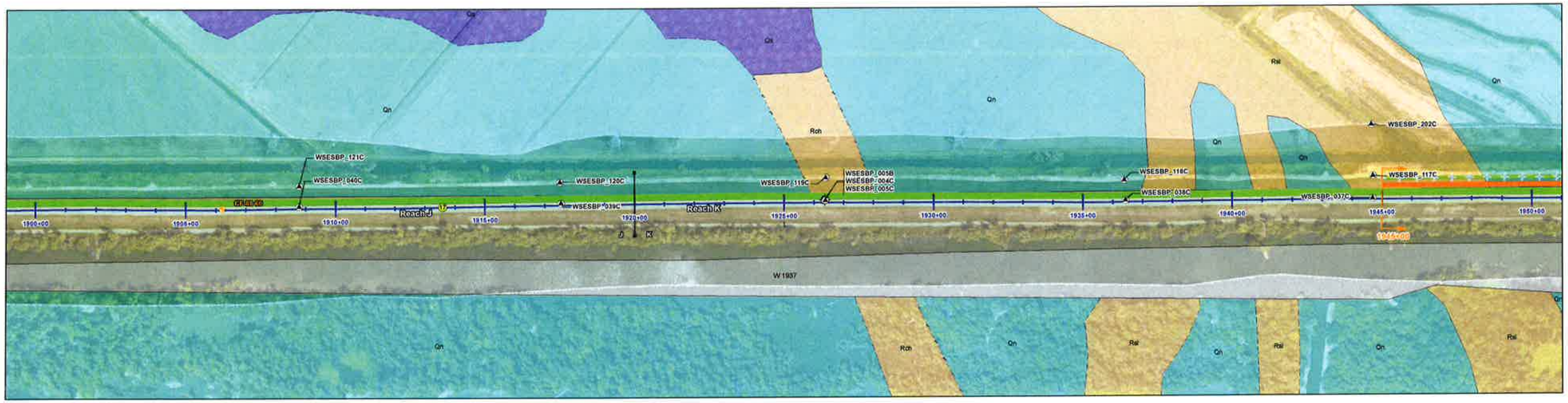
URS

Sutter Bypass-Wadsworth Canal Plan and Profile
Station 1850+00 to Station 1900+00
Sutter Bypass

URBAN LEVEE EVALUATIONS

Plate 20

Geotechnical Evaluation Report



N
0 100 200
Feet

NOTES:

1. Elevations of levee crown, landside toe, and landside depression/ditch are approximate.
2. Stratigraphy between explorations may differ from that shown at exploration locations.
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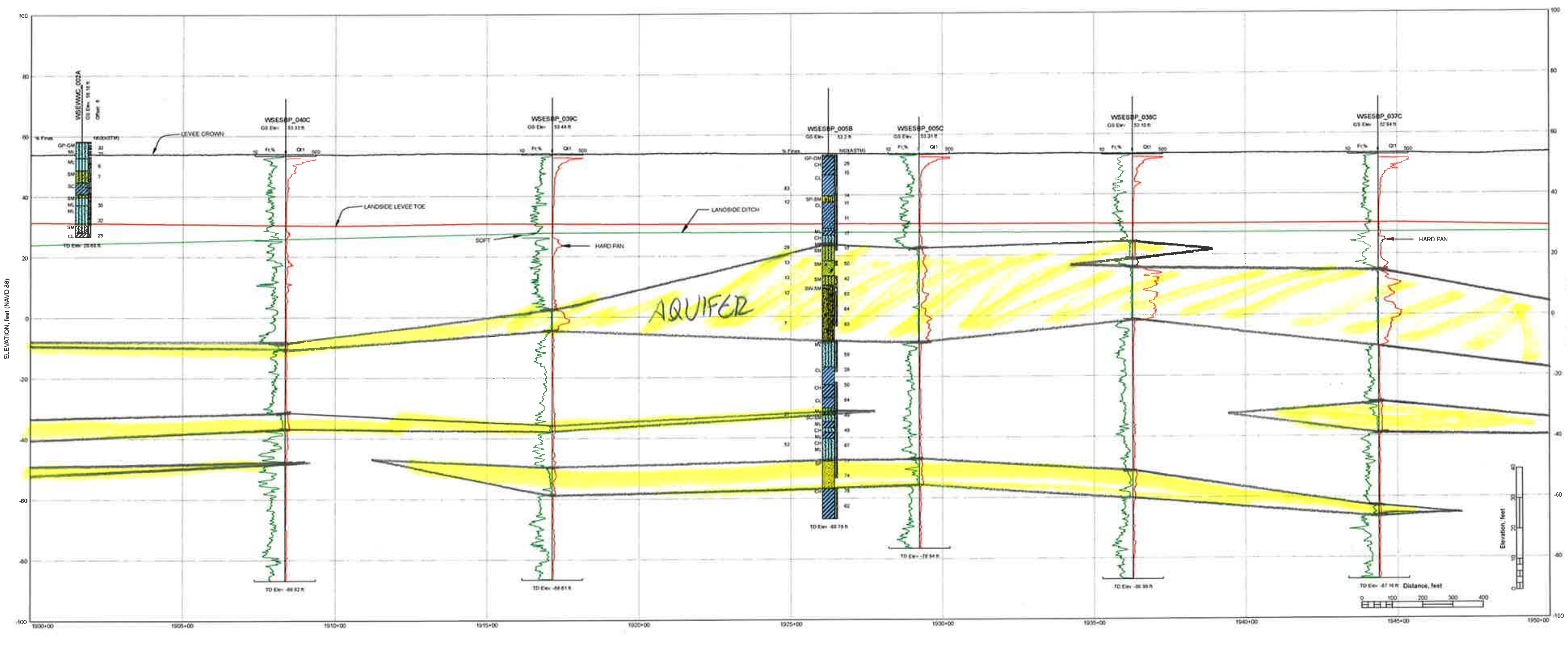
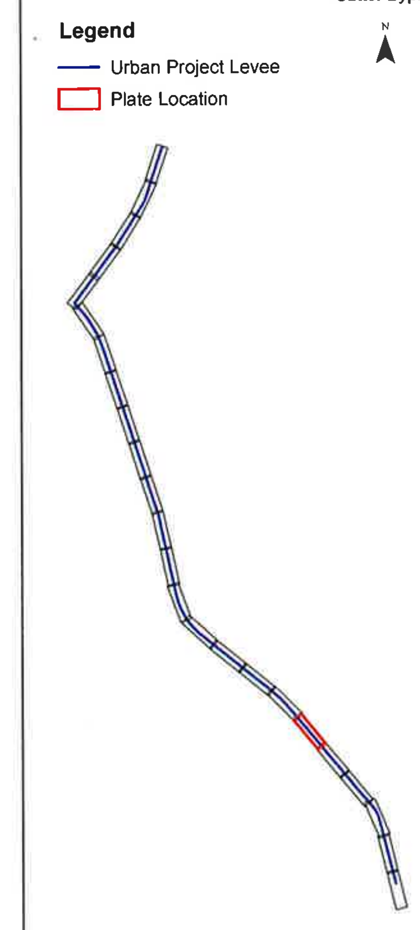
6. This is a color figure. Black and white reproductions should not be relied upon as data will be lost.
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
8. Surficial geology was mapped at 1:20,000



DETAIL AREA

Sutter Bypass



Department of Water Resources
Division of Flood Management

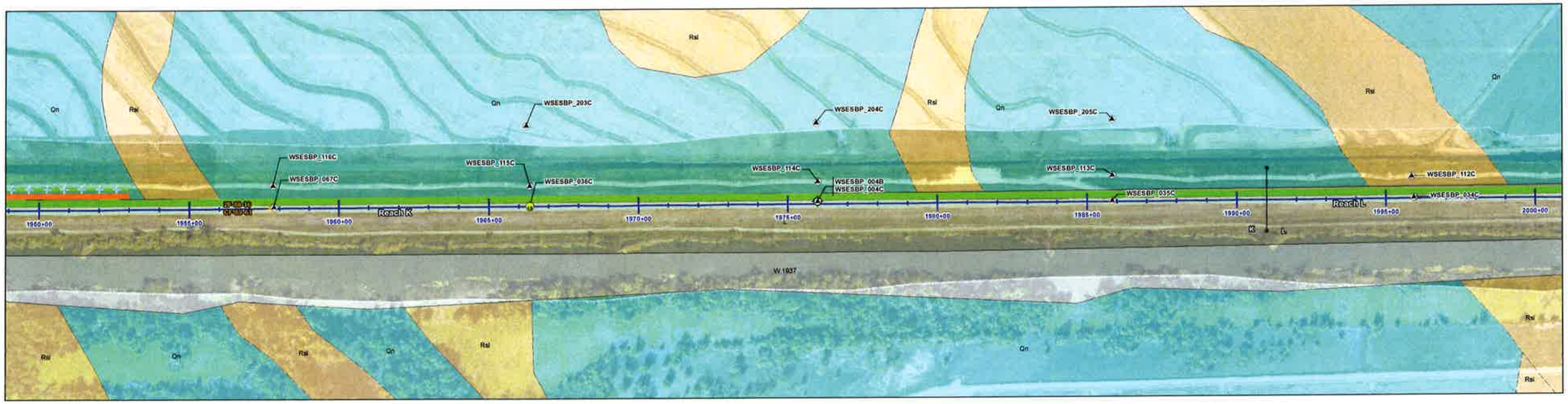
URS

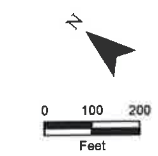
Sutter Bypass-Wadsworth Canal Plan and Profile
Station 1900+00 to Station 1950+00
Sutter Bypass

URBAN LEVEE EVALUATIONS

Plate 21

Geotechnical Evaluation Report





NOTES:

1. Elevations of levee crown, landside toe, and landside depression/ditch are approximate.
2. Stratigraphy between explorations may differ from that shown at exploration locations.
3. Only explorations through the levee crown are shown on the profile.
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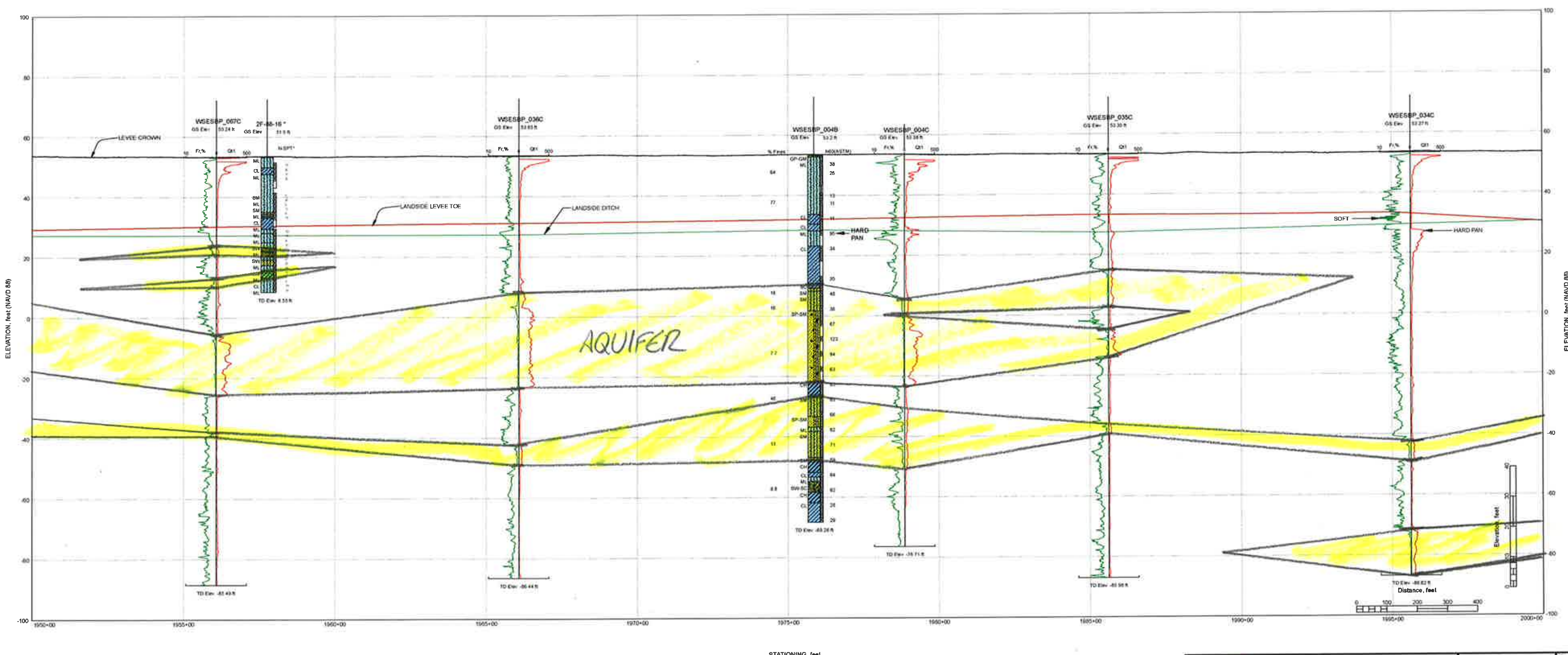
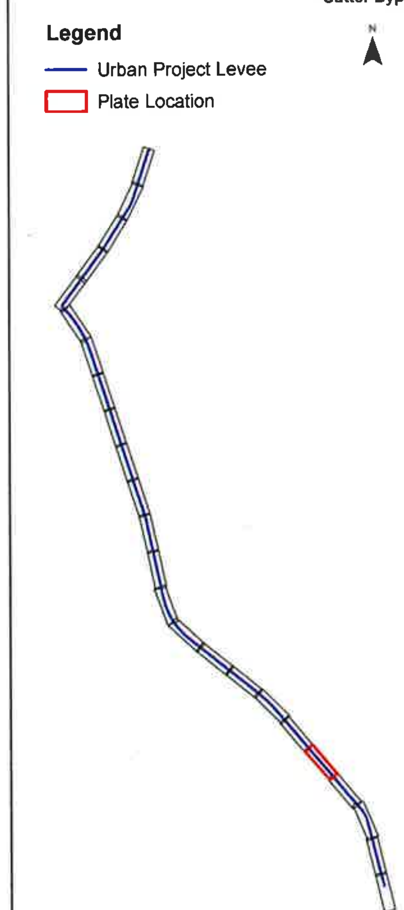
5. USCS classification labels are not presented on the profiles for soil lenses (thickness less than 1.5 ft).
6. This is a color figure. Black and white reproductions should not be relied upon as data will be lost.
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
8. Surficial geology was mapped at 1:20,000



DETAIL AREA

Sutter Bypass



Department of Water Resources
Division of Flood Management

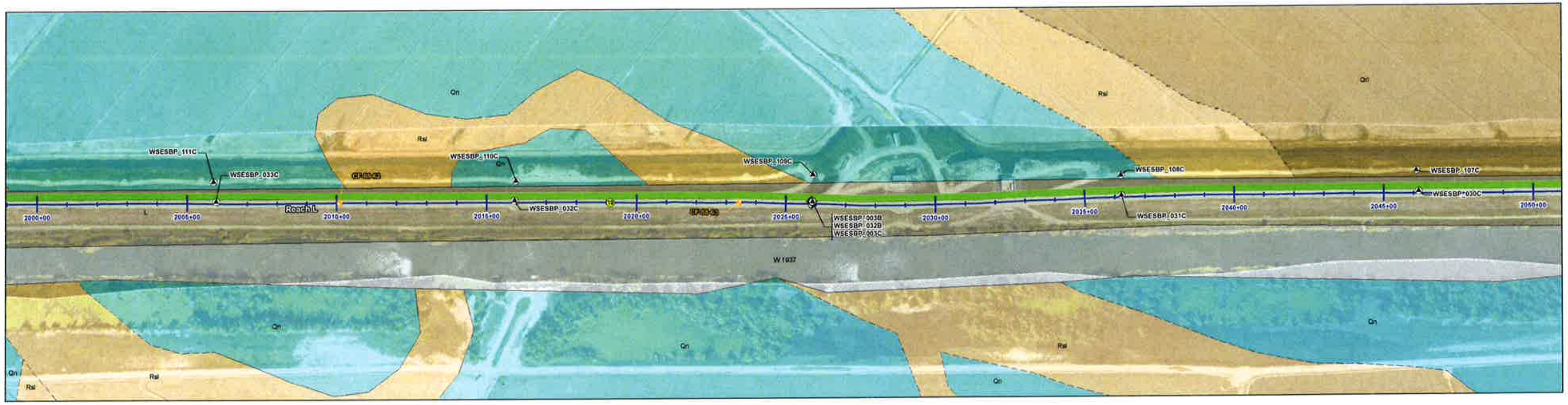
URS

Sutter Bypass-Wadsworth Canal Plan and Profile
Station 1950+00 to Station 2000+00
Sutter Bypass

URBAN LEVEE EVALUATIONS

Plate 22

Geotechnical Evaluation Report



N

0 100 200

Feet

NOTES:

1. Elevations of levee crown, landside toe, and landside depression/ditch are approximate.
2. Stratigraphy between explorations may differ from that shown at exploration locations.
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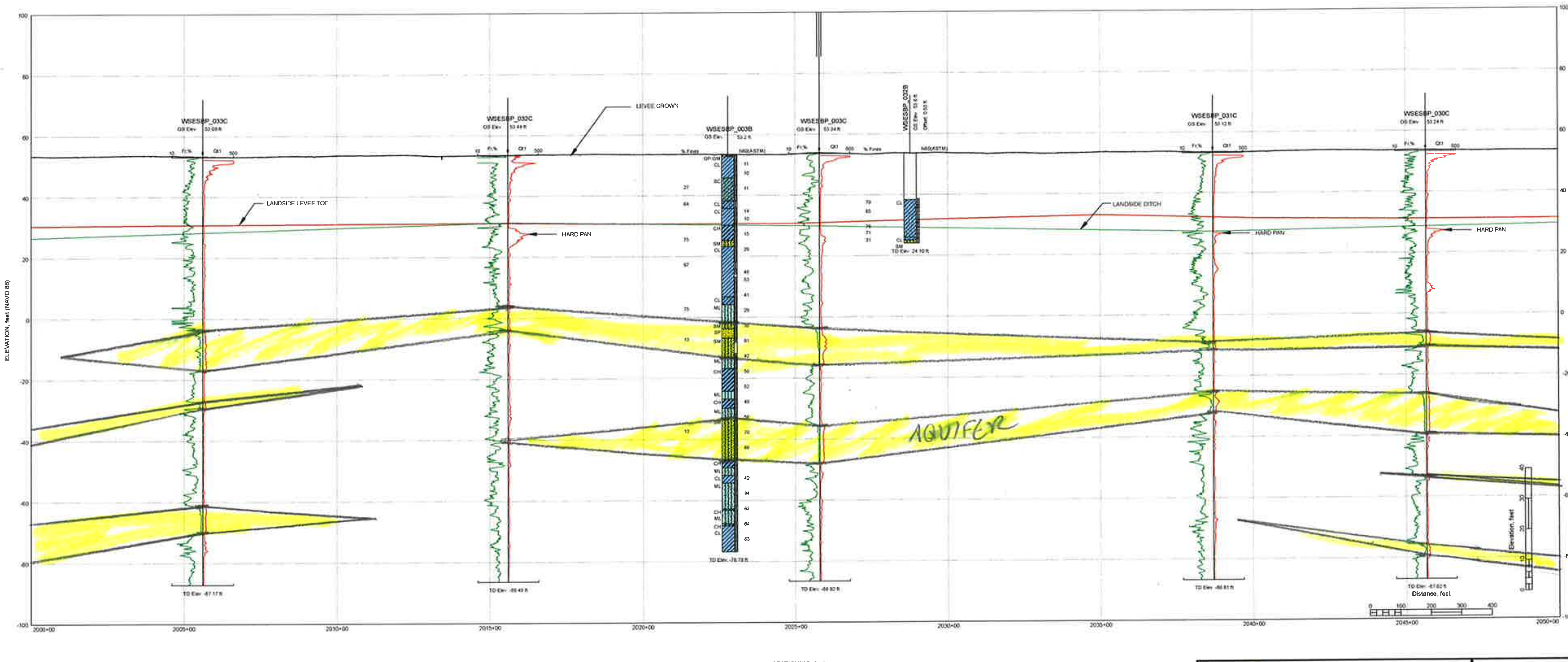
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
8. Surficial geology was mapped at 1:20,000



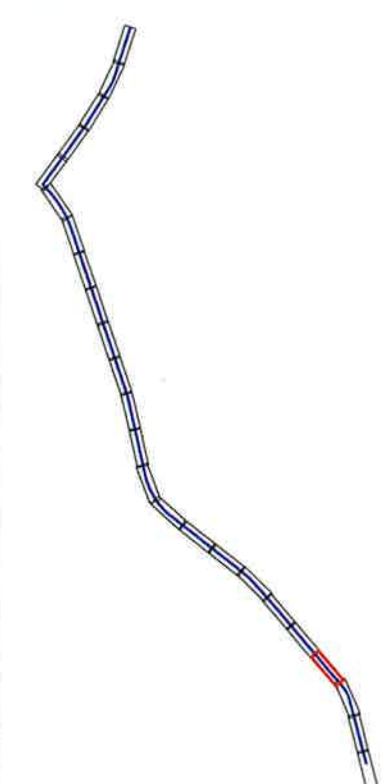
DETAIL AREA

Sutter Bypass

Legend

Urban Project Levee

Plate Location



Department of Water Resources
Division of Flood Management

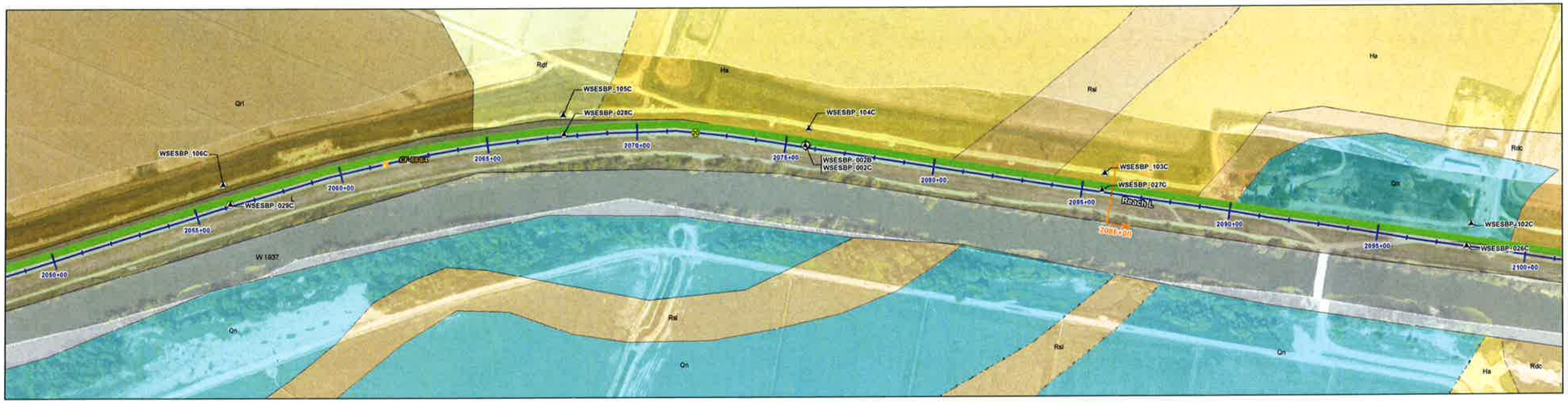
URS

Sutter Bypass-Wadsworth Canal Plan and Profile
Station 2000+00 to Station 2050+00
Sutter Bypass

URBAN LEVEE EVALUATIONS

Plate 23

Geotechnical Evaluation Report



0 100 200
Feet

NOTES:

1. Elevations of levee crown, landside toe, and landside depression/ditch are approximate.
2. Stratigraphy between explorations may differ from that shown at exploration locations.
3. Only explorations through the levee crown are shown on the profile.
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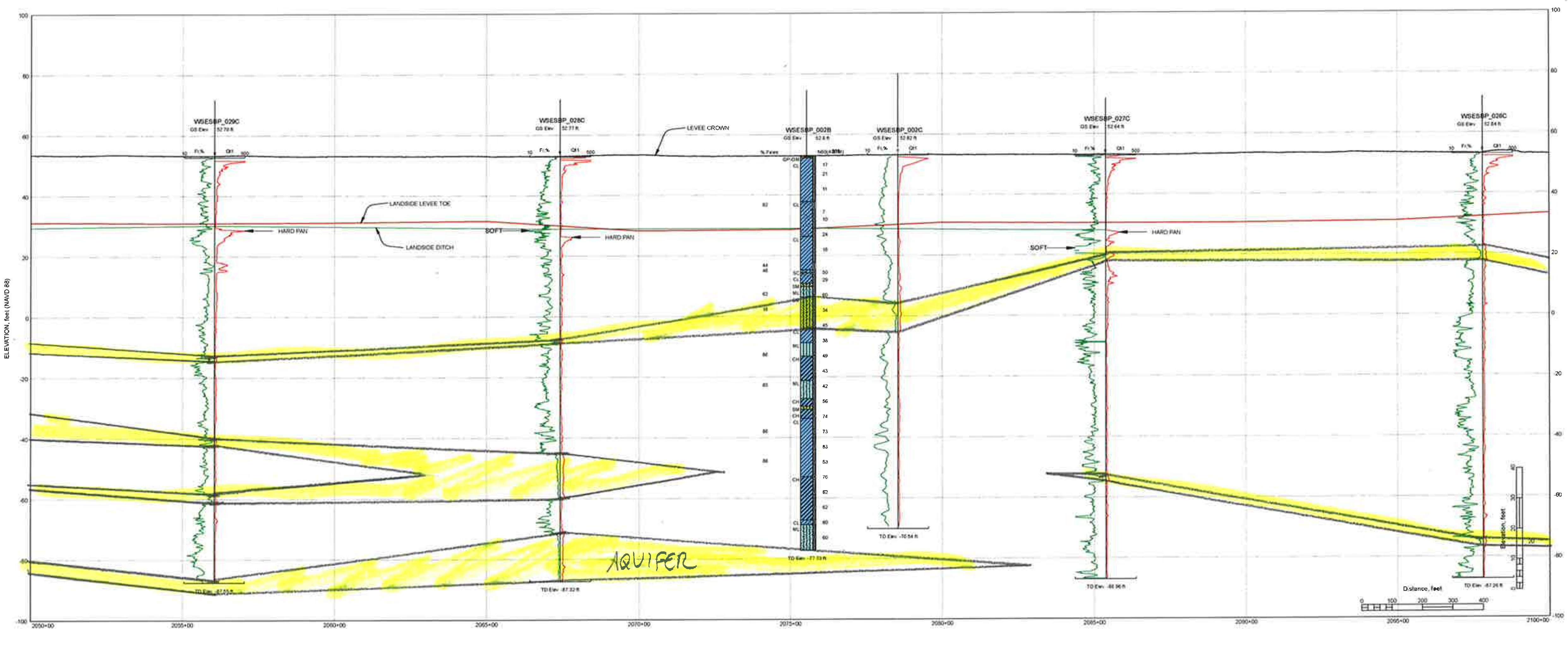
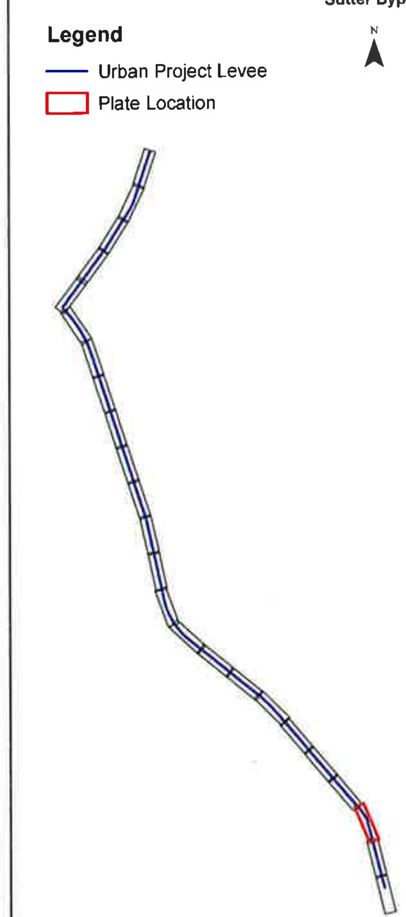
6. This is a color figure. Black and white reproductions should not be relied upon as data will be lost.
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
8. Surficial geology was mapped at 1:20,000



DETAIL AREA

Sutter Bypass



Department of Water Resources
Division of Flood Management

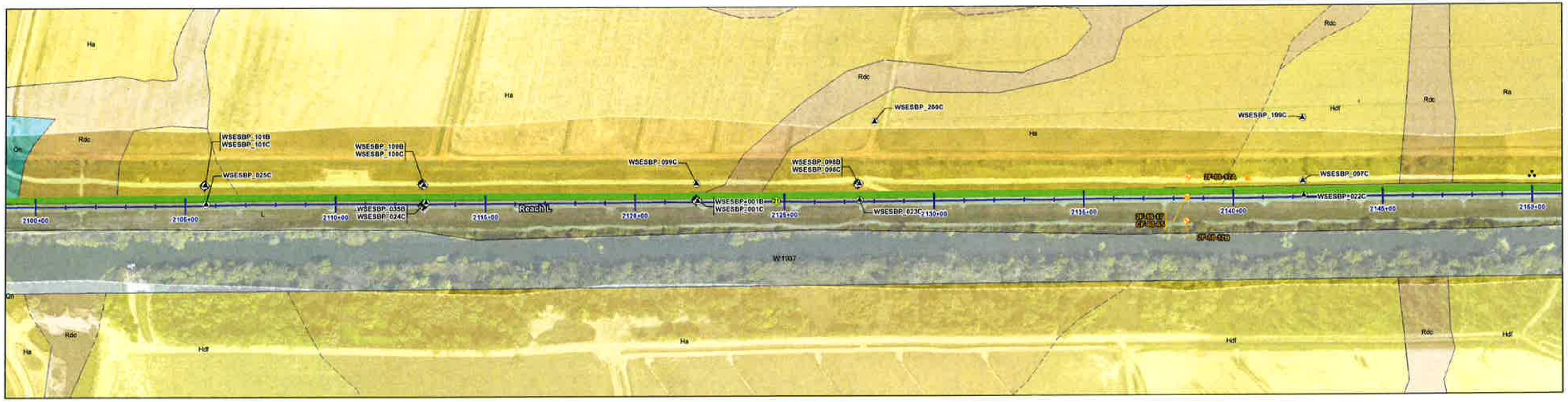
URS

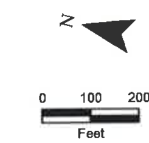
Sutter Bypass-Wadsworth Canal Plan and Profile
Station 2050+00 to Station 2100+00
Sutter Bypass

URBAN LEVEE EVALUATIONS

Plate 24

Geotechnical Evaluation Report





NOTES:

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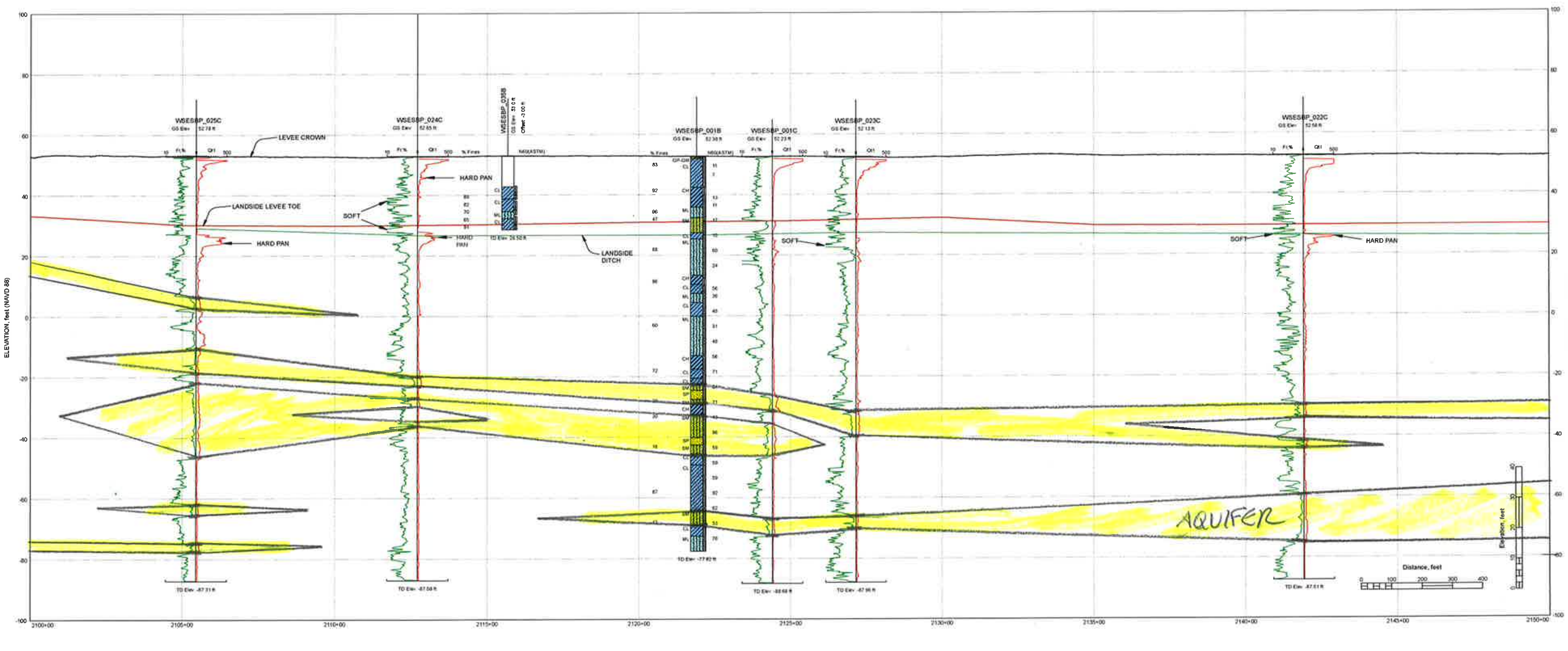
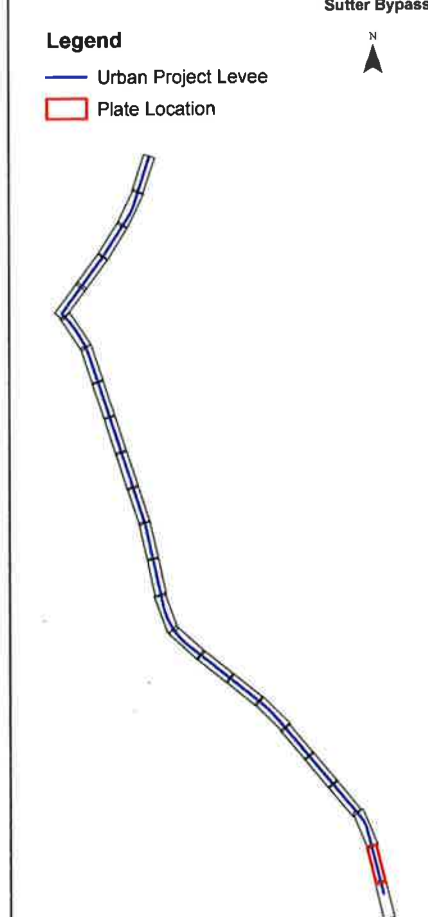
5. USCS classification labels are not presented on the profiles for soil lenses (thickness less than 1.5 ft).
6. This is a color figure. Black and white reproductions should not be relied upon as data will be lost.
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 Inches).
8. Surficial geology was mapped at 1:20,000



DETAIL AREA

Sutter Bypass



Department of Water Resources Division of Flood Management	URS	Sutter Bypass-Wadsworth Canal Plan and Profile Station 2100+00 to Station 2150+00 Sutter Bypass URBAN LEVEE EVALUATIONS	Plate 25

Geotechnical Evaluation Report

NOTES:

1. Elevations of levee crown, landside toe, and landside depression/ditch are approximate.
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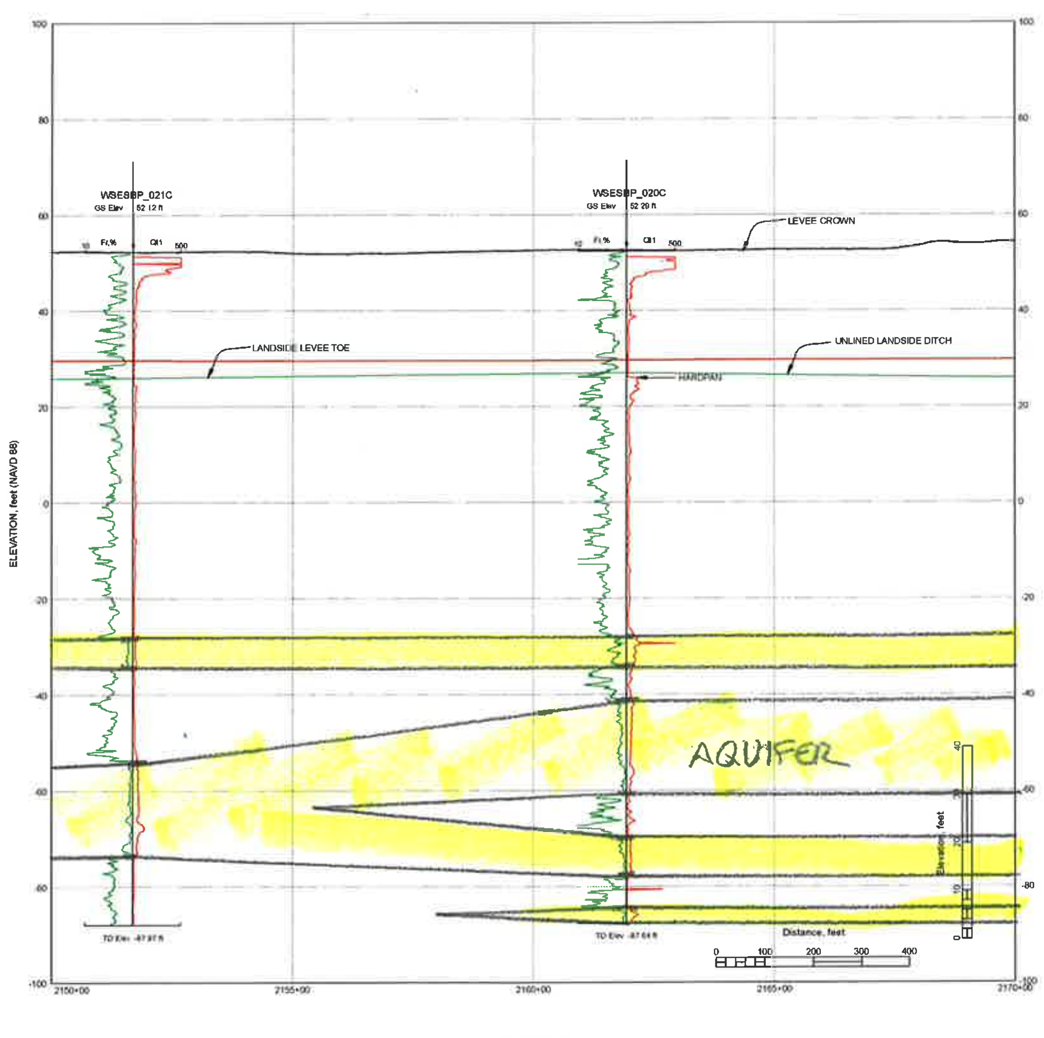
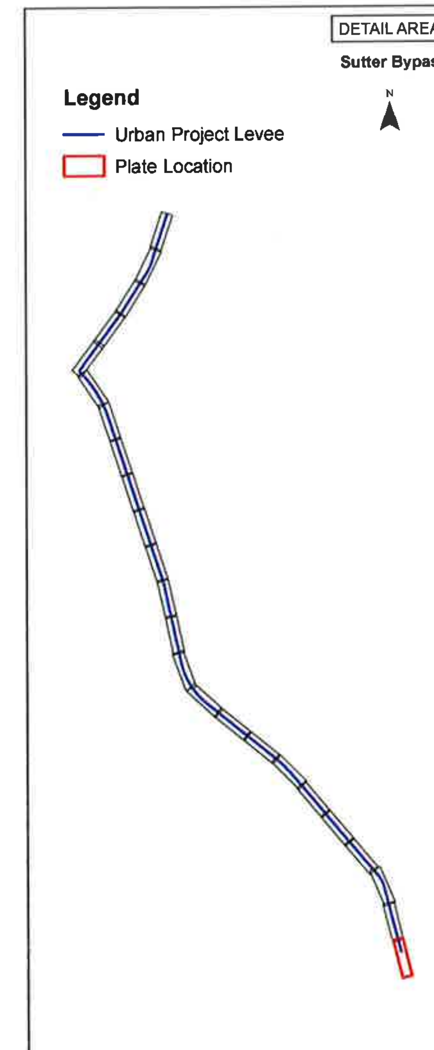
7. To prevent scale distortion, this map should be printed on a "D" size sheet (22x34 inches).
8. Surficial geology was mapped at 1:20,000





Department of Water Resources
Division of Flood Management

URS

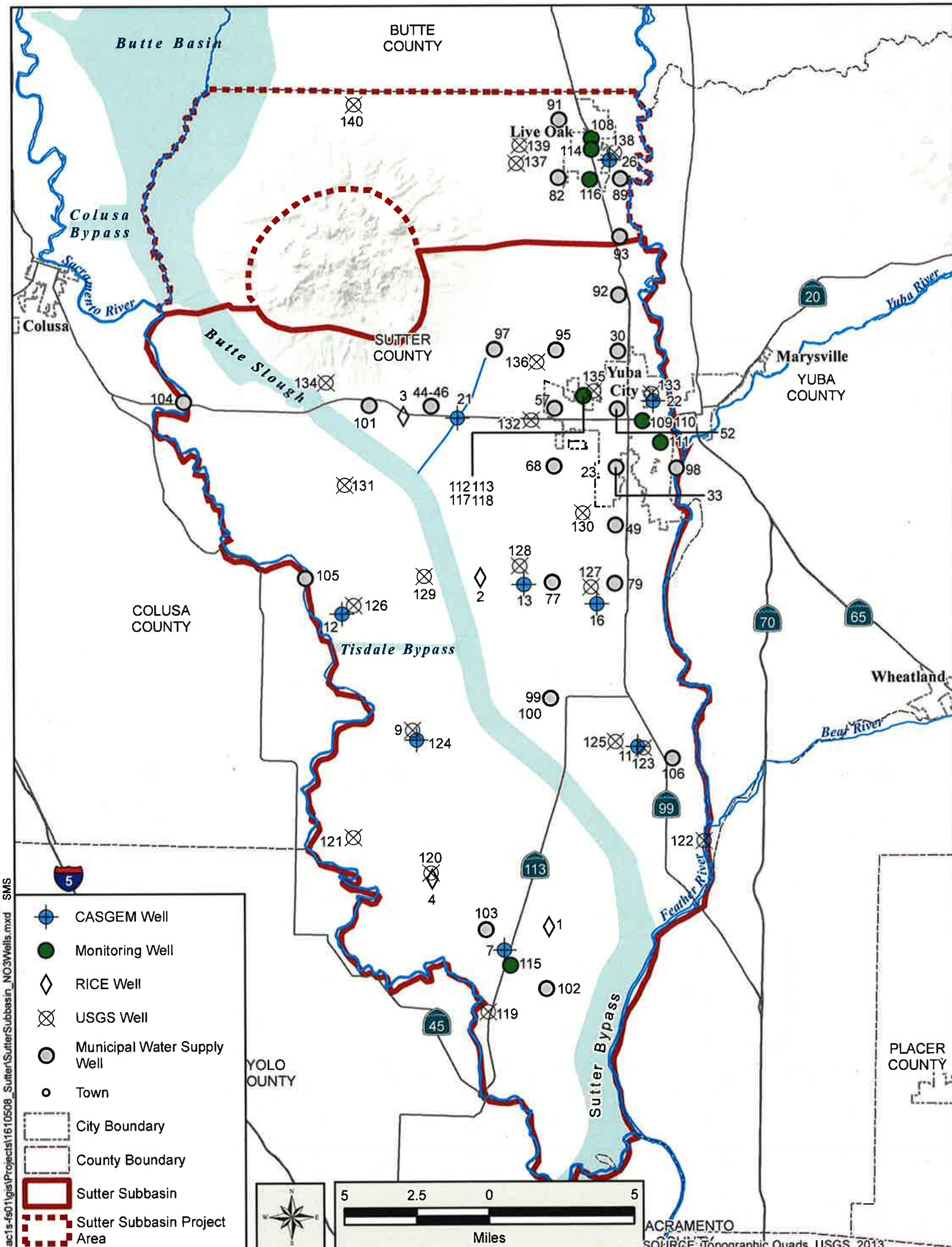
Sutter Bypass-Wadsworth Canal Plan and Profile
Station 2150+00 to Station 2166+22
Sutter Bypass

URBAN LEVEE EVALUATIONS

Plate 26

Geotechnical Evaluation Report

APPENDIX F
WATER QUALITY TREND GRAPHS



\\sac1s-fs01\gis\Projects\1610508_Sutter\SutterSubbasin_NO3Wells.mxd SMS

08-Nov-2016

Alternative Submittal Sutter Subbasin	GEI Consultants	Groundwater Quality Monitoring Network
Sutter County		NOVEMBER 2016 FIGURE 23

Label_ID	Well_Name	Lat_83	Long_83	CASGEM_Data	CASGEM_ID
1	RICE-01	38.888	-121.681	RICE	
2	RICE-02	39.062	-121.728	RICE	
3	RICE-03	39.142	-121.779	RICE	
4	RICE-20	38.911	-121.756	RICE	
5	11N02E14F004M	38.8048	-121.7186	No	
6	12N02E06D001M	38.9235	-121.7997	No	
7	12N02E23H002M	38.8759	-121.7094	Yes	388761N1217094W002
8	12N02E26Q001M	38.8516	-121.7146	No	
9	13N02E17A001M	38.9803	-121.7675	Yes	389803N1217675W001
10	13N03E10M002I	38.9892	-121.6306	No	
11	13N03E15C003M	38.9786	-121.6259	Yes	389786N1216259W001
12	14N01E24N001M	39.0426	-121.8166	Yes	390426N1218166W001
13	14N02E13L001M	39.0588	-121.7004	Yes	390588N1217004W001
14	14N02E17A003M	39.0687	-121.7649	No	
15	14N03E06A002M	39.0979	-121.6719	No	
16	14N03E20H003M	39.0497	-121.6535	Yes	390497N1216535W001
17	15N01E14B001M	39.1556	-121.8245	No	
18	15N01E35G001M	39.1085	-121.8252	No	
19	15N01W13R001I	39.1458	-121.9141	No	
20	15N02E01R001M	39.1737	-121.6908	No	
21	15N02E22D001M	39.1414	-121.7442	Yes	391414N1217442W001
22	15N03E15H004M	39.1513	-121.6191	Yes	391512N1216190W001
23	15N03E29G003M	39.1234	-121.6593	No	
24	16N01E05C001M	39.2717	-121.8849	No	
25	16N02E02R001M	39.2678	-121.7099	No	
26	16N03E04E001M	39.2712	-121.6493	Yes	392712N1216493W001
27	16N03E20F002M	39.2316	-121.6634	No	
28	17N01E25D001M	39.3016	-121.8138	No	
29	17N02E35A002M	39.293	-121.7099	No	
30	5110002-007	39.176	-121.642	Municipal Water Supply Well	
31	5110008-001	39.176	-121.642	Municipal Water Supply Well	
32	5110008-002	39.176	-121.642	Municipal Water Supply Well	
33	5100120-001	39.118	-121.642	Municipal Water Supply Well	
34	5100120-002	39.118	-121.642	Municipal Water Supply Well	
35	5100128-001	39.118	-121.642	Municipal Water Supply Well	
36	5103331-001	39.118	-121.642	Municipal Water Supply Well	
37	5110003-004	39.118	-121.642	Municipal Water Supply Well	
38	5110003-007	39.118	-121.642	Municipal Water Supply Well	
39	5110003-009	39.118	-121.642	Municipal Water Supply Well	
40	5110003-012	39.118	-121.642	Municipal Water Supply Well	
41	5110003-013	39.118	-121.642	Municipal Water Supply Well	
42	5115001-003	39.118	-121.642	Municipal Water Supply Well	
43	5115001-005	39.118	-121.642	Municipal Water Supply Well	
44	5102032-001	39.147	-121.761	Municipal Water Supply Well	
45	5110007-002	39.147	-121.761	Municipal Water Supply Well	
46	5110007-003	39.147	-121.761	Municipal Water Supply Well	

47	5100149-001	39.089	-121.642	Municipal Water Supply Well
48	5100180-001	39.089	-121.642	Municipal Water Supply Well
49	5103327-001	39.089	-121.642	Municipal Water Supply Well
50	5105006-001	39.089	-121.642	Municipal Water Supply Well
51	5115001-004	39.089	-121.642	Municipal Water Supply Well
52	5100131-002	39.147	-121.642	Municipal Water Supply Well
53	5100169-001	39.147	-121.642	Municipal Water Supply Well
54	5103303-001	39.147	-121.642	Municipal Water Supply Well
55	5110002-011	39.147	-121.642	Municipal Water Supply Well
56	5110002-012	39.147	-121.642	Municipal Water Supply Well
57	5100112-002	39.147	-121.682	Municipal Water Supply Well
58	5100134-001	39.147	-121.682	Municipal Water Supply Well
59	5100176-001	39.147	-121.682	Municipal Water Supply Well
60	5101001-001	39.147	-121.682	Municipal Water Supply Well
61	5101016-001	39.147	-121.682	Municipal Water Supply Well
62	5102025-001	39.147	-121.682	Municipal Water Supply Well
63	5103326-001	39.147	-121.682	Municipal Water Supply Well
64	5110005-003	39.147	-121.682	Municipal Water Supply Well
65	5110005-004	39.147	-121.682	Municipal Water Supply Well
66	5110005-005	39.147	-121.682	Municipal Water Supply Well
67	5110005-021	39.147	-121.682	Municipal Water Supply Well
68	5100102-001	39.118	-121.682	Municipal Water Supply Well
69	5100109-001	39.118	-121.682	Municipal Water Supply Well
70	5100109-002	39.118	-121.682	Municipal Water Supply Well
71	5100139-001	39.118	-121.682	Municipal Water Supply Well
72	5101006-001	39.118	-121.682	Municipal Water Supply Well
73	5101006-002	39.118	-121.682	Municipal Water Supply Well
74	5101007-001	39.118	-121.682	Municipal Water Supply Well
75	5101009-001	39.118	-121.682	Municipal Water Supply Well
76	5101013-001	39.118	-121.682	Municipal Water Supply Well
77	5105003-001	39.06	-121.682	Municipal Water Supply Well
78	5105003-002	39.06	-121.682	Municipal Water Supply Well
79	5100125-001	39.06	-121.642	Municipal Water Supply Well
80	5103005-001	39.06	-121.642	Municipal Water Supply Well
81	5103007-001	39.06	-121.642	Municipal Water Supply Well
82	5110001-001	39.262	-121.682	Municipal Water Supply Well
83	5110001-002	39.262	-121.682	Municipal Water Supply Well
84	5110001-011	39.262	-121.682	Municipal Water Supply Well
85	5110001-013	39.262	-121.682	Municipal Water Supply Well
86	5100158-001	39.262	-121.642	Municipal Water Supply Well
87	5103335-001	39.262	-121.642	Municipal Water Supply Well
88	5110001-003	39.262	-121.642	Municipal Water Supply Well
89	5110001-004	39.262	-121.642	Municipal Water Supply Well
90	5110001-005	39.262	-121.642	Municipal Water Supply Well
91	5103313-001	39.291	-121.682	Municipal Water Supply Well
92	5102009-001	39.204	-121.642	Municipal Water Supply Well
93	5100172-001	39.233	-121.642	Municipal Water Supply Well

94	5102016-001	39.233	-121.642	Municipal Water Supply Well
95	5100142-001	39.176	-121.682	Municipal Water Supply Well
96	5100142-002	39.176	-121.682	Municipal Water Supply Well
97	5110007-001	39.176	-121.721	Municipal Water Supply Well
98	5100111-001	39.118	-121.603	Municipal Water Supply Well
99	5100150-001	39.002	-121.682	Municipal Water Supply Well
100	5100150-002	39.002	-121.682	Municipal Water Supply Well
101	5103325-001	39.147	-121.801	Municipal Water Supply Well
102	5100107-002	38.857	-121.682	Municipal Water Supply Well
103	5100107-004	38.886	-121.721	Municipal Water Supply Well
104	5100141-002	39.147	-121.92	Municipal Water Supply Well
105	5100145-001	39.06	-121.84	Municipal Water Supply Well
106	5100168-001	38.973	-121.603	Municipal Water Supply Well
107	5115001-006	39.118	-121.642	Municipal Water Supply Well
108	MW-1	39.28194	-121.66109	Monitoring Well
109	MW-11	39.14129	-121.62538	Monitoring Well
110	MW-12	39.14139	-121.62551	Monitoring Well
111	MW-2	39.13054	-121.61367	Monitoring Well
112	MW-3	39.1534	-121.66374	Monitoring Well
113	MW-4	39.15335	-121.66377	Monitoring Well
114	MW-5	39.2763	-121.6609	Monitoring Well
115	MW-6	38.86835	-121.70525	Monitoring Well
116	MW-7	39.26132	-121.66159	Monitoring Well
117	MW-8	39.1535	-121.66374	Monitoring Well
118	MW-9	39.15339	-121.66355	Monitoring Well
119	USGS-38510412:	38.845	-121.719	USGS
120	USGS-38543212:	38.914	-121.757	USGS
121	USGS-38552612:	38.931	-121.807	USGS
122	USGS-38555012:	38.932	-121.582	USGS
123	USGS-38584312:	38.978	-121.622	USGS
124	USGS-38584812:	38.985	-121.77	USGS
125	USGS-38591912:	38.981	-121.64	USGS
126	USGS-39023812:	39.047	-121.809	USGS
127	USGS-39030112:	39.058	-121.657	USGS
128	USGS-39034112:	39.068	-121.703	USGS
129	USGS-39041012:	39.062	-121.764	USGS
130	USGS-39055312:	39.095	-121.663	USGS
131	USGS-39062612:	39.107	-121.816	USGS
132	USGS-39075612:	39.141	-121.697	USGS
133	USGS-39090212:	39.155	-121.62	USGS
134	USGS-39092112:	39.158	-121.829	USGS
135	USGS-39095412:	39.156	-121.657	USGS
136	USGS-39101612:	39.17	-121.694	USGS
137	USGS-39155012:	39.269	-121.709	USGS
138	USGS-39162012:	39.275	-121.646	USGS
139	USGS-39171412:	39.278	-121.707	USGS
140	USGS-39180612:	39.297	-121.814	USGS

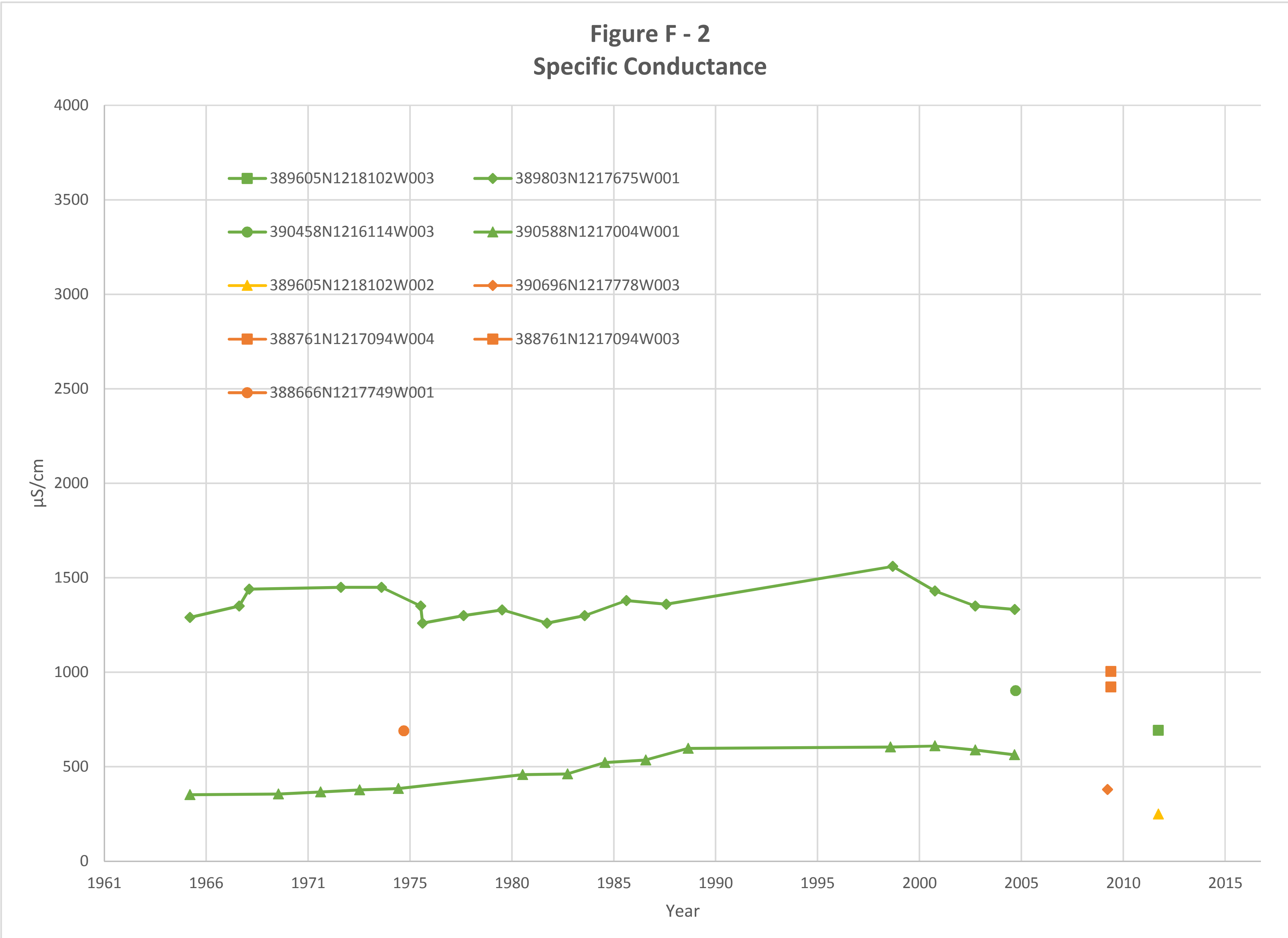


Figure F - 2
Specific Conductance
µS/cm
Year
0
500
1000
1500
2000
2500
3000
3500
4000
1961
1966
1971
1975
1980
1985
1990
1995
2000
2005
2010
2015
389605N1218102W003
389803N1217675W001
390458N1216114W003
390588N1217004W001
389605N1218102W002
390696N1217778W003
388761N1217094W004
388761N1217094W003
388666N1217749W001

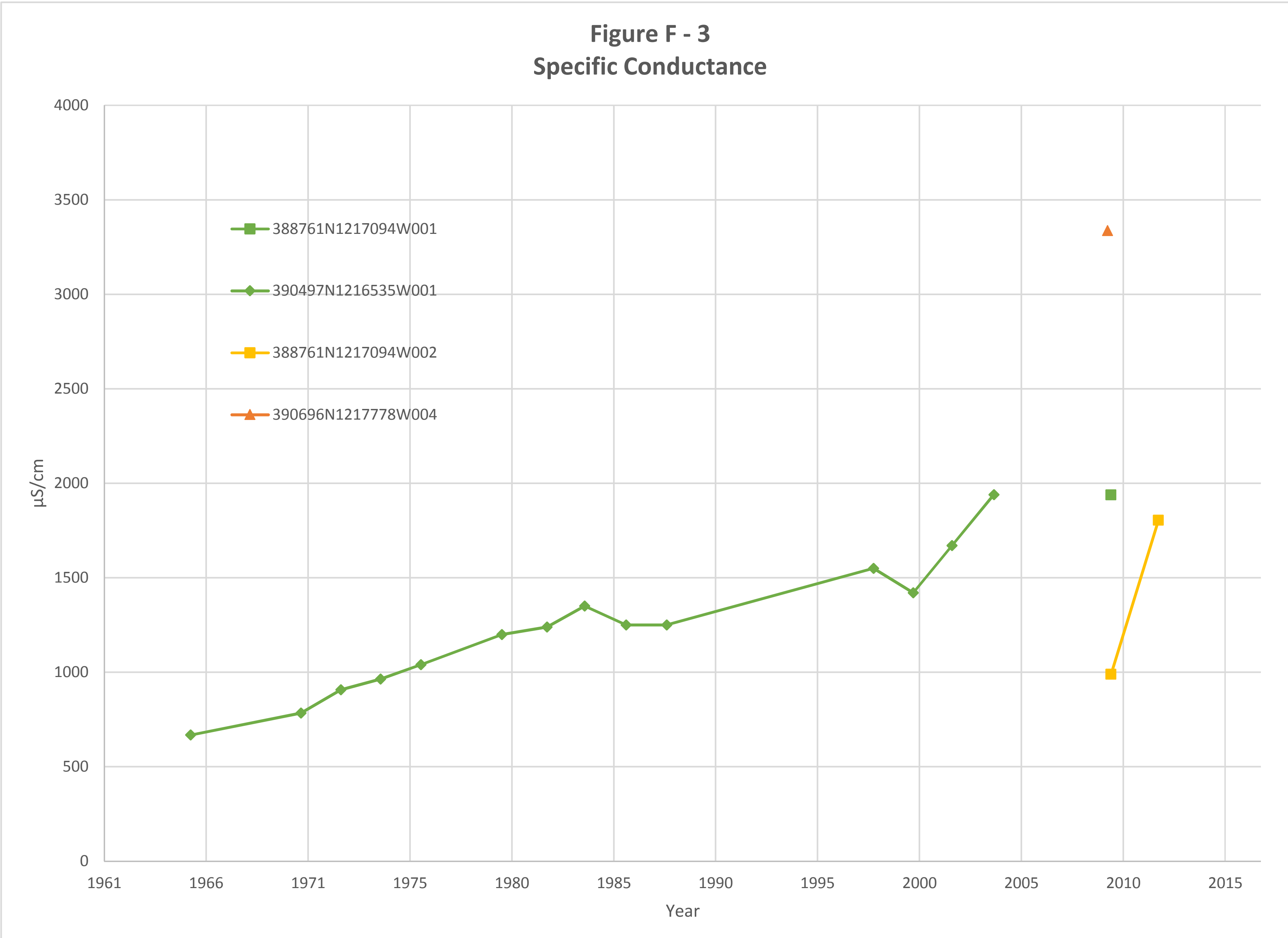


Figure F - 3
Specific Conductance
4000
3500
3000
2500
2000
1500
1000
500
0
µS/cm
388761N1217094W001
390497N1216535W001
388761N1217094W002
390696N1217778W004
1961
1966
1971
1975
1980
1985
1990
1995
2000
2005
2010
2015
Year

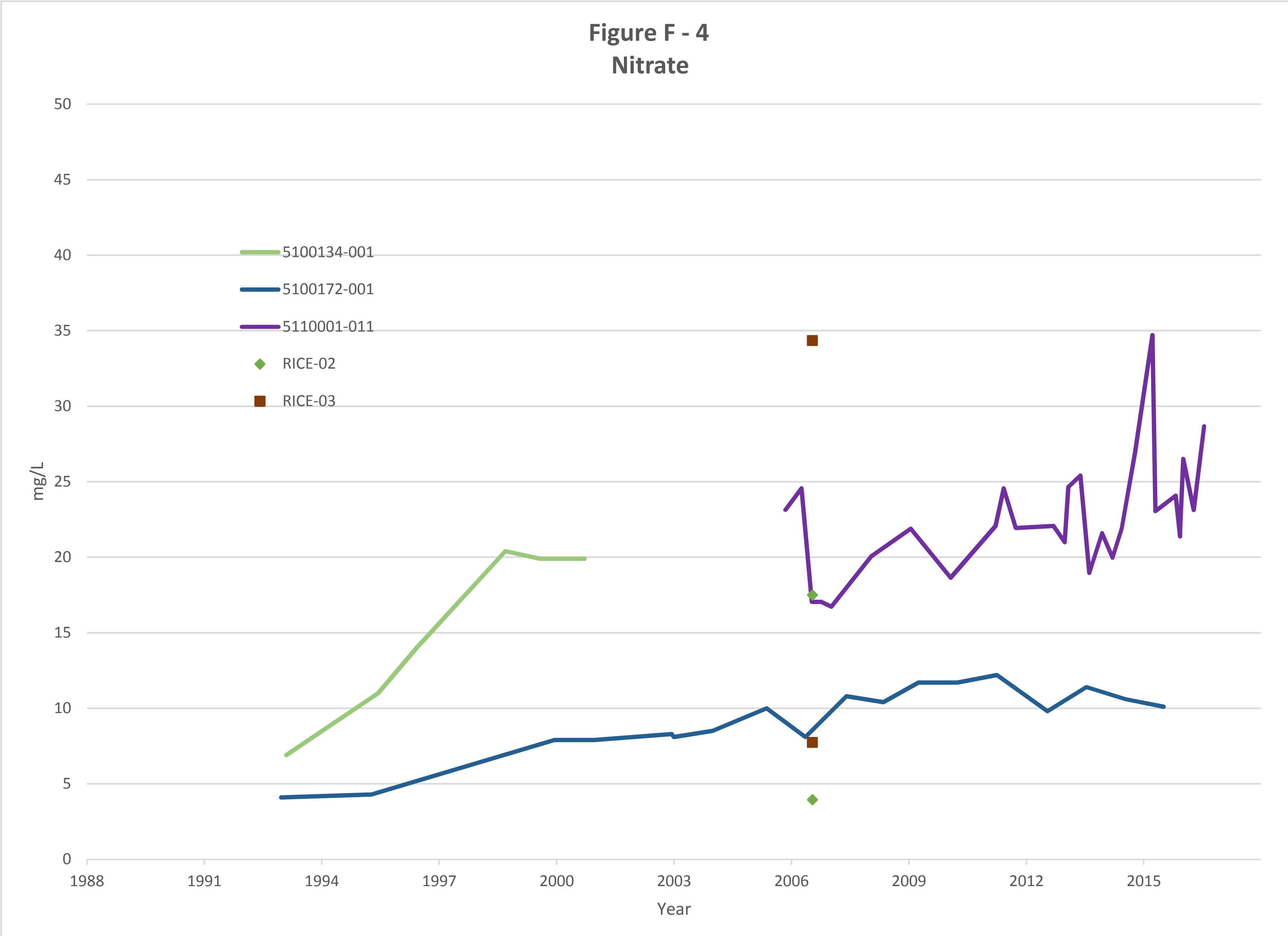


Figure F - 4
Nitrate
mg/L
Year
50
45
40
35
30
25
20
15
10
5
0
1988
1991
1994
1997
2000
2003
2006
2009
2012
2015
5100134-001
5100172-001
5110001-011
RICE-02
RICE-03

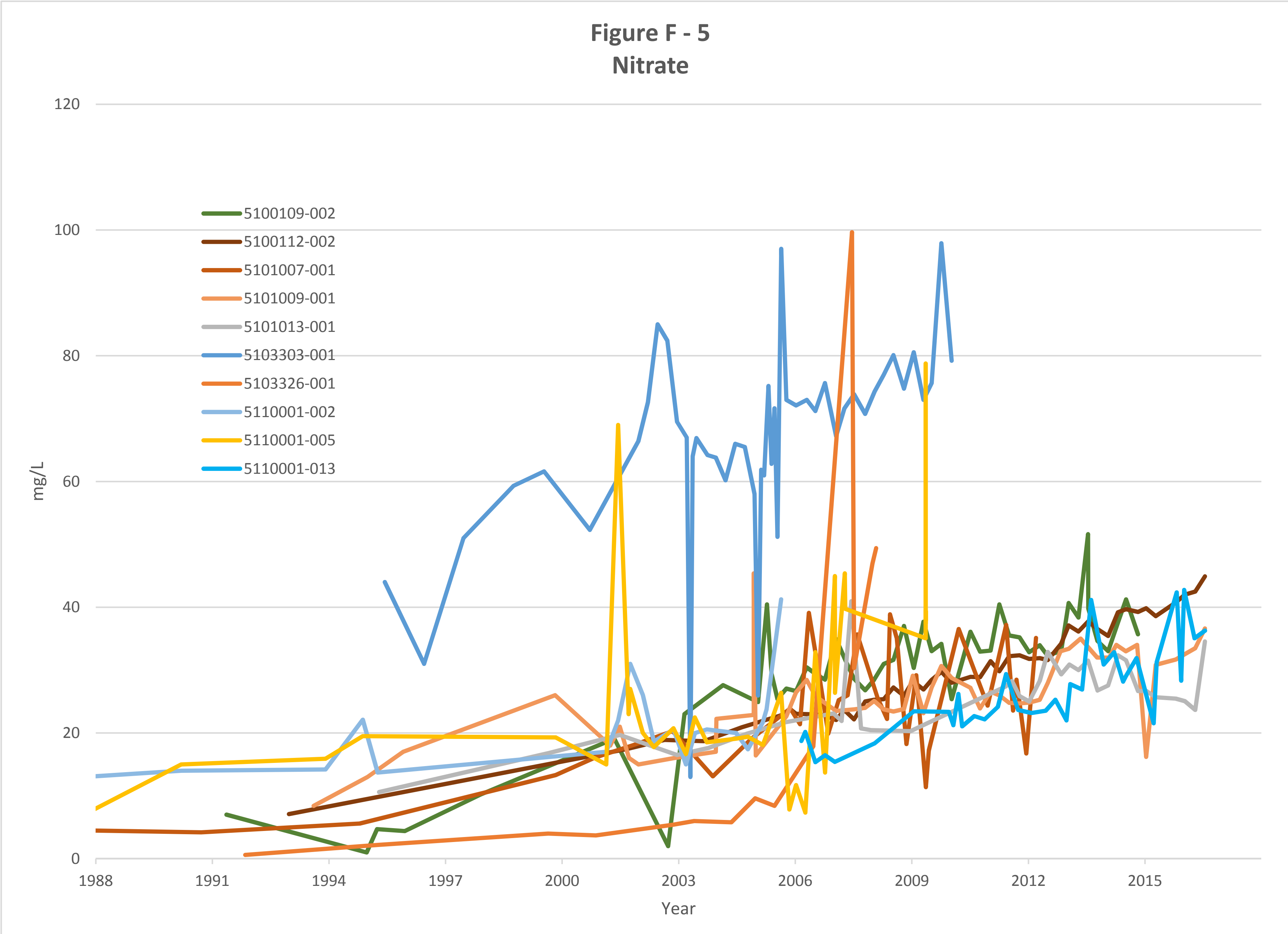


Figure F - 5
Nitrate
mg/L
Year
0
20
40
60
80
100
120
1988
1991
1994
1997
2000
2003
2006
2009
2012
2015
5100109-002
5100112-002
5101007-001
5101009-001
5101013-001
5103303-001
5103326-001
5110001-002
5110001-005
5110001-013

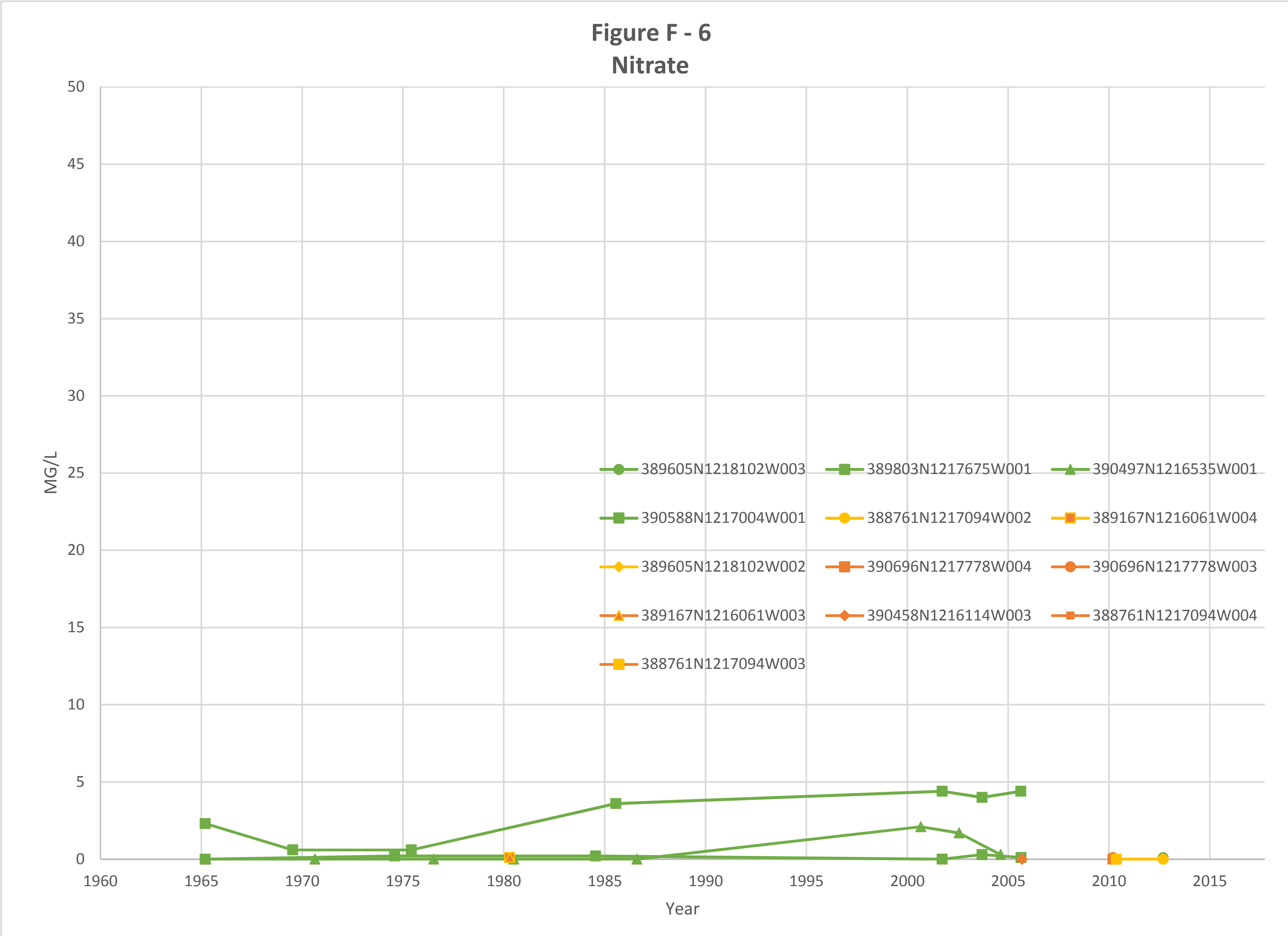
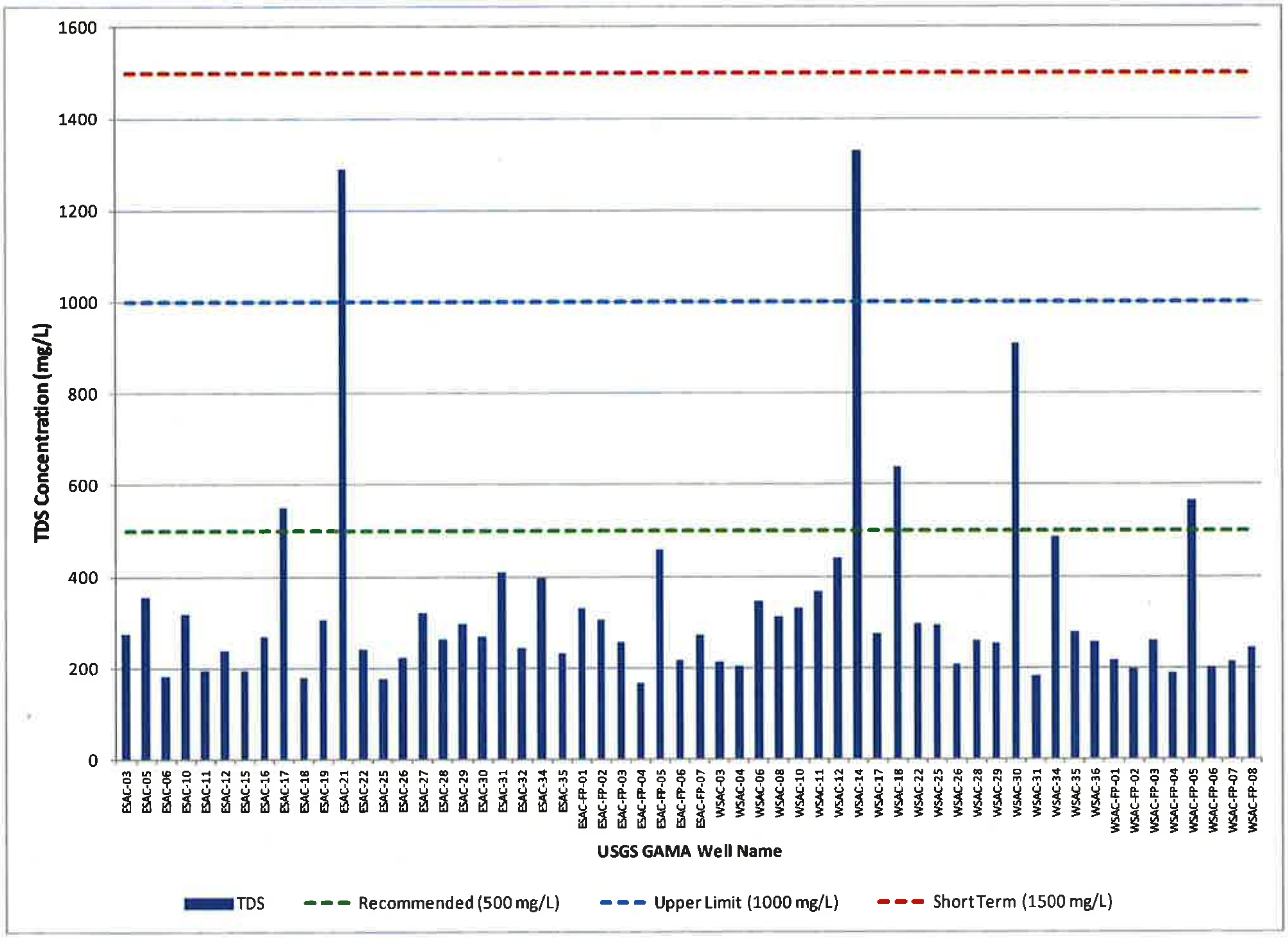


Figure F - 6
Nitrate
50
45
40
35
30
25
20
15
10
5
0
MG/L
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
Year
389605N1218102W003
389803N1217675W001
390497N1216535W001
390588N1217004W001
388761N1217094W002
389167N1216061W004
389605N1218102W002
390696N1217778W004
390696N1217778W003
389167N1216061W003
390458N1216114W003
388761N1217094W004
388761N1217094W003

5.3.2.3 TDS in USGS GAMA Wells

Figure 5-13 shows the TDS results of sampling conducted at USGS GAMA Wells.

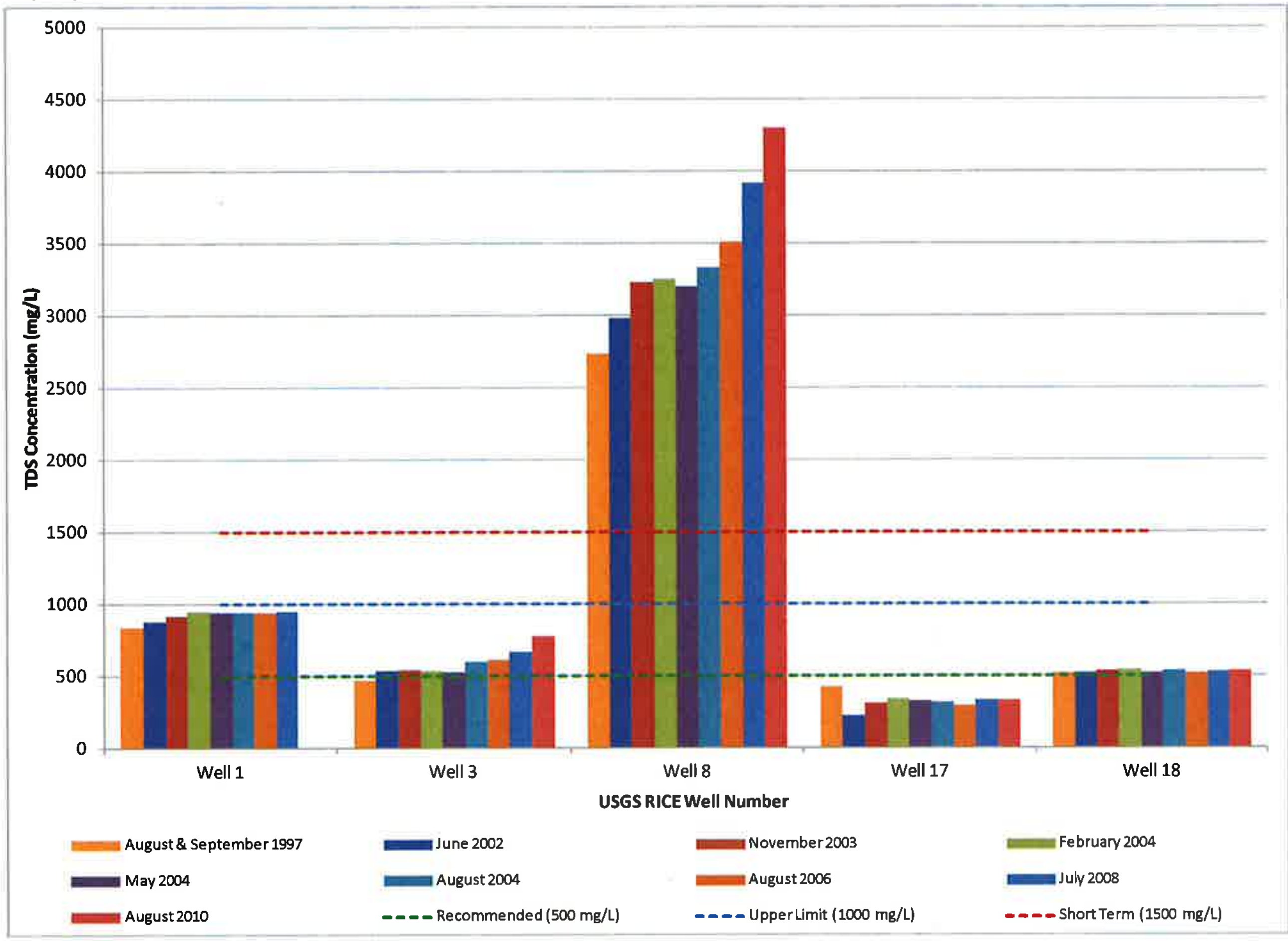
FIGURE 5-13
TDS Concentrations in USGS GAMA Wells



The following summarizes the TDS results for USGS GAMA Wells:

- In 56 of 58 USGS GAMA Wells, TDS was less than the upper limit.
- A maximum observed TDS concentration of 1,330 mg/L was observed at Well WSAC-14.
- These results are consistent with the known low-salinity quality of deep groundwater in the SVGB.
- Specific conductance and TDS are well correlated for this dataset.

FIGURE 5-10
TDS Trends Observed in USGS Rice Wells



The following summarizes the TDS results of the USGS Rice Wells:

- In 22 of 28 USGS Rice Wells, the maximum observed TDS concentration was less than 1,000 mg/L.
- Three wells had maximum observed TDS concentrations between 1,000 mg/L and the 1,500 mg/L upper limit SMCL, and three wells had maximum observed TDS concentrations above 1,500 mg/L.
- The maximum observed TDS concentration was detected at USGS Rice Well 2, located in the southern Sutter Groundwater Subbasin in Sutter County (see Maps 3-1 and 5-2), with a concentration of 7,510 mg/L (brackish water). This well exceeds the 3,000 mg/L drinking water quality threshold. This well is located south of the Sutter Buttes, which is an area where high TDS levels in deeper wells are also generally found (USGS 2001a). The source of high TDS levels in Well 2 is inconclusive at this time, but cannot reasonably be attributed to rice land use. Indeed, the presence of high TDS in deeper units suggests that near-surface irrigation is unlikely to be the source of salinity in this area.
- USGS Rice Wells 8 and 9 also showed TDS concentrations above 2,000 mg/L. This area, between Arbuckle and Maxwell in Colusa County, has high levels of TDS as identified in past reports (see Section 2.3.3).
- As shown in Figure 5-10, TDS trends within four of five wells are very consistent. The exception to this is Well 8, which shows an apparent upward TDS trend. Well 3 also shows a slightly fluctuating and increasing trend in TDS concentrations. Rice farming is not believed to be the cause for this upward trend; a more regional analysis, such as performed under CV-Salts would be appropriate for this area.

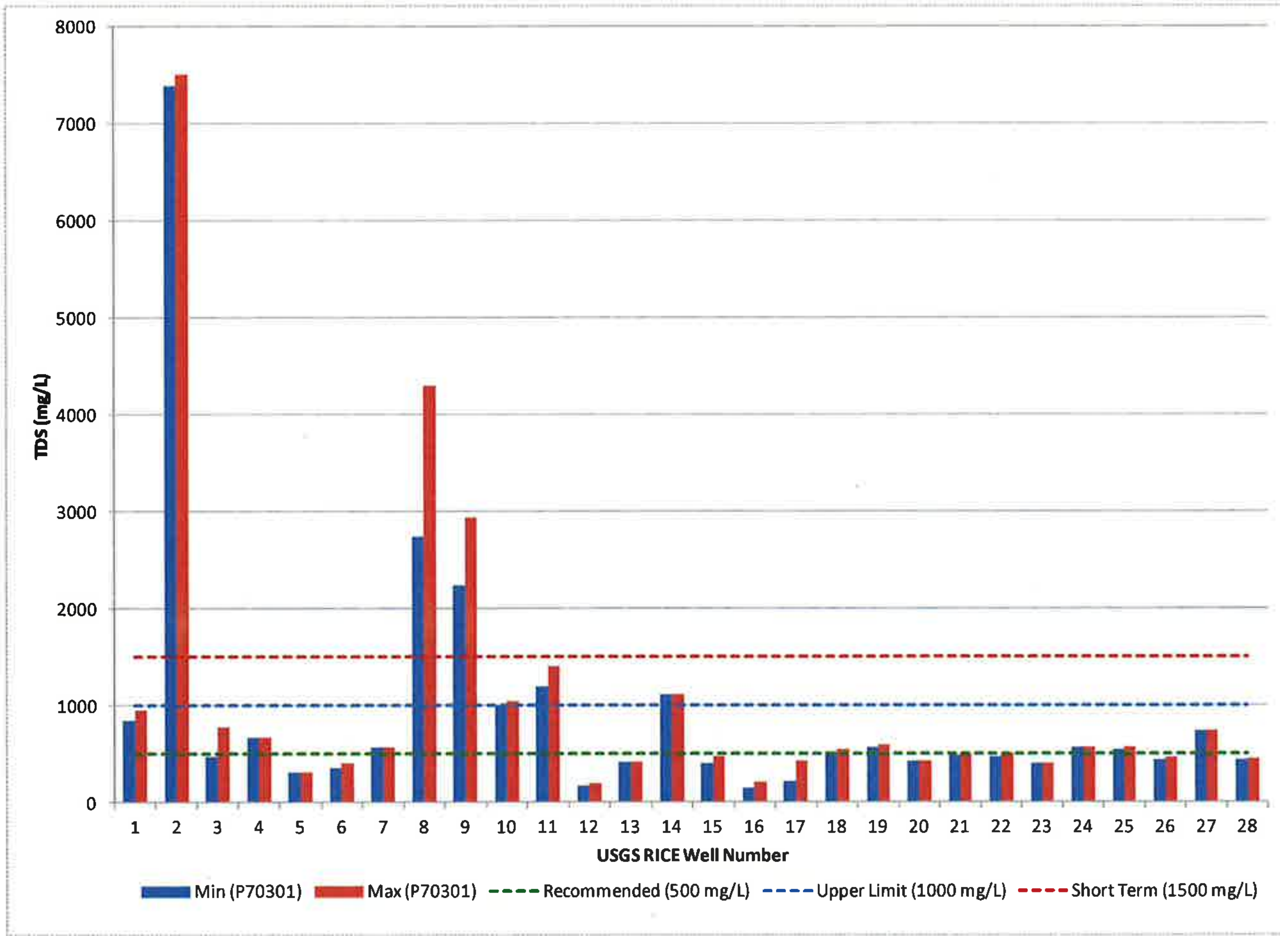
5.3.2 TDS

Map 5-2 shows the TDS results from the USGS Rice Wells, Shallow Rice Wells, and USGS GAMA Wells.

5.3.2.1 TDS in USGS Rice Wells

Figure 5-9 shows the minimum and maximum observed TDS concentration in each USGS Rice Well for the period 1997 through 2010. Figure 5-10 shows the trends of the five wells sampled nine times.

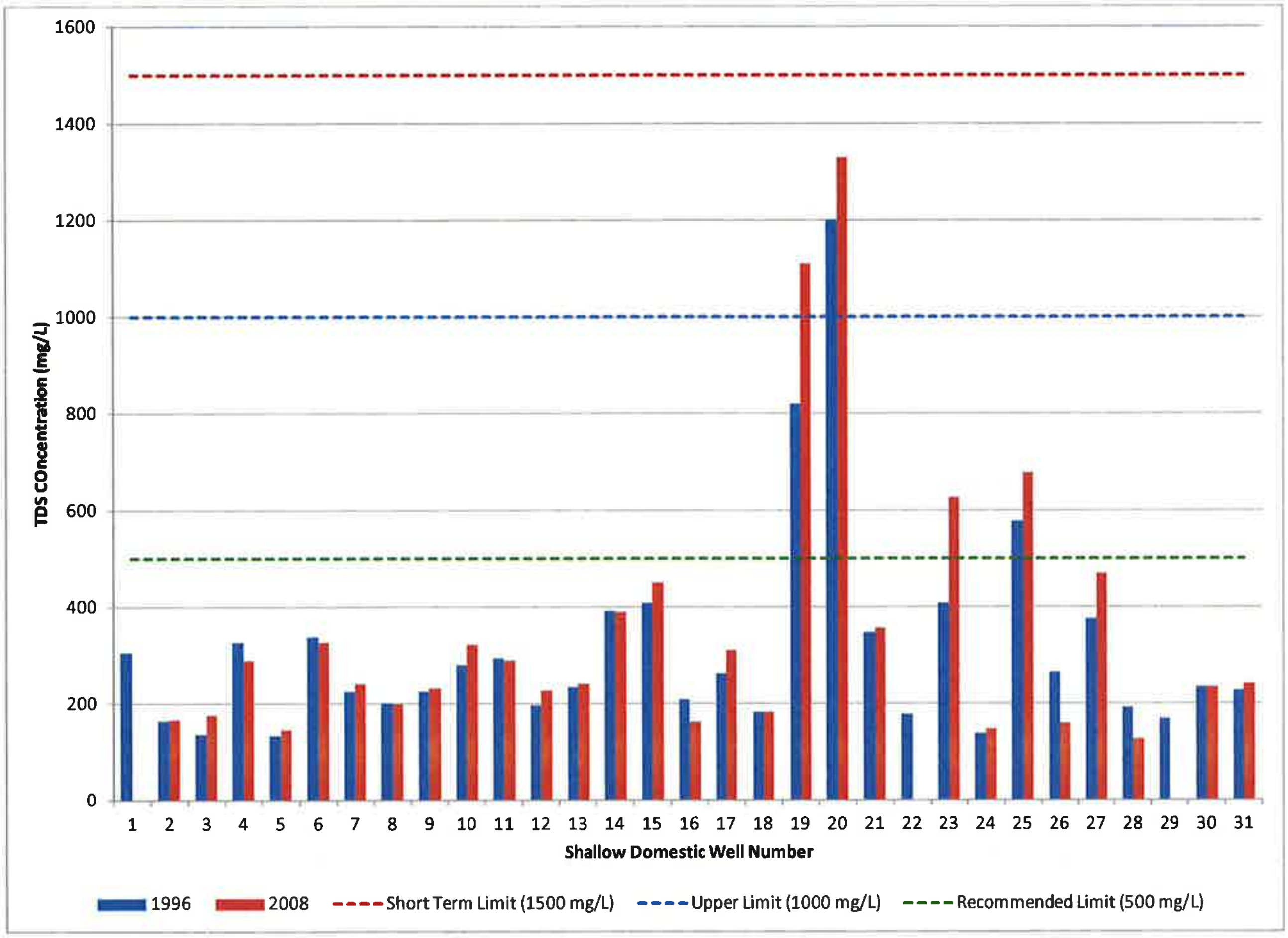
FIGURE 5-9
Minimum and Maximum TDS Concentrations in USGS Rice Wells



5.3.2.2 TDS in Shallow Domestic Wells

Figure 5-11 shows the TDS results of sampling conducted at Shallow Domestic Wells in 1996 and 2006.

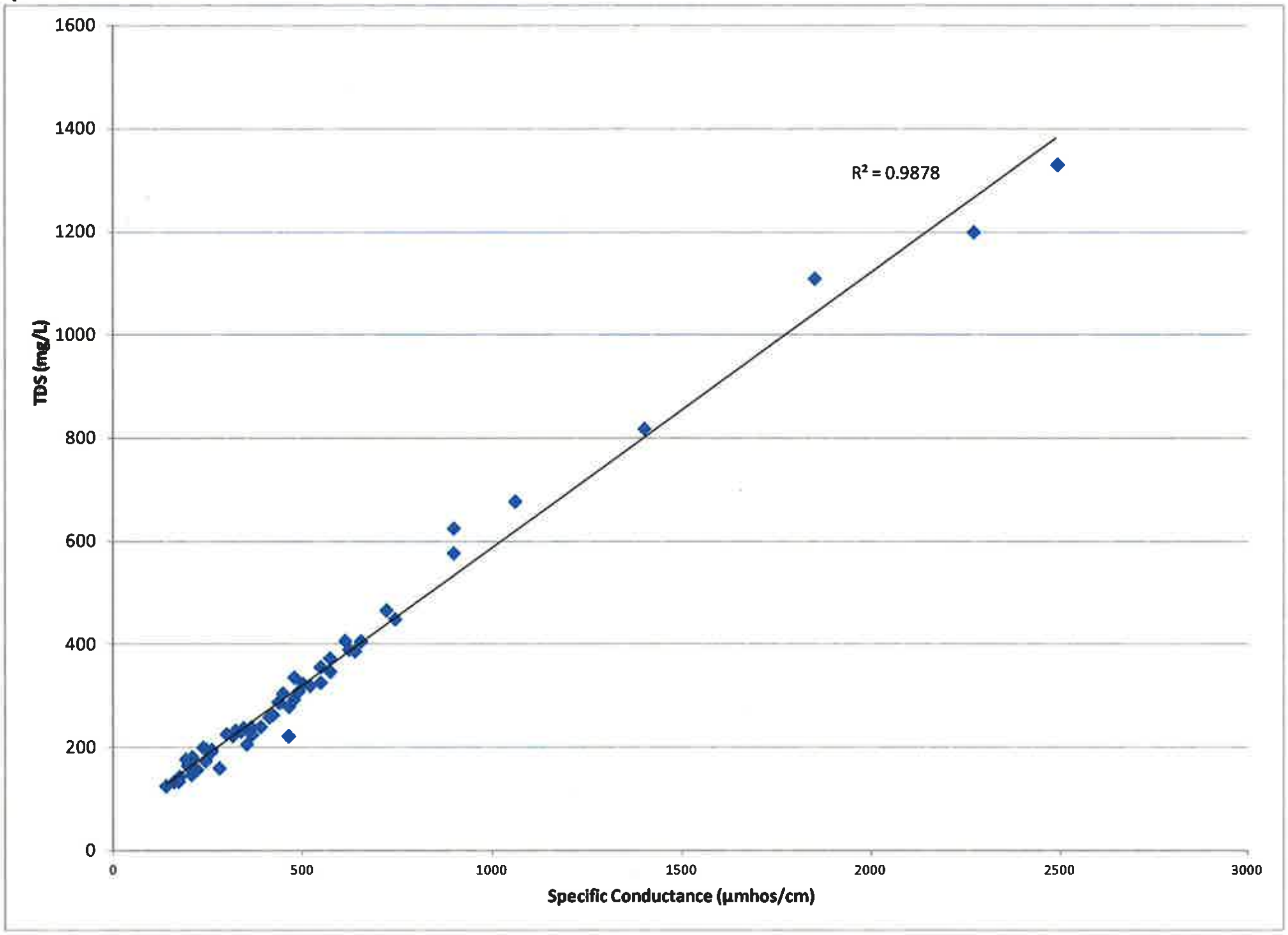
FIGURE 5-11
TDS Concentrations in Shallow Domestic Wells



The following summarizes the results of TDS sampling in Shallow Domestic Wells:

- Maximum observed TDS concentrations were less than 1,000 mg/L in 29 of 31 Shallow Domestic Wells.
- Wells 19 and 20 had concentrations greater than 1,000 mg/L.
- Figure 5-12 shows the specific conductance versus TDS plot for the Shallow Domestic Well dataset. As shown, there is a strong correlation between the two parameters, as expected.

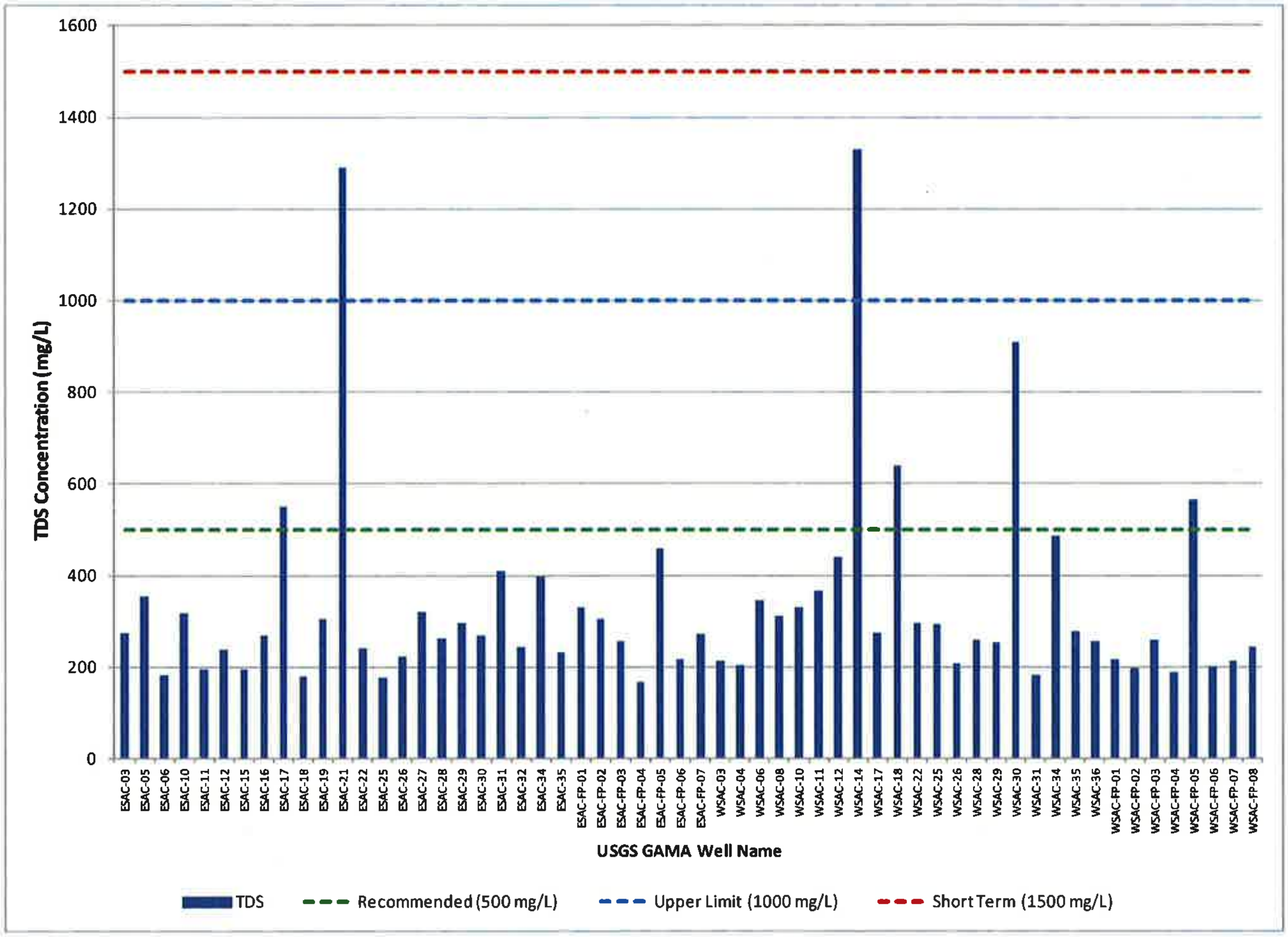
FIGURE 5-12
Specific Conductance vs. TDS in Shallow Domestic Wells



5.3.2.3 TDS in USGS GAMA Wells

Figure 5-13 shows the TDS results of sampling conducted at USGS GAMA Wells.

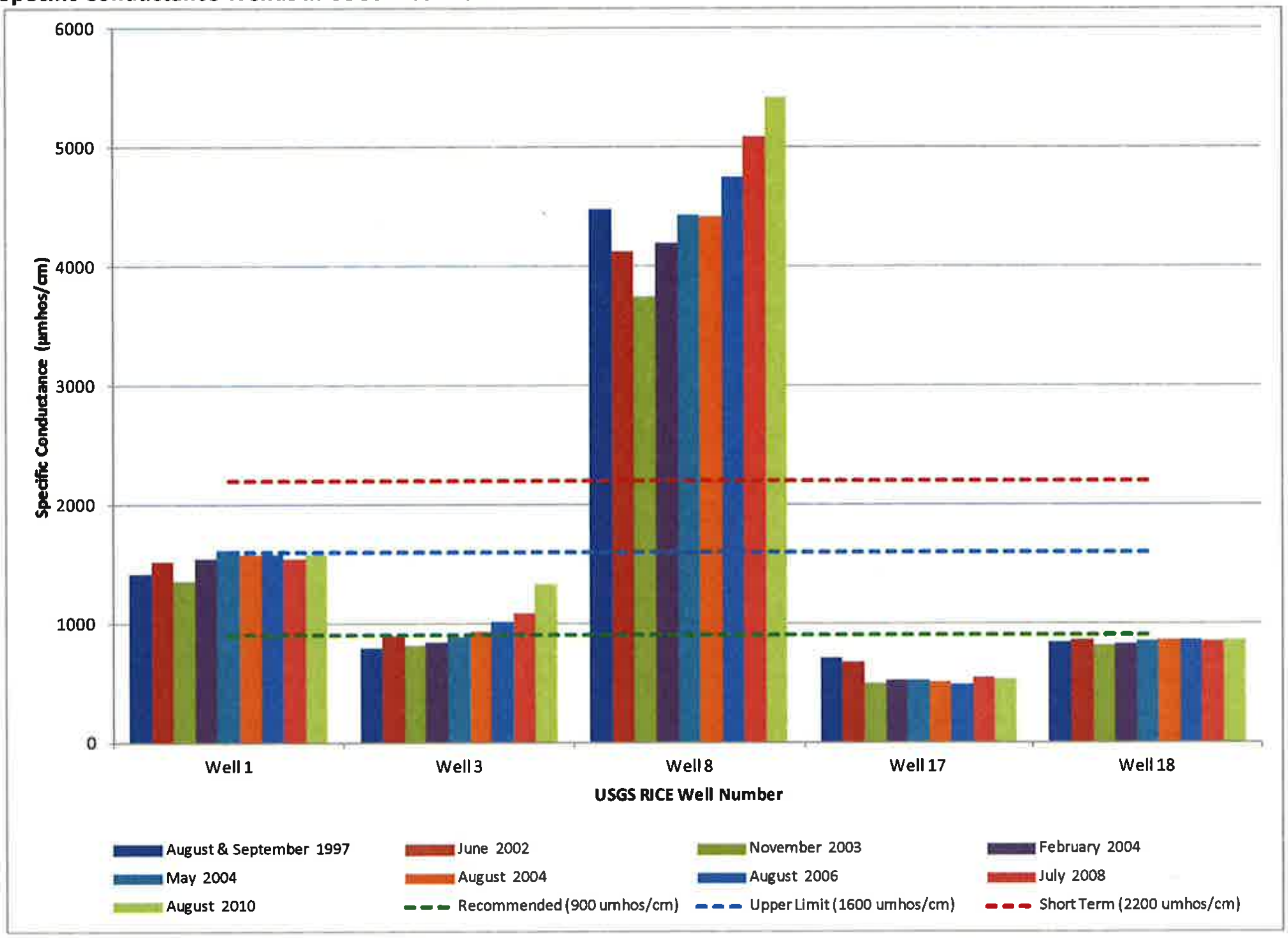
FIGURE 5-13
TDS Concentrations in USGS GAMA Wells



The following summarizes the TDS results for USGS GAMA Wells:

- In 56 of 58 USGS GAMA Wells, TDS was less than the upper limit.
- A maximum observed TDS concentration of 1,330 mg/L was observed at Well WSAC-14.
- These results are consistent with the known low-salinity quality of deep groundwater in the SVGB.
- Specific conductance and TDS are well correlated for this dataset.

FIGURE 5-6
Specific Conductance Trends in USGS Rice Wells



The following summarizes the specific conductance measurements observed in USGS Rice Wells:

- In 21 of 28 USGS Rice Wells, specific conductance was below the upper limit SMCL. In 25 of the 28 wells, specific conductance was less than the short-term PMCL.
- A maximum observed specific conductance of 13,800 µmhos/cm was observed in Well 2, located south of the Sutter Buttes. Two additional wells had specific conductance above the short-term SMCL; Well 8 and Well 9 had maximum observed specific conductance of 5,420 and 4,060 µmhos/cm, respectively.
- As shown in Figure 5-6, specific conductance values fluctuate between sampling events for Wells 3 and 8. Well 3 shows a slight increase in specific conductance over time. Differences of 1,000 µmhos/cm are observed, both in the increasing and decreasing direction for Well 8, with an increasing trend shown for the last 6 sampling events.

FIGURE 5-15

Arsenic Minimum and Maximum Observations in USGS Rice Wells

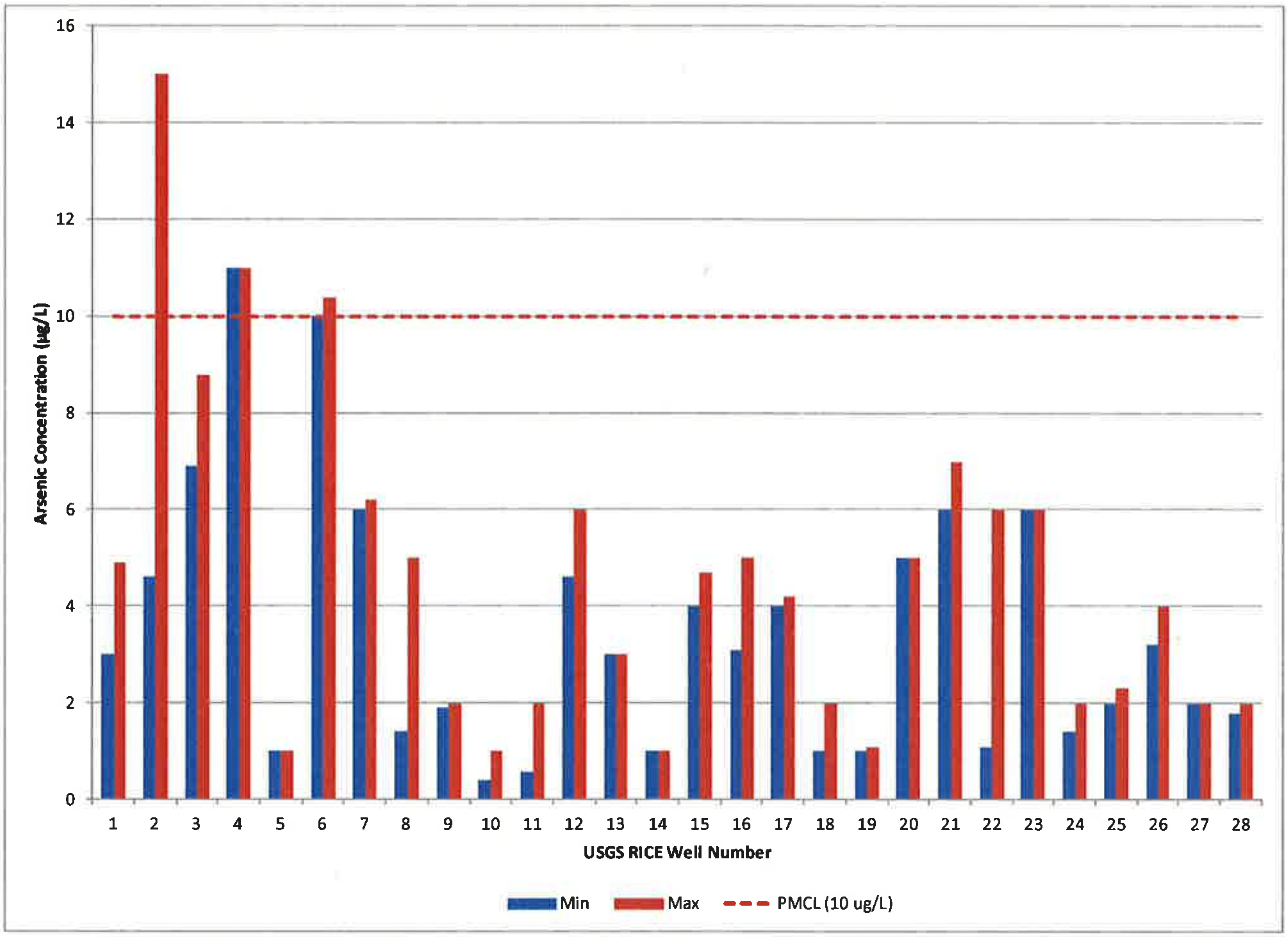
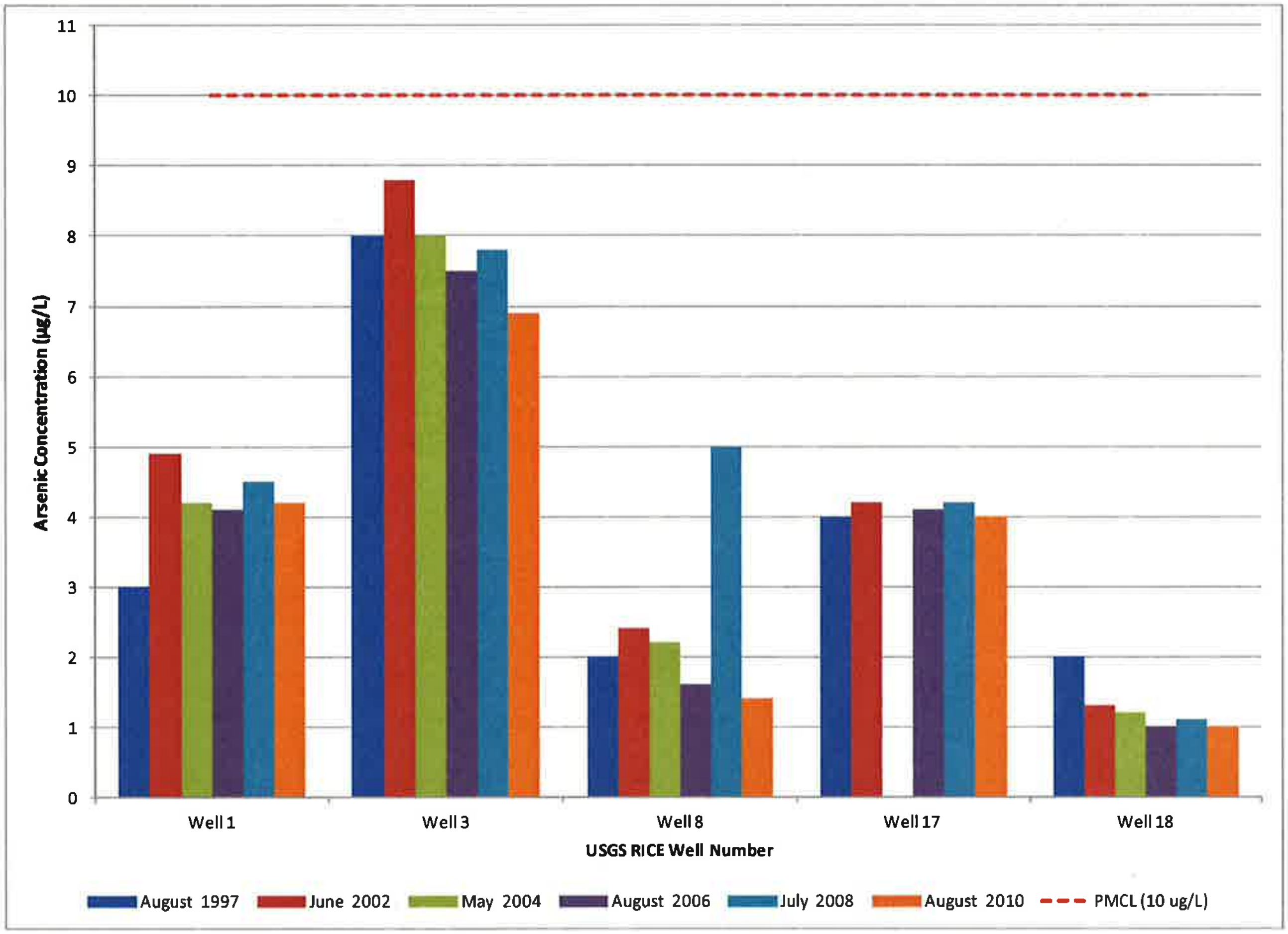


FIGURE 5-16
Arsenic Trends in USGS Rice Wells



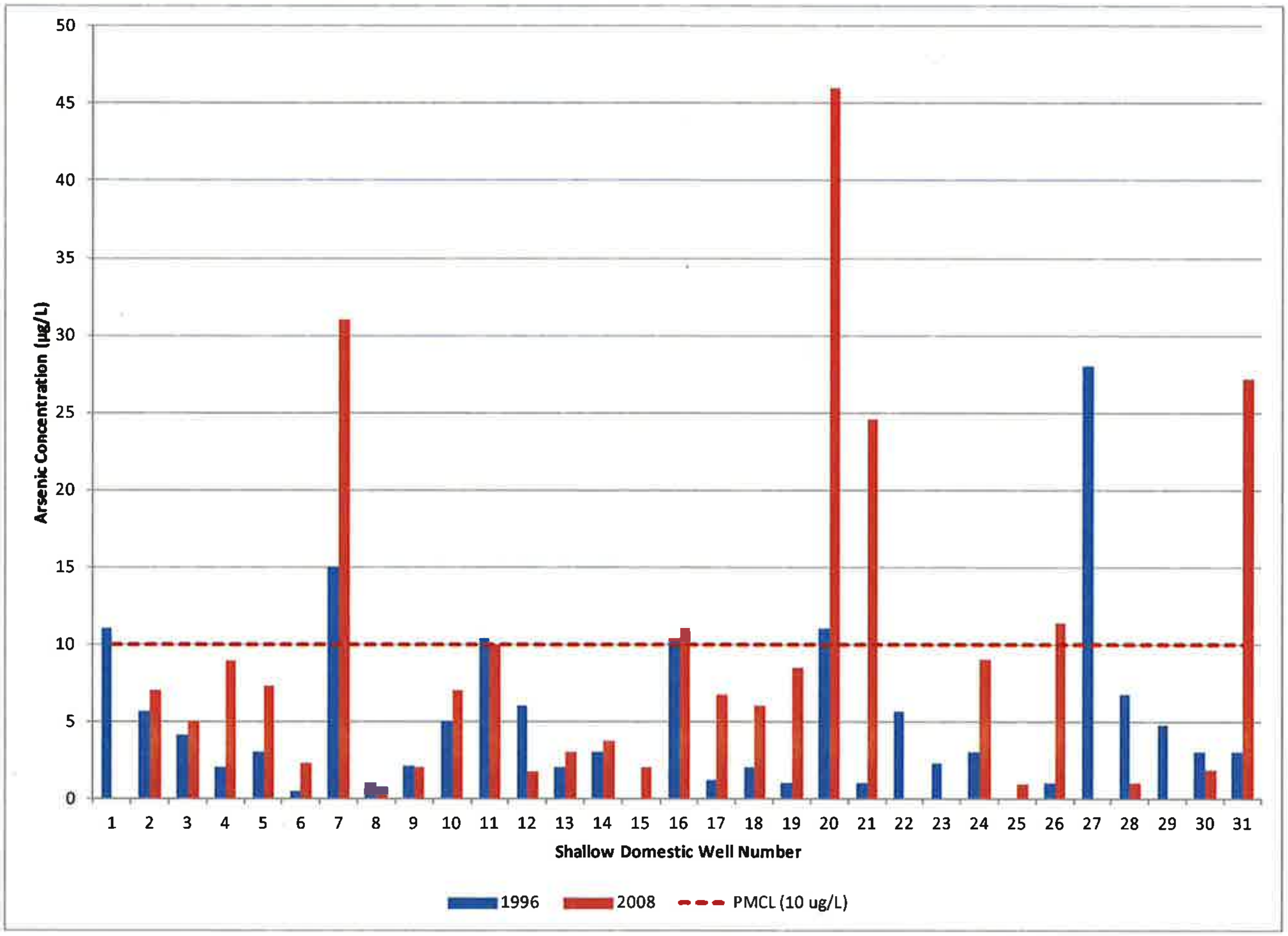
The following summarizes the arsenic results from the USGS Rice Wells:

- In 25 of 28 USGS Rice Wells, maximum observed arsenic concentrations were less than 10 µg/L.
- The maximum arsenic detection of 15 µg/L occurred at Well 2 in 1997. A subsequent 2006 measurement at Well 2 showed a concentration of 4.9 µg/L. Well 2 is located in the Sutter groundwater basin, south of the Sutter Buttes. Wells 4 and 6 had maximum concentrations of 11 µg/L and 10.4 µg/L, respectively.
- An analysis of the results of the five wells that have been sampled six times shows relatively stable concentrations in each well, with some fluctuations in the 2 to 3 µg/L range.

Arsenic in Shallow Domestic Wells

Figure 5-17 shows the arsenic concentrations detected in 1996 and 2008 sampling of the Shallow Domestic Wells.

FIGURE 5-17
Arsenic Concentrations in Shallow Domestic Wells



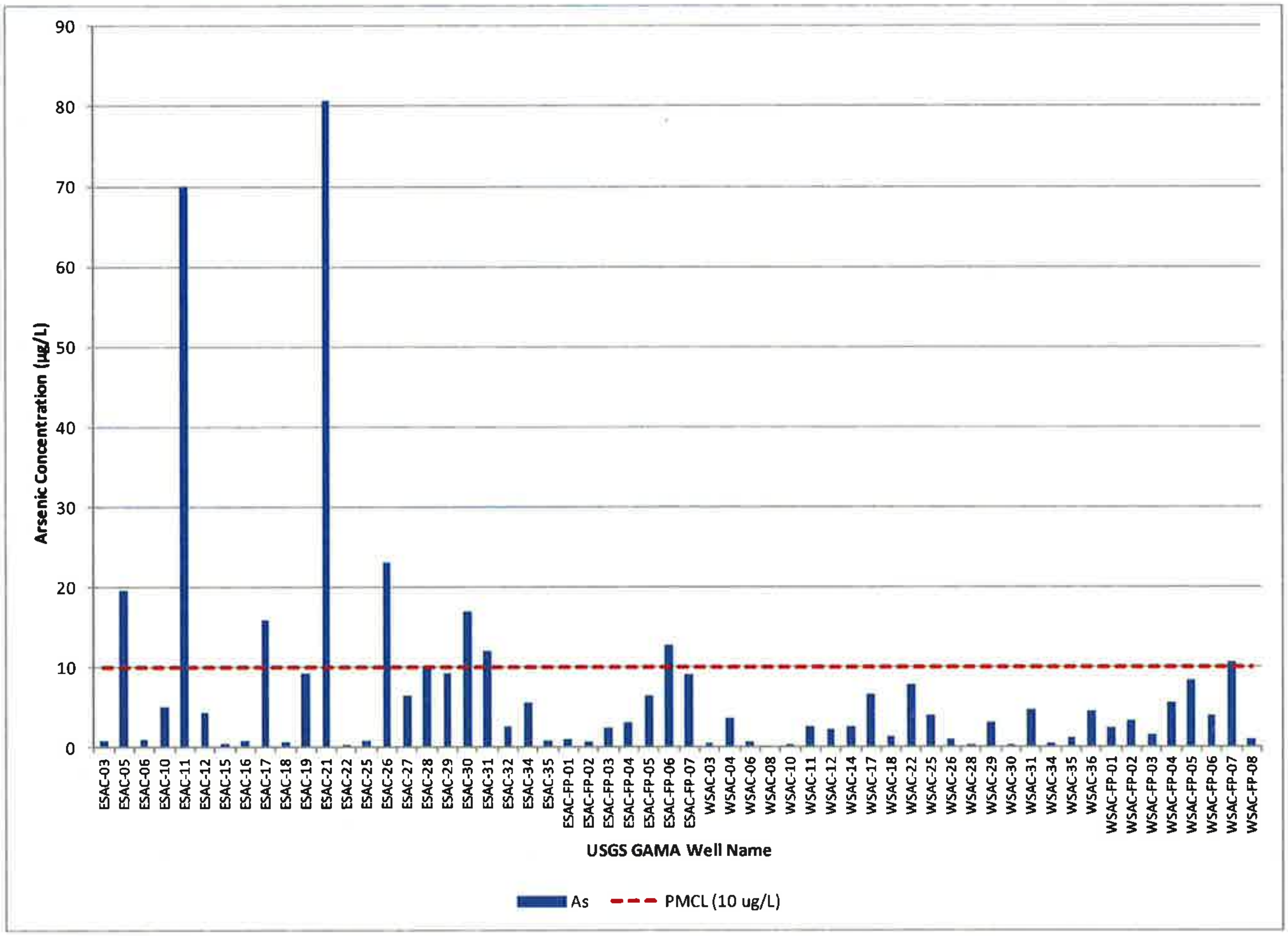
The following summarizes these results:

- In 22 of 31 Shallow Domestic Wells, the maximum arsenic concentration was less than 10 µg/L.
- A maximum observed arsenic concentration of 46 µg/L was detected in Well 20 in June 2008.
- The following additional wells had maximum arsenic observations above 10 µg/L: Wells 1, 7, 11, 16, 20, 21, 26, 27, and 31.
- In general, results from 2008 samples showed increased concentrations relative to 1996 samples.
- Concentrations observed in Shallow Domestic Wells generally exceeded those found in USGS Rice Wells.
- It is noted that this dataset included two duplicate samples in the 1996 sampling. Well 4 duplicates had results of 2 µg/L and 1 µg/L, and the Well 5 duplicates had results of 3 and 0.46 µg/L. These highly variable duplicate results indicate potential variability in test methods and/or within-well samples. The maximum value from the two duplicate samples was used in the graphing and summary.

Arsenic in USGS GAMA Wells

Figure 5-18 shows the results of the arsenic analysis for USGS GAMA Wells.

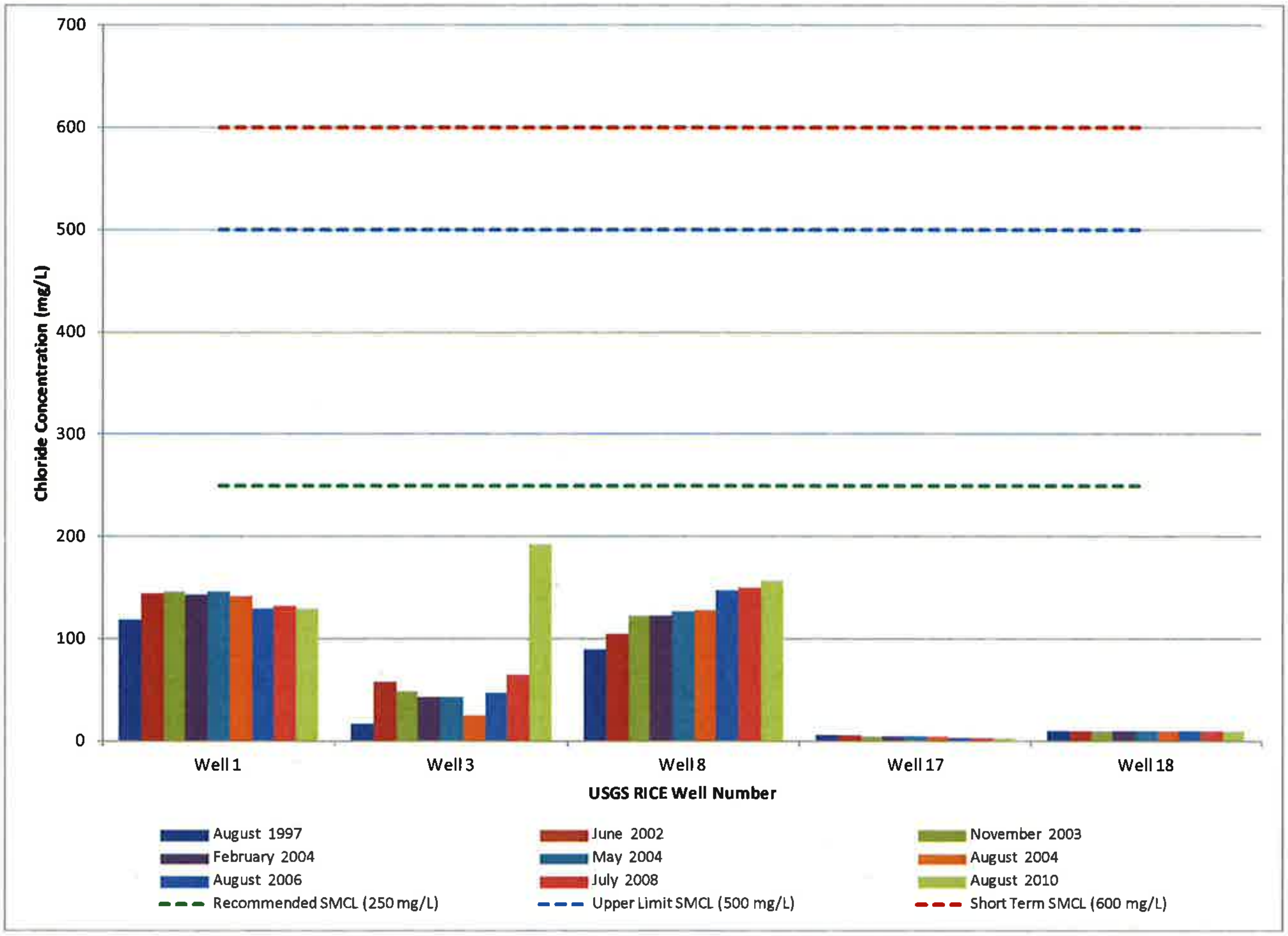
FIGURE 5-18
Arsenic Concentrations in USGS GAMA Wells



The following summarizes the arsenic results:

- Arsenic results are reported for 43 USGS GAMA grid wells and 15 USGS GAMA flow path wells.
- Observed arsenic was less than 10 µg/L in 35 of 43 grid wells and in 13 of 15 flow path wells.
- The maximum observed arsenic concentration was 80.6 µg/L, observed in Well ESAC-21.
- No WSAC grid wells had concentrations above 10 µg/L.

FIGURE 5-25
Chloride Trends in USGS Rice Wells



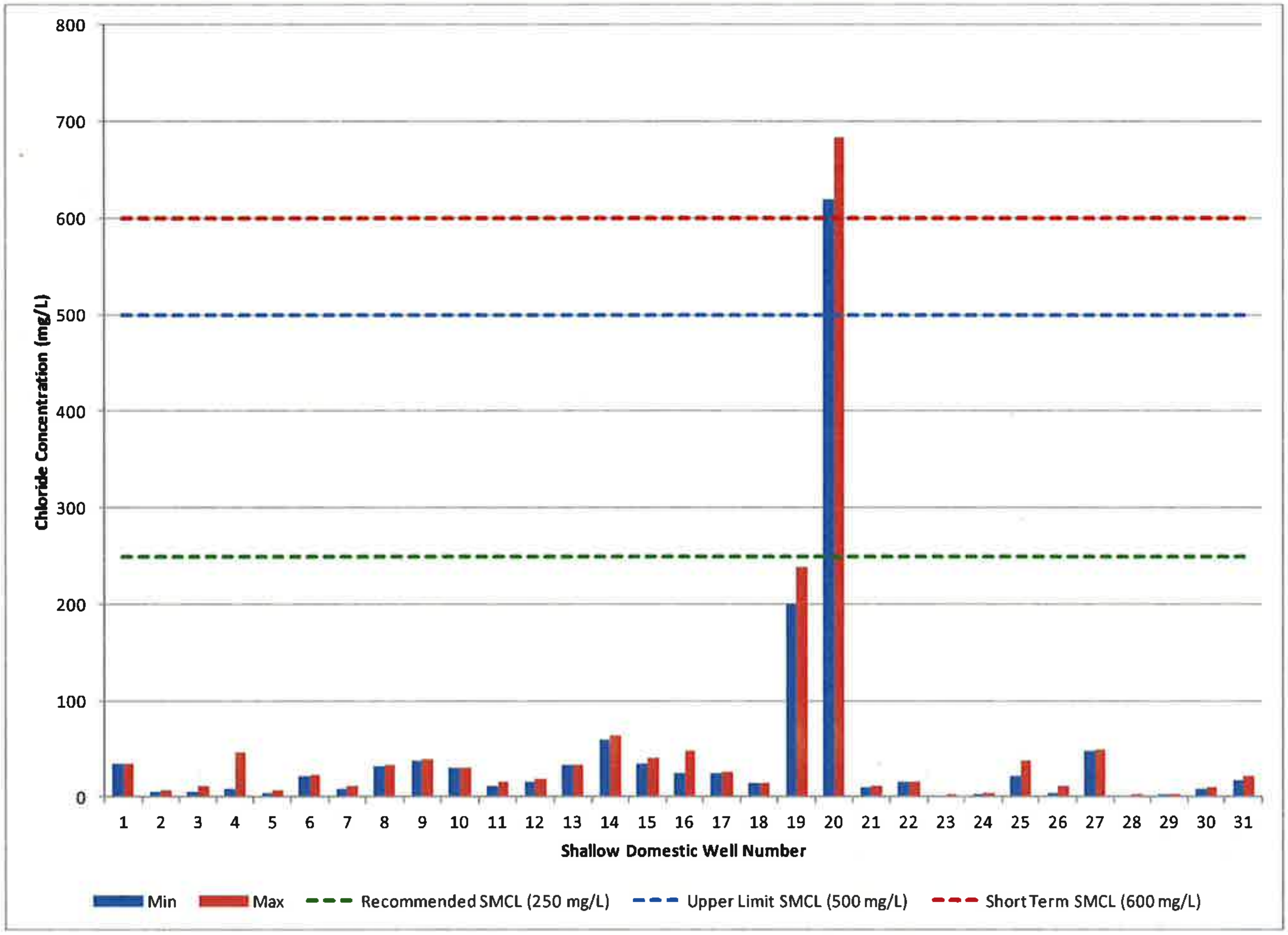
The following summarizes the results of chloride sampling in USGS Rice Wells:

- In 24 of 28 USGS Rice Wells, the maximum observed chloride concentration was less than 1,000 µg/L.
- The maximum observed chloride concentration of 4,770 µg/L was from Well 2 in 1997.

Chloride in Shallow Domestic Wells

Figure 5-26 shows the minimum and maximum observed chloride concentrations in the Shallow Domestic Wells.

FIGURE 5-26
Minimum and Maximum Observed Chloride Concentrations in Shallow Domestic Wells



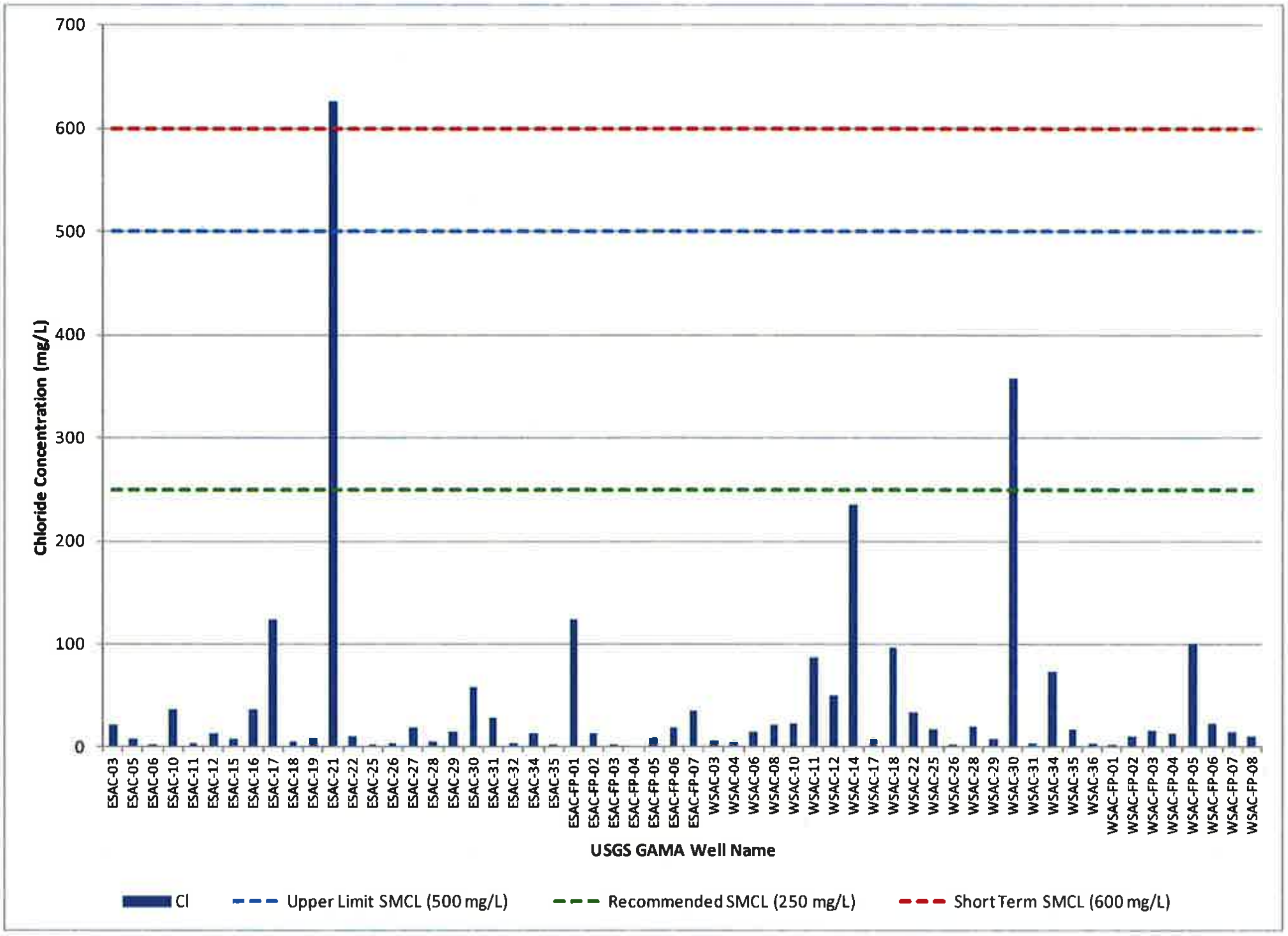
The following summarizes the results of chloride sampling in Shallow Domestic Wells:

- None of the 31 Shallow Domestic Wells had a maximum observed chloride concentration above 1,000 µg/L.
- The maximum observed chloride concentration of 683 µg/L was from Well 20 in 2008. Well 20 is the only well that has exceeded the Upper Limit SMCL for chloride (500 µg/L).

Chloride in USGS GAMA Wells

Figure 5-27 shows the results of chloride sampling in the USGS GAMA Wells.

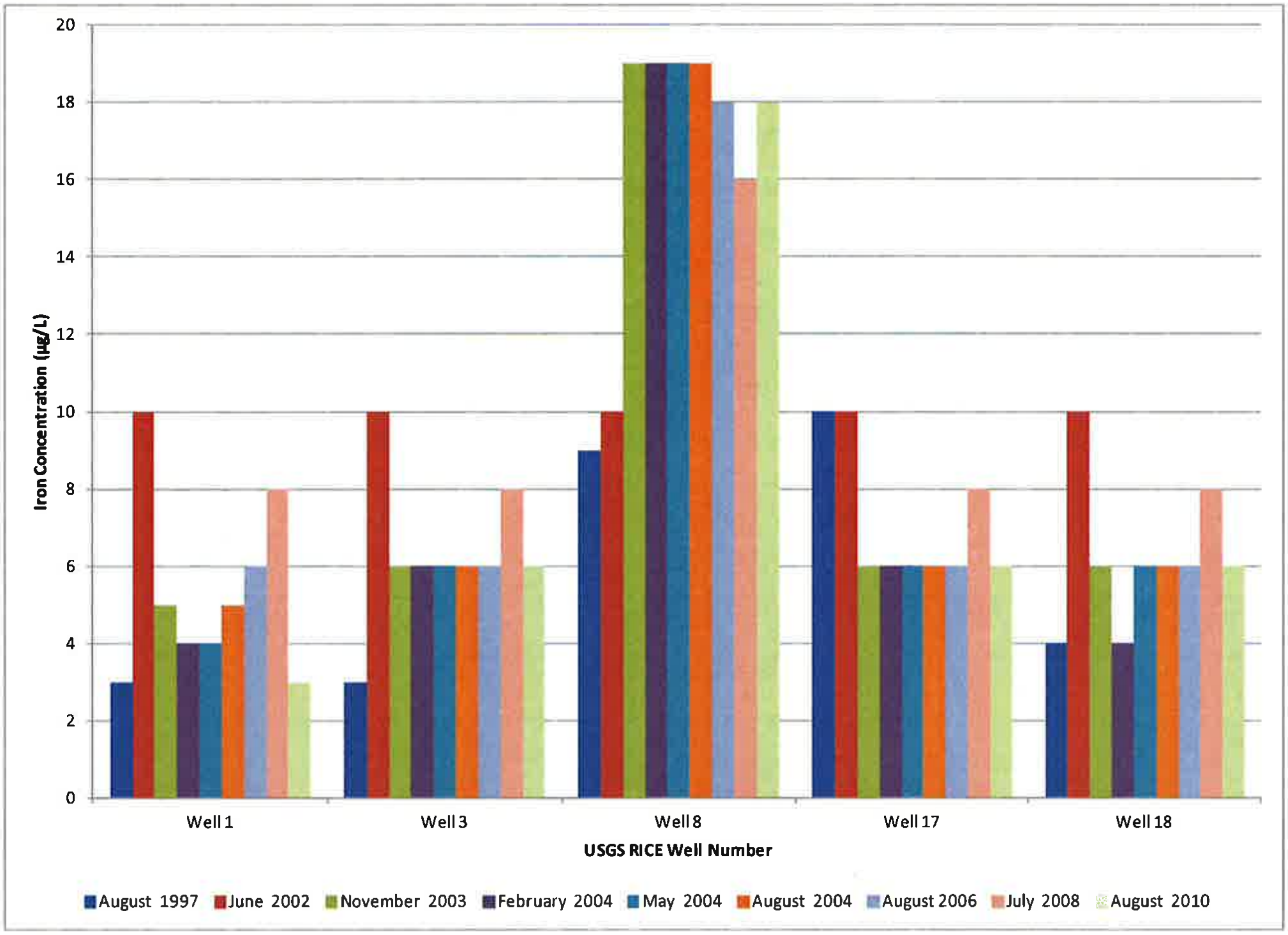
FIGURE 5-27
Chloride Concentrations in USGS GAMA Wells



The following summarizes the results of chloride sampling in USGS GAMA Wells:

- Chloride results are reported for 43 USGS GAMA grid wells and 15 USGS GAMA flowpath wells.
- In 42 of 43 of USGS grid wells, observed chloride was less than the SMCL. Chloride was less than the SMCL in all flowpath wells.
- The maximum observed chloride concentration of 626 mg/L in Well ESAC-21.

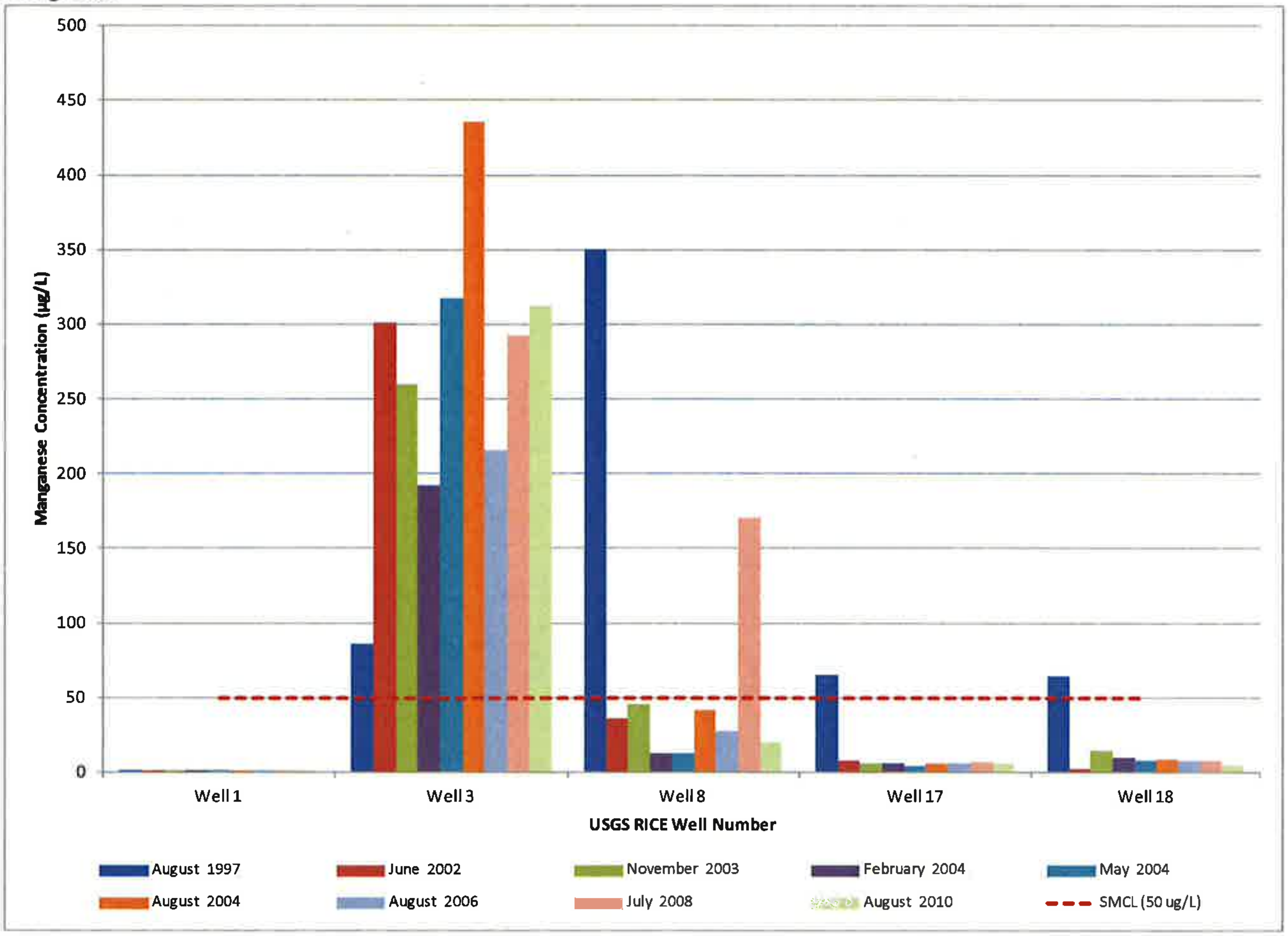
FIGURE 5-29
Iron Trends in USGS Rice Wells



The following summarizes the USGS Rice Well iron observations:

- In 24 of 28 USGS Rice Wells, iron concentrations were less than the 300 µg/L PMCL.
- The maximum iron observation was 5,340 µg/L, observed in Well 2 in 1997.
- In 1997, the iron concentration in Well 9 was 328 µg/L. Subsequent 2006 samples resulted in an iron concentration of 166 µg/L. Likewise, the 1997 observation in Well 22 was 319 µg/L, followed by a 2006 result of 110 µg/L.
- Most USGS Rice Wells showed very low iron concentrations.

FIGURE 5-33
Manganese Trends in USGS Rice Wells



The following summarizes the results of manganese sampling in USGS Rice Wells:

- Maximum observed manganese exceeded the SMCL in 21 of 28 wells. As shown, the concentrations within individual wells can vary greatly. Some wells consistently show negligible concentrations (Wells 1, 17, and 18), but other wells can fluctuate by an order of magnitude. These highly variable results are consistent with the known mobile behavior of manganese. These results show the highly variable concentrations within a single well and indicate that a single high result is not indicative of a trend.

APPENDIX G
SUTTER SUBBASIN
CASGEM AND USGS MONITORING WELL CONSTRUCTION DETAILS

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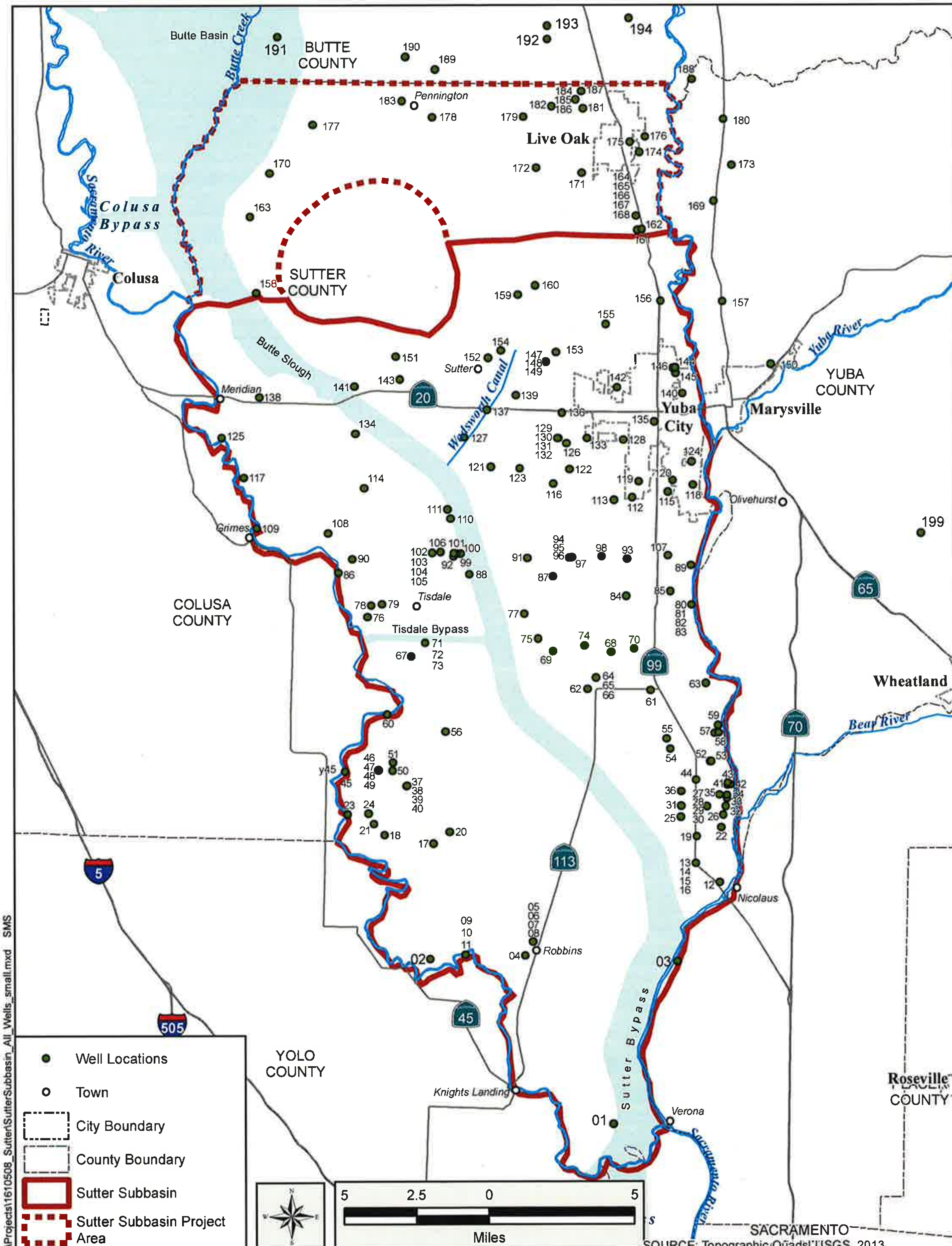

Alternative Submittal Sutter Subbasin	GEI Consultants	Wells Used for Data Analysis
Sutter County		NOVEMBER 2016 FIGURE

Z:\Projects\1610508_Sutter\SutterSubbasin_All_Wells_small.mxd SMS

05-Nov-2016

Label_ID	CASGEM_ID	State ID	Local_ID	Lat_N83	Long_N83	Aquifer
01	387859N1216565W001	11N03E20H003M	RD 1500 Karnak	38.7859000	-121.6565000	Intermediate
02	388666N1217749W001	12N02E20P001M	12N02E20P001M	38.8666000	-121.7749000	Deep
03	388674N1216168W001	12N03E23N001M	12N03E23N001M	38.8674000	-121.6168000	Unknown
04	388691N1217143W001	12N02E23K001M	12N02E23K001M	38.8691000	-121.7143000	Intermediate
05	388761N1217094W001	12N02E23H001M	Sutter County MW-2A	38.8761000	-121.7094000	Shallow
06	388761N1217094W002	12N02E23H002M	Sutter County MW-2B	38.8761000	-121.7094000	Intermediate
07	388761N1217094W003	12N02E23H003M	Sutter County MW-2C	38.8761000	-121.7094000	Deep
08	388761N1217094W004	12N02E23H004M	Sutter County MW-2D	38.8761000	-121.7094000	Deep
09	388813N1217525W001	12N02E21Q001M	SR-1A	38.8690270	-121.7524990	Shallow
10	388813N1217525W002	12N02E21Q002M	SR-1B	38.8690270	-121.7524990	Intermediate
11	388813N1217525W003	12N02E21Q003M	SR-1C	38.8690270	-121.7524990	Deep
12	389074N1215903W001	12N03E12C001M		38.9074000	-121.5903000	Shallow
13	389167N1216061W001	12N03E02G004M		38.9167000	-121.6061000	Shallow
14	389167N1216061W002	12N03E02G001M	12N03E02G001M	38.9167000	-121.6061000	Deep
15	389167N1216061W003	12N03E02G002M	12N03E02G002M	38.9167000	-121.6061000	Deep
16	389167N1216061W004	12N03E02G003M	12N03E02G003M	38.9167000	-121.6061000	Intermediate
17	389242N1217740W001	13N02E32P001M	Well 3 (Klein)	38.9242300	-121.7739600	Intermediate
18	389281N1218056W001		Klein #2	38.9280600	-121.8055600	Intermediate
19	389300N1216056W001	13N03E35K002M		38.9300000	-121.6056000	Unknown
20	389303N1217639W001		Tennis #1	38.9302800	-121.7638900	Unknown
21	389336N1218125W001		Broomiside #2	38.9336110	-121.8125000	Unknown
22	389347N1215897W001		GH Well 19	38.9347470	-121.5897350	Intermediate
23	389382N1218291W001		South Well	38.9381730	-121.8290770	Deep
24	389389N1218161W001		MW-9	38.9388890	-121.8161110	Unknown
25	389398N1216162W001		GH Well 3	38.9397500	-121.6161700	Unknown
26	389410N1215884W001		GH Well 18	38.9410480	-121.5884460	Shallow
27	389452N1215992W001	13N03E26J002M	Sutter County MW-4A	38.9451590	-121.5991500	Intermediate
28	389452N1215992W002	13N03E26J003M	Sutter County MW-4B	38.9451590	-121.5991500	Deep
29	389452N1215992W003	13N03E26J004M	Sutter County MW-4C	38.9451590	-121.5991500	Deep
30	389452N1215992W004	13N03E26J005M	Sutter County MW-4D	38.9451590	-121.5991500	Deep
31	389453N1216159W001		GH Well 2	38.9452900	-121.6159400	Unknown
32	389454N1215870W001		GH Atwal Well	38.9454030	-121.5869940	Unknown
33	389495N1215863W001		GH Well 22	38.9495160	-121.5863100	Intermediate
34	389509N1215863W001		GH Well 4	38.9508860	-121.5862580	Intermediate
35	389510N1215913W001		GH Well 17	38.9510440	-121.5912760	Intermediate
36	389525N1216161W001		GH Well 1	38.9524700	-121.6161300	Unknown
37	389528N1217918W001		Pelger #1 - Shallow	38.9527700	-121.7918400	Intermediate
38	389528N1217918W002		Pelger #1 - Middle	38.9527700	-121.7918400	Intermediate
39	389528N1217918W003		Pelger #1 - Deep	38.9527700	-121.7918400	Intermediate
40	389529N1217917W001		PMWC #1	38.9529000	-121.7917200	Intermediate
41	389560N1215860W001		GH Well 23	38.9560000	-121.5860000	Intermediate
42	389563N1215843W001		GH East MW Site	38.9562630	-121.5843490	Shallow
43	389571N1215858W001		GH North MW Site	38.9570960	-121.5858230	Shallow
44	389582N1216067W001	13N03E23K001M		38.9582000	-121.6067000	Shallow
45	389596N1218314W001		North Well	38.9595940	-121.8313690	Deep
46	389605N1218102W001	13N01E24G002M	Flood MW-1A (deep)	38.9605000	-121.8102000	Intermediate
47	389605N1218102W002	13N01E24G003M	Flood MW-1B (int)	38.9605000	-121.8102000	Intermediate
48	389605N1218102W003	13N01E24G004M	Flood MW-1C (shall)	38.9605000	-121.8102000	Shallow
49	389605N1218103W001	13N01E24K001M	Well 2 (Flopet)	38.9605000	-121.8102600	Intermediate
50	389606N1218011W001		Tucker #2	38.9605600	-121.8011100	Unknown
51	389644N1218010W001	13N02E19D001M	Well 1 (Tucker)	38.9644300	-121.8009600	Deep
52	389677N1215974W001		GH Rouse Ranch Well	38.9677100	-121.5974300	Unknown

53	389678N1215967W001	13N03E24D001M		38.9678000	-121.5967000	Unknown
54	389736N1216233W001		Feather WD-3	38.9736070	-121.6232810	Shallow
55	389786N1216259W001	13N03E15C003M	13N03E15C003M	38.9786000	-121.6259000	Unknown
56	389803N1217675W001	13N02E17A001M	13N02E17A001M	38.9803000	-121.7675000	Shallow
57	389819N1215949W001	13N03E13D001M		38.9819000	-121.5949000	Intermediate
58	389820N1215923W001		Feather WD-2	38.9820250	-121.5922930	Shallow
59	389860N1215928W001		Feather WD-1	38.9859830	-121.5927750	Intermediate
60	389885N1218051W001	13N01E12J002M	13N01E12J002M	38.9885000	-121.8051000	Shallow
61	390027N1216367W001	13N03E04J001M	13N03E04J001M	39.0027000	-121.6367000	Shallow
62	390028N1216772W001	13N03E06K001M		39.0028000	-121.6772000	Unknown
63	390067N1216012W001	13N03E02H001M		39.0067000	-121.6012000	Unknown
64	390087N1216722W001	13N03E06A001M	Sutter County MW-6A	39.0086410	-121.6718700	Shallow
65	390087N1216722W002	13N03E06A002M	Sutter County MW-6B	39.0086410	-121.6718700	Intermediate
66	390087N1216722W003	13N03E06A003M	Sutter County MW-6C	39.0086410	-121.6718700	Intermediate
67	390176N1217902W001	14N02E31K001M	14N02E31K001M	39.0176000	-121.7902000	Shallow
68	390214N1216625W001		Feather WD-4	39.0214100	-121.6624780	Shallow
69	390215N1216994W001	14N02E36F001M	14N02E36F001M	39.0215000	-121.6994000	Intermediate
70	390234N1216478W001	14N03E33C001M	14N03E33C001M	39.0234000	-121.6478000	Unknown
71	390244N1217813W001	14N02E32D001M	SMWC MW-1A	39.0244290	-121.7812770	Shallow
72	390244N1217813W002	14N02E32D002M	SMWC MW-1B	39.0244290	-121.7812770	Intermediate
73	390244N1217813W003	14N02E32D003M	SMWC MW-1C	39.0244290	-121.7812770	Deep
74	390245N1216796W001	14N03E31B001M	14N03E31B001M	39.0245000	-121.6796000	Unknown
75	390277N1217090W001	14N02E26R001M		39.0277000	-121.7090000	Unknown
76	390369N1218189W001		TID Park-Lonon	39.0369080	-121.8189100	Unknown
77	390398N1217181W001	14N02E26C001M	14N02E26C001M	39.0398320	-121.7181220	Intermediate
78	390426N1218166W001	14N01E24N001M	14N01E24N001M	39.0426000	-121.8166000	Shallow
79	390433N1218097W001	14N01E24Q001M	14N01E24Q001M	39.0433000	-121.8097000	Unknown
80	390458N1216114W001	14N03E23D003M	Feather River MW-1A	39.0458000	-121.6114000	Shallow
81	390458N1216114W002	14N03E23D004M	Feather River MW-1B	39.0458000	-121.6114000	Intermediate
82	390458N1216114W003	14N03E23D005M	Feather River MW-1C	39.0458000	-121.6114000	Deep
83	390458N1216114W004	14N03E23D006M	Feather River MW-1D	39.0458000	-121.6114000	Deep
84	390497N1216535W001	14N03E20H003M	14N03E20H003M	39.0497000	-121.6535000	Shallow
85	390524N1216249W001	14N03E22B002M	14N03E22B002M	39.0524000	-121.6249000	Unknown
86	390587N1218380W001		TID Park-Windship	39.0586970	-121.8379650	Intermediate
87	390588N1217004W001	14N02E13L001M	14N02E13L001M	39.0588000	-121.7004000	Shallow
88	390590N1217538W001	14N02E16K001M	TBF Well 5	39.0589900	-121.7538300	Intermediate
89	390654N1216120W001	14N03E14E002M		39.0654000	-121.6120000	Unknown
90	390657N1218291W001	14N01E14G001M	14N01E14G001M	39.0657000	-121.8291000	Unknown
91	390676N1217169W001	14N02E14B001M		39.0676000	-121.7169000	Unknown
92	390679N1217641W001		TBF Well 6	39.0678800	-121.7641100	Unknown
93	390681N1216534W001	14N03E17A003M		39.0681000	-121.6534000	Intermediate
94	390682N1216901W001	14N02E13A003M	SEWD MW-3A	39.0682330	-121.6901020	Shallow
95	390682N1216901W002	14N02E13A004M	SEWD MW-3B	39.0682330	-121.6901020	Intermediate
96	390682N1216901W003	14N02E13A005M	SEWD MW-3C	39.0682330	-121.6901020	Deep
97	390684N1216886W001	14N03E18D001M		39.0684000	-121.6886000	Unknown
98	390691N1216695W001	14N03E08N001M		39.0691000	-121.6695000	Unknown
99	390694N1217599W001	14N02E16D002M	TBF Well 2	39.0694200	-121.7598800	Intermediate
100	390695N1217623W001	14N02E16D001M	TBF Well 3	39.0694500	-121.7623000	Deep
101	390695N1217640W001	14N02E16D003M	TBF Well 7	39.0694600	-121.7640000	Intermediate
102	390696N1217778W001	14N02E17C001M	Sutter County MW-1A	39.0696000	-121.7778000	Shallow
103	390696N1217778W002	14N02E17C002M	Sutter County MW-1B	39.0696000	-121.7778000	Intermediate
104	390696N1217778W003	14N02E17C003M	Sutter County MW-1C	39.0696000	-121.7778000	Deep
105	390696N1217778W004	14N02E17C004M	Sutter County MW-1D	39.0696000	-121.7778000	Deep

106	390700N1217725W001	14N02E08Q001M	TBF Well 4	39.0700200	-121.7724800	Deep
107	390701N1216268W001	14N03E10P003M		39.0701000	-121.6268000	Shallow
108	390784N1218450W001		MFWC Park2	39.0783890	-121.8449660	Intermediate
109	390803N1218906W001		MFWC Park-Miller	39.0802570	-121.8905990	Intermediate
110	390867N1217665W001	14N02E05R001M	TBF Well 1	39.0867400	-121.7664600	Intermediate
111	390914N1217685W001		TBF Well 8	39.0914000	-121.7685200	Unknown
112	390976N1216622W001	14N03E05C001M		39.0976000	-121.6622000	Intermediate
113	390989N1216505W001	15N03E33N004M		39.0989000	-121.6505000	Unknown
114	391012N1218222W001		BS1-McClatchy	39.1011890	-121.8222240	Intermediate
115	391021N1216275W001	15N03E34L001M		39.1021000	-121.6275000	Intermediate
116	391051N1217012W001	15N02E36L001M	15N02E36L001M	39.1051130	-121.7012000	Shallow
117	391052N1218994W001		MFWC S Meridian	39.1052380	-121.8993770	Unknown
118	391057N1216114W001		WWTP Well	39.1056560	-121.6114110	Unknown
119	391068N1216464W001		Edwin	39.1068280	-121.6464450	Intermediate
120	391078N1216244W001		La Grande	39.1077920	-121.6244330	Intermediate
121	391115N1217425W001	15N02E34D002M	15N02E34D002M	39.1129530	-121.7411100	Shallow
122	391124N1216910W001	15N02E36A001M		39.1124000	-121.6910000	Shallow
123	391124N1217226W001	15N02E35D001M	15N02E35D001M	39.1124000	-121.7226000	Intermediate
124	391173N1216125W001	15N03E26M001M		39.1173000	-121.6125000	Intermediate
125	391251N1219138W001	15N01W25A001M	15N01W25A001M	39.1251000	-121.9138000	Shallow
126	391254N1216930W001	15N02E25A001M		39.1254000	-121.6930000	Shallow
127	391274N1217586W001	15N02E28D002M		39.1274000	-121.7586000	Shallow
128	391275N1216569W001	15N03E20R001M	15N03E20R001M	39.1275000	-121.6569000	Unknown
129	391278N1216984W001	15N02E24P004M	SEWD Well #2	39.1277860	-121.6984270	Deep
130	391279N1216989W001	15N02E24P001M	SEWD MW-2A	39.1278610	-121.6988810	Intermediate
131	391279N1216989W002	15N02E24P002M	SEWD MW-2B	39.1278610	-121.6988810	Intermediate
132	391279N1216989W003	15N02E24P003M	SEWD MW-2C	39.1278610	-121.6988810	Deep
133	391282N1216799W001		Lyndsey	39.1281760	-121.6799280	Unknown
134	391283N1218286W001		BS2-Franklin	39.1283000	-121.8285620	Intermediate
135	391370N1216371W001	15N03E21H002M		39.1370000	-121.6371000	Intermediate
136	391406N1216961W001	15N02E24B001M	15N02E24B001M	39.1406000	-121.6961000	Shallow
137	391414N1217442W001	15N02E22D001M	15N02E22D001M	39.1414000	-121.7442000	Intermediate
138	391456N1218904W001		MFWC Prop 50	39.1455930	-121.8904030	Intermediate
139	391489N1217259W001	15N02E14M001M	15N02E14M001M	39.1488830	-121.7258500	Intermediate
140	391512N1216190W001	15N03E15H004M	15N03E15H004M	39.1512000	-121.6190000	Shallow
141	391518N1218295W001	15N01E14F001M		39.1518000	-121.8295000	Intermediate
142	391537N1216612W001	15N03E17B002M	15N03E17B002M	39.1537000	-121.6612000	Unknown
143	391558N1218004W001	15N01E13A001M		39.1558000	-121.8004000	Intermediate
144	391613N1216236W001		WTP Well	39.1613370	-121.6236420	Deep
145	391638N1216252W001	15N03E10G002M		39.1638000	-121.6252000	Unknown
146	391642N1216240W001	15N03E10G001M		39.1642000	-121.6240000	Intermediate
147	391658N1217070W001	15N02E12E001M	SEWD MW-1A	39.1658460	-121.7070330	Intermediate
148	391658N1217070W002	15N02E12E002M	SEWD MW-1B	39.1658460	-121.7070330	Intermediate
149	391658N1217070W003	15N02E12E003M	SEWD MW-1C	39.1658460	-121.7070330	Deep
150	391667N1215622W001	15N04E07H001M	15N04E07H001M	39.1667000	-121.5622000	Unknown
151	391672N1218034W001	15N01E12A001M		39.1672000	-121.8034000	Unknown
152	391673N1217440W001	15N02E10D002M		39.1673000	-121.7440000	Shallow
153	391707N1217006W001	15N02E12C001M	SEWD Well #1	39.1707460	-121.7006080	Deep
154	391710N1217359W001		SCSD Well #1	39.1710310	-121.7358900	Unknown
155	391851N1216691W001	15N03E05D002M		39.1851000	-121.6691000	Intermediate
156	391970N1216340W001	16N03E33J002M		39.1970000	-121.6340000	Unknown
157	391975N1215940W001	16N03E36M001M	YCWA-01	39.1975000	-121.5940000	Intermediate
158	391975N1218937W001	16N01E31H001M	16N01E31H001M	39.1975000	-121.8937000	Shallow

159	391990N1217257W001	16N02E35C003M	16N02E35	39.1989500	-121.7256500	Intermediate
160	392038N1217147W001	16N02E26Q001M	16N02E26Q001M	39.2038000	-121.7147000	Shallow
161	392324N1216499W001	16N03E21D001M	16N03E21D001M	39.2324000	-121.6499000	Shallow
162	392328N1216469W001	16N03E21D002M	16N03E21D002M	39.2328000	-121.6469000	Shallow
163	392355N1218985W001	16N01E18K001M		39.2355000	-121.8985000	Shallow
164	392394N1216509W001	16N03E17J001M	Sutter County MW-3A	39.2394000	-121.6509000	Shallow
165	392394N1216509W002	16N03E17J002M	Sutter County MW-3B	39.2394000	-121.6509000	Intermediate
166	392394N1216509W003	16N03E17J003M	Sutter County MW-3C	39.2394000	-121.6509000	Deep
167	392394N1216509W004	16N03E17J004M	Sutter County MW-3D	39.2394000	-121.6509000	Deep
168	392394N1216509W005	16N03E17J005M	Sutter County MW-3E	39.2394000	-121.6509000	Deep
169	392475N1216005W001	16N03E14B004M	YCWA-03	39.2475000	-121.6005000	Intermediate
170	392575N1218863W001	16N01E08C001M	16N01E08C001M	39.2575000	-121.8863000	Unknown
171	392603N1216860W001	16N03E07D002M	16N03E07D002M	39.2603000	-121.6860000	Intermediate
172	392634N1217141W001	16N02E02Q001M	16N02E02Q001M	39.2623860	-121.7150420	Unknown
173	392655N1215894W001	16N03E01P002M		39.2655000	-121.5894000	Shallow
174	392712N1216493W001	16N03E04E001M	16N03E04E001M	39.2712000	-121.6493000	Shallow
175	392762N1216556W001		Live Oak Well 5	39.2762340	-121.6556140	Unknown
176	392790N1216451W001	17N03E33P001M	17N03E33P001M	39.2790100	-121.6457130	Unknown
177	392821N1218593W001	17N01E33G001M		39.2821000	-121.8593000	Unknown
178	392867N1217825W001	17N02E31A001M	17N02E31A001M	39.2867000	-121.7825000	Deep
179	392878N1217240W001	17N02E34A001M		39.2878000	-121.7240000	Shallow
180	392883N1215952W001	17N03E35H003M	YCWA-04	39.2883000	-121.5952000	Intermediate
181	392929N1216859W001	17N03E30N001M	17N03E30N001M	39.2926440	-121.6860930	Unknown
182	392935N1217061W001	17N02E26R001M	17N02E26R001M	39.2935000	-121.7061000	Deep
183	392947N1218022W001	17N01E25J001M	17N01E25J001M	39.2947000	-121.8022000	Unknown
184	392970N1216907W001	17N02E25J001M	BWD MW-1A	39.2970510	-121.6906990	Deep
185	392970N1216907W002	17N02E25J002M	BWD MW-1B	39.2970510	-121.6906990	Intermediate
186	392970N1216907W003	17N02E25J003M	BWD MW-1C	39.2970510	-121.6906990	Shallow
187	393012N1216873W001	17N03E30E001M	17N03E30E001M	39.3012000	-121.6873000	Deep
188	393081N1216163W001	17N03E22R001M		39.3081000	-121.6163000	Unknown
189	393108N1217811W001	17N02E19J001M	BMO 17N02E19J001M	39.3108000	-121.7811000	Intermediate
190	393169N1218004W002	17N01E24A003M	BMO 17N01E24A003M	39.3169000	-121.8004000	Deep
191	393257N1218830W001	17N01E17F001M	BMO 17N01E17F001M	39.3257000	-121.8830000	Intermediate
192	393269N1217096W001	17N02E14H001M	BMO 17N02E14H001M	39.3269000	-121.7096000	Shallow
193	393337N1217097W001	17N02E14A001M	BMO 17N02E14A001M	39.3337000	-121.7097000	Shallow
194	393383N1216575W001	17N03E08K002M	17N03E08K002M	39.3383000	-121.6575000	Shallow
195	393457N1218375W001	17N01E10A001M	BMO 17N01E10A001M	39.3457000	-121.8375000	Shallow
196	USGS 385314121401701		012N003E18H001M	38.5312900	-121.4021880	Shallow
197	USGS 385431121451401		012N002E09B002M	38.5430560	-121.4518240	Shallow
198	USGS 390416121433601		014N002E10R001M	39.0415430	-121.4339140	Shallow
199	USGS 390832121463601		015N002E20D001M	39.0832690	-121.4638780	Shallow

Sutter Subbasin Well Construction Details

State Well Number	CASGEM Well Number	Local Well Designation	Type of Well	Status of Well	Well Usage	Total Well Depth	Measurement Count	Earliest Elevation Measurement Date	Most Recent Elevation Measurement Date	Latitude (NAD 83)	Longitude (NAD 83)	Completion Type	Well Completion Report #	Total Depth	S1 Top	S1 Bottom	S2 Top	S2 Bottom	S3 Top	S3 Bottom	S4 Top	S4 Bottom
Shallow Aquifer																						
15N02E28D002M	391274N1217586W001		Voluntary	Active	Unknown	Confidential				39.1274	-121.7586	Unknown	0	19	0	0	0	0	0	0	0	0
15N02E28D002M	391274N1217586W001		Voluntary	Active	Unknown	Confidential				39.1274	-121.7586	Unknown	0	19	0	0	0	0	0	0	0	0
	389563N1215843W001	GH East MW Site	Voluntary	Active	Observation	Confidential	57	6/10/2014 8:55	3/3/2016 13:15	38.95626	-121.5843	Single Well	e0181229	40	30	40	0	0	0	0	0	0
	389571N1215858W001	GH North MW Site	Voluntary	Active	Observation	Confidential	56	6/10/2014 8:45	3/3/2016 13:26	38.9571	-121.5858	Single Well	e0181226	40	30	40	0	0	0	0	0	0
15N02E24B001M	391406N1216961W001	15N02E24B001M	Voluntary	Active	Irrigation	Confidential	179	12/22/1947 0:00	5/10/2016 0:00	39.1406	-121.6961	Single Well	0	50	0	0	0	0	0	0	0	0
15N02E10D002M	391673N1217440W001		Voluntary	Active	Residential	Confidential	21	8/7/1962 0:00	3/16/1972 0:00	39.1673	-121.744	Unknown	0	55	0	0	0	0	0	0	0	0
15N02E10D002M	391673N1217440W001		Voluntary	Active	Residential	Confidential	21	8/7/1962 0:00	3/16/1972 0:00	39.1673	-121.744	Unknown	0	55	0	0	0	0	0	0	0	0
16N02E26Q001M	392038N1217147W001	16N02E26Q001M	Voluntary	Active	Irrigation	Confidential	169	9/18/1957 0:00	5/19/2016 0:00	39.2038	-121.7147	Single Well	0	60	0	0	0	0	0	0	0	0
14N02E17C001M	390696N1217778W001	Sutter County MW-1A	CASGEM	Active	Observation	60	66	2/24/2010 0:00	3/28/2016 13:58	39.0696	-121.7778	Part of a nested/multi-completion well	E0108475	60	33	53	0	0	0	0	0	0
14N02E32D001M	390244N1217813W001	SMWC MW-1A	CASGEM	Active	Observation	64	35	6/18/2012 10:12	3/28/2016 13:00	39.02443	-121.7813	Part of a nested/multi-completion well	E0155755A	64	34	54	0	0	0	0	0	0
14N03E23D003M	390458N1216114W001	Feather River MW-1A	CASGEM	Active	Observation	65	71	10/20/2005 0:00	8/30/2016 11:57	39.0458	-121.6114	Part of a nested/multi-completion well	E033117	65	40	60	0	0	0	0	0	0
13N03E06A001M	390087N1216722W001	Sutter County MW-6A	CASGEM	Active	Observation	65	34	4/5/2012 14:47	8/30/2016 9:21	39.00864	-121.6719	Part of a nested/multi-completion well	E124062A-C	65	45	55	0	0	0	0	0	0
13N03E23K001M	389582N1216067W001		Voluntary	Active	Residential	Confidential	132	6/29/1962 0:00	5/11/1982 0:00	38.9582	-121.6067	Unknown	0	75	0	0	0	0	0	0	0	0
13N03E23K001M	389582N1216067W001		Voluntary	Active	Residential	Confidential	132	6/29/1962 0:00	5/11/1982 0:00	38.9582	-121.6067	Unknown	0	75	0	0	0	0	0	0	0	0
12N03E02G004M	389167N1216061W001		Voluntary	Active	Residential	Confidential	35	7/19/1985 0:00	9/7/1989 0:00	38.9167	-121.6061	Unknown	0	80	0	0	0	0	0	0	0	0
12N03E02G004M	389167N1216061W001		Voluntary	Active	Residential	Confidential	35	7/19/1985 0:00	9/7/1989 0:00	38.9167	-121.6061	Unknown	0	80	0	0	0	0	0	0	0	0
14N02E13L001M	390588N1217004W001	14N02E13L001M	Voluntary	Active	Irrigation	Confidential	140	2/2/2005 0:00	5/10/2016 0:00	39.0588	-121.7004	Unknown	64451	82	68	82	0	0	0	0	0	0
14N03E10P003M	390701N1216268W001		Voluntary	Active	Unknown	Confidential	18	2/11/1966 0:00	10/14/1974 0:00	39.0701	-121.6268	Unknown	0	85	0	0	0	0	0	0	0	0
15N02E36A001M	391124N1216910W001		Voluntary	Active	Irrigation	Confidential	121	12/22/1947 0:00	10/24/2006 0:00	39.1124	-121.691	Unknown	0	100	0	0	0	0	0	0	0	0
15N02E36A001M	391124N1216910W001		Voluntary	Active	Irrigation	Confidential	121	12/22/1947 0:00	10/24/2006 0:00	39.1124	-121.691	Unknown	0	100	0	0	0	0	0	0	0	0
13N03E04J001M	390027N1216367W001	13N03E04J001M	Voluntary	Active	Irrigation	Confidential	145	2/11/1966 0:00	5/10/2016 0:00	39.0027	-121.6367	Single Well	0	100	0	0	0	0	0	0	0	0
13N03E04J001M	390027N1216367W001	13N03E04J001M	Voluntary	Active	Irrigation	Confidential	145	2/11/1966 0:00	5/10/2016 0:00	39.0027	-121.6367	Single Well	0	100	0	0	0	0	0	0	0	0
13N01E24G004M	389605N1218102W003	Flood MW-1C (shall)	CASGEM	Active	Observation	100	134	9/15/2004 0:00	3/28/2016 12:04	38.9605	-121.8102	Part of a nested/multi-completion well	579929C	100	70	90	0	0	0	0	0	0
12N03E12C001M	389074N1215903W001		Voluntary	Active	Residential	Confidential				38.9074	-121.5903	Unknown	51-158	115	70	101	0	0	0	0	0	0
12N03E12C001M	389074N1215903W001		Voluntary	Active	Residential	Confidential				38.9074	-121.5903	Unknown	51-158	115	70	101	0	0	0	0	0	0

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State Well Number	CASGEM Well Number	Local Well Designation	Type of Well	Status of Well	Well Usage	Total Well Depth	Measurement Count	Earliest Elevation Measurement Date	Most Recent Elevation Measurement Date	Latitude (NAD 83)	Longitude (NAD 83)	Completion Type	Well Completion Report #	Total Depth	S1 Top	S1 Bottom	S2 Top	S2 Bottom	S3 Top	S3 Bottom	S4 Top	S4 Bottom
14N02E13A003M	390682N1216901W001	SEWD MW-3A	CASGEM	Active	Observation	115	178	1/31/2006 0:00	4/5/2016 9:51	39.06823	-121.6901	Part of a nested/multi-completion well	EO38757A-C	115	90	110	0	0	0	0	0	0
15N02E34D002M	391115N1217425W001	15N02E34D002M	Voluntary	Active	Irrigation	Confidential	55	6/19/2013 8:35	1/7/2015 0:00	39.11295	-121.7411	Single Well	57852	120	56	120	0	0	0	0	0	0
15N02E25A001M	391254N1216930W001		Voluntary	Active	Irrigation	Confidential	46	12/22/1947 0:00	3/16/1972 0:00	39.1254	-121.693	Unknown	296	122	0	0	0	0	0	0	0	0
15N02E25A001M	391254N1216930W001		Voluntary	Active	Irrigation	Confidential	46	12/22/1947 0:00	3/16/1972 0:00	39.1254	-121.693	Unknown	296	122	0	0	0	0	0	0	0	0
14N03E20H003M	390497N1216535W001	14N03E20H003M	Voluntary	Active	Irrigation	Confidential	140	2/2/2005 0:00	5/10/2016 0:00	39.0497	-121.6535	Unknown	74861	125	68	125	0	0	0	0	0	0
	389820N1215923W001	Feather WD-2	CASGEM	Active	Irrigation	130	13	12/1/2011 10:00	3/10/2016 9:30	38.98203	-121.5923	Single Well	0	130	0	0	0	0	0	0	0	0
	389736N1216233W001	Feather WD-3	CASGEM	Active	Irrigation	130	13	12/1/2011 10:00	3/10/2016 10:00	38.97361	-121.6233	Single Well	0	130	0	0	0	0	0	0	0	0
15N03E15H004M	391512N1216190W001	15N03E15H004M	Voluntary	Active	Residential	Confidential	214	2/13/1968 0:00	5/10/2016 0:00	39.1512	-121.619	Single Well	39086	133	0	0	0	0	0	0	0	0
	390214N1216625W001	Feather WD-4	CASGEM	Active	Irrigation	140	13	12/1/2011 10:00	3/10/2016 10:30	39.02141	-121.6625	Single Well	0	140	0	0	0	0	0	0	0	0
15N02E36L001M	391051N1217012W001	15N02E36L001M	Voluntary	Active	Irrigation	Confidential	70	3/16/2009 0:00	1/7/2015 0:00	39.10511	-121.7012	Single Well	338929	150	100	150	0	0	0	0	0	0
	389410N1215884W001	GH Well 18	CASGEM	Active	Irrigation	150	120	6/30/2009 9:30	3/3/2016 12:49	38.94105	-121.5884	Single Well	427654	150	90	100	0	0	0	0	0	0
12N02E23H001M	388761N1217094W001	Sutter County MW-2A	CASGEM	Active	Observation	150	58	5/12/2010 0:00	3/28/2016 11:40	38.8761	-121.7094	Part of a nested/multi-completion well	E0113997	150	120	140	0	0	0	0	0	0
015N002E20D001M	USGS 390832121463601	#7	USGS	Unknown	Observation	35		8/7/1997 11:20	8/7/2013 11:15	39.08327	-121.4639	Unknown		35								
014N002E10R001M	USGS 390416121433601	#6	USGS	Unknown	Observation	44		8/8/1997 13:00	8/8/2013 11:47	39.04154	-121.4339	Unknown		44								
012N002E09B002M	USGS 385431121451401	#3	USGS	Unknown	Observation	35		8/25/1997 19:05	8/8/2013 12:22	38.54306	-121.4518	Unknown		35		29						
012N003E18H001M	USGS 385314121401701	#2	USGS	Unknown	Observation	50		8/7/1997 12:40	8/8/2013 12:52	38.53129	-121.4022	Unknown		50								
Intermediate Aquifer																						
16N02E35C003M	391990N1217257W001	16N02E35	Voluntary	Active	Irrigation	Confidential	26	6/19/2013 13:15	4/2/2014 0:00	39.19895	-121.7257	Single Well	0	160	90	157	0	0	0	0	0	0
13N01E24G003M	389605N1218102W002	Flood MW-1B (int)	CASGEM	Active	Observation	160	151	9/15/2004 0:00	3/28/2016 12:04	38.9605	-121.8102	Part of a nested/multi-completion well	579929B	160	130	160	0	0	0	0	0	0
	389528N1217918W001	Pelger #1 - Shallow	Voluntary	Active	Irrigation	Confidential	74	6/24/2013 11:00	3/23/2016 11:31	38.95277	-121.7918	Single Well	E0183815A	160	140	150	0	0	0	0	0	0
11N03E20H003M	387859N1216565W001	RD 1500 Karnak	CASGEM	Active	Industrial	165	149	10/22/1963 0:00	5/13/2016 0:00	38.7859	-121.6565	Single Well	0	165	0	0	0	0	0	0	0	0
15N02E12E001M	391658N1217070W001	SEWD MW-1A	CASGEM	Active	Observation	173	178	1/31/2006 0:00	4/5/2016 8:04	39.16585	-121.707	Part of a nested/multi-completion well	816295	173	148	168	0	0	0	0	0	0

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State Well Number	CASGEM Well Number	Local Well Designation	Type of Well	Status of Well	Well Usage	Total Well Depth	Measurement Count	Earliest Elevation Measurement Date	Most Recent Elevation Measurement Date	Latitude (NAD 83)	Longitude (NAD 83)	Completion Type	Well Completion Report #	Total Depth	S1 Top	S1 Bottom	S2 Top	S2 Bottom	S3 Top	S3 Bottom	S4 Top	S4 Bottom
13N03E26J002M	389452N1215992W001	Sutter County MW-4A	CASGEM	Active	Observation	175	55	8/4/2010 0:00	9/15/2016 11:10	38.94516	-121.5992	Part of a nested/multi-completion well	E0115603A-D	175	145	165	0	0	0	0	0	0
13N03E06A002M	390087N1216722W002	Sutter County MW-6B	CASGEM	Active	Observation	175	38	3/9/2011 0:00	8/30/2016 9:22	39.00864	-121.6719	Part of a nested/multi-completion well	E124062A-C	175	155	165	0	0	0	0	0	0
15N03E10G001M	391642N1216240W001		Voluntary	Active	Irrigation	Confidential	52	11/19/1947 0:00	10/9/1975 0:00	39.1642	-121.624	Unknown	0	180	0	0	0	0	0	0	0	0
15N03E10G001M	391642N1216240W001		Voluntary	Active	Irrigation	Confidential	52	11/19/1947 0:00	10/9/1975 0:00	39.1642	-121.624	Unknown	0	180	0	0	0	0	0	0	0	0
15N01E14F001M	391518N1218295W001		Voluntary	Active	Irrigation	Confidential				39.1518	-121.8295	Unknown	0	181	0	0	0	0	0	0	0	0
15N01E14F001M	391518N1218295W001		Voluntary	Active	Irrigation	Confidential				39.1518	-121.8295	Unknown	0	181	0	0	0	0	0	0	0	0
	391068N1216464W001	Edwin	CASGEM	Inactive	Other	190				39.10683	-121.6464	Single Well	0	190	0	0	0	0	0	0	0	0
	390784N1218450W001	MFWC Park2	CASGEM	Active	Irrigation	190				39.07839	-121.845	Single Well	966371	190	0	0	0	0	0	0	0	0
	390587N1218380W001	TID Park-Windship	CASGEM	Active	Irrigation	195				39.0587	-121.838	Single Well	0	195	0	0	0	0	0	0	0	0
15N03E05D002M	391851N1216691W001		Voluntary	Active	Irrigation	Confidential	159	12/19/1947 0:00	3/15/2005 0:00	39.1851	-121.6691	Unknown	323	200	38	200	0	0	0	0	0	0
15N03E05D002M	391851N1216691W001		Voluntary	Active	Irrigation	Confidential	159	12/19/1947 0:00	3/15/2005 0:00	39.1851	-121.6691	Unknown	323	200	38	200	0	0	0	0	0	0
	389495N1215863W001	GH Well 22	CASGEM	Active	Irrigation	200	111	6/30/2009 9:10	3/3/2016 13:03	38.94952	-121.5863	Single Well	966345	200	0	0	0	0	0	0	0	0
15N02E14M001M	391489N1217259W001	15N02E14M001M	Voluntary	Active	Irrigation	Confidential	55	6/19/2013 13:30	1/7/2015 0:00	39.14888	-121.7259	Single Well	536107	203	105	203	0	0	0	0	0	0
15N03E34L001M	391021N1216275W001		Voluntary	Active	Irrigation	Confidential	66	11/14/1947 0:00	10/7/1976 0:00	39.1021	-121.6275	Unknown	0	210	0	0	0	0	0	0	0	0
15N03E34L001M	391021N1216275W001		Voluntary	Active	Irrigation	Confidential	66	11/14/1947 0:00	10/7/1976 0:00	39.1021	-121.6275	Unknown	0	210	0	0	0	0	0	0	0	0
14N02E32D002M	390244N1217813W002	SMWC MW-1B	CASGEM	Active	Observation	210	35	6/18/2012 10:12	3/28/2016 13:00	39.02443	-121.7813	Part of a nested/multi-completion well	E0155755B	210	170	200	0	0	0	0	0	0
15N03E21H002M	391370N1216371W001		Voluntary	Active	Residential	Confidential	248	6/28/1962 0:00	7/29/1987 0:00	39.137	-121.6371	Unknown	72	212	80	212	0	0	0	0	0	0
14N02E36F001M	390215N1216994W001	14N02E36F001M	Voluntary	Active	Irrigation	Confidential	58	6/19/2013 8:00	1/7/2015 0:00	39.0215	-121.6994	Single Well	420691	215	110	215	0	0	0	0	0	0
14N03E17A003M	390681N1216534W001		Voluntary	Active	Irrigation	Confidential	42	3/27/2012 0:00	5/10/2016 0:00	39.0681	-121.6534	Unknown	0	220	0	0	0	0	0	0	0	0
	389509N1215863W001	GH Well 4	CASGEM	Active	Irrigation	225	110	6/30/2009 9:05	3/3/2016 13:09	38.95089	-121.5863	Single Well	113395	225	95	108	135	148	153	163	0	0

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State Well Number	CASGEM Well Number	Local Well Designation	Type of Well	Status of Well	Well Usage	Total Well Depth	Measurement Count	Earliest Elevation Measurement Date	Most Recent Elevation Measurement Date	Latitude (NAD 83)	Longitude (NAD 83)	Completion Type	Well Completion Report #	Total Depth	S1 Top	S1 Bottom	S2 Top	S2 Bottom	S3 Top	S3 Bottom	S4 Top	S4 Bottom
	389528N1217918W002	Pelger #1 - Middle	Voluntary	Active	Irrigation	Confidential	73	6/24/2013 11:01	3/23/2016 11:31	38.95277	-121.7918	Single Well	E0183815B	240	210	230	0	0	0	0	0	0
13N03E13D001M	389819N1215949W001		Voluntary	Active	Irrigation	Confidential	161	5/5/1948 0:00	3/27/2007 0:00	38.9819	-121.5949	Unknown	94	242	140	158	0	0	0	0	0	0
13N03E13D001M	389819N1215949W001		Voluntary	Active	Irrigation	Confidential	161	5/5/1948 0:00	3/27/2007 0:00	38.9819	-121.5949	Unknown	94	242	140	158	0	0	0	0	0	0
14N02E13A004M	390682N1216901W002	SEWD MW-3B	CASGEM	Active	Observation	245	178	1/31/2006 0:00	4/5/2016 9:52	39.06823	-121.6901	Part of a nested/multi-completion well	EO38757A-C	245	210	240	0	0	0	0	0	0
14N02E17C002M	390696N1217778W002	Sutter County MW-1B	CASGEM	Active	Observation	245	66	2/24/2010 0:00	3/28/2016 13:58	39.0696	-121.7778	Part of a nested/multi-completion well	E0108475	245	205	235	0	0	0	0	0	0
	389510N1215913W001	GH Well 17	CASGEM	Active	Irrigation	248	110	6/30/2009 8:55	3/3/2016 13:28	38.95104	-121.5913	Single Well	339117	248	148	168	0	0	0	0	0	0
15N03E26M001M	391173N1216125W001		Voluntary	Active	Irrigation	Confidential	117	11/14/1947 0:00	3/15/2004 0:00	39.1173	-121.6125	Unknown	440	250	100	250	0	0	0	0	0	0
15N03E26M001M	391173N1216125W001		Voluntary	Active	Irrigation	Confidential	117	11/14/1947 0:00	3/15/2004 0:00	39.1173	-121.6125	Unknown	440	250	100	250	0	0	0	0	0	0
13N02E32P001M	389242N1217740W001	Well 3 (Klein)	Voluntary	Active	Irrigation	Confidential	94	7/2/2009 8:00	3/23/2016 12:00	38.92423	-121.774	Single Well	467619	250	140	170	180	250	0	0	0	0
	391078N1216244W001	La Grande	CASGEM	Inactive	Other	254				39.10779	-121.6244	Single Well	0	254	0	0	0	0	0	0	0	0
15N02E24P001M	391279N1216989W001	SEWD MW-2A	CASGEM	Active	Observation	254	178	1/31/2006 0:00	4/5/2016 10:22	39.12786	-121.6989	Part of a nested/multi-completion well	EO36360	254	204	244	0	0	0	0	0	0
14N02E26C001M	390398N1217181W001	14N02E26C001M	Voluntary	Active	Irrigation	Confidential	69	3/16/2009 0:00	1/7/2015 0:00	39.03983	-121.7181	Single Well	391338	255	140	255	0	0	0	0	0	0
14N03E23D004M	390458N1216114W002	Feather River MW-1B	CASGEM	Active	Observation	260	71	10/20/2005 0:00	8/30/2016 11:59	39.0458	-121.6114	Part of a nested/multi-completion well	E033118	260	235	255	0	0	0	0	0	0
15N02E12E002M	391658N1217070W002	SEWD MW-1B	CASGEM	Active	Observation	265	178	1/31/2006 0:00	4/5/2016 8:05	39.16585	-121.707	Part of a nested/multi-completion well	816295	265	240	260	0	0	0	0	0	0
13N03E06A003M	390087N1216722W003	Sutter County MW-6C	CASGEM	Active	Observation	265	38	3/9/2011 0:00	8/30/2016 9:23	39.00864	-121.6719	Part of a nested/multi-completion well	E124062A-C	265	245	255	0	0	0	0	0	0
	389560N1215860W001	GH Well 23	CASGEM	Active	Irrigation	280	101	6/30/2010 10:06	3/3/2016 13:20	38.956	-121.586	Single Well	E0103053	280	150	165	170	190	0	0	0	0
	389528N1217918W003	Pelger #1 - Deep	Voluntary	Active	Irrigation	Confidential	74	6/24/2013 11:02	3/23/2016 11:31	38.95277	-121.7918	Single Well	E0183815C	285	265	275	0	0	0	0	0	0
15N02E35D001M	391124N1217226W001	15N02E35D001M	Voluntary	Active	Irrigation	Confidential	178	12/23/1947 0:00	5/10/2016 0:00	39.1124	-121.7226	Single Well	301	286	0	0	0	0	0	0	0	0
14N03E05C001M	390976N1216622W001		Voluntary	Active	Irrigation	Confidential	179	12/16/1947 0:00	3/15/2005 0:00	39.0976	-121.6622	Unknown	209	288	0	0	0	0	0	0	0	0

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State Well Number	CASGEM Well Number	Local Well Designation	Type of Well	Status of Well	Well Usage	Total Well Depth	Measurement Count	Earliest Elevation Measurement Date	Most Recent Elevation Measurement Date	Latitude (NAD 83)	Longitude (NAD 83)	Completion Type	Well Completion Report #	Total Depth	S1 Top	S1 Bottom	S2 Top	S2 Bottom	S3 Top	S3 Bottom	S4 Top	S4 Bottom
14N03E05C001M	390976N1216622W001		Voluntary	Active	Irrigation	Confidential	179	12/16/1947 0:00	3/15/2005 0:00	39.0976	-121.6622	Unknown	209	288	0	0	0	0	0	0	0	0
	391283N1218286W001	BS2-Franklin	CASGEM	Active	Irrigation	300				39.1283	-121.8286	Single Well	413866	300	0	0	0	0	0	0	0	0
12N02E23H002M	388761N1217094W002	Sutter County MW-2B	CASGEM	Active	Observation	300	58	5/12/2010 0:00	3/28/2016 11:40	38.8761	-121.7094	Part of a nested/multi-completion well	E0113997	300	260	280	0	0	0	0	0	0
15N02E22D001M	391414N1217442W001	15N02E22D001M	Voluntary	Active	Residential	Confidential	61	9/7/2011 0:00	5/19/2016 0:00	39.1414	-121.7442	Single Well	0	302	0	0	0	0	0	0	0	0
	389860N1215928W001	Feather WD-1	CASGEM	Active	Irrigation	305	13	12/1/2011 10:00	3/10/2016 9:00	38.98598	-121.5928	Single Well	0	305	0	0	0	0	0	0	0	0
	389529N1217917W001	PMWC #1	Voluntary	Active	Irrigation	Confidential	58	5/16/2014 10:30	3/23/2016 11:30	38.9529	-121.7917	Single Well	E0197067	305	135	160	195	240	260	285	295	305
13N01E24G002M	389605N1218102W001	Flood MW-1A (deep)	CASGEM	Active	Observation	310	154	9/15/2004 0:00	3/28/2016 12:04	38.9605	-121.8102	Part of a nested/multi-completion well	579929A	310	240	300	0	0	0	0	0	0
14N02E16D002M	390694N1217599W001	TBF Well 2	Voluntary	Active	Irrigation	Confidential	37	6/30/2009 10:15	1/9/2014 14:05	39.06942	-121.7599	Single Well	498170	310	170	310	0	0	0	0	0	0
15N01E13A001M	391558N1218004W001		Voluntary	Active	Irrigation	Confidential	96	12/22/1947 0:00	10/9/1979 0:00	39.1558	-121.8004	Unknown	276	315	200	0	0	0	0	0	0	0
15N01E13A001M	391558N1218004W001		Voluntary	Active	Irrigation	Confidential	96	12/22/1947 0:00	10/9/1979 0:00	39.1558	-121.8004	Unknown	276	315	200	0	0	0	0	0	0	0
	390803N1218906W001	MFWC Park-Miller	CASGEM	Active	Irrigation	320				39.08026	-121.8906	Single Well	0	320	0	0	0	0	0	0	0	0
	391456N1218904W001	MFWC Prop 50	CASGEM	Active	Irrigation	320				39.14559	-121.8904	Single Well	0	320	125	155	280	310	0	0	0	0
14N02E16K001M	390590N1217538W001	TBF Well 5	Voluntary	Active	Irrigation	Confidential	33	6/30/2009 10:30	1/9/2014 14:13	39.05899	-121.7538	Single Well	38676	320	95	320	0	0	0	0	0	0
13N01E24K001M	389605N1218103W001	Well 2 (Flopet)	Voluntary	Active	Irrigation	Confidential	92	7/8/2009 14:00	3/23/2016 11:05	38.9605	-121.8103	Single Well	579927	320	130	160	190	200	240	260	280	300
12N03E02G003M	389167N1216061W004	12N03E02G003M	CASGEM	Active	Observation	321				38.9167	-121.6061	Part of a nested/multi-completion well	0	321	0	0	0	0	0	0	0	0
14N02E16D003M	390695N1217640W001	TBF Well 7	Voluntary	Active	Irrigation	Confidential	41	6/30/2009 10:15	1/9/2014 14:00	39.06946	-121.764	Single Well	38675	330	210	330	0	0	0	0	0	0
	389347N1215897W001	GH Well 19	CASGEM	Active	Irrigation	365	107	6/30/2009 9:40	3/3/2016 12:42	38.93475	-121.5897	Single Well	427656	365	160	175	0	0	0	0	0	0
	391012N1218222W001	BS1-McClatchy	CASGEM	Active	Irrigation	370				39.10119	-121.8222	Single Well	413863	370	0	0	0	0	0	0	0	0

Sutter Subbasin Well Construction Details

State Well Number	CASGEM Well Number	Local Well Designation	Type of Well	Status of Well	Well Usage	Total Well Depth	Measurement Count	Earliest Elevation Measurement Date	Most Recent Elevation Measurement Date	Latitude (NAD 83)	Longitude (NAD 83)	Completion Type	Well Completion Report #	Total Depth	S1 Top	S1 Bottom	S2 Top	S2 Bottom	S3 Top	S3 Bottom	S4 Top	S4 Bottom
15N02E24P002M	391279N1216989W002	SEWD MW-2B	CASGEM	Active	Observation	379	178	1/31/2006 0:00	4/5/2016 10:23	39.12786	-121.6989	Part of a nested/multi-completion well	EO36360	379	354	374	0	0	0	0	0	0
14N02E05R001M	390867N1217665W001	TBF Well 1	Voluntary	Active	Irrigation	Confidential	40	8/3/2009 18:30	1/9/2014 13:39	39.08674	-121.7665	Single Well	E036636	380	120	140	250	280	320	360	0	0
	389281N1218056W001	Klein #2	Voluntary	Active	Irrigation	Confidential	81	7/6/2009 9:51	3/23/2016 12:00	38.92806	-121.8056	Single Well	115407	393	188	198	232	247	300	310	358	383
Deep Aquifer																						
14N02E16D001M	390695N1217623W001	TBF Well 3	Voluntary	Active	Irrigation	Confidential	35	6/30/2009 10:15	1/9/2014 14:02	39.06945	-121.7623	Single Well	498181	405	130	405	0	0	0	0	0	0
14N02E17C003M	390696N1217778W003	Sutter County MW-1C	CASGEM	Active	Observation	425	66	2/24/2010 0:00	3/28/2016 13:58	39.0696	-121.7778	Part of a nested/multi-completion well	E0108475	425	395	415	0	0	0	0	0	0
13N03E26J003M	389452N1215992W002	Sutter County MW-4B	CASGEM	Active	Observation	445	55	8/4/2010 0:00	9/15/2016 11:11	38.94516	-121.5992	Part of a nested/multi-completion well	E0115603A-D	445	425	435	0	0	0	0	0	0
13N02E19D001M	389644N1218010W001	Well 1 (Tucker)	Voluntary	Active	Irrigation	Confidential	90	7/2/2009 15:00	3/23/2016 10:47	38.96443	-121.801	Single Well	16802	485	101	143	146	296	341	365	389	485
15N02E24P003M	391279N1216989W003	SEWD MW-2C	CASGEM	Active	Observation	488	178	1/31/2006 0:00	4/5/2016 10:23	39.12786	-121.6989	Part of a nested/multi-completion well	EO36360	488	438	478	0	0	0	0	0	0
14N02E08Q001M	390700N1217725W001	TBF Well 4	Voluntary	Active	Irrigation	Confidential	41	6/30/2009 10:45	1/9/2014 14:00	39.07002	-121.7725	Single Well	816258	490	120	160	190	310	360	410	460	470
14N02E32D003M	390244N1217813W003	SMWC MW-1C	CASGEM	Active	Observation	500	35	6/18/2012 10:13	3/28/2016 13:00	39.02443	-121.7813	Part of a nested/multi-completion well	E0155755C	500	460	490	0	0	0	0	0	0
15N02E12E003M	391658N1217070W003	SEWD MW-1C	CASGEM	Active	Observation	559	178	1/31/2006 0:00	4/5/2016 8:05	39.16585	-121.707	Part of a nested/multi-completion well	816295	559	524	554	0	0	0	0	0	0
15N02E12C001M	391707N1217006W001	SEWD Well #1	Voluntary	Active	Irrigation	Confidential	137	4/28/2009 9:35	4/5/2016 7:50	39.17075	-121.7006	Single Well	935659	570	210	230	250	360	370	490	500	550
14N02E13A005M	390682N1216901W003	SEWD MW-3C	CASGEM	Active	Observation	585	178	1/31/2006 0:00	4/5/2016 9:53	39.06823	-121.6901	Part of a nested/multi-completion well	EO38757A-C	585	550	580	0	0	0	0	0	0
15N02E24P004M	391278N1216984W001	SEWD Well #2	Voluntary	Active	Irrigation	Confidential	136	4/28/2009 8:20	4/5/2016 10:15	39.12779	-121.6984	Single Well	935663	600	354	384	410	490	500	580	0	0
12N02E23H003M	388761N1217094W003	Sutter County MW-2C	CASGEM	Active	Observation	600	58	5/12/2010 0:00	3/28/2016 11:40	38.8761	-121.7094	Part of a nested/multi-completion well	E0113997	600	570	590	0	0	0	0	0	0
	391613N1216236W001	WTP Well	CASGEM	Active	Other	600				39.16134	-121.6236	Single Well	935784	600	130	200	0	0	0	0	0	0
13N03E26J004M	389452N1215992W003	Sutter County MW-4C	CASGEM	Active	Observation	610	55	8/4/2010 0:00	9/15/2016 11:12	38.94516	-121.5992	Part of a nested/multi-completion well	E0115603A-D	610	590	600	0	0	0	0	0	0

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State Well Number	CASGEM Well Number	Local Well Designation	Type of Well	Status of Well	Well Usage	Total Well Depth	Measurement Count	Earliest Elevation Measurement Date	Most Recent Elevation Measurement Date	Latitude (NAD 83)	Longitude (NAD 83)	Completion Type	Well Completion Report #	Total Depth	S1 Top	S1 Bottom	S2 Top	S2 Bottom	S3 Top	S3 Bottom	S4 Top	S4 Bottom
14N03E23D005M	390458N1216114W003	Feather River MW-1C	CASGEM	Active	Observation	689	71	10/20/2005 0:00	8/30/2016 12:02	39.0458	-121.6114	Part of a nested/multi-completion well	E033119	689	664	684	0	0	0	0	0	0
	389596N1218314W001	North Well	Voluntary	Active	Irrigation	Confidential	29	5/14/2015 0:00	3/23/2016 12:30	38.95959	-121.8314	Single Well	e0147829	700	200	260	320	480	640	700	0	0
12N02E23H004M	388761N1217094W004	Sutter County MW-2D	CASGEM	Active	Observation	705	58	5/12/2010 0:00	3/28/2016 11:40	38.8761	-121.7094	Part of a nested/multi-completion well	E0113997	705	655	695	0	0	0	0	0	0
12N03E02G002M	389167N1216061W003	12N03E02G002M	CASGEM	Active	Observation	721				38.9167	-121.6061	Part of a nested/multi-completion well	0	721	0	0	0	0	0	0	0	0
12N03E02G002M	389167N1216061W003	12N03E02G002M	CASGEM	Active	Observation	721				38.9167	-121.6061	Part of a nested/multi-completion well	0	721	0	0	0	0	0	0	0	0
14N02E17C004M	390696N1217778W004	Sutter County MW-1D	CASGEM	Active	Observation	755	66	2/24/2010 0:00	3/28/2016 13:58	39.0696	-121.7778	Part of a nested/multi-completion well	E0108475	755	725	745	0	0	0	0	0	0
	389382N1218291W001	South Well	Voluntary	Active	Irrigation	Confidential	29	5/14/2015 0:00	3/23/2016 12:40	38.93817	-121.8291	Single Well	e0147837	820	340	380	400	560	600	720	780	820
13N03E26J005M	389452N1215992W004	Sutter County MW-4D	CASGEM	Active	Observation	1005	55	8/4/2010 0:00	9/15/2016 11:13	38.94516	-121.5992	Part of a nested/multi-completion well	E0115603A-D	1005	985	995	0	0	0	0	0	0
14N03E23D006M	390458N1216114W004	Feather River MW-1D	CASGEM	Active	Observation	1021	71	10/20/2005 0:00	8/30/2016 11:53	39.0458	-121.6114	Part of a nested/multi-completion well	E033120	1021	996	1016	0	0	0	0	0	0
12N03E02G001M	389167N1216061W002	12N03E02G001M	CASGEM	Active	Observation	1081				38.9167	-121.6061	Part of a nested/multi-completion well	0	1081	0	0	0	0	0	0	0	0
Unknown Principal Aquifer																						
13N03E35K002M	389300N1216056W001		Voluntary	Active	Residential	Confidential	42	12/13/1963 0:00	4/25/1984 0:00	38.93	-121.6056	Unknown	0	0	0	0	0	0	0	0	0	0
13N03E24D001M	389678N1215967W001		Voluntary	Active	Irrigation	Confidential	64	11/19/1947 0:00	4/16/1981 0:00	38.9678	-121.5967	Unknown	0	0	0	0	0	0	0	0	0	0
13N03E06K001M	390028N1216772W001		Voluntary	Active	Irrigation	Confidential	114	12/15/1948 0:00	3/16/2005 0:00	39.0028	-121.6772	Unknown	0	0	0	0	0	0	0	0	0	0
13N03E02H001M	390067N1216012W001		Voluntary	Active	Irrigation	Confidential	118	11/13/1947 0:00	3/19/2008 0:00	39.0067	-121.6012	Unknown	0	0	0	0	0	0	0	0	0	0
14N02E26R001M	390277N1217090W001		Voluntary	Active	Residential	Confidential	104	3/10/1941 0:00	11/1/1981 0:00	39.0277	-121.709	Unknown	0	0	0	0	0	0	0	0	0	0
14N03E14E002M	390654N1216120W001		Voluntary	Active	Irrigation	Confidential	122	11/10/1947 0:00	10/26/2006 0:00	39.0654	-121.612	Unknown	0	0	0	0	0	0	0	0	0	0
14N02E14B001M	390676N1217169W001		Voluntary	Active	Residential	Confidential	44	8/7/1962 0:00	4/23/1982 0:00	39.0676	-121.7169	Unknown	0	0	0	0	0	0	0	0	0	0
14N03E18D001M	390684N1216886W001		Voluntary	Active	Residential	Confidential	75	11/26/1929 0:00	10/11/1978 0:00	39.0684	-121.6886	Unknown	0	0	0	0	0	0	0	0	0	0
14N03E08N001M	390691N1216695W001		Voluntary	Active	Residential	Confidential	54	12/16/1947 0:00	10/20/1969 0:00	39.0691	-121.6695	Unknown	0	0	0	0	0	0	0	0	0	0

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State Well Number	CASGEM Well Number	Local Well Designation	Type of Well	Status of Well	Well Usage	Total Well Depth	Measurement Count	Earliest Elevation Measurement Date	Most Recent Elevation Measurement Date	Latitude (NAD 83)	Longitude (NAD 83)	Completion Type	Well Completion Report #	Total Depth	S1 Top	S1 Bottom	S2 Top	S2 Bottom	S3 Top	S3 Bottom	S4 Top	S4 Bottom
15N03E33N004M	390989N1216505W001		Voluntary	Active	Irrigation	Confidential	57	3/11/1966 0:00	3/30/1995 0:00	39.0989	-121.6505	Unknown	0	0	0	0	0	0	0	0	0	0
15N03E10G002M	391638N1216252W001		Voluntary	Active	Unknown	Confidential	37	10/26/1972 0:00	4/5/1990 0:00	39.1638	-121.6252	Unknown	0	0	0	0	0	0	0	0	0	0
15N01E12A001M	391672N1218034W001		Voluntary	Active	Stockwaterin	Confidential	31	12/2/1948 0:00	10/11/1971 0:00	39.1672	-121.8034	Unknown	0	0	0	0	0	0	0	0	0	0
16N03E33J002M	391970N1216340W001		Voluntary	Active	Irrigation	Confidential	79	5/12/1948 0:00	11/2/1987 0:00	39.197	-121.634	Unknown	0	0	0	0	0	0	0	0	0	0
13N03E35K002M	389300N1216056W001		Voluntary	Active	Residential	Confidential	42	12/13/1963 0:00	4/25/1984 0:00	38.93	-121.6056	Unknown	0	0	0	0	0	0	0	0	0	0
13N03E24D001M	389678N1215967W001		Voluntary	Active	Irrigation	Confidential	64	11/19/1947 0:00	4/16/1981 0:00	38.9678	-121.5967	Unknown	0	0	0	0	0	0	0	0	0	0
13N03E06K001M	390028N1216772W001		Voluntary	Active	Irrigation	Confidential	114	12/15/1948 0:00	3/16/2005 0:00	39.0028	-121.6772	Unknown	0	0	0	0	0	0	0	0	0	0
13N03E02H001M	390067N1216012W001		Voluntary	Active	Irrigation	Confidential	118	11/13/1947 0:00	3/19/2008 0:00	39.0067	-121.6012	Unknown	0	0	0	0	0	0	0	0	0	0
14N02E26R001M	390277N1217090W001		Voluntary	Active	Residential	Confidential	104	3/10/1941 0:00	11/1/1981 0:00	39.0277	-121.709	Unknown	0	0	0	0	0	0	0	0	0	0
14N03E14E002M	390654N1216120W001		Voluntary	Active	Irrigation	Confidential	122	11/10/1947 0:00	10/26/2006 0:00	39.0654	-121.612	Unknown	0	0	0	0	0	0	0	0	0	0
14N02E14B001M	390676N1217169W001		Voluntary	Active	Residential	Confidential	44	8/7/1962 0:00	4/23/1982 0:00	39.0676	-121.7169	Unknown	0	0	0	0	0	0	0	0	0	0
14N03E18D001M	390684N1216886W001		Voluntary	Active	Residential	Confidential	75	11/26/1929 0:00	10/11/1978 0:00	39.0684	-121.6886	Unknown	0	0	0	0	0	0	0	0	0	0
14N03E08N001M	390691N1216695W001		Voluntary	Active	Residential	Confidential	54	12/16/1947 0:00	10/20/1969 0:00	39.0691	-121.6695	Unknown	0	0	0	0	0	0	0	0	0	0
15N03E33N004M	390989N1216505W001		Voluntary	Active	Irrigation	Confidential	57	3/11/1966 0:00	3/30/1995 0:00	39.0989	-121.6505	Unknown	0	0	0	0	0	0	0	0	0	0
15N03E10G002M	391638N1216252W001		Voluntary	Active	Unknown	Confidential	37	10/26/1972 0:00	4/5/1990 0:00	39.1638	-121.6252	Unknown	0	0	0	0	0	0	0	0	0	0
15N01E12A001M	391672N1218034W001		Voluntary	Active	Stockwaterin	Confidential	31	12/2/1948 0:00	10/11/1971 0:00	39.1672	-121.8034	Unknown	0	0	0	0	0	0	0	0	0	0
16N03E33J002M	391970N1216340W001		Voluntary	Active	Irrigation	Confidential	79	5/12/1948 0:00	11/2/1987 0:00	39.197	-121.634	Unknown	0	0	0	0	0	0	0	0	0	0
12N03E23N001M	388674N1216168W001	12N03E23N001M	Voluntary	Active	Irrigation	Confidential	261	12/19/1947 0:00	5/6/2016 0:00	38.8674	-121.6168	Single Well	0	0	0	0	0	0	0	0	0	0
13N03E15C003M	389786N1216259W001	13N03E15C003M	CASGEM	Active	Irrigation	Unknown	141	2/3/2005 0:00	5/6/2016 0:00	38.9786	-121.6259	Single Well	49866	0	0	0	0	0	0	0	0	0
13N03E15C003M	389786N1216259W001	13N03E15C003M	CASGEM	Active	Irrigation	Unknown	141	2/3/2005 0:00	5/6/2016 0:00	38.9786	-121.6259	Single Well	49866	0	0	0	0	0	0	0	0	0
13N03E15C003M	389786N1216259W001	13N03E15C003M	CASGEM	Active	Irrigation	Unknown	141	2/3/2005 0:00	5/6/2016 0:00	38.9786	-121.6259	Single Well	49866	0	0	0	0	0	0	0	0	0
14N03E22B002M	390524N1216249W001	14N03E22B002M	Voluntary	Active	Irrigation	Confidential	163	11/7/1947 0:00	5/10/2016 0:00	39.0524	-121.6249	Single Well	0	0	0	0	0	0	0	0	0	0
14N03E31B001M	390245N1216796W001	14N03E31B001M	Voluntary	Active	Irrigation	Confidential	176	12/11/1947 0:00	5/10/2016 0:00	39.0245	-121.6796	Single Well	0	0	0	0	0	0	0	0	0	0
14N03E33C001M	390234N1216478W001	14N03E33C001M	Voluntary	Active	Irrigation	Confidential	213	11/15/1956 0:00	5/10/2016 0:00	39.0234	-121.6478	Single Well	0	0	0	0	0	0	0	0	0	0
15N03E17B002M	391537N1216612W001	15N03E17B002M	Voluntary	Active	Irrigation	Confidential	144	2/11/1966 0:00	5/10/2016 0:00	39.1537	-121.6612	Single Well	0	0	0	0	0	0	0	0	0	0
15N03E20R001M	391275N1216569W001	15N03E20R001M	Voluntary	Active	Unknown	Confidential	181	12/19/1947 0:00	5/10/2016 0:00	39.1275	-121.6569	Single Well	0	0	0	0	0	0	0	0	0	0
	389336N1218125W001	Broomiside #2	Voluntary	Active	Irrigation	Confidential	10	7/6/2009 11:45	9/7/2009 9:15	38.93361	-121.8125	Single Well	0	0	0	0	0	0	0	0	0	0

Sutter Subbasin Well Construction Details

State Well Number	CASGEM Well Number	Local Well Designation	Type of Well	Status of Well	Well Usage	Total Well Depth	Measurement Count	Earliest Elevation Measurement Date	Most Recent Elevation Measurement Date	Latitude (NAD 83)	Longitude (NAD 83)	Completion Type	Well Completion Report #	Total Depth	S1 Top	S1 Bottom	S2 Top	S2 Bottom	S3 Top	S3 Bottom	S4 Top	S4 Bottom
	389454N1215870W001	GH Atwal Well	Voluntary	Active	Irrigation	Confidential	58	5/30/2014 15:25	3/1/2016 10:40	38.9454	-121.587	Single Well		0	0	0	0	0	0	0	0	0
	389677N1215974W001	GH Rouse Ranch Well	CASGEM	Active	Irrigation	Unknown	97	6/30/2010 14:30	3/3/2016 13:35	38.96771	-121.5974	Single Well		0	0	0	0	0	0	0	0	0
	389525N1216161W001	GH Well 1	CASGEM	Active	Irrigation	Unknown	103	6/30/2009 8:30	3/3/2016 13:45	38.95247	-121.6161	Single Well		0	0	0	0	0	0	0	0	0
	389453N1216159W001	GH Well 2	CASGEM	Active	Irrigation	Unknown	102	6/30/2009 8:35	3/3/2016 13:42	38.94529	-121.6159	Single Well		0	0	0	0	0	0	0	0	0
	389398N1216162W001	GH Well 3	CASGEM	Active	Irrigation	Unknown	102	6/30/2009 8:42	3/3/2016 13:40	38.93975	-121.6162	Single Well		0	0	0	0	0	0	0	0	0
	391282N1216799W001	Lyndsey	CASGEM	Active	Irrigation	Unknown				39.12818	-121.6799	Single Well		0	0	0	0	0	0	0	0	0
	391052N1218994W001	MFWC S Meridian	CASGEM	Active	Irrigation	Unknown				39.10524	-121.8994	Single Well		0	0	0	0	0	0	0	0	0
	389389N1218161W001	MW-9	Voluntary	Active	Irrigation	Confidential	35	7/27/2009 9:37	3/23/2016 12:55	38.93889	-121.8161	Single Well		0	0	0	0	0	0	0	0	0
	391710N1217359W001	SCSD Well #1	Voluntary	Active	Unknown	Confidential	70	6/3/2013 0:00	11/2/2015 0:00	39.17103	-121.7359	Single Well		0	0	0	0	0	0	0	0	0
	390679N1217641W001	TBF Well 6	Voluntary	Unknown	Unknown	Confidential	41	6/30/2009 10:40	1/9/2014 14:26	39.06788	-121.7641	Single Well		0	0	0	0	0	0	0	0	0
	390914N1217685W001	TBF Well 8	Voluntary	Unknown	Unknown	Confidential	39	6/30/2009 10:00	1/9/2014 13:30	39.0914	-121.7685	Single Well		0	0	0	0	0	0	0	0	0
	389303N1217639W001	Tennis #1	Voluntary	Active	Irrigation	Confidential	31	7/6/2009 9:00	3/24/2014 16:20	38.93028	-121.7639	Single Well		0	0	0	0	0	0	0	0	0
	390369N1218189W001	TID Park-Lonon	CASGEM	Active	Irrigation	Unknown				39.03691	-121.8189	Single Well		0	0	0	0	0	0	0	0	0
	389606N1218011W001	Tucker #2	Voluntary	Active	Irrigation	Confidential	89	7/2/2009 9:00	3/23/2016 10:47	38.96056	-121.8011	Single Well		0	0	0	0	0	0	0	0	0
	391057N1216114W001	WWTP Well	CASGEM	Inactive	Other	Unknown				39.10566	-121.6114	Single Well		0	0	0	0	0	0	0	0	0

APPENDIX H
SUTTER COUNTY PORTION OF EAST BUTTE SUBBASIN CASGEM MONITORING WELL CONSTRUCTION DETAILS

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Sutter County Portion of East Butte Subbasin Well Construction Details

State Well Number	CASGEM Well Number	Local Well Designation	Type of Well	Status of Well	Well Usage	Total Well Depth	Measurement Count	Earliest Elevation Measurement Date	Most Recent Elevation Measurement Date	Latitude (NAD 83)	Longitude (NAD 83)	Completion Type	Well Completion Report #	Total Depth	S1 Top	S1 Bottom	S2 Top	S2 Bottom	S3 Top	S3 Bottom	S4 Top	S4 Bottom
Shallow Aquifer																						
17N02E25J002M	392970N1216907W002	BWD MW-1B	CASGEM	Active	Observation	370	29	3/26/2012 10:44	8/1/2016 12:00	39.29705	-121.6907	Unknown	0	9	0	0	0	0	0	0	0	0
16N03E21D002M	392328N1216469W001	16N03E21D002M	CASGEM	Active	Residential	30	247	6/28/1962 0:00	5/19/2016 0:00	39.2328	-121.6469	Single Well	0	30	0	0	0	0	0	0	0	0
16N01E18K001M	392355N1218985W001		Voluntary	Active	Unknown	Confidential	19	8/7/1962 0:00	3/24/1971 0:00	39.2355	-121.8985	Single Well	0	30	0	0	0	0	0	0	0	0
16N01E08C001M	392575N1218863W001	16N01E08C001M	CASGEM	Active	Stockwatering	Unknown	130	8/6/1962 0:00	1/29/2014 0:00	39.2575	-121.8863	Single Well	0	36	0	0	0	0	0	0	0	0
17N02E26R001M	392935N1217061W001	17N02E26R001M	Voluntary	Active	Irrigation	Confidential	20	3/26/2012 1:00	8/1/2016 12:00	39.2935	-121.7061	Unknown	0	65	0	0	0	0	0	0	0	0
17N02E31A001M	392867N1217825W001	17N02E31A001M	CASGEM	Active	Irrigation	540	181	3/25/1948 0:00	5/19/2016 0:00	39.2867	-121.7825	Unknown	72302	70	32	70	0	0	0	0	0	0
	392762N1216556W001	Live Oak Well 5	CASGEM	Inactive	Other	399	57	6/12/2014 0:00	6/2/2016 0:00	39.27623	-121.6556	Part of a nested/multi-completion well	E0114617	85	65	75	0	0	0	0	0	0
16N01E31H001M	391975N1218937W001	16N01E31H001M	Voluntary	Active	Unknown	Confidential	191	12/8/1932 0:00	5/19/2016 0:00	39.1975	-121.8937	Single Well	525	95	0	0	0	0	0	0	0	0
17N02E25J003M	392970N1216907W003	BWD MW-1C	CASGEM	Active	Observation	127	22	3/26/2012 10:54	8/1/2016 12:00	39.29705	-121.6907	Part of a nested/multi-completion well	E058334	127	70	90	0	0	0	0	0	0
Intermediate Aquifer																						
17N02E34A001M	392878N1217240W001		Voluntary	Active	Unknown	Confidential	139	12/22/1947 0:00	3/23/1973 0:00	39.2878	-121.724	Single Well	0	196	0	0	0	0	0	0	0	0
17N02E31A001M	392867N1217825W001	17N02E31A001M	CASGEM	Active	Irrigation	540	181	3/25/1948 0:00	5/19/2016 0:00	39.2867	-121.7825	Part of a nested/multi-completion well	E0114617	315	285	305	0	0	0	0	0	0
17N01E25J001M	392947N1218022W001	17N01E25J001M	Voluntary	Active	Irrigation	Confidential	42	3/30/2012 0:00	5/19/2016 0:00	39.2947	-121.8022	Part of a nested/multi-completion well	E058334	370	320	360	0	0	0	0	0	0
16N01E08C001M	392575N1218863W001	16N01E08C001M	CASGEM	Active	Stockwatering	Unknown	130	8/6/1962 0:00	1/29/2014 0:00	39.2575	-121.8863	Single Well	38167	399	0	0	0	0	0	0	0	0

Sutter County Portion of East Butte Subbasin Well Construction Details

State Well Number	CASGEM Well Number	Local Well Designation	Type of Well	Status of Well	Well Usage	Total Well Depth	Measurement Count	Earliest Elevation Measurement Date	Most Recent Elevation Measurement Date	Latitude (NAD 83)	Longitude (NAD 83)	Completion Type	Well Completion Report #	Total Depth	S1 Top	S1 Bottom	S2 Top	S2 Bottom	S3 Top	S3 Bottom	S4 Top	S4 Bottom
17N02E25J001M	392970N1216907W001	BWD MW-1A	CASGEM	Active	Observation	591	26	3/26/2012 10:38	8/1/2016 12:00	39.29705	-121.6907	Part of a nested/multi-completion well	E0114617	430	400	420	0	0	0	0	0	0
16N03E17J005M	392394N1216509W005	Sutter County MW-3E	CASGEM	Active	Observation	785	40	8/4/2010 0:00	8/30/2016 12:49	39.2394	-121.6509	Single Well	104	540	0	0	0	0	0	0	0	0
17N02E34A001M	392878N1217240W001		Voluntary	Active	Unknown	Confidential	139	12/22/1947 0:00	3/23/1973 0:00	39.2878	-121.724	Part of a nested/multi-completion well	e058334	591	490	590	0	0	0	0	0	0
16N03E17J003M	392394N1216509W003	Sutter County MW-3C	CASGEM	Active	Observation	430	40	8/4/2010 0:00	8/30/2016 12:44	39.2394	-121.6509	Single Well	944093	598	279	593	0	0	0	0	0	0
17N02E25J002M	392970N1216907W002	BWD MW-1B	CASGEM	Active	Observation	370	29	3/26/2012 10:44	8/1/2016 12:00	39.29705	-121.6907	Part of a nested/multi-completion well	E0114617	615	595	605	0	0	0	0	0	0
16N02E02Q001M	392634N1217141W001	16N02E02Q001M	CASGEM	Active	Residential	Unknown	223	8/7/1962 0:00	5/19/2016 0:00	39.26239	-121.715	Single Well	944094	620	263	353	463	493	545	580	590	620
17N02E25J003M	392970N1216907W003	BWD MW-1C	CASGEM	Active	Observation	127	22	3/26/2012 10:54	8/1/2016 12:00	39.29705	-121.6907	Part of a nested/multi-completion well	E0114617	785	765	775	0	0	0	0	0	0
Unknown Principal Aquifer																						
17N02E25J001M	392970N1216907W001	BWD MW-1A	CASGEM	Active	Observation	591	26	3/26/2012 10:38	8/1/2016 12:00	39.29705	-121.6907	Unknown	0	0	0	0	0	0	0	0	0	0
16N01E31H001M	391975N1218937W001	16N01E31H001M	Voluntary	Active	Unknown	Confidential	191	12/8/1932 0:00	5/19/2016 0:00	39.1975	-121.8937	Single Well	0	0	0	0	0	0	0	0	0	0
16N02E02Q001M	392634N1217141W001	16N02E02Q001M	CASGEM	Active	Residential	Unknown	223	8/7/1962 0:00	5/19/2016 0:00	39.26239	-121.715	Single Well	0	0	0	0	0	0	0	0	0	0
16N03E17J001M	392394N1216509W001	Sutter County MW-3A	CASGEM	Active	Observation	85	40	8/4/2010 0:00	8/30/2016 12:42	39.2394	-121.6509	Single Well	0	0	0	0	0	0	0	0	0	0
	392762N1216556W001	Live Oak Well 5	CASGEM	Inactive	Other	399	57	6/12/2014 0:00	6/2/2016 0:00	39.27623	-121.6556	Single Well	0	0	0	0	0	0	0	0	0	0
17N01E33G001M	392821N1218593W001		Voluntary	Active	Irrigation	Confidential	91	8/6/1962 0:00	3/16/2004 0:00	39.2821	-121.8593	Single Well	0	0	0	0	0	0	0	0	0	0

APPENDIX I
LONG-TERM AND SHORT-TERM HYDROGRAPHS FOR CASGEM MONITORING WELLS

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SHALLOW AQUIFER HYDROGRAPHS

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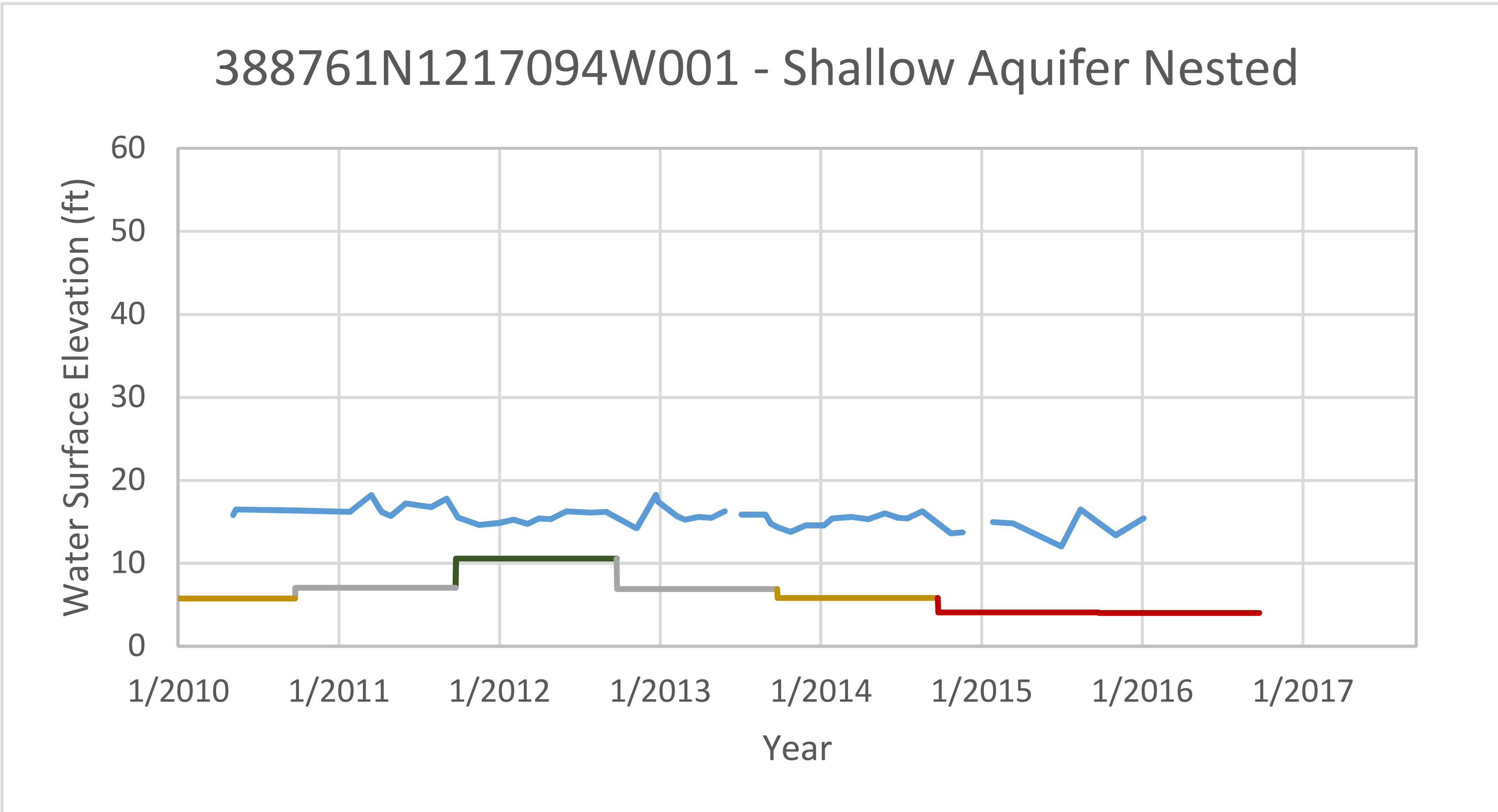
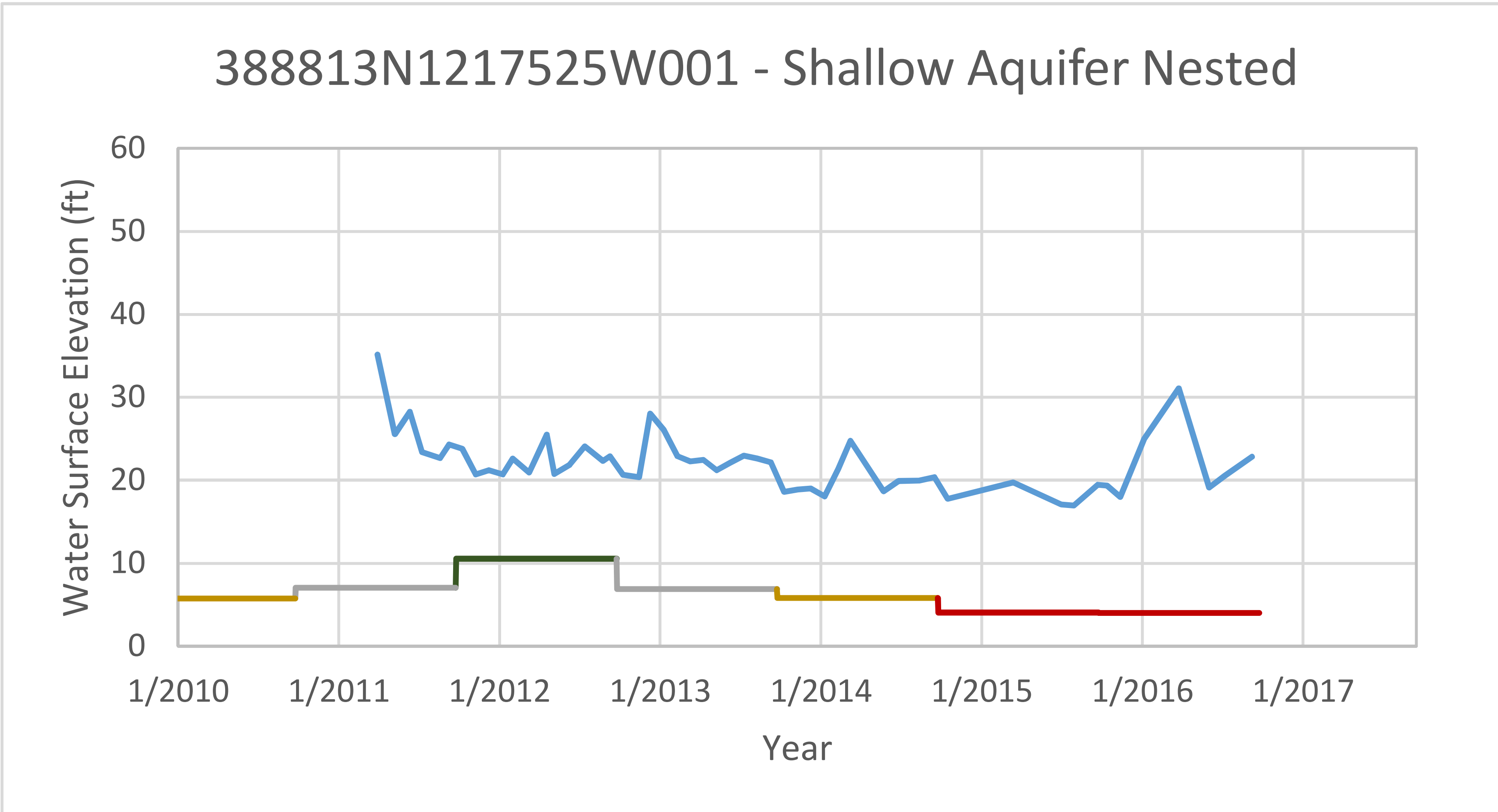
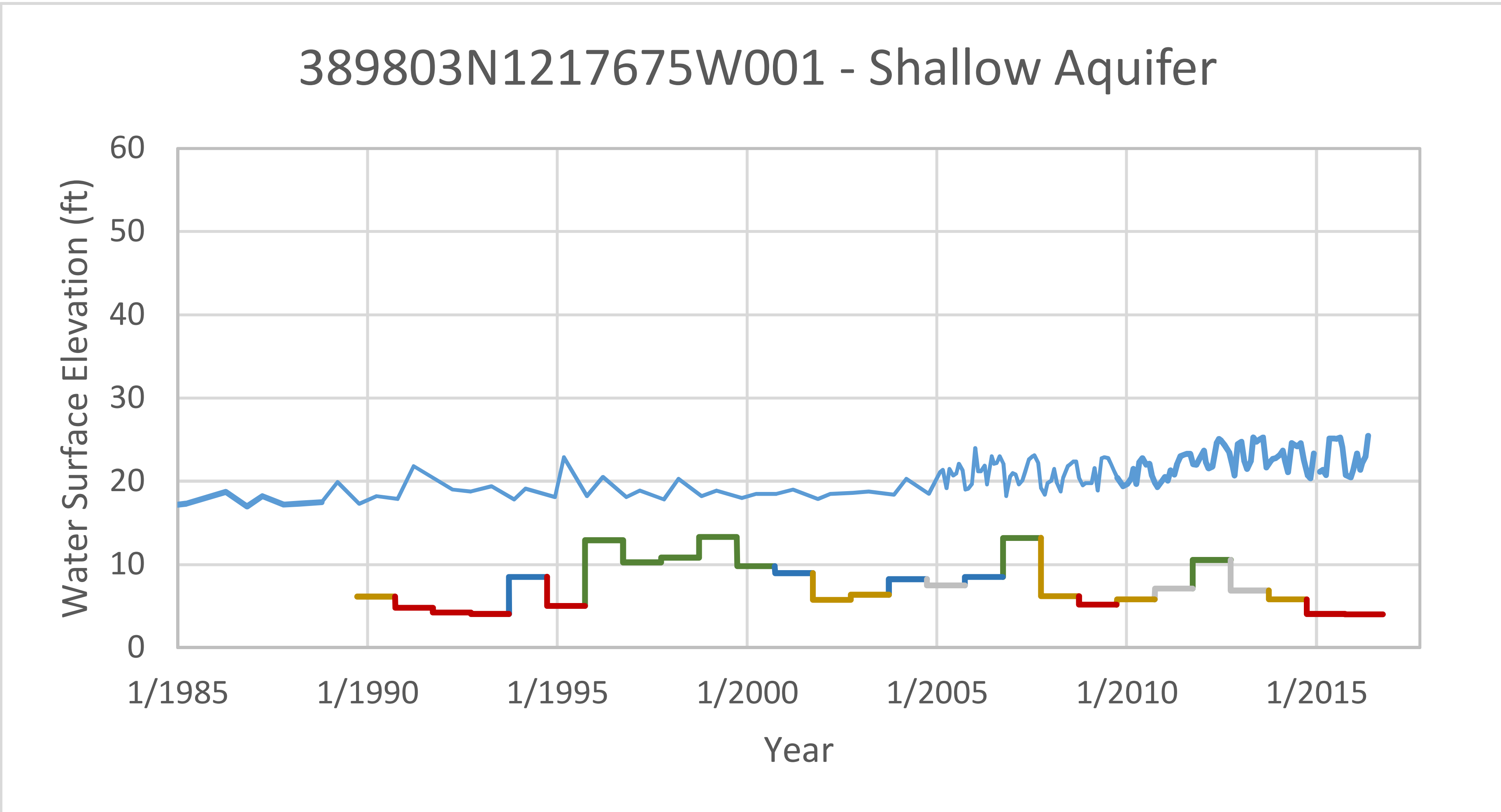
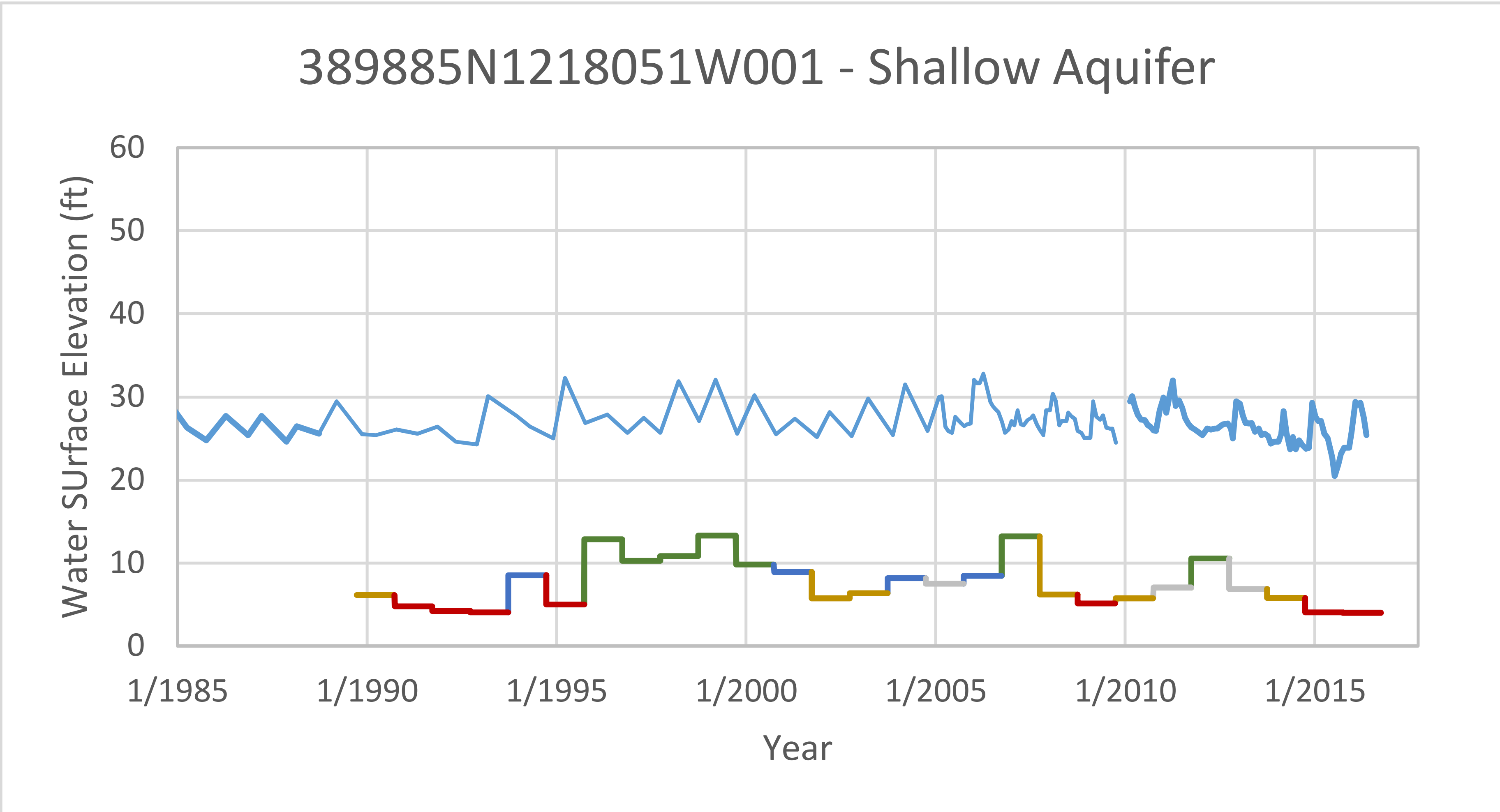


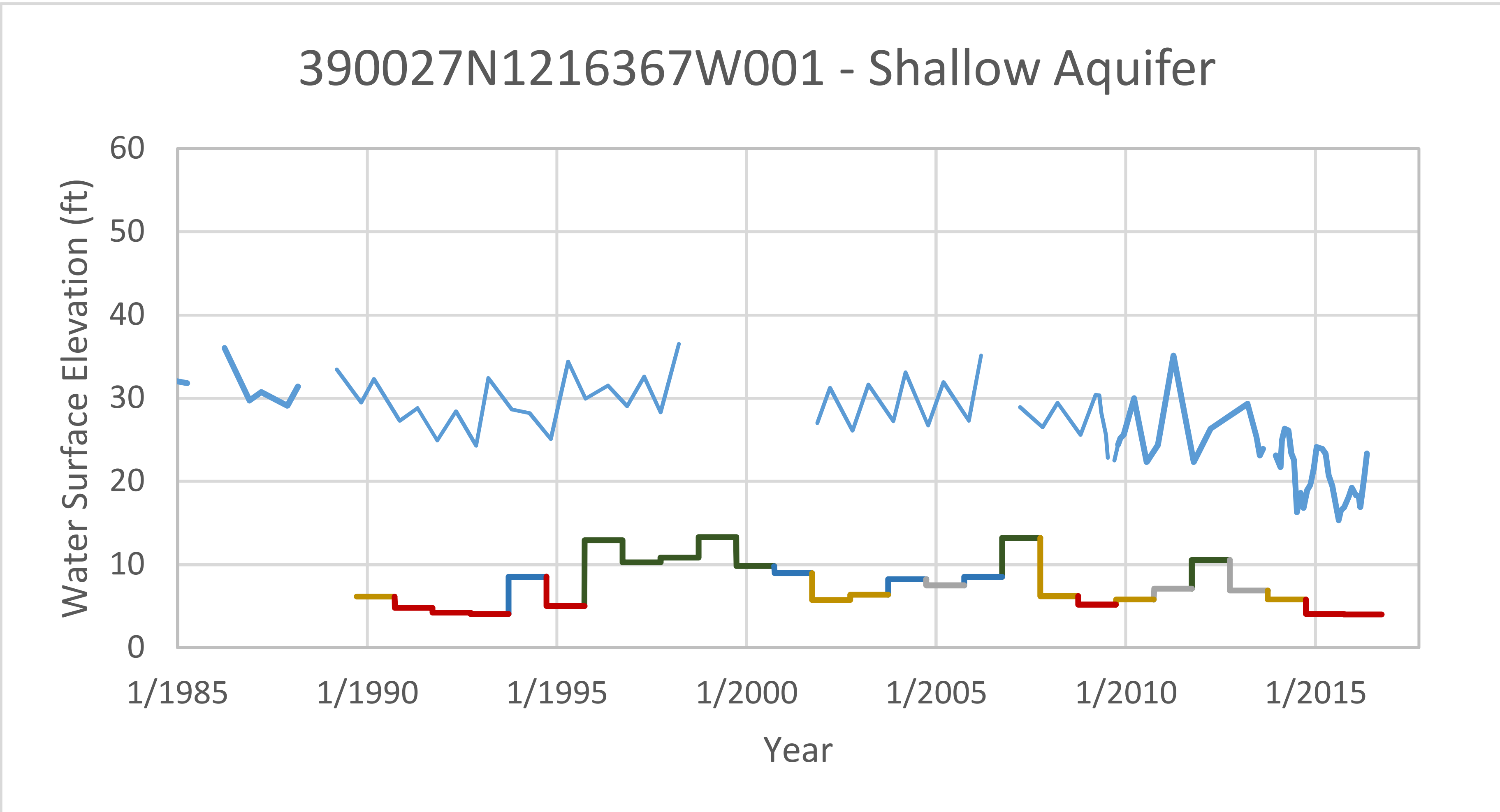
388761N1217094W001 - Shallow Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

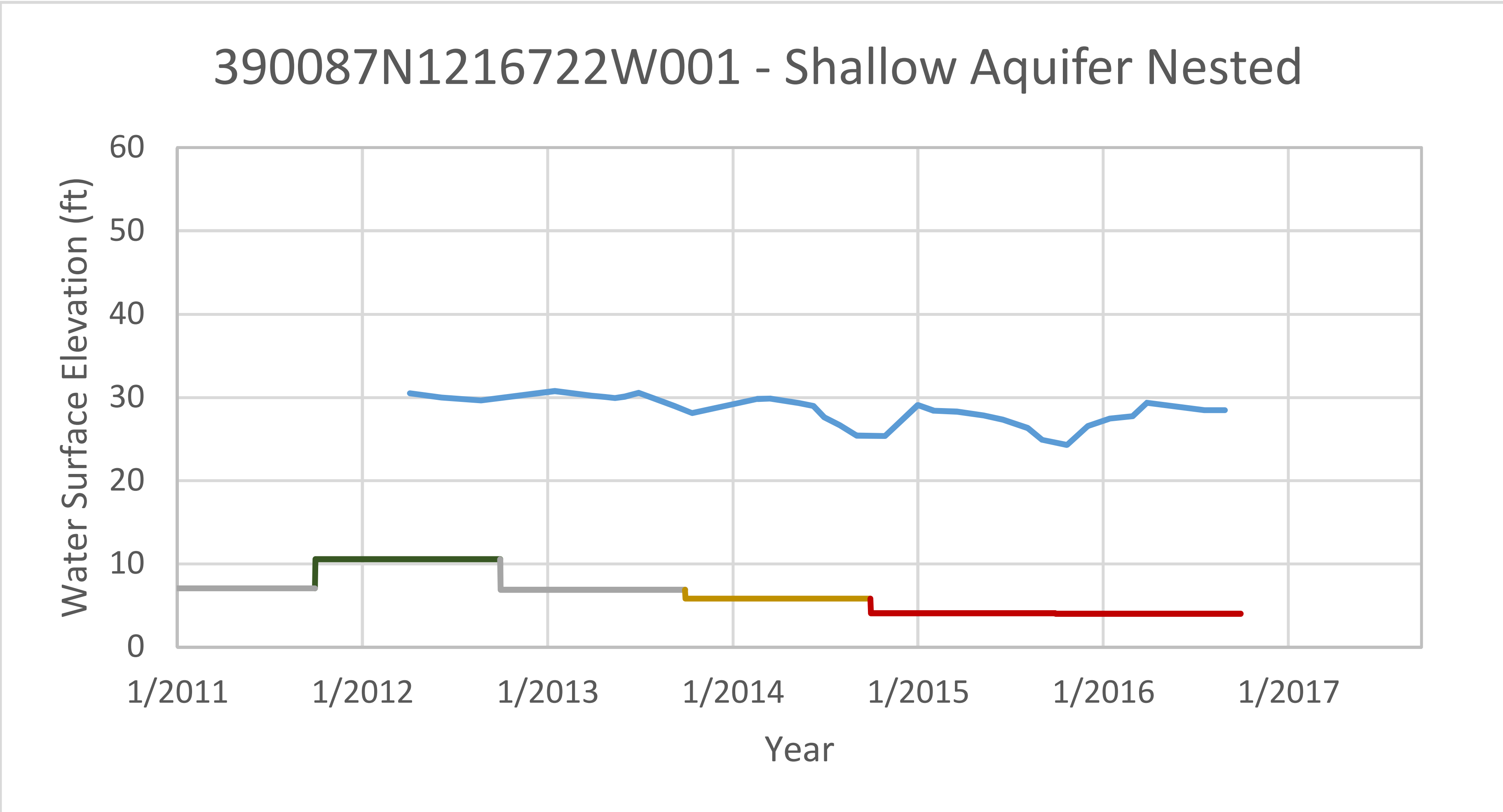

388813N1217525W001 - Shallow Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year


389803N1217675W001 - Shallow Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

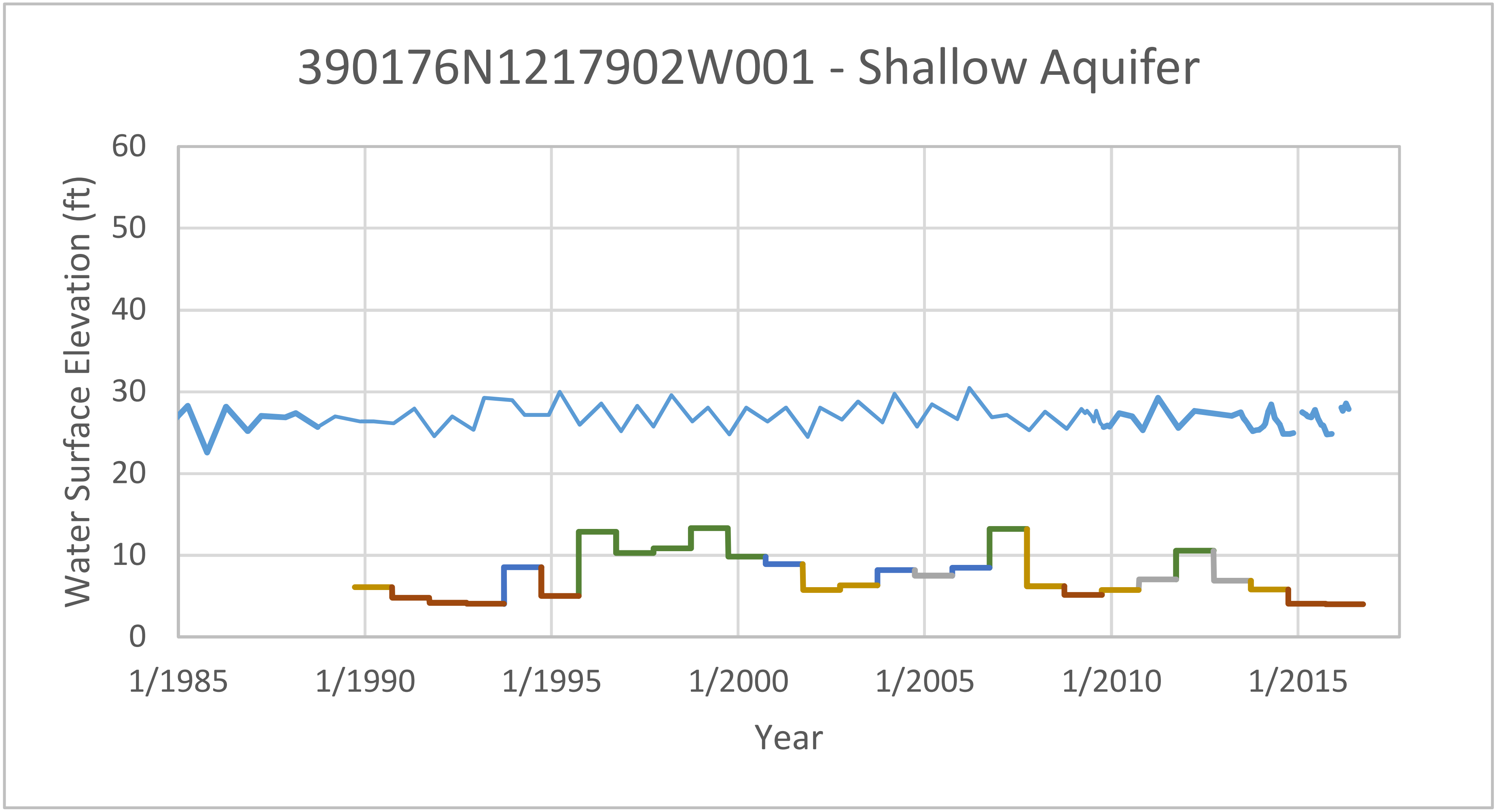


389885N1218051W001 - Shallow Aquifer
Water SUrface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

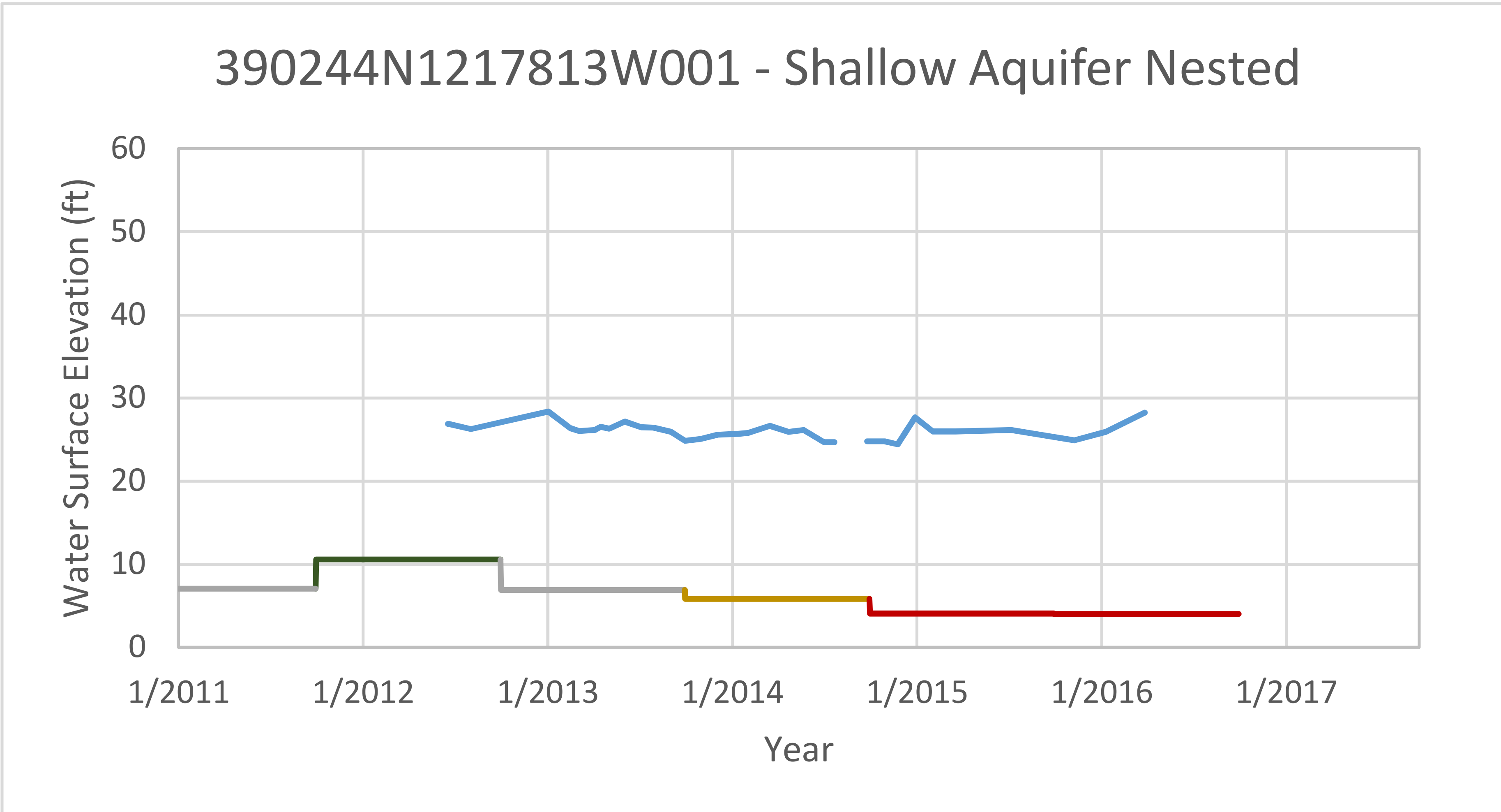

390027N1216367W001 - Shallow Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

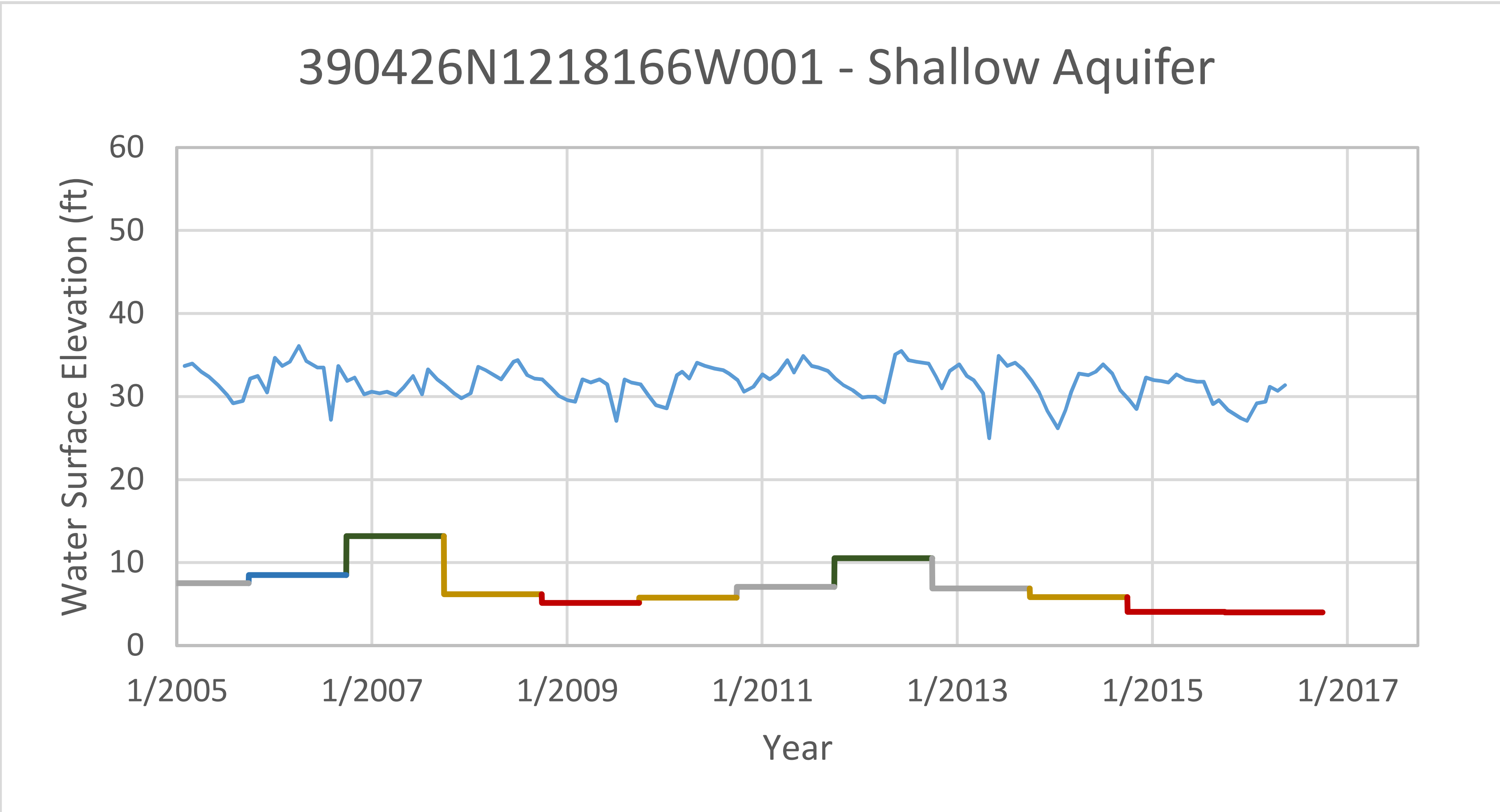


390087N1216722W001 - Shallow Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

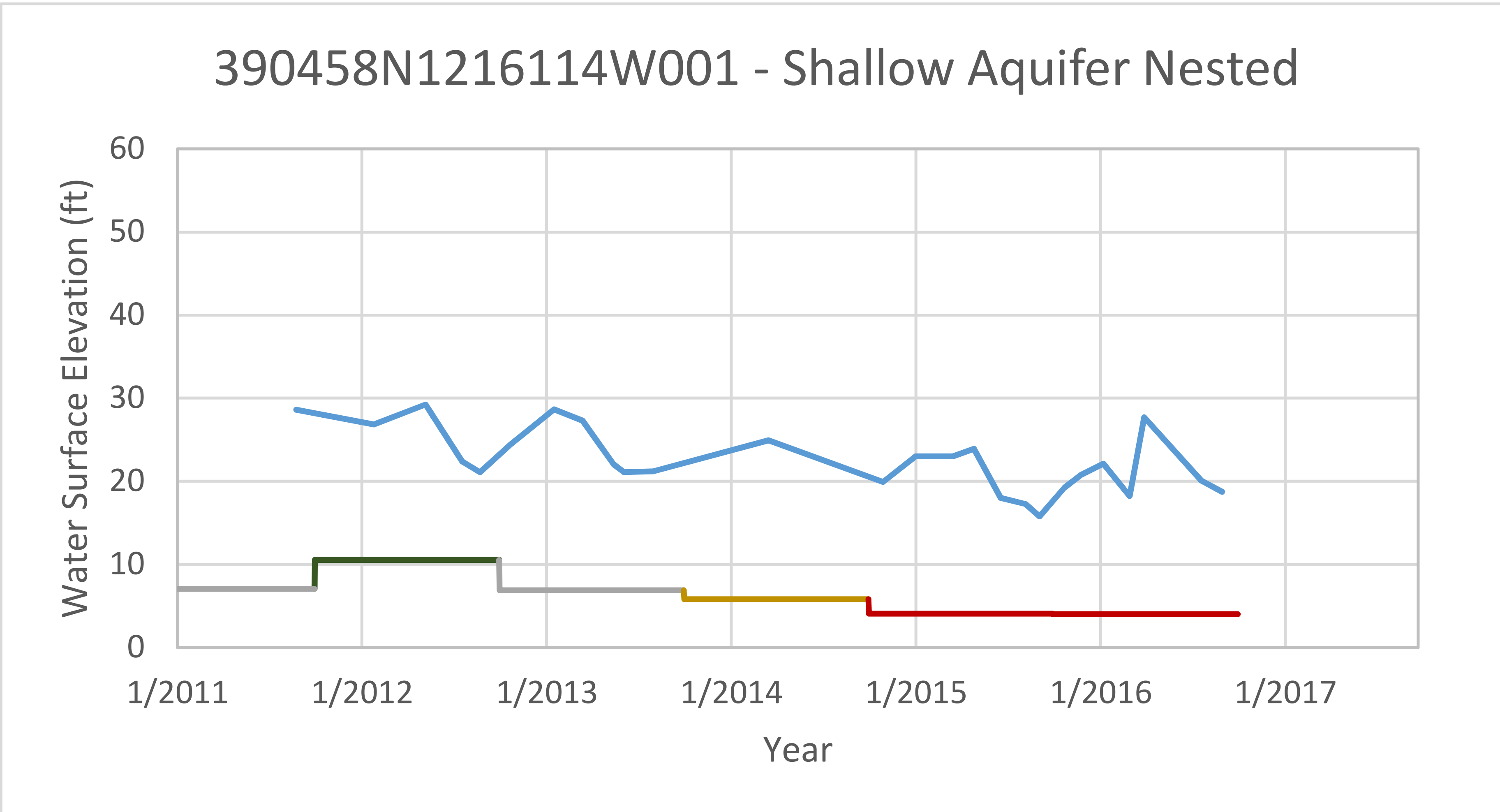


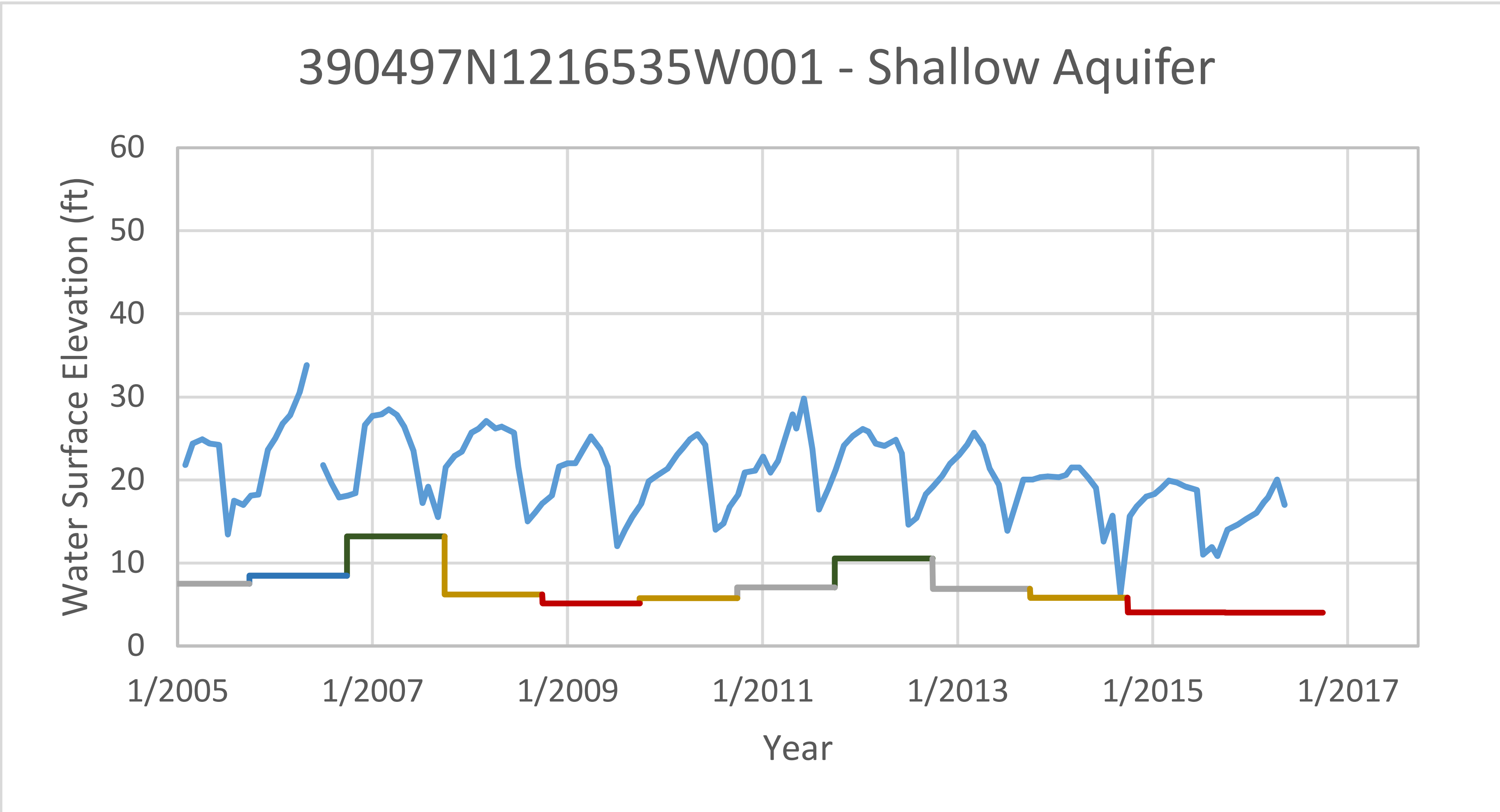
390176N1217902W001 - Shallow Aquifer
Water Surface Elevation (ft)
0
10
20
30
40
50
60
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

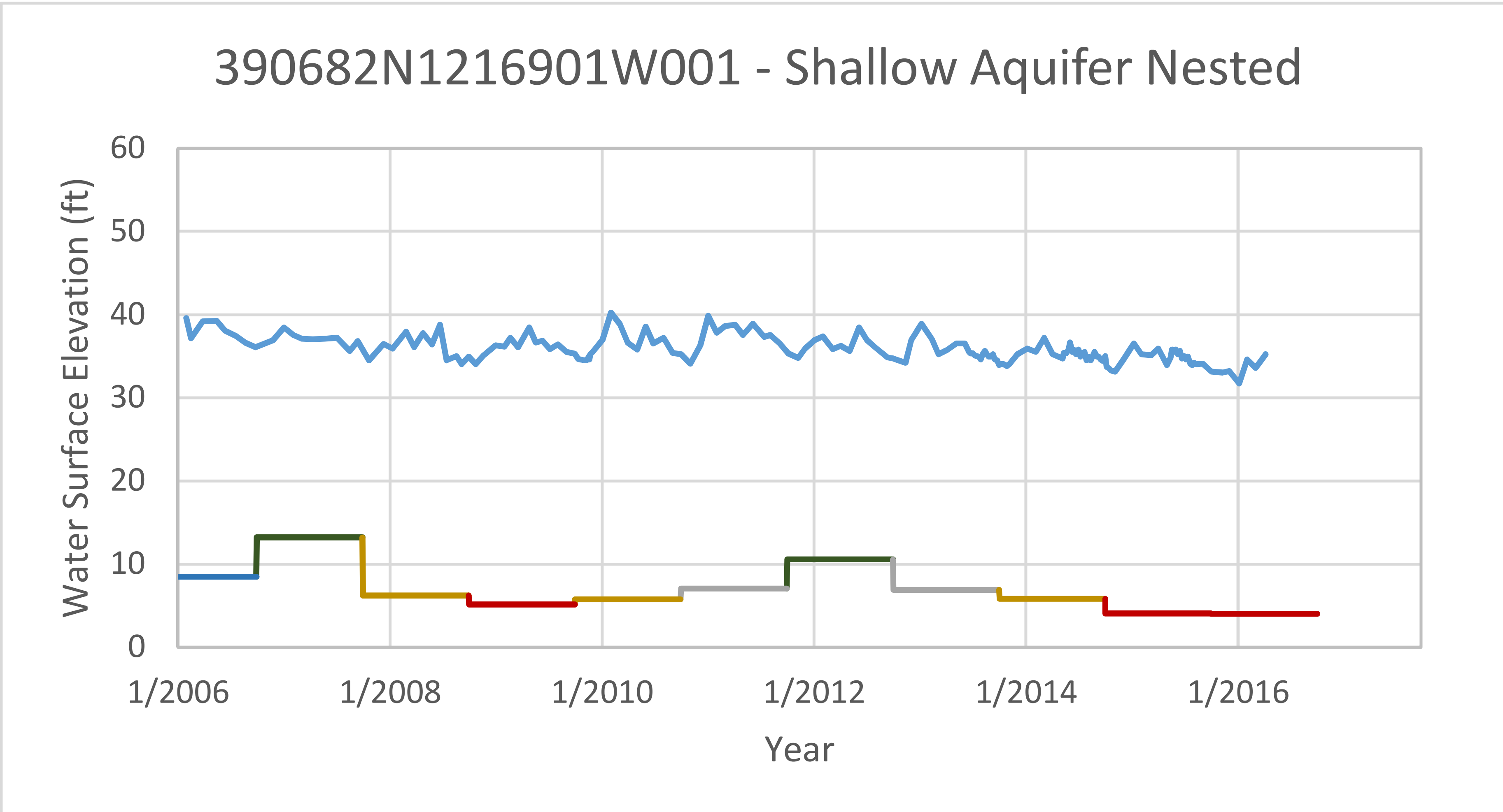

390244N1217813W001 - Shallow Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year



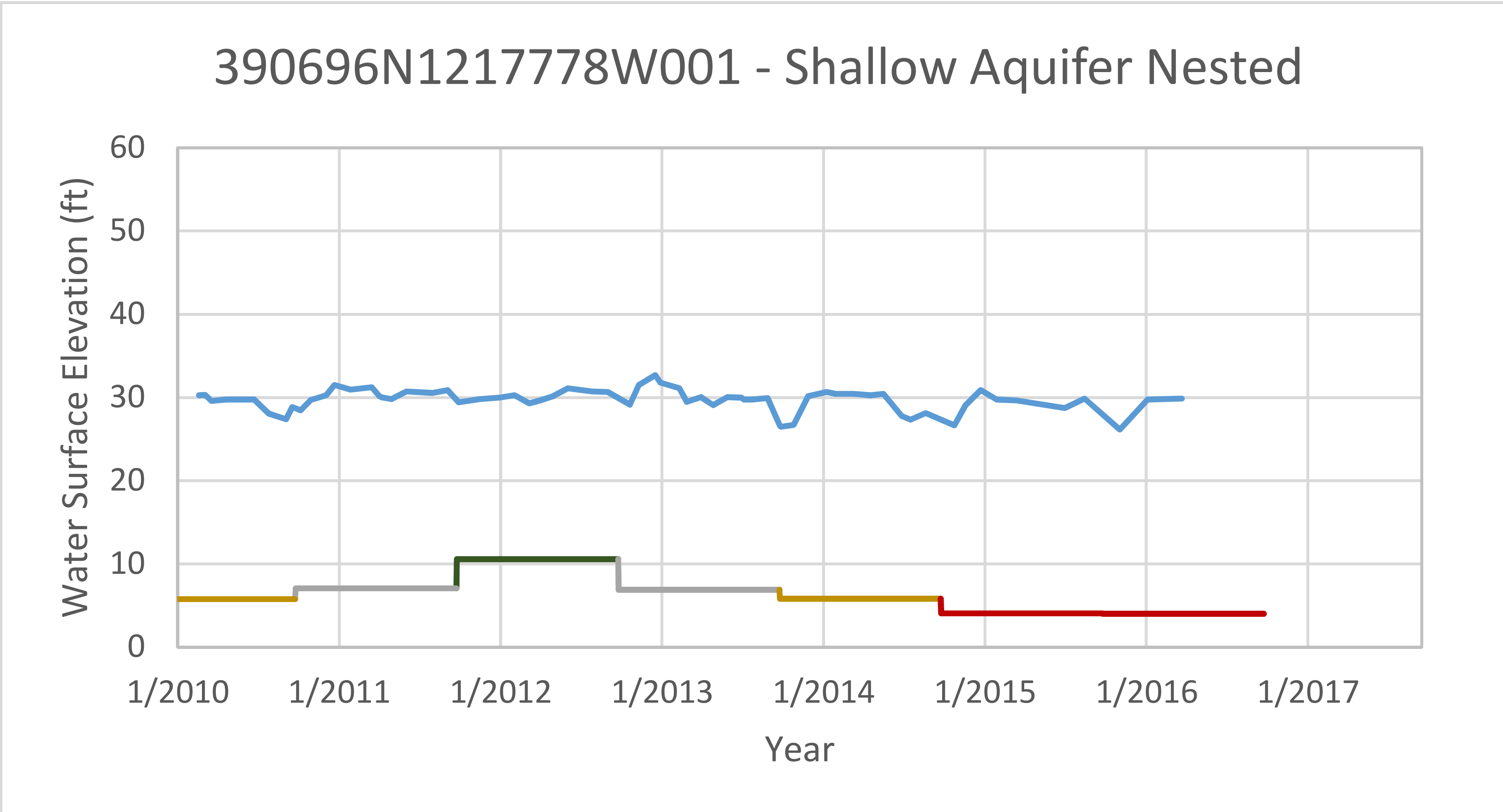
390426N1218166W001 - Shallow Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2005
1/2007
1/2009
1/2011
1/2013
1/2015
1/2017
Year


390458N1216114W001 - Shallow Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

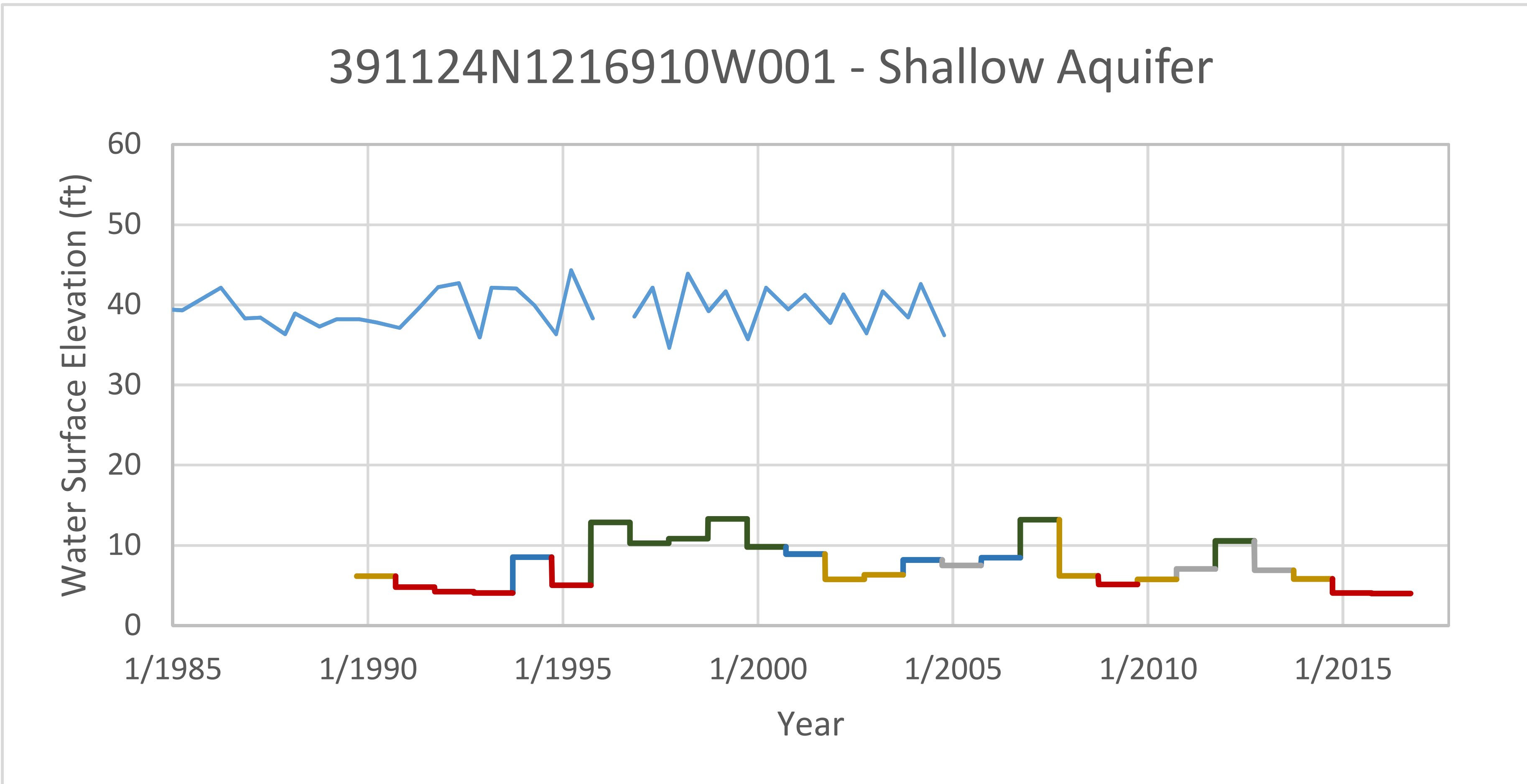

390497N1216535W001 - Shallow Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2005
1/2007
1/2009
1/2011
1/2013
1/2015
1/2017
Year

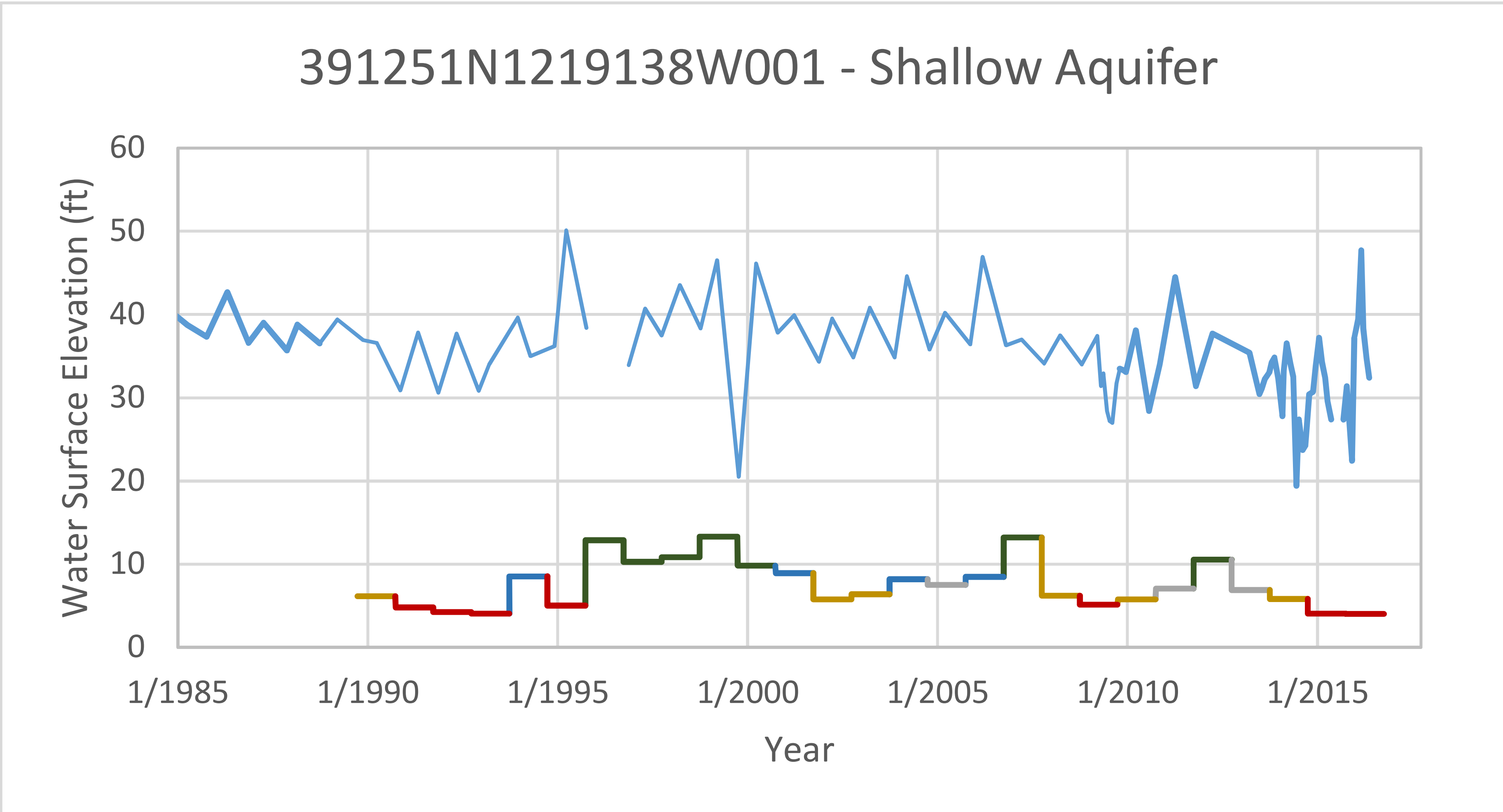


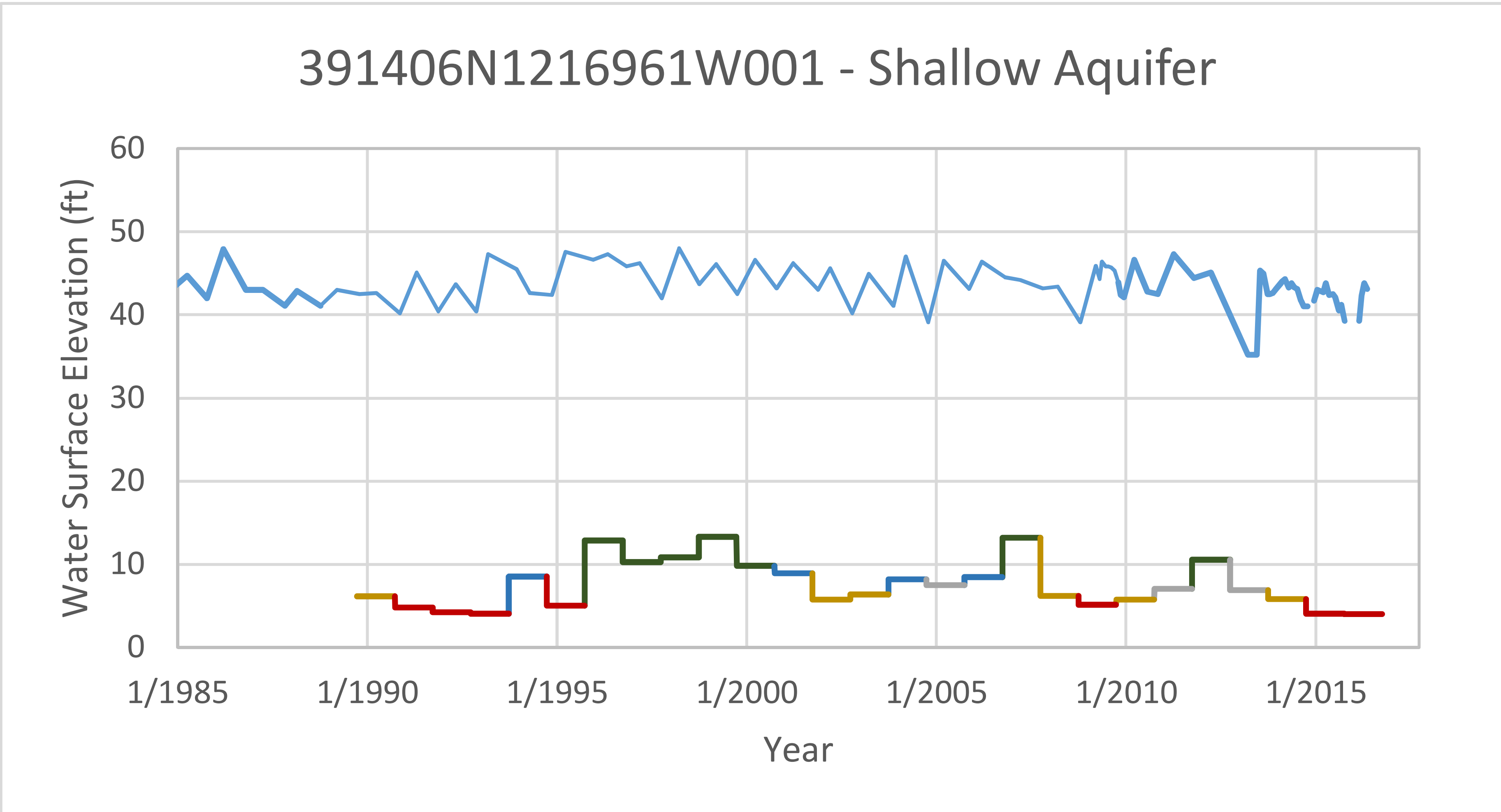
390682N1216901W001 - Shallow Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2006
1/2008
1/2010
1/2012
1/2014
1/2016
Year

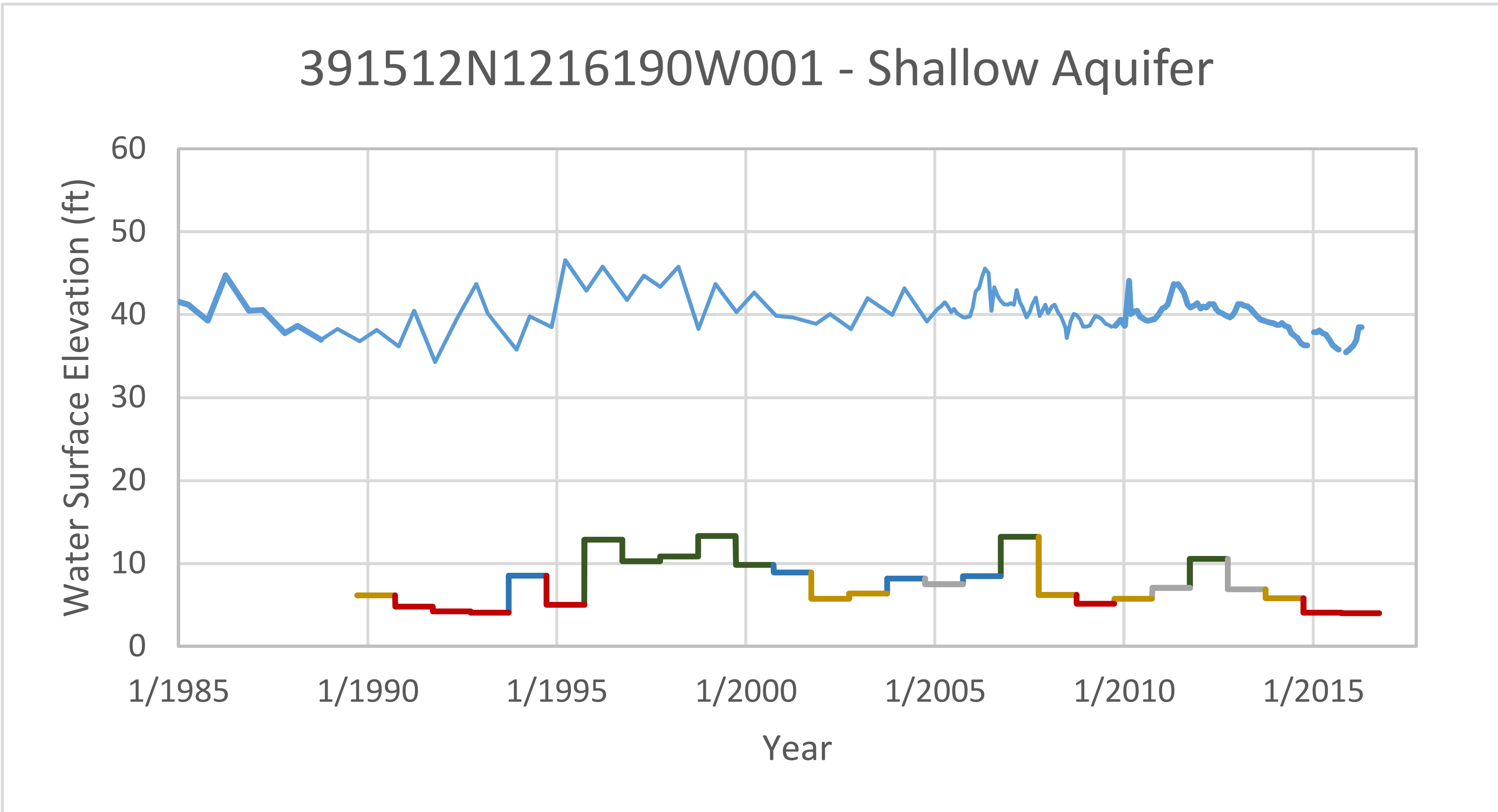


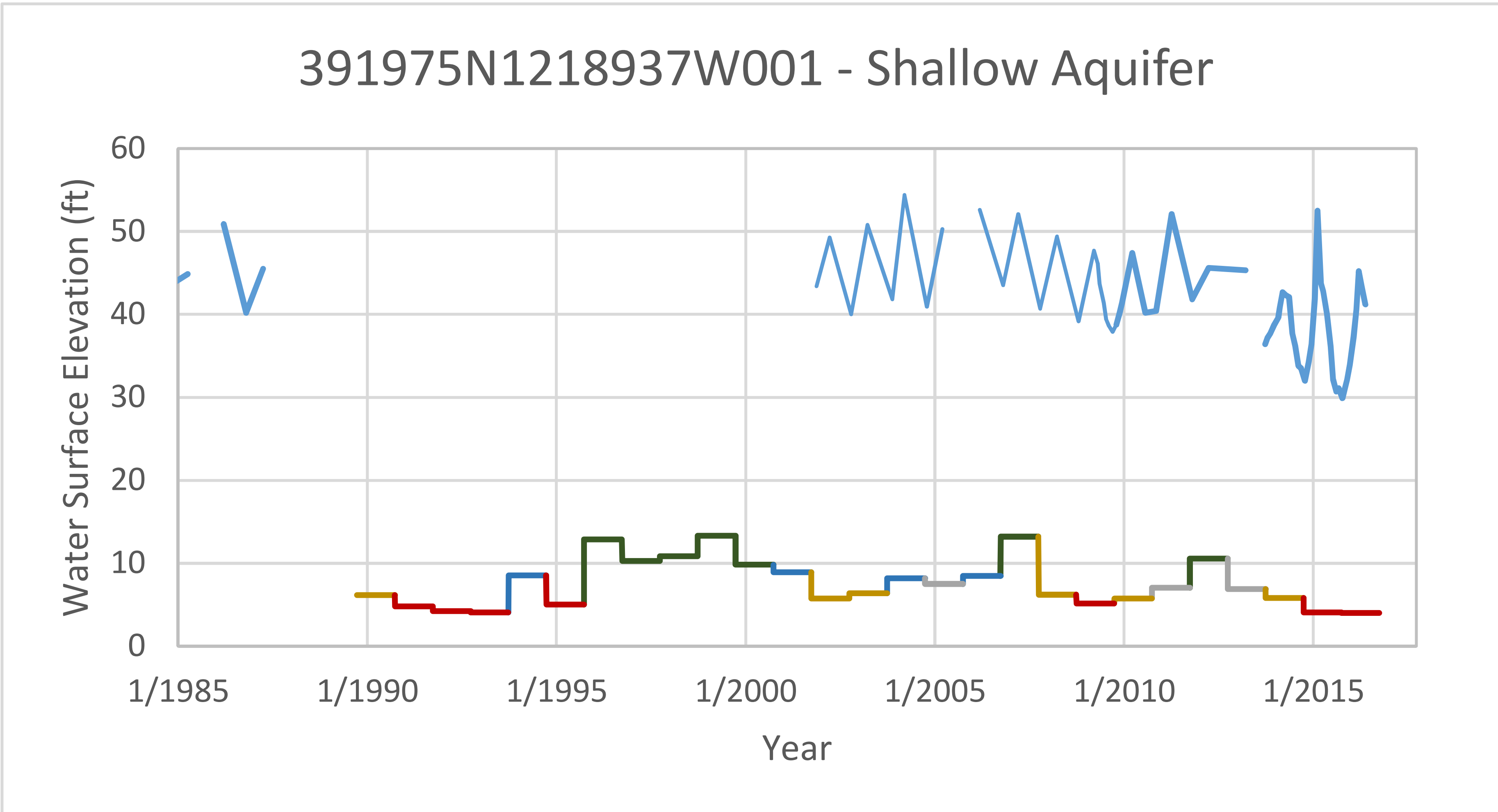
390696N1217778W001 - Shallow Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year


391124N1216910W001 - Shallow Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

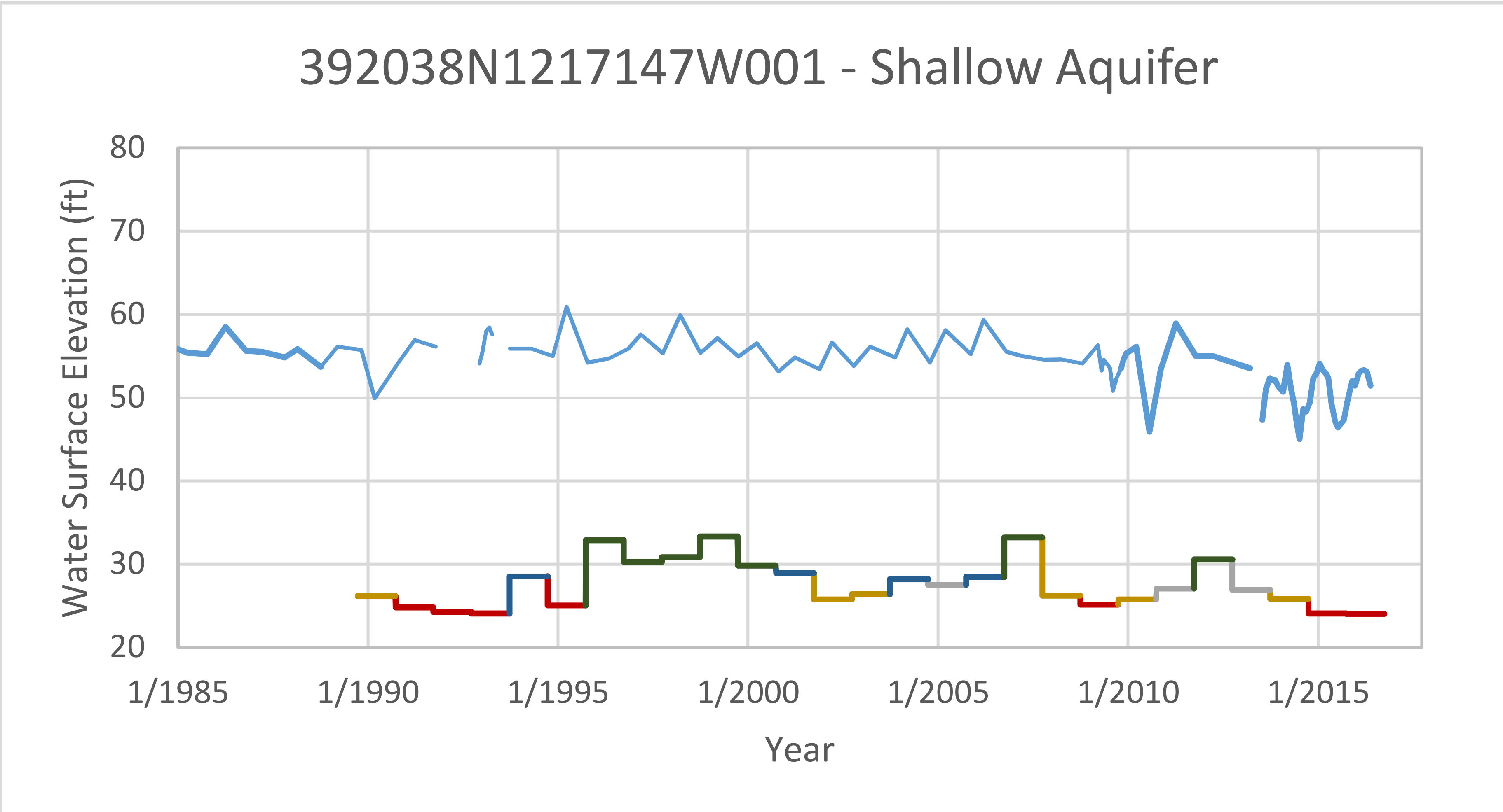

391251N1219138W001 - Shallow Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year


391406N1216961W001 - Shallow Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

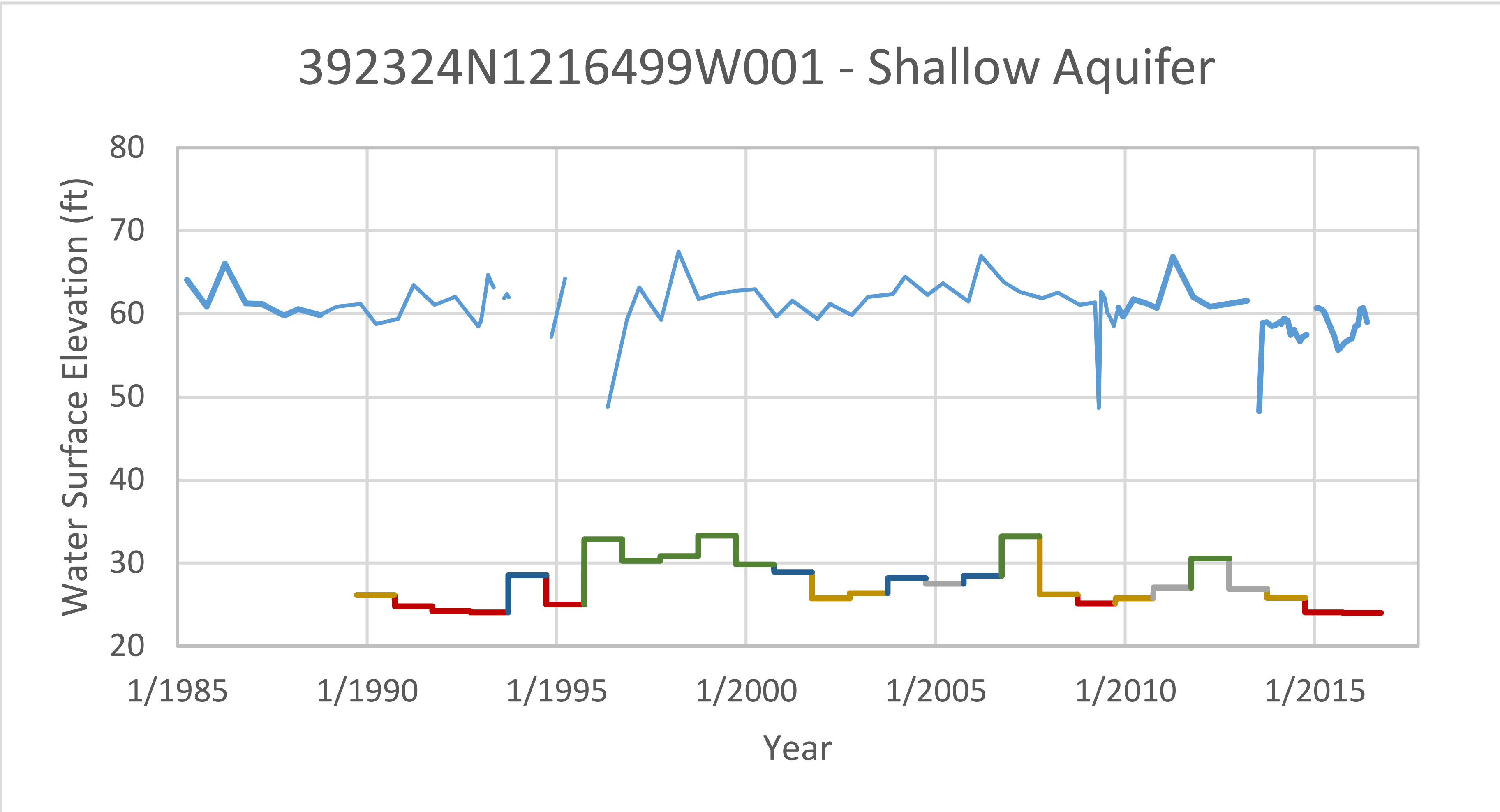

391512N1216190W001 - Shallow Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

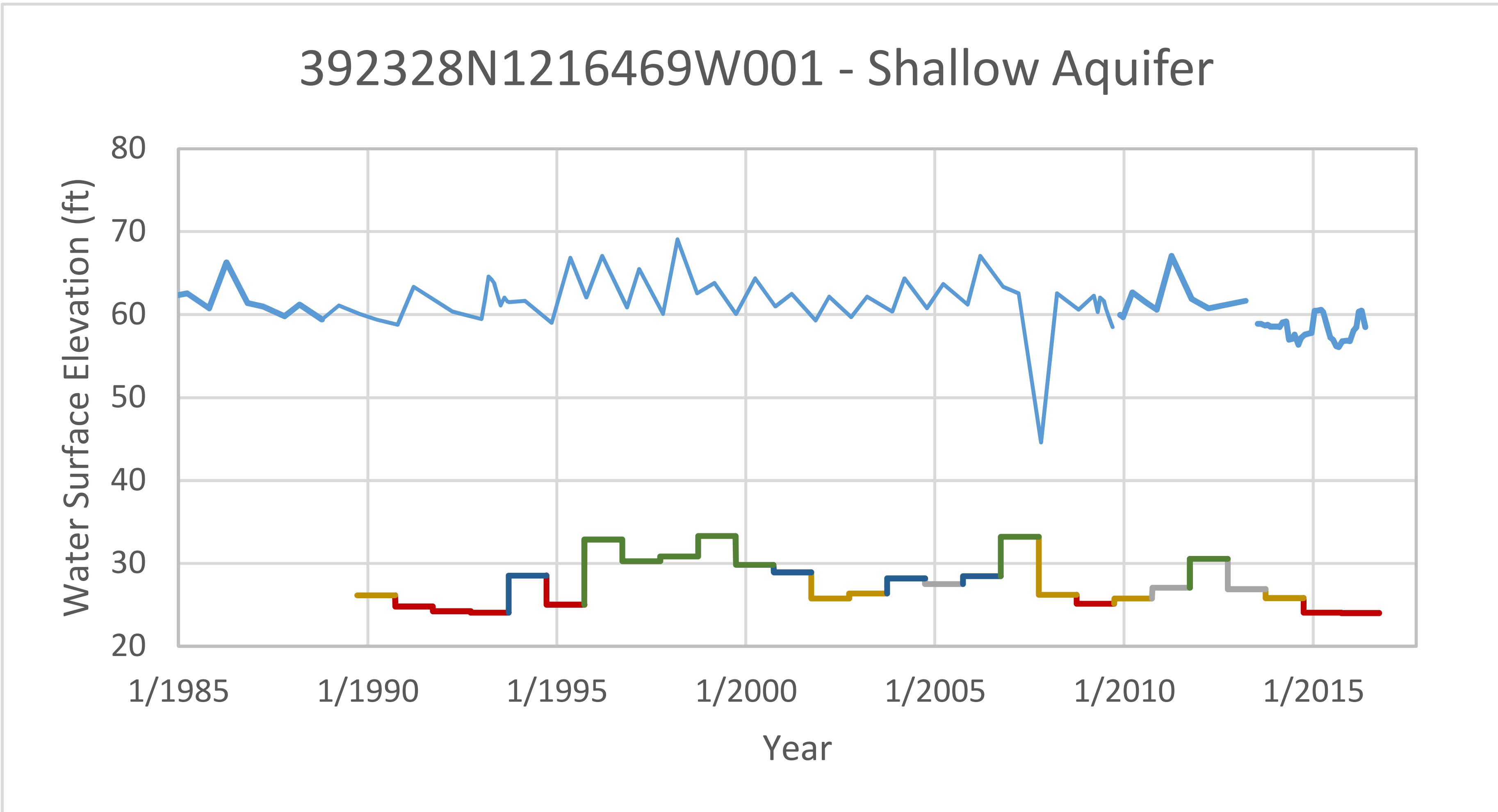


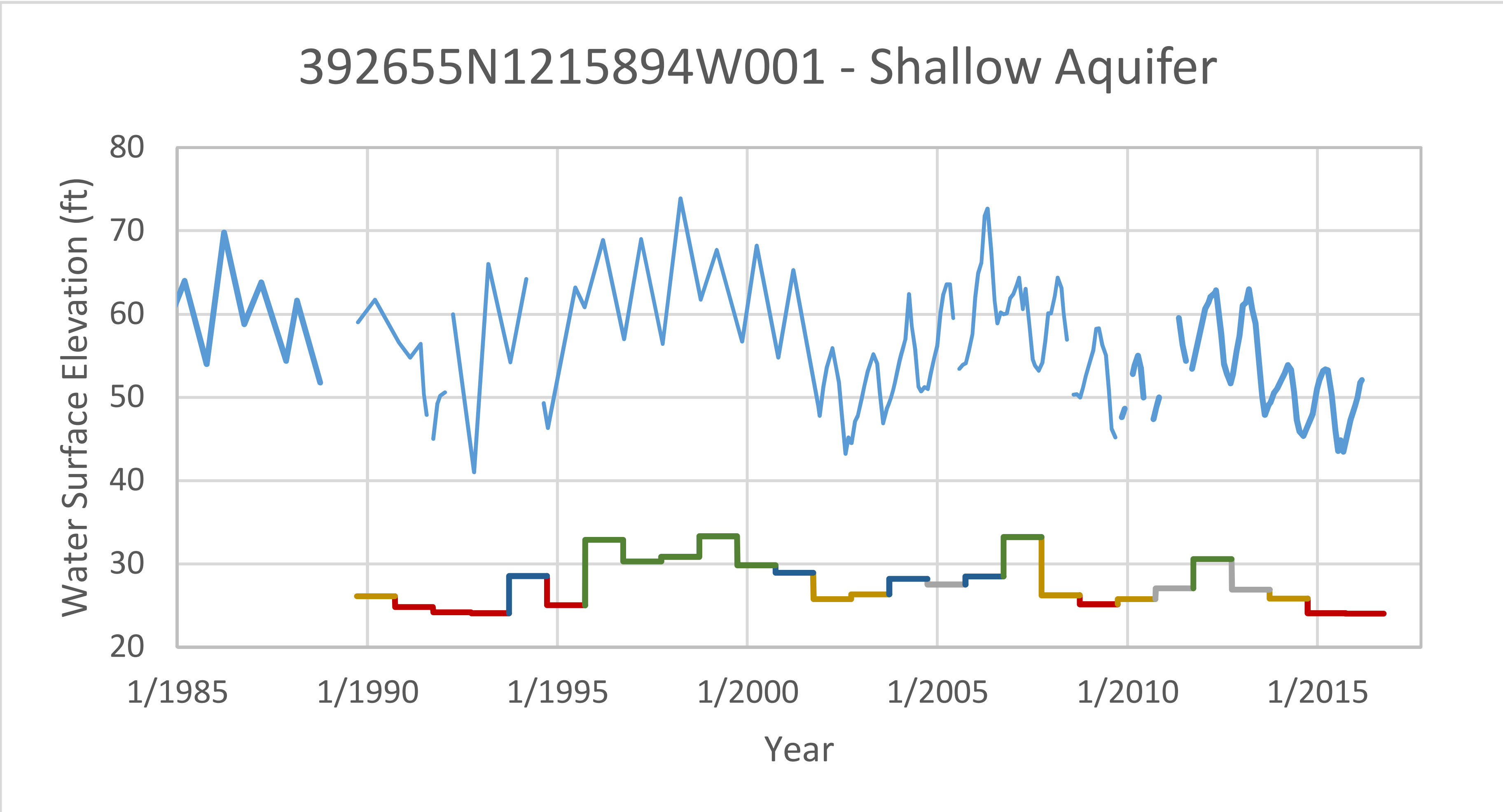
391975N1218937W001 - Shallow Aquifer
60
50
40
30
20
10
0
Water Surface Elevation (ft)
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

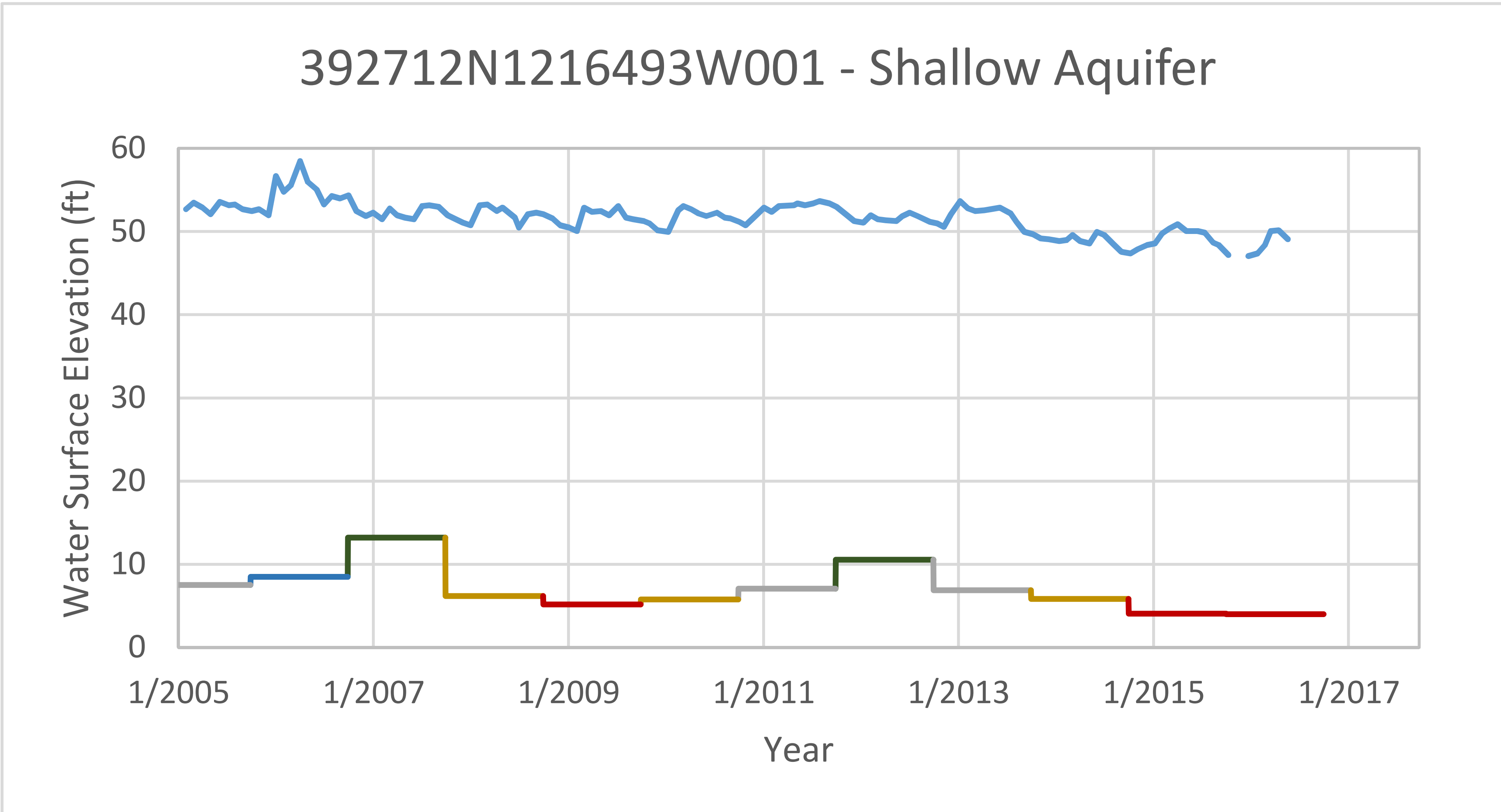


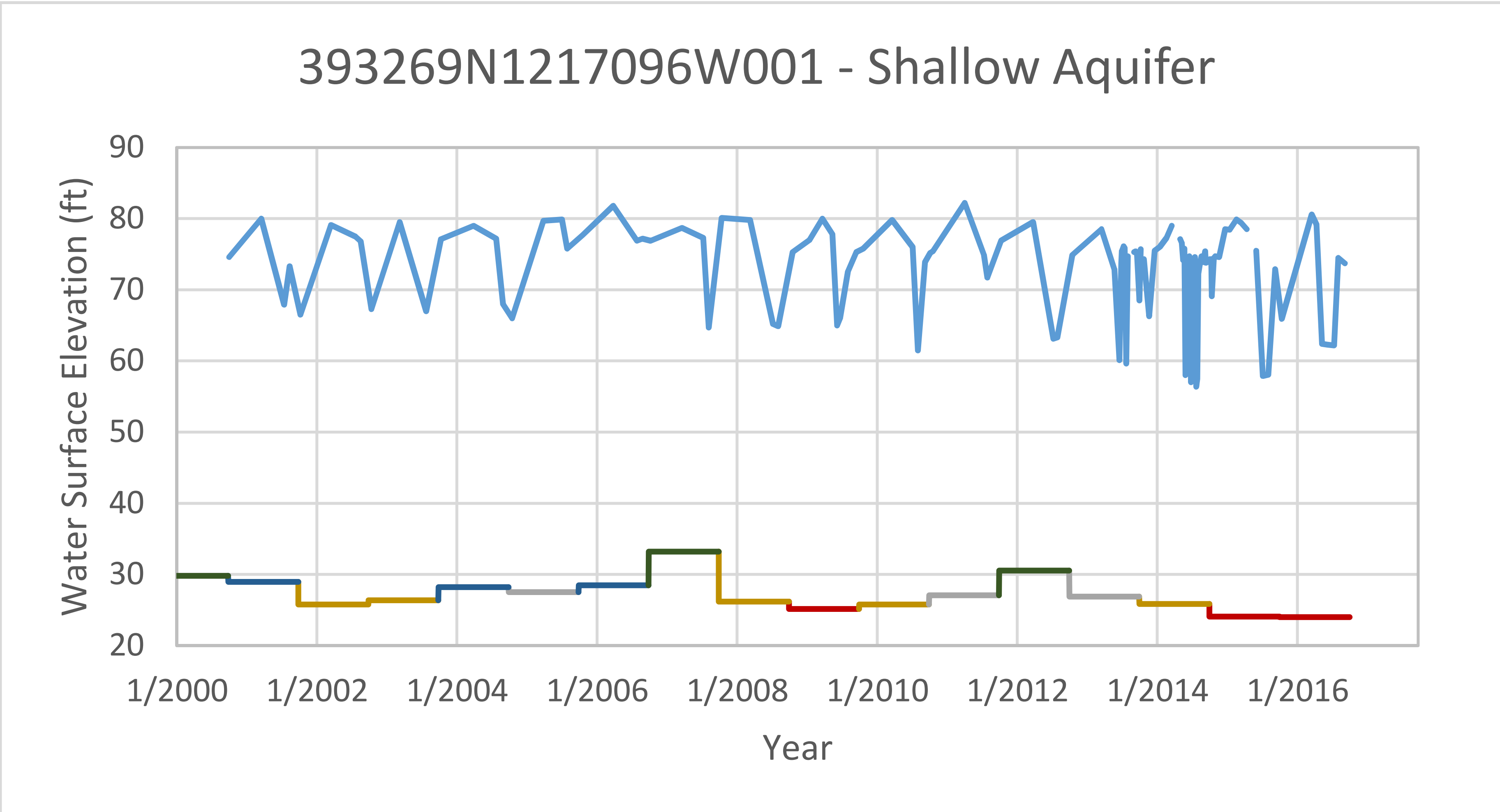
392038N1217147W001 - Shallow Aquifer
Water Surface Elevation (ft)
80
70
60
50
40
30
20
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year


392324N1216499W001 - Shallow Aquifer
Water Surface Elevation (ft)
80
70
60
50
40
30
20
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

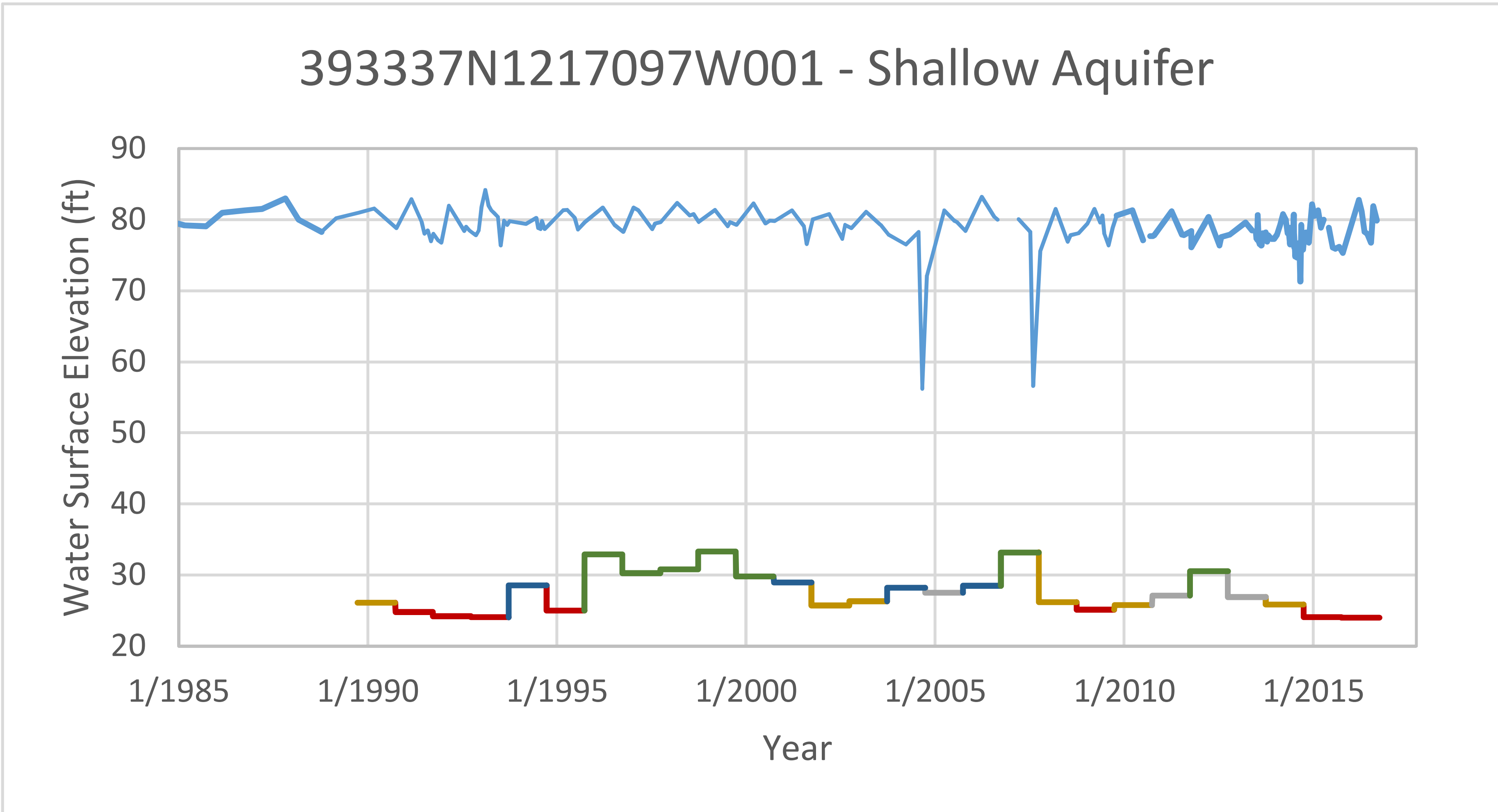

392328N1216469W001 - Shallow Aquifer
Water Surface Elevation (ft)
80
70
60
50
40
30
20
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

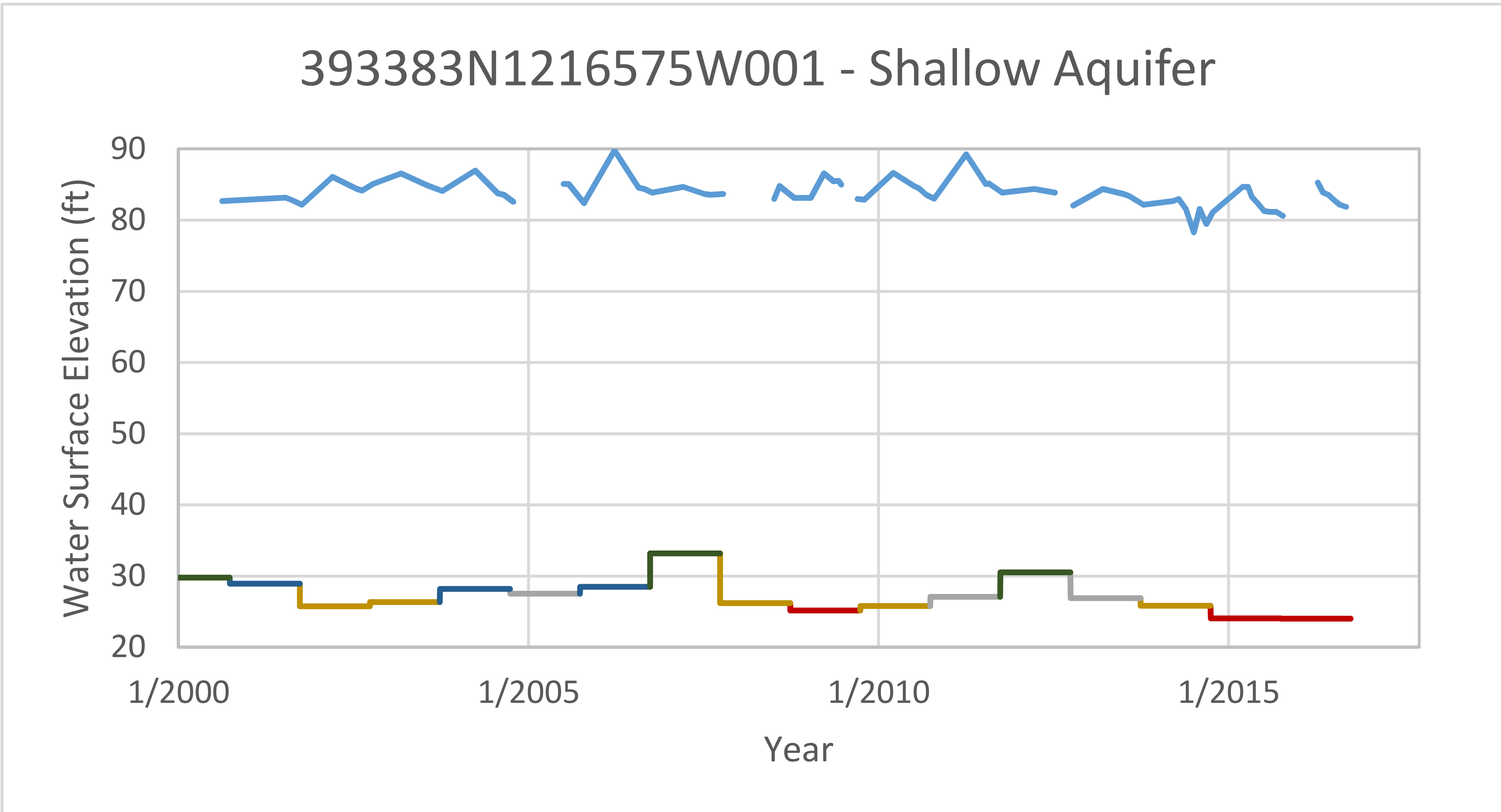

392655N1215894W001 - Shallow Aquifer
Water Surface Elevation (ft)
80
70
60
50
40
30
20
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year


392712N1216493W001 - Shallow Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2005
1/2007
1/2009
1/2011
1/2013
1/2015
1/2017
Year

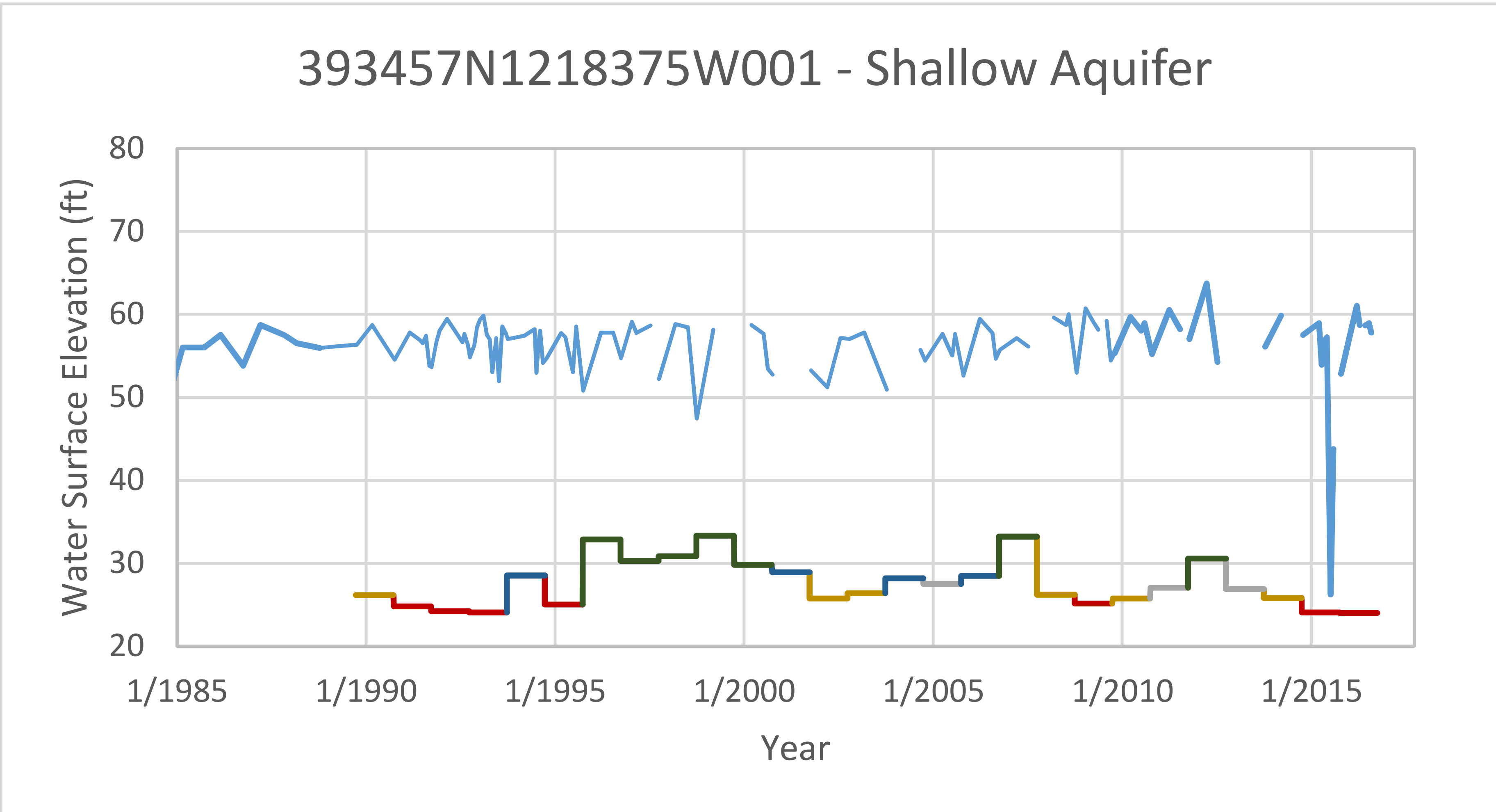


393269N1217096W001 - Shallow Aquifer
Water Surface Elevation (ft)
90
80
70
60
50
40
30
20
1/2000
1/2002
1/2004
1/2006
1/2008
1/2010
1/2012
1/2014
1/2016
Year

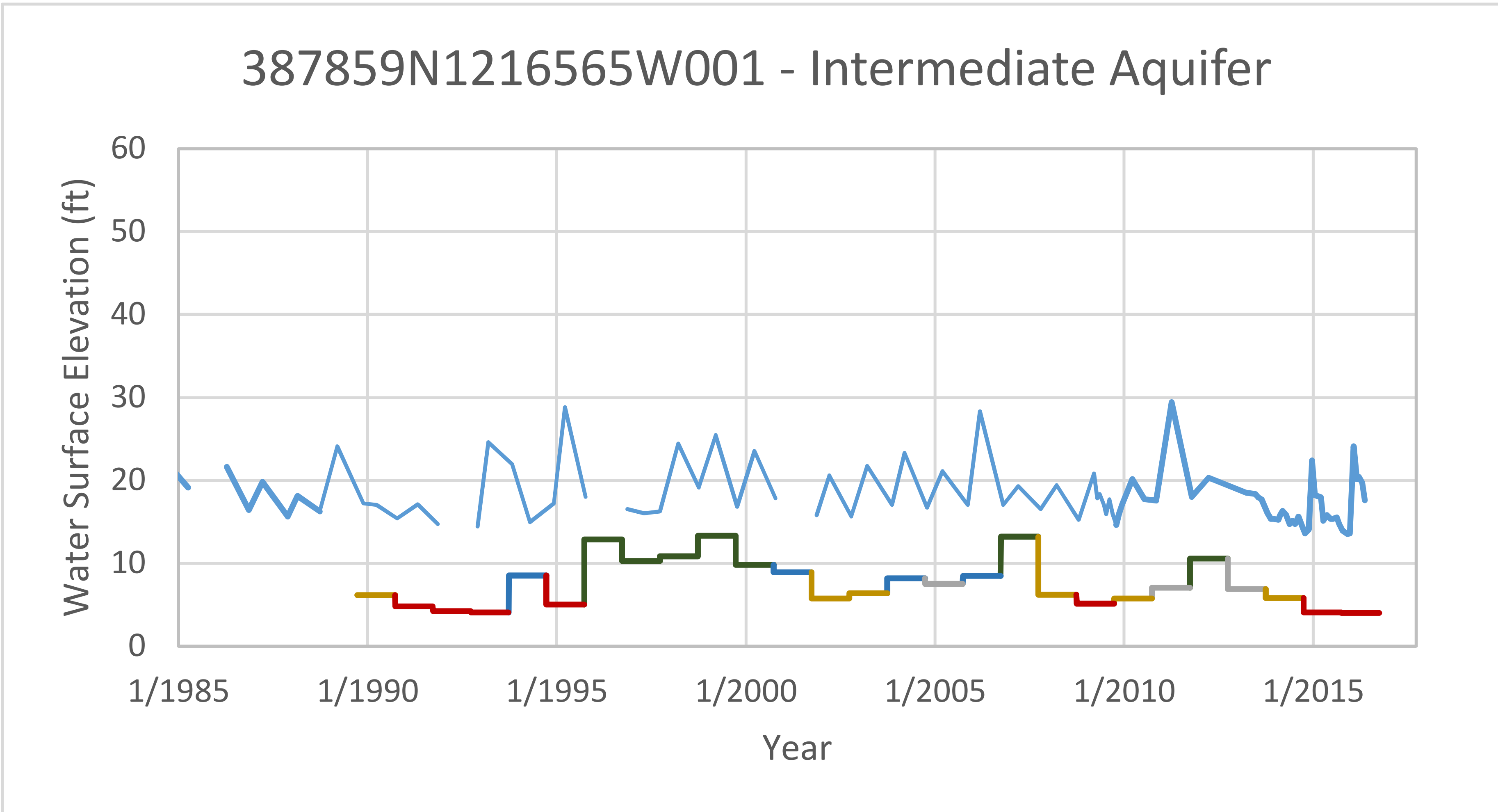

393337N1217097W001 - Shallow Aquifer
Water Surface Elevation (ft)
90
80
70
60
50
40
30
20
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

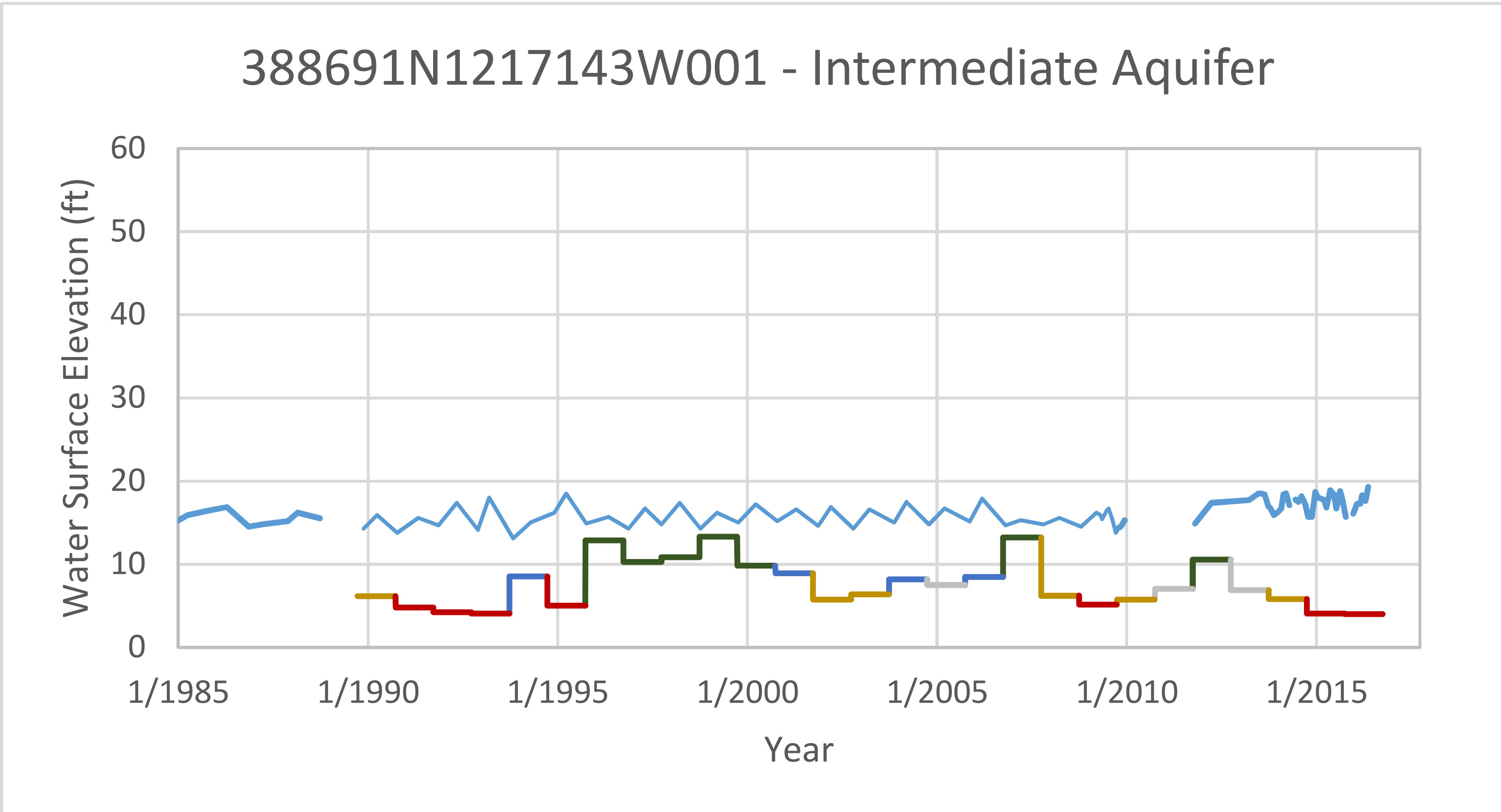


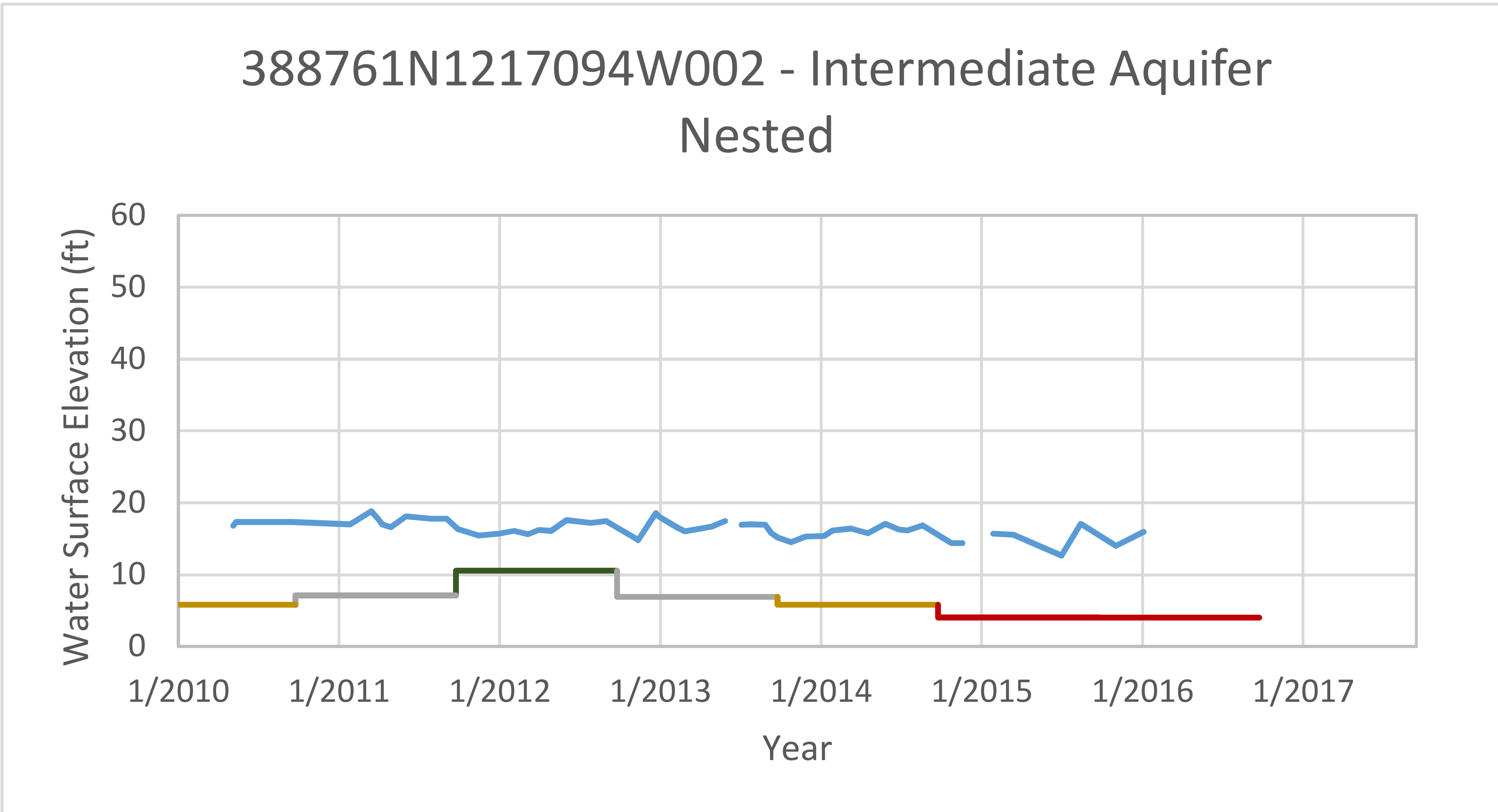
393383N1216575W001 - Shallow Aquifer
Water Surface Elevation (ft)
90
80
70
60
50
40
30
20
1/2000
1/2005
1/2010
1/2015
Year


393457N1218375W001 - Shallow Aquifer
Water Surface Elevation (ft)
80
70
60
50
40
30
20
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

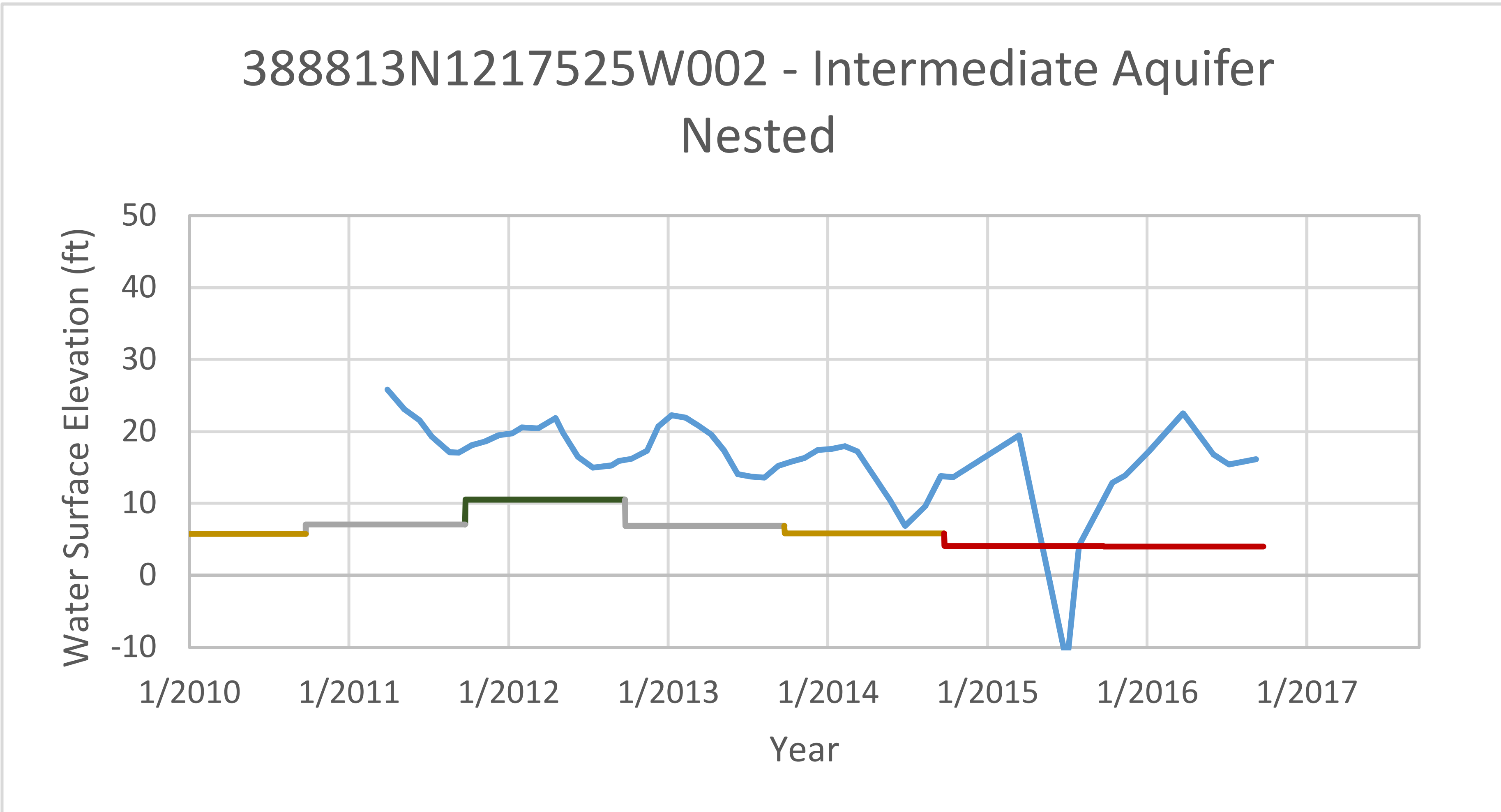
INTERMEDIATE AQUIFER


387859N1216565W001 - Intermediate Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

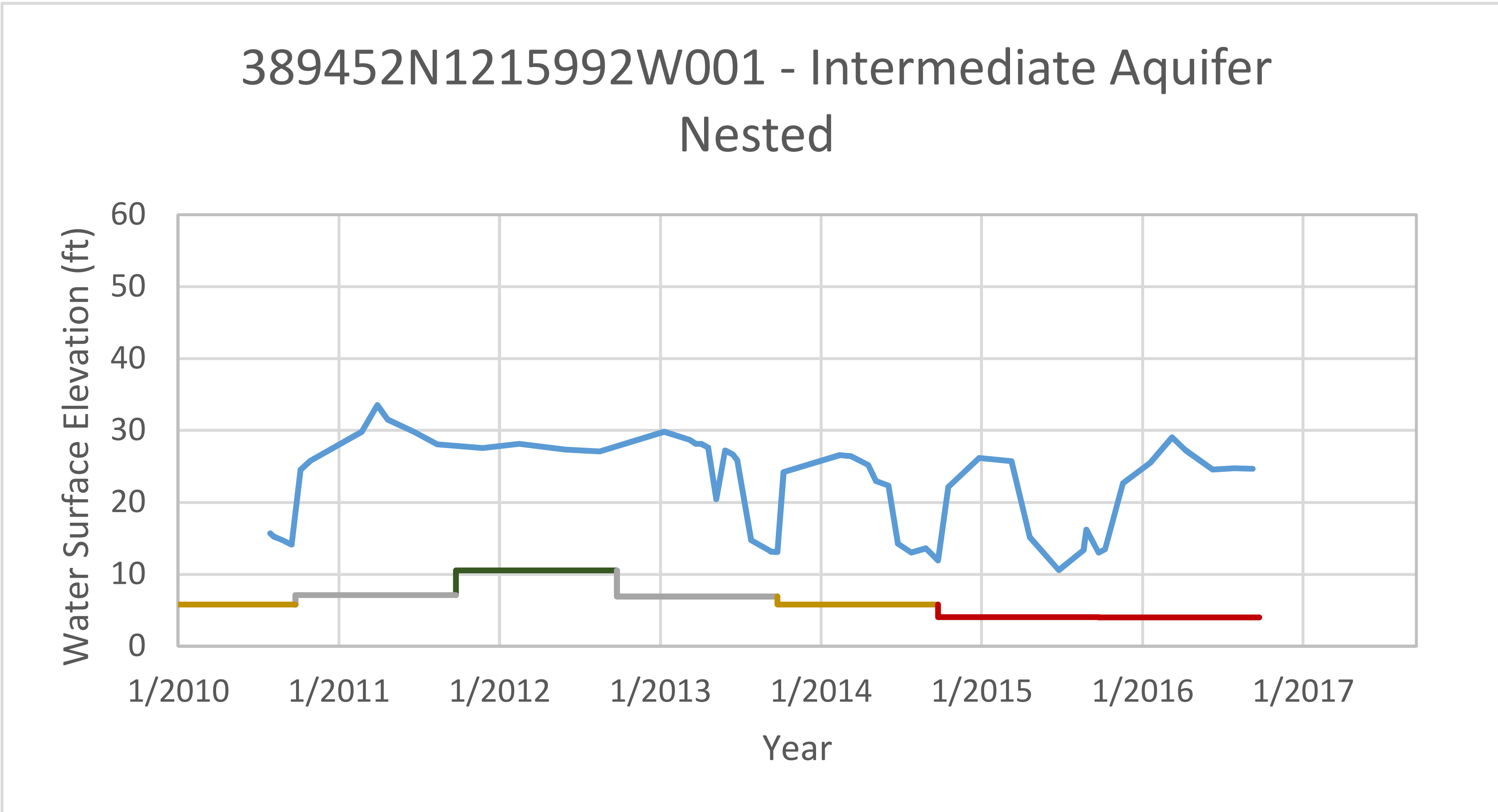

388691N1217143W001 - Intermediate Aquifer
Water Surface Elevation (ft)
0
10
20
30
40
50
60
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year



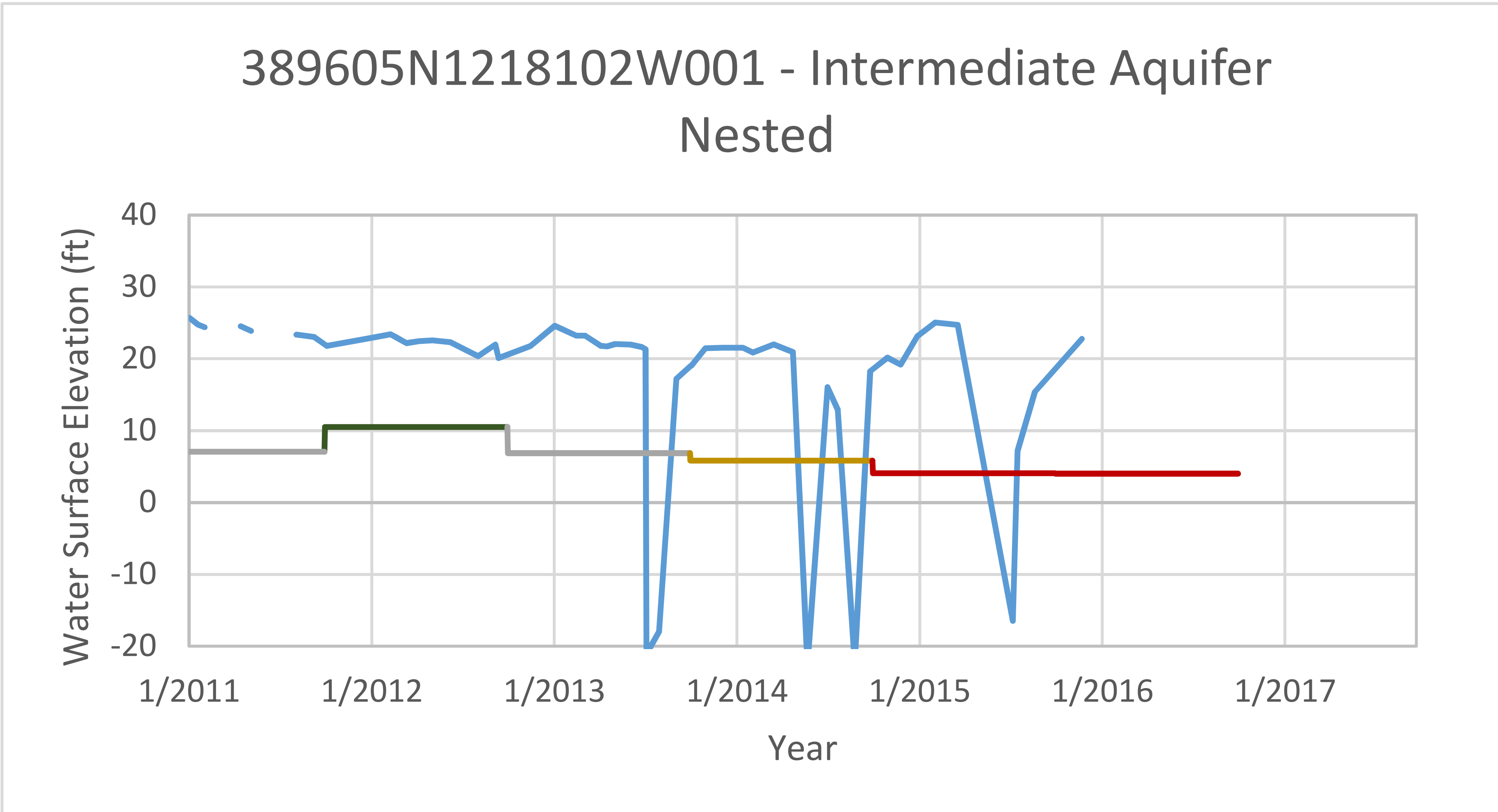
388761N1217094W002 - Intermediate Aquifer Nested
Water Surface Elevation (ft)
0
10
20
30
40
50
60
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year



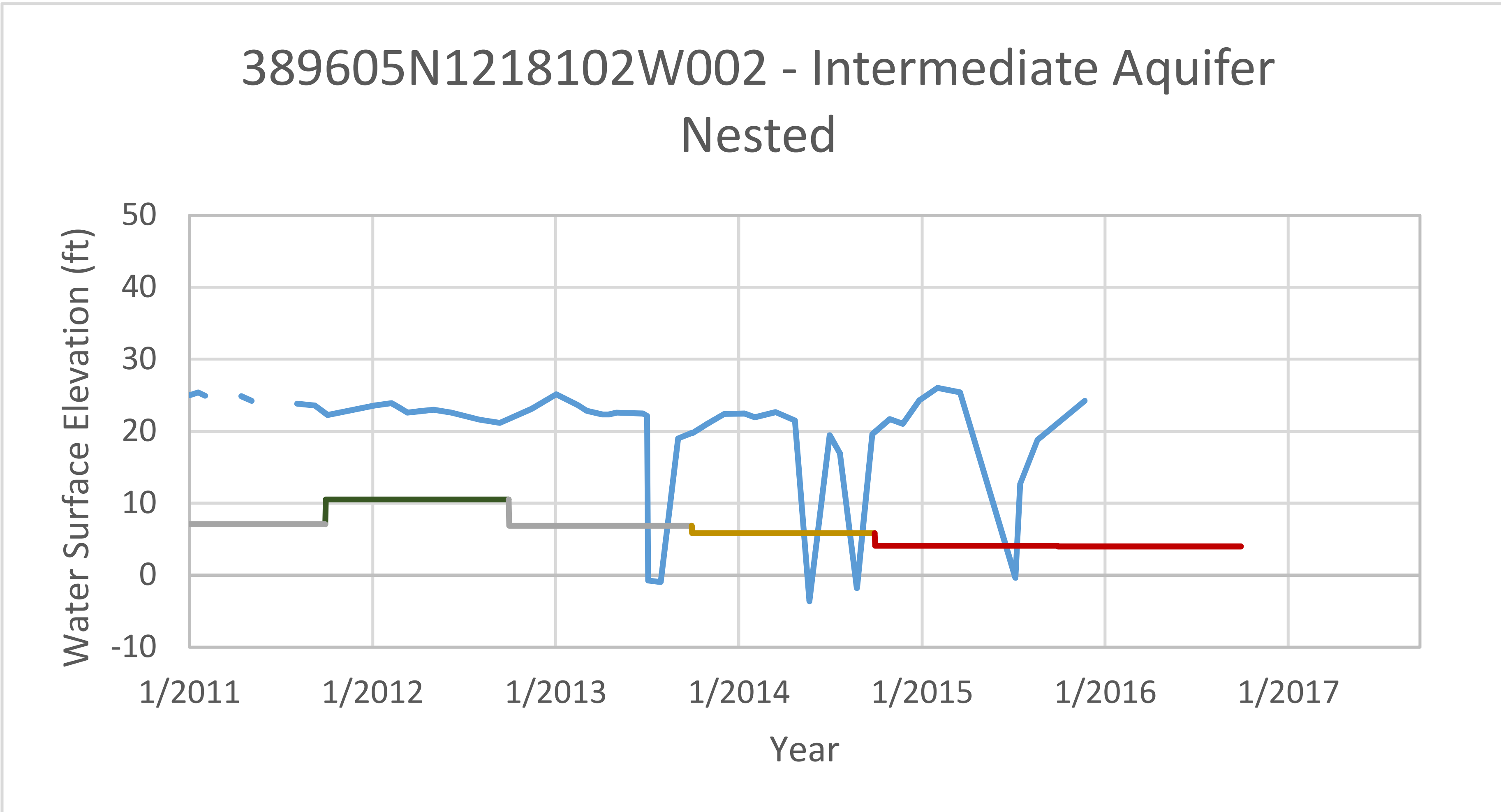
388813N1217525W002 - Intermediate Aquifer Nested
Water Surface Elevation (ft)
50
40
30
20
10
0
-10
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

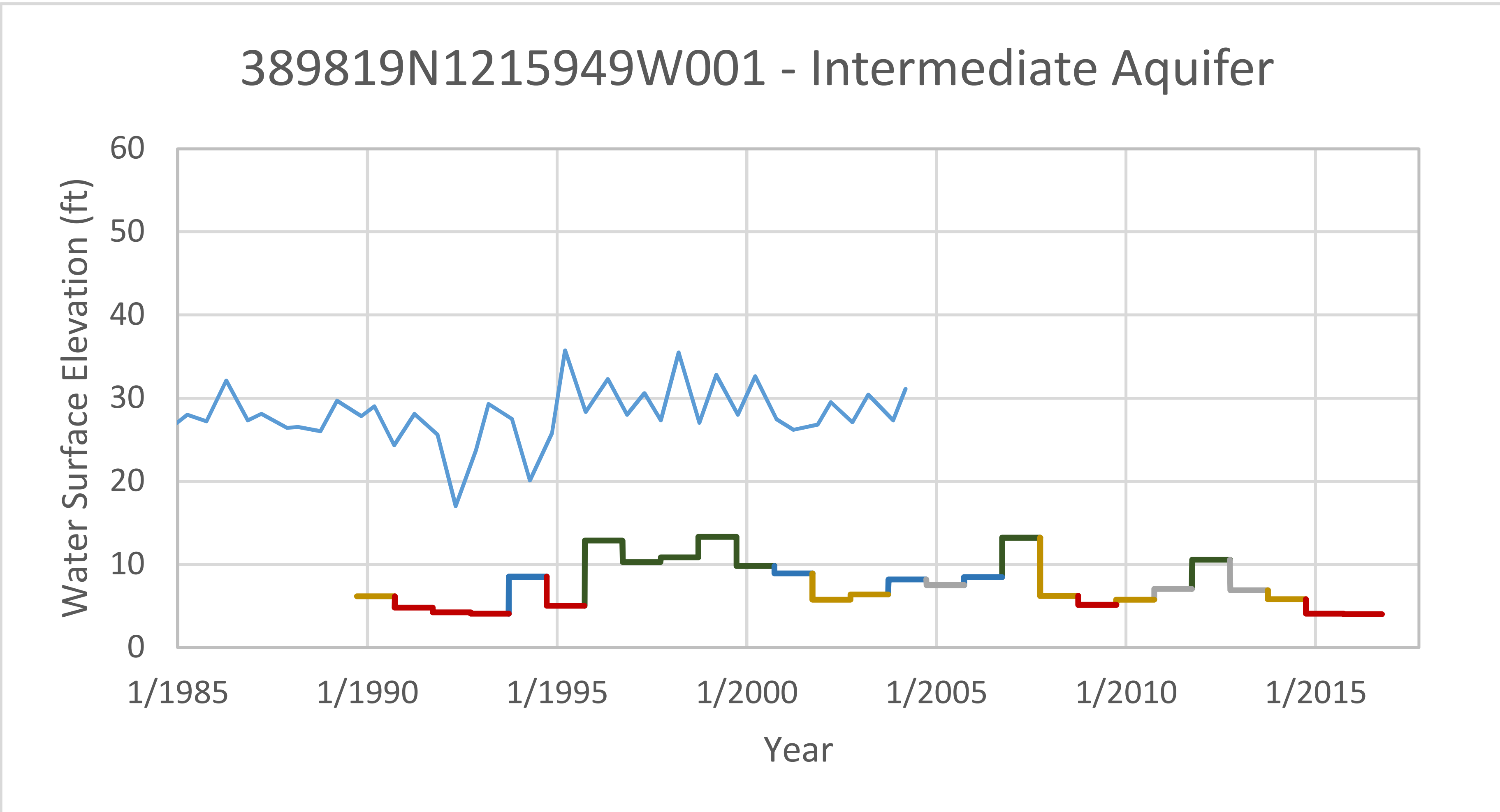


389452N1215992W001 - Intermediate Aquifer Nested
Water Surface Elevation (ft)
0
10
20
30
40
50
60
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

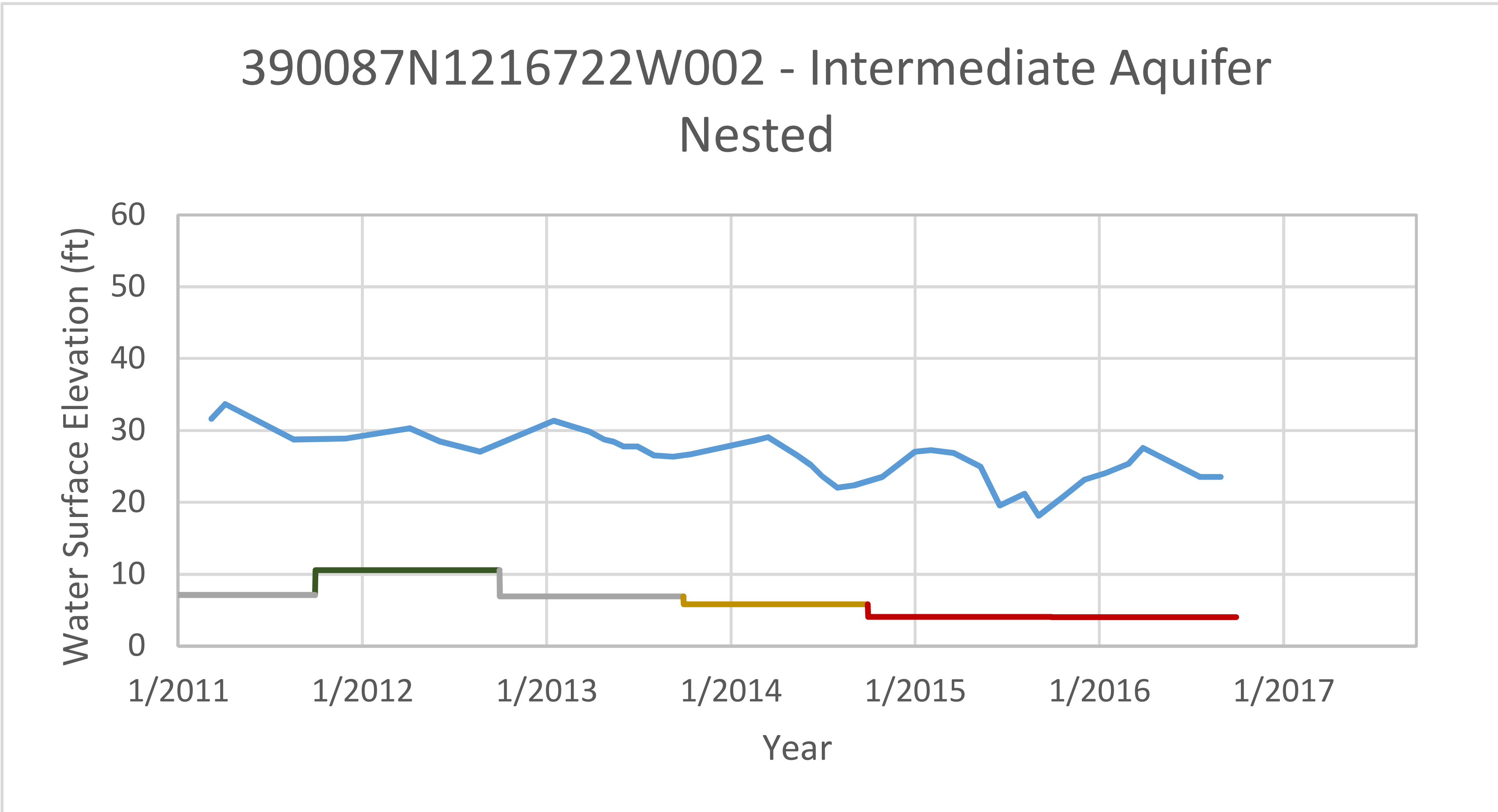


389605N1218102W001 - Intermediate Aquifer Nested
Water Surface Elevation (ft)
40
30
20
10
0
-10
-20
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

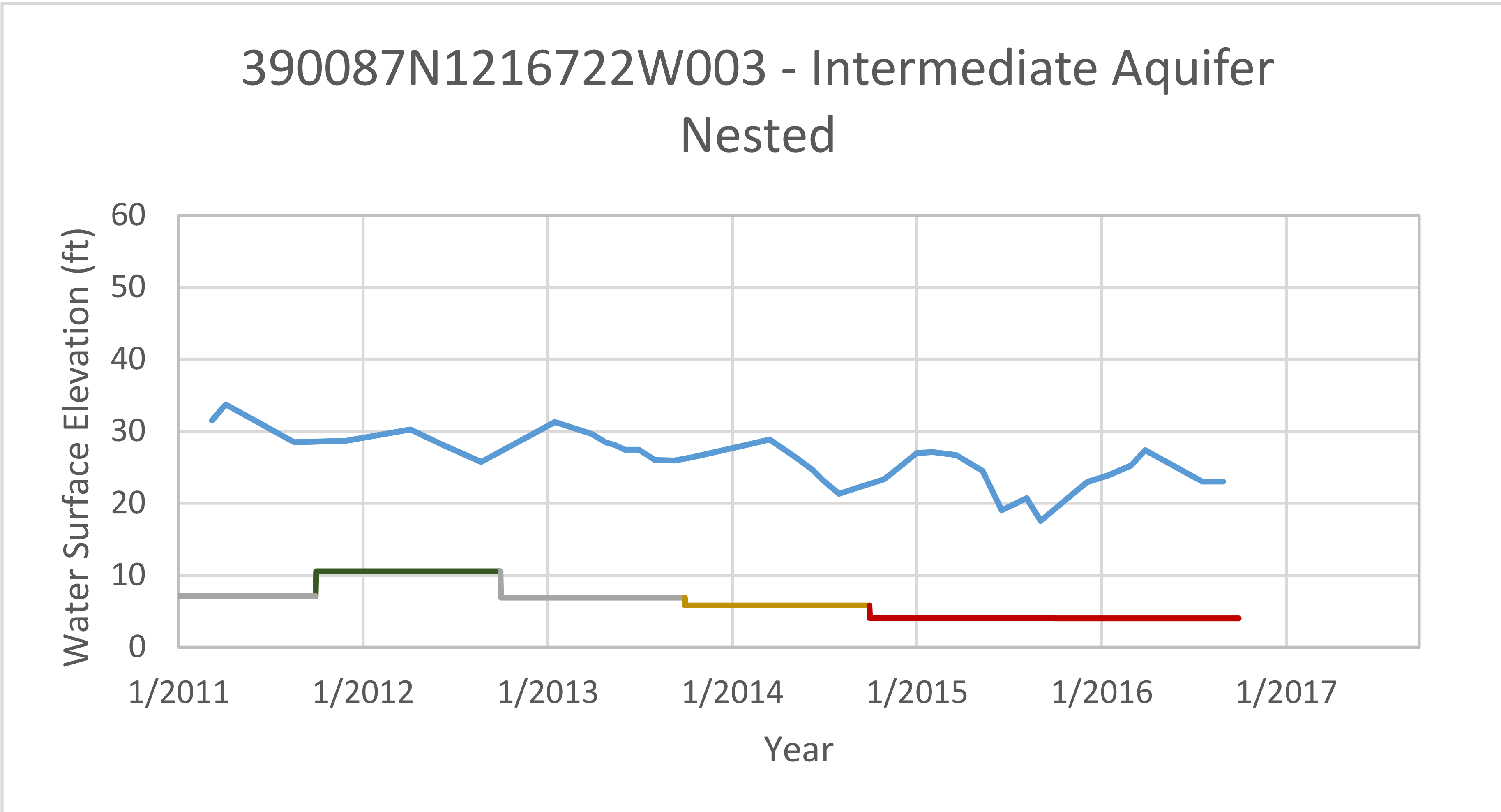

389605N1218102W002 - Intermediate Aquifer Nested
Water Surface Elevation (ft)
50
40
30
20
10
0
-10
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year



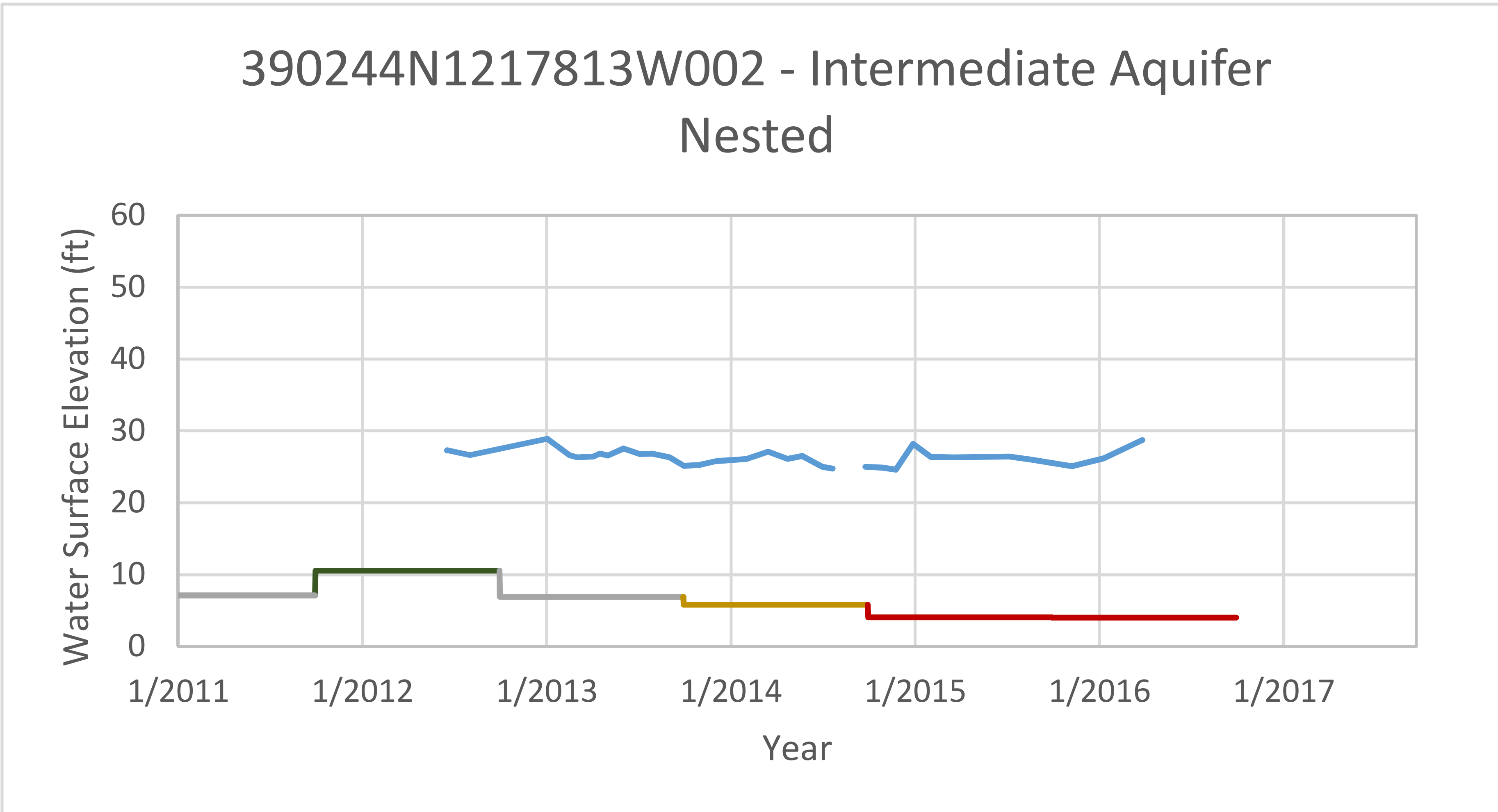
389819N1215949W001 - Intermediate Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

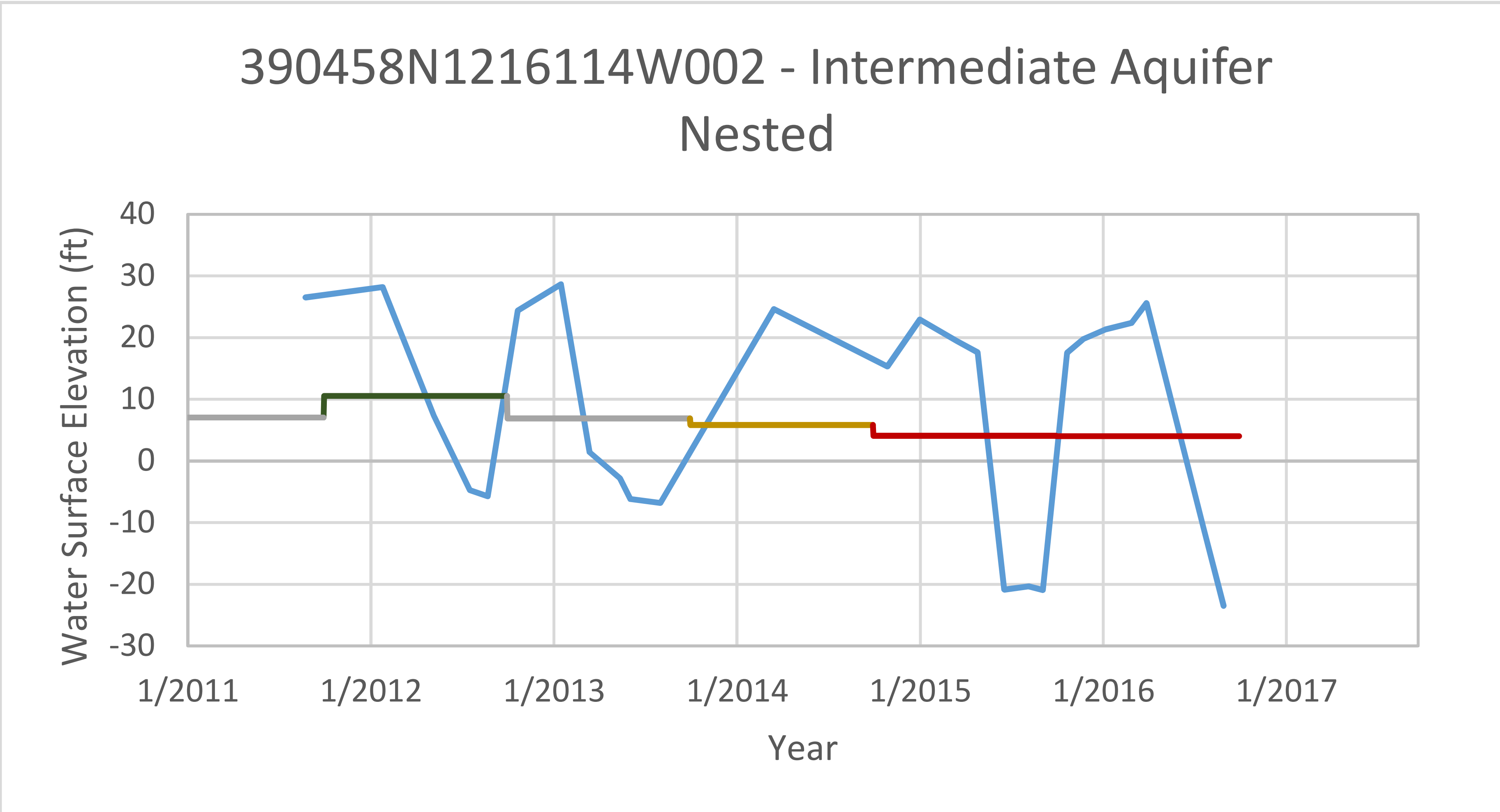


390087N1216722W002 - Intermediate Aquifer Nested
Water Surface Elevation (ft)
0
10
20
30
40
50
60
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

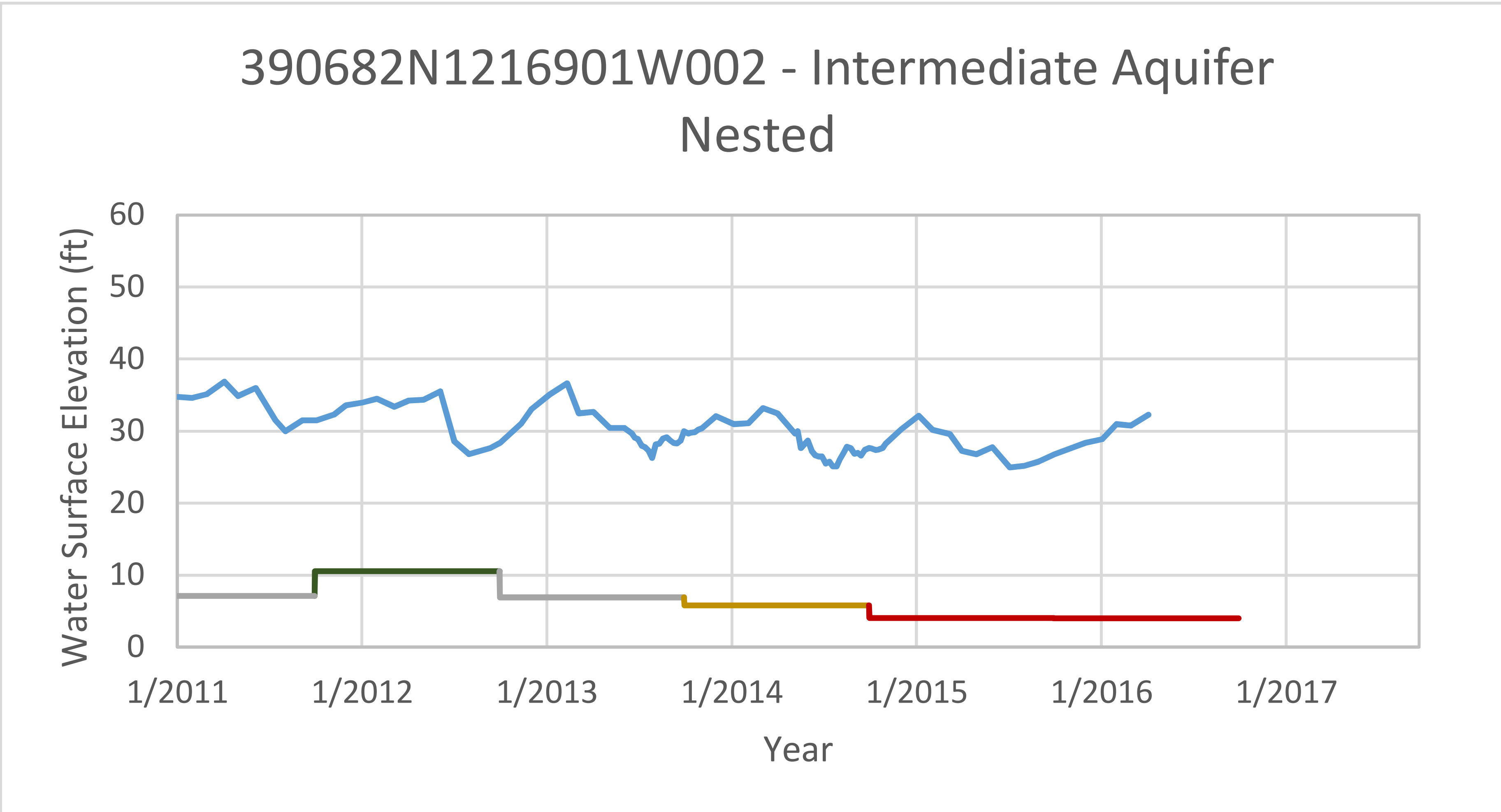


390087N1216722W003 - Intermediate Aquifer Nested
Water Surface Elevation (ft)
0
10
20
30
40
50
60
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

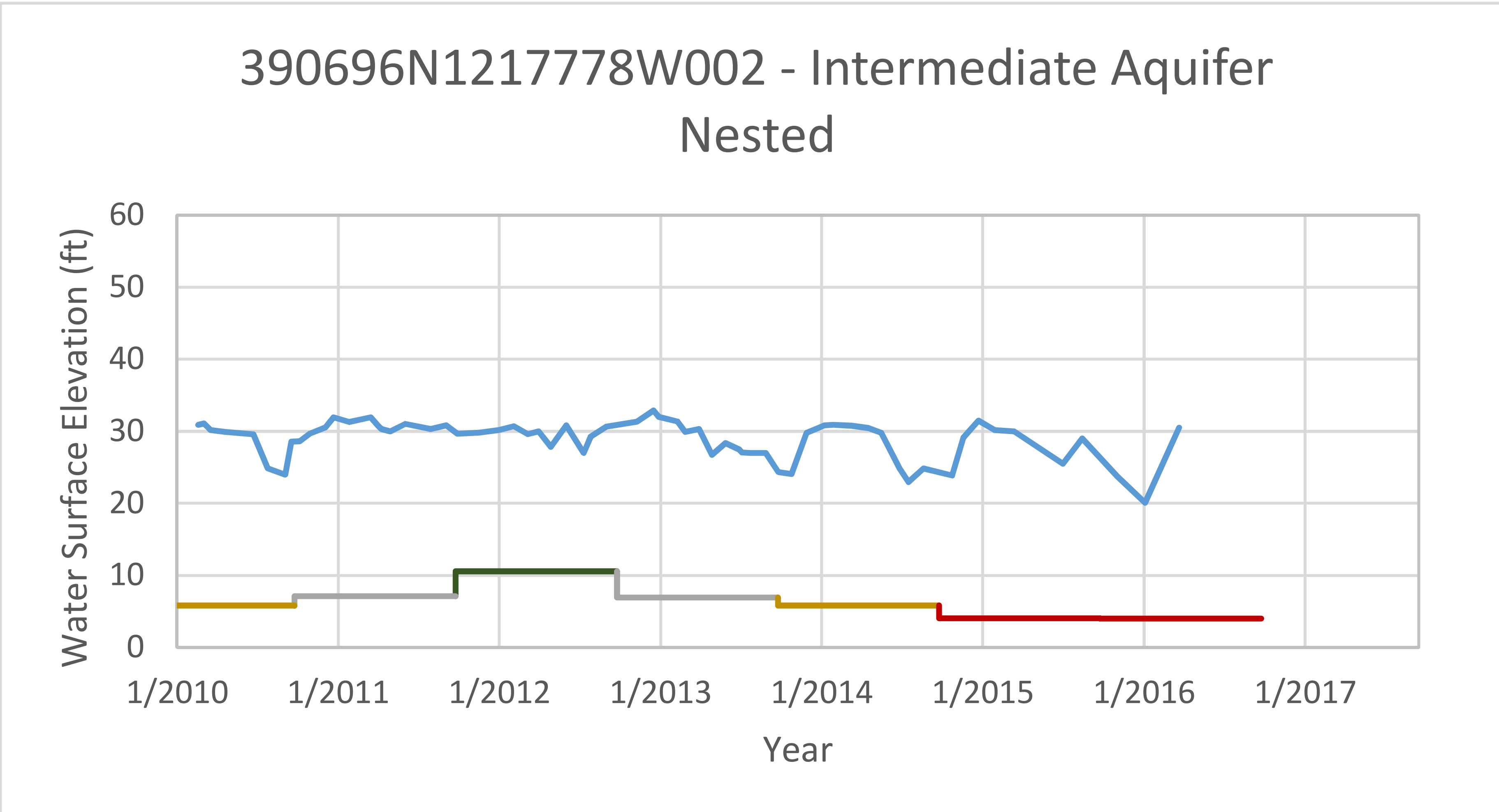

390244N1217813W002 - Intermediate Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year



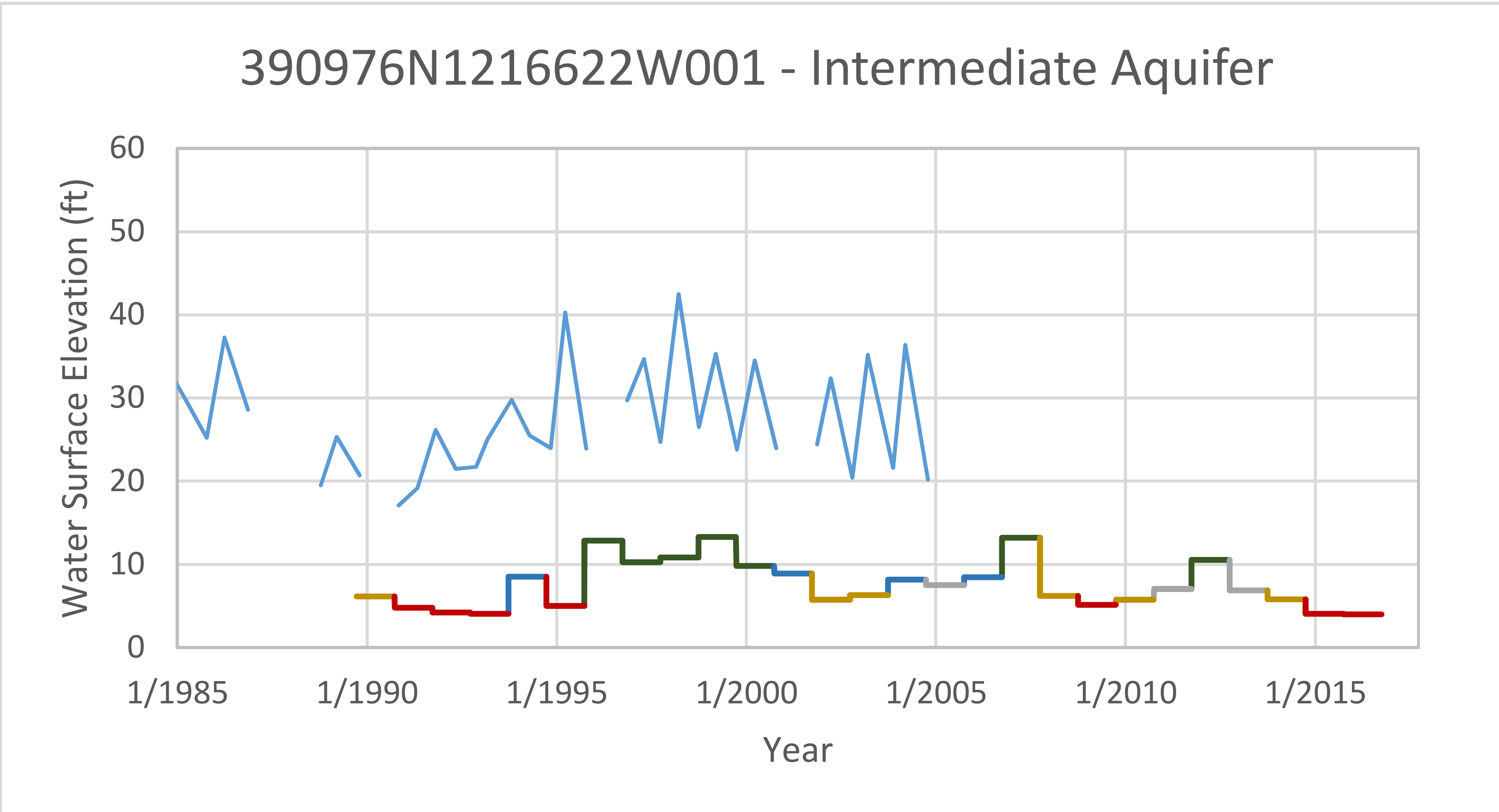
390458N1216114W002 - Intermediate Aquifer
Nested
Water Surface Elevation (ft)
40
30
20
10
0
-10
-20
-30
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

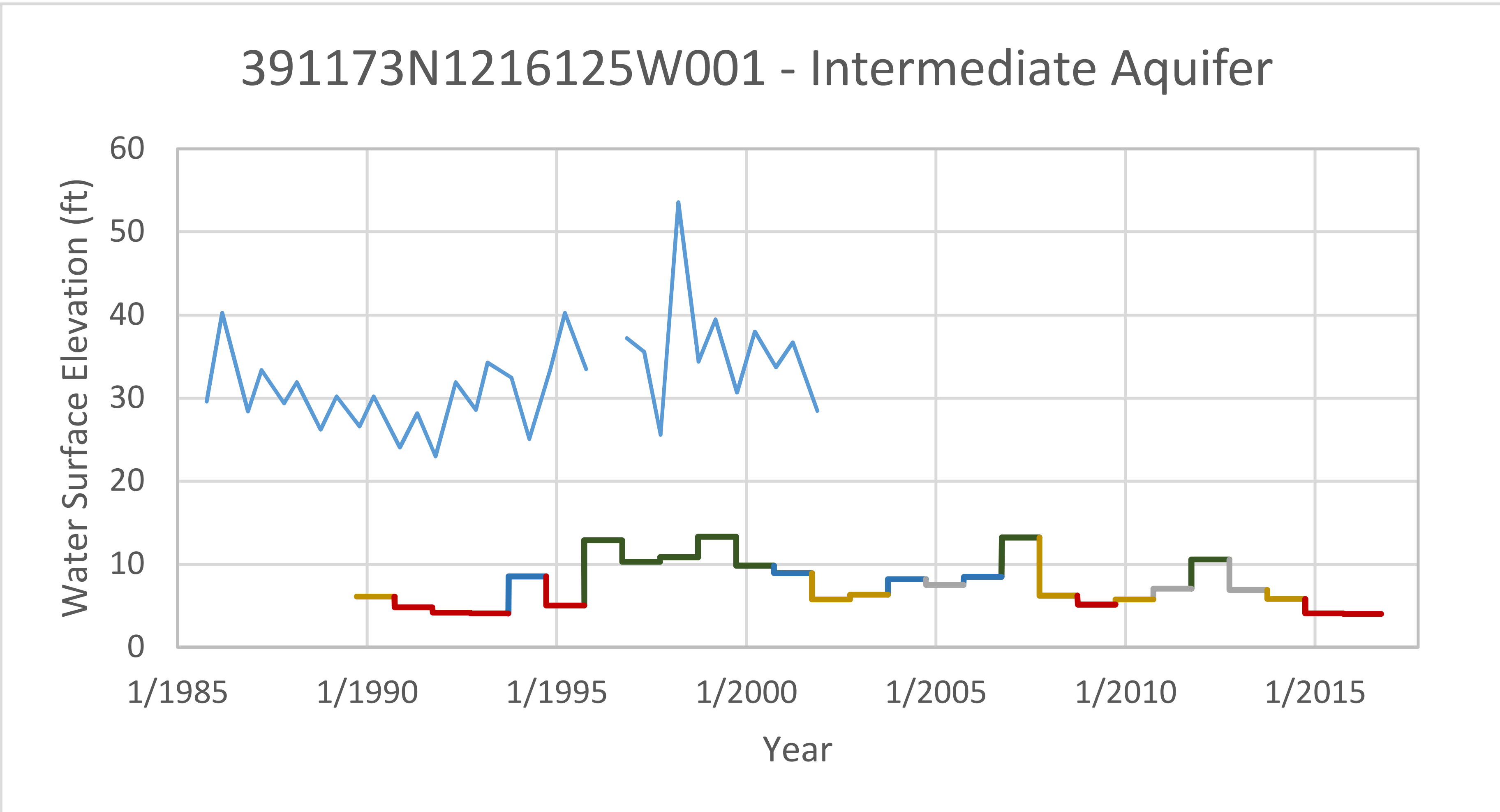


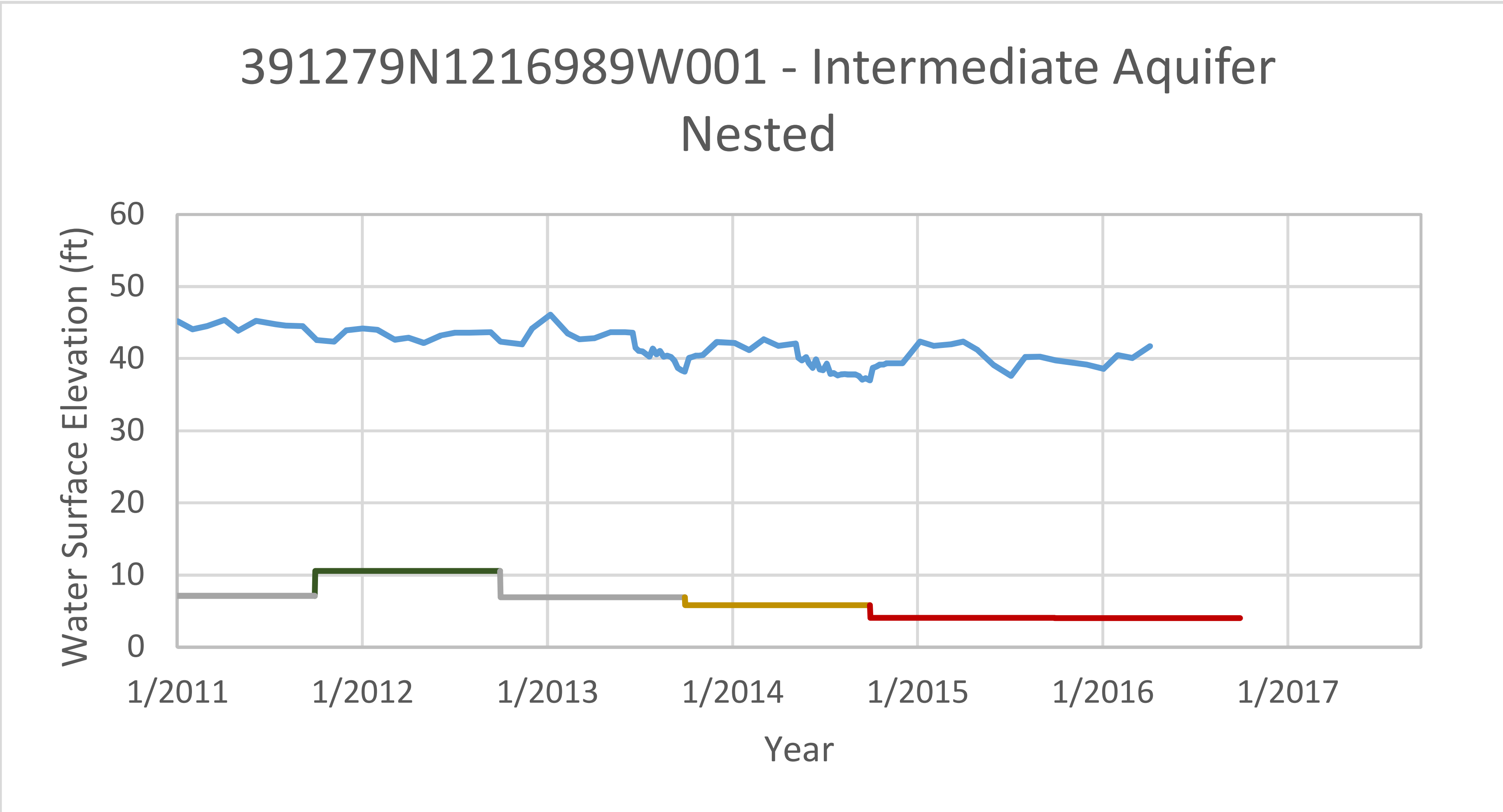
390682N1216901W002 - Intermediate Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

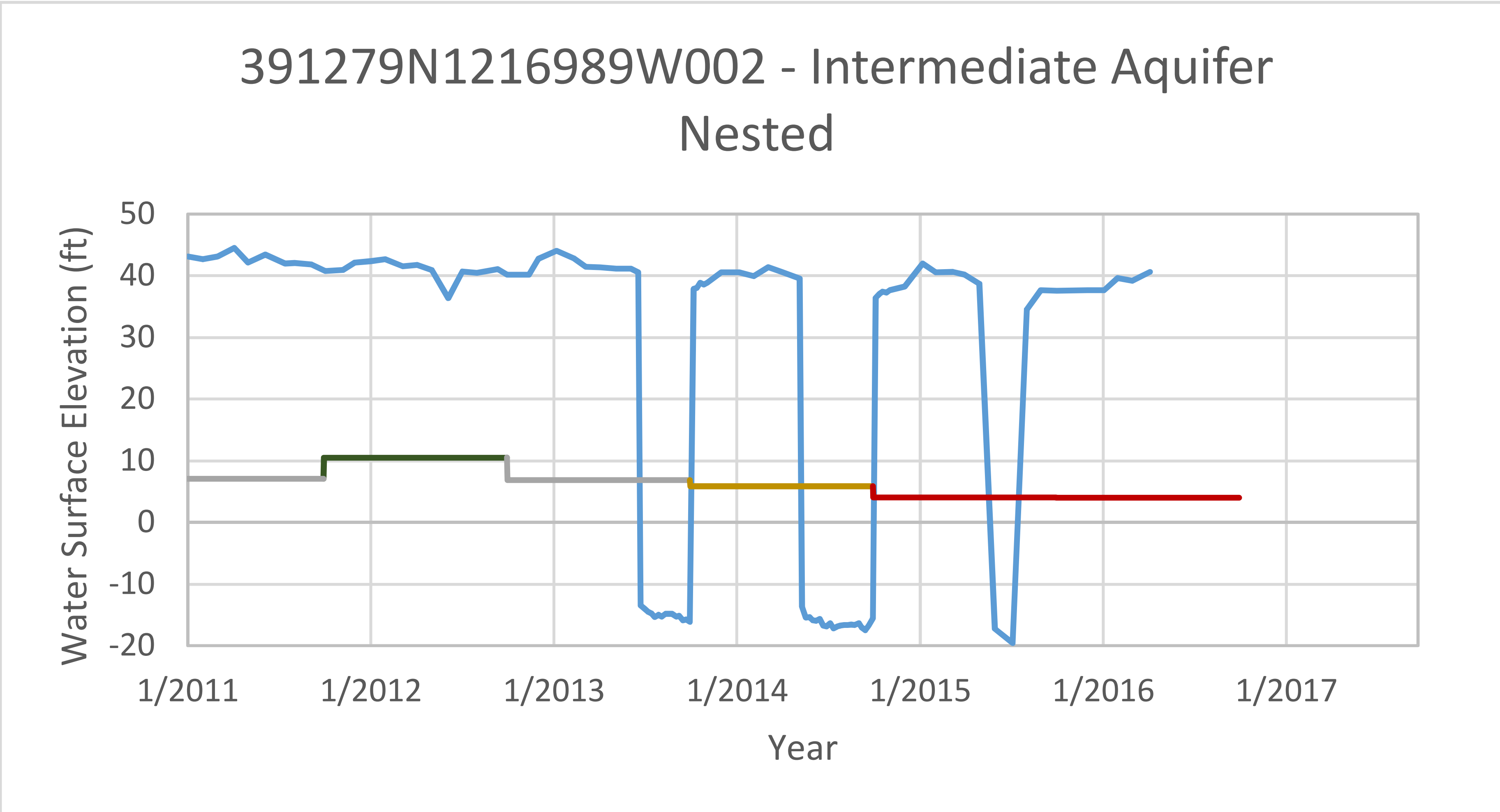


390696N1217778W002 - Intermediate Aquifer Nested
60
50
40
30
20
10
0
Water Surface Elevation (ft)
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

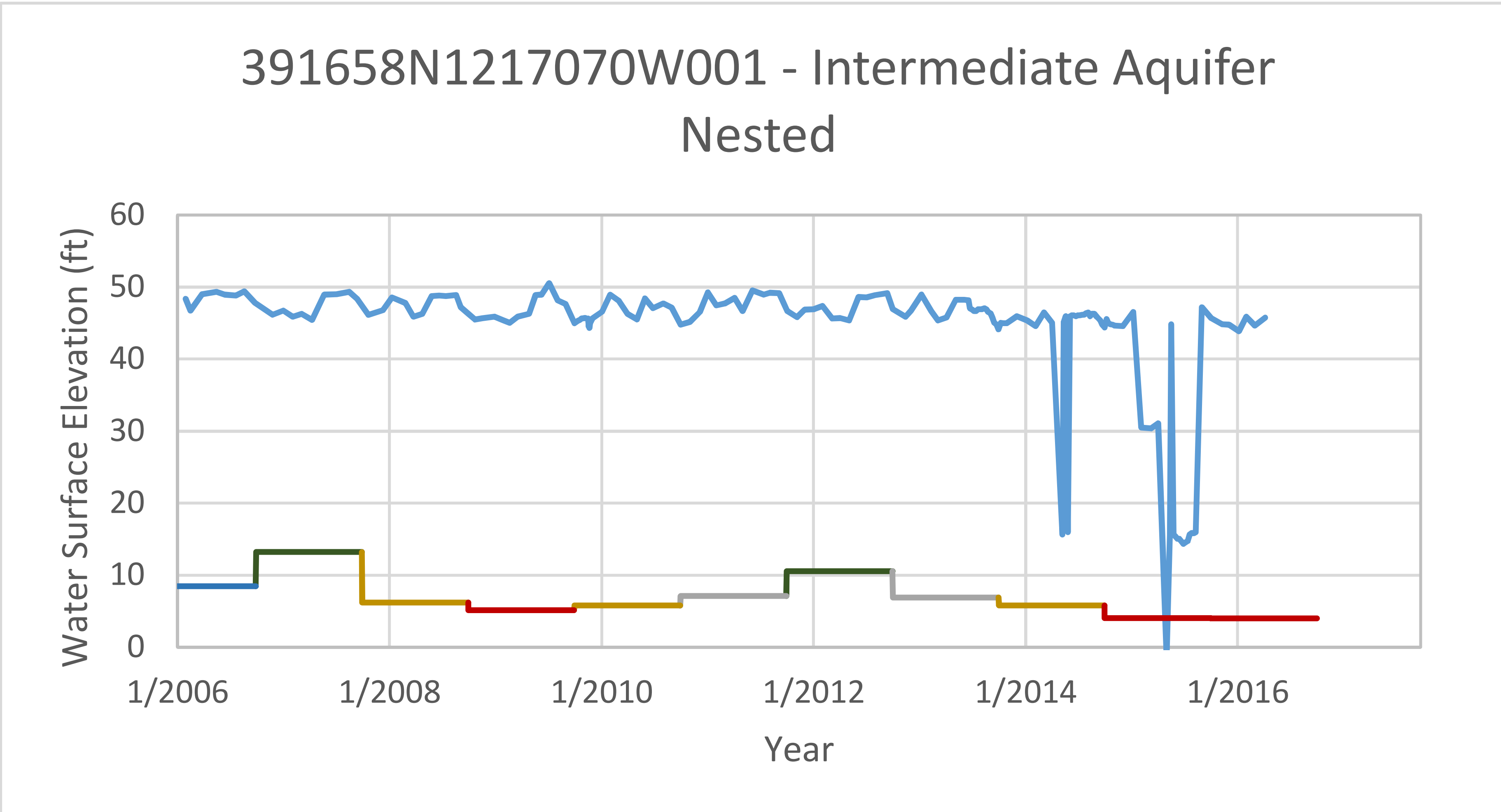

390976N1216622W001 - Intermediate Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

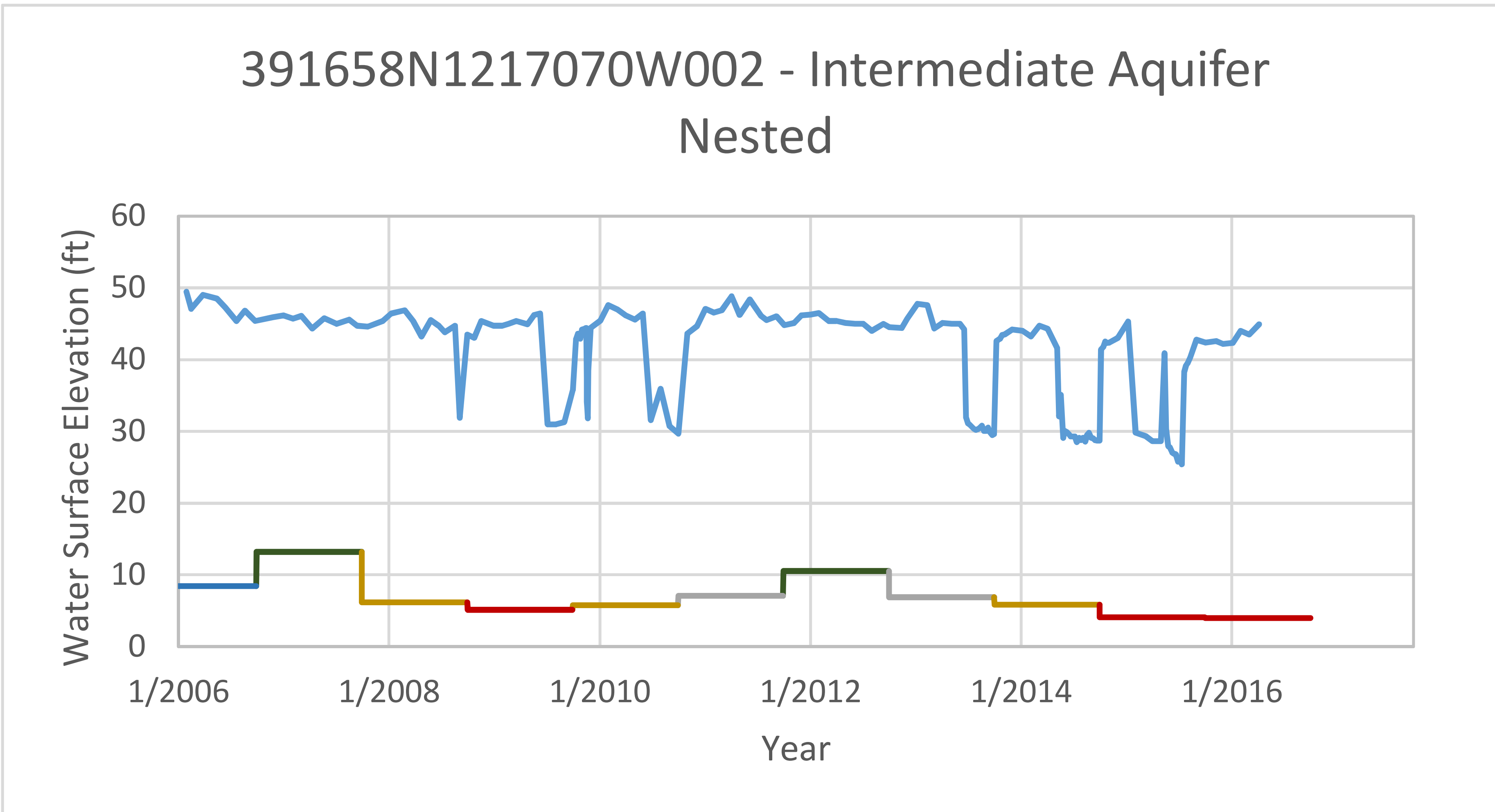

391173N1216125W001 - Intermediate Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

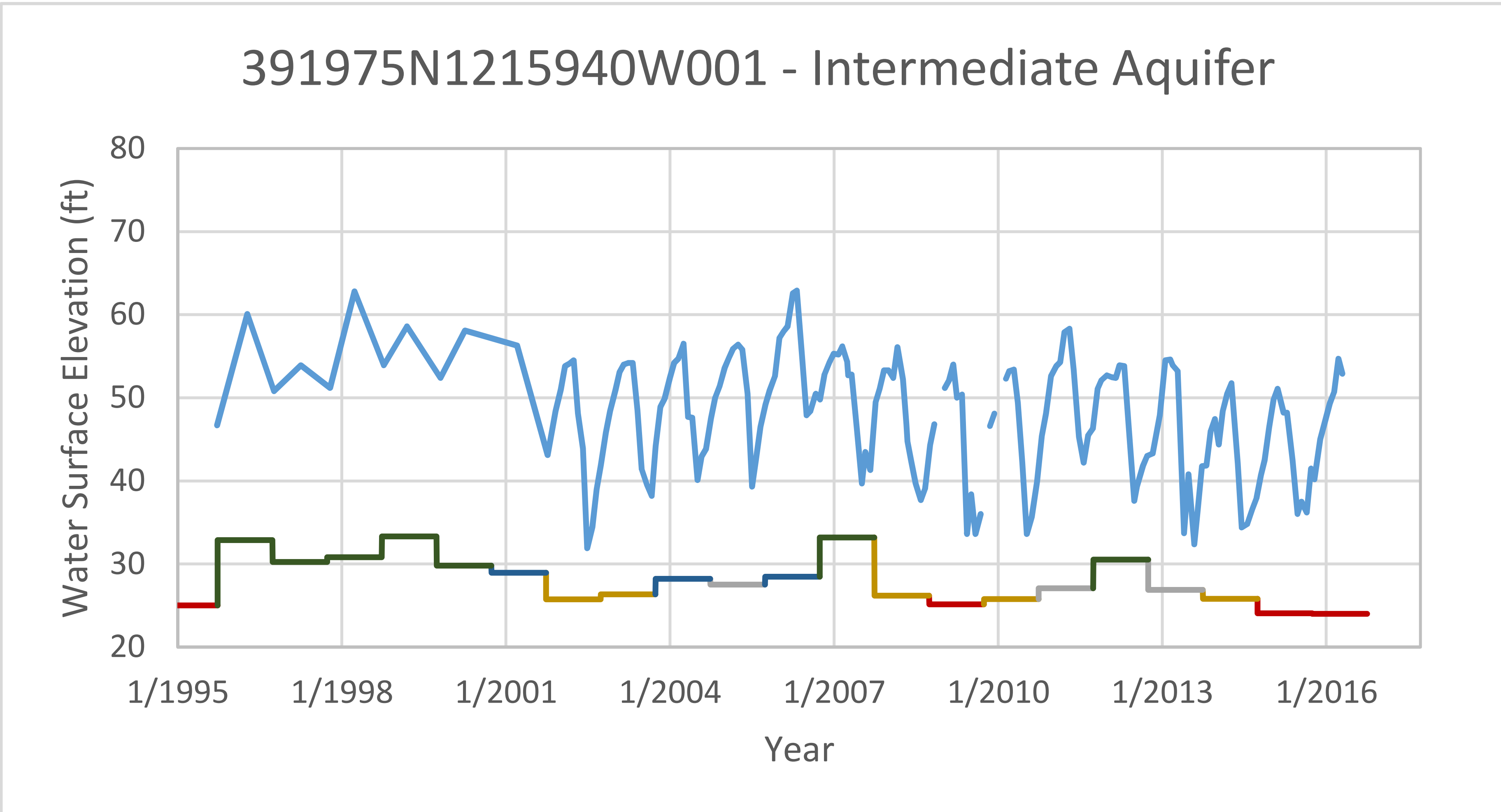

391279N1216989W001 - Intermediate Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year



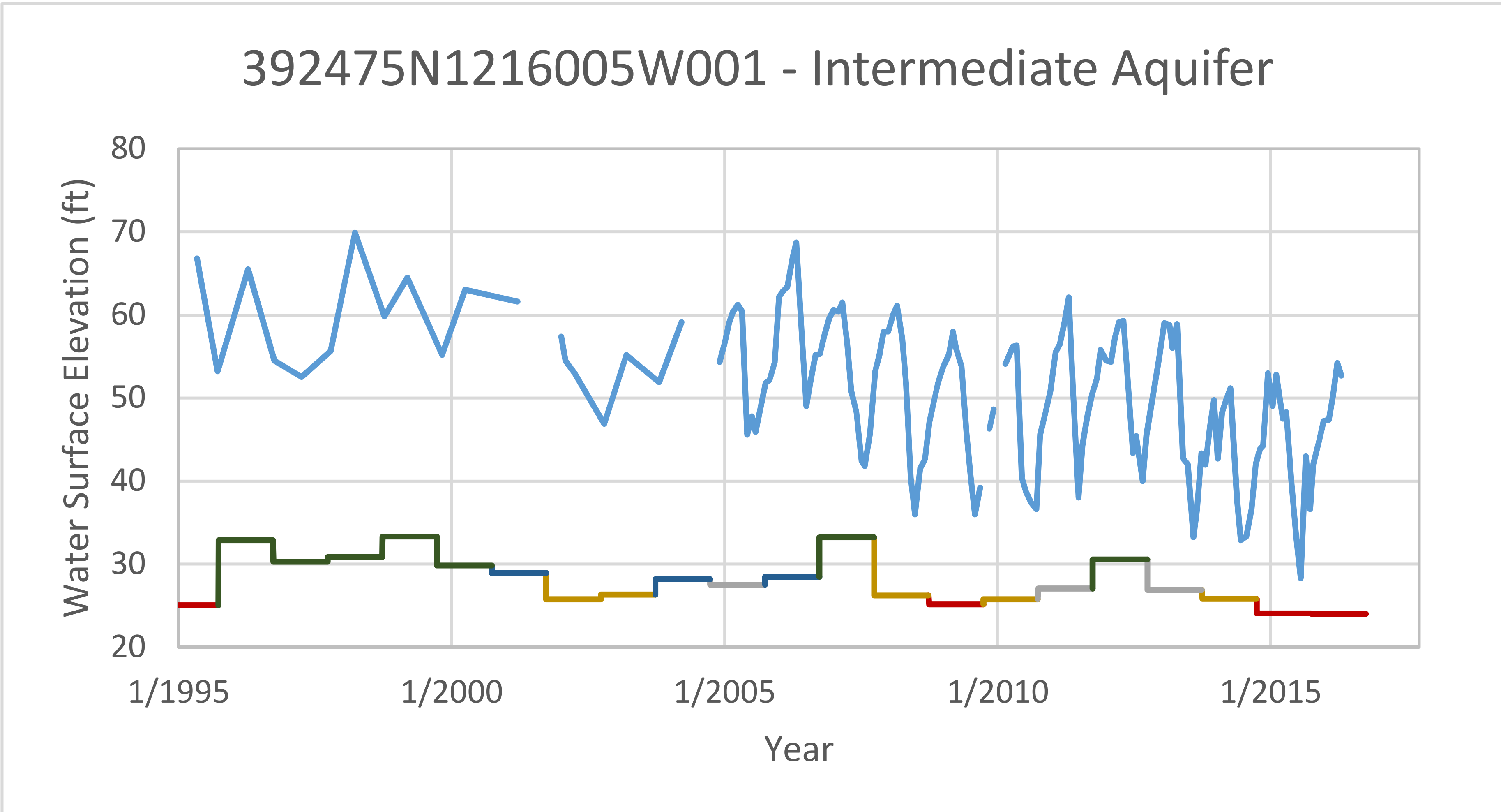
391279N1216989W002 - Intermediate Aquifer Nested
Water Surface Elevation (ft)
50
40
30
20
10
0
-10
-20
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year


391658N1217070W001 - Intermediate Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2006
1/2008
1/2010
1/2012
1/2014
1/2016
Year

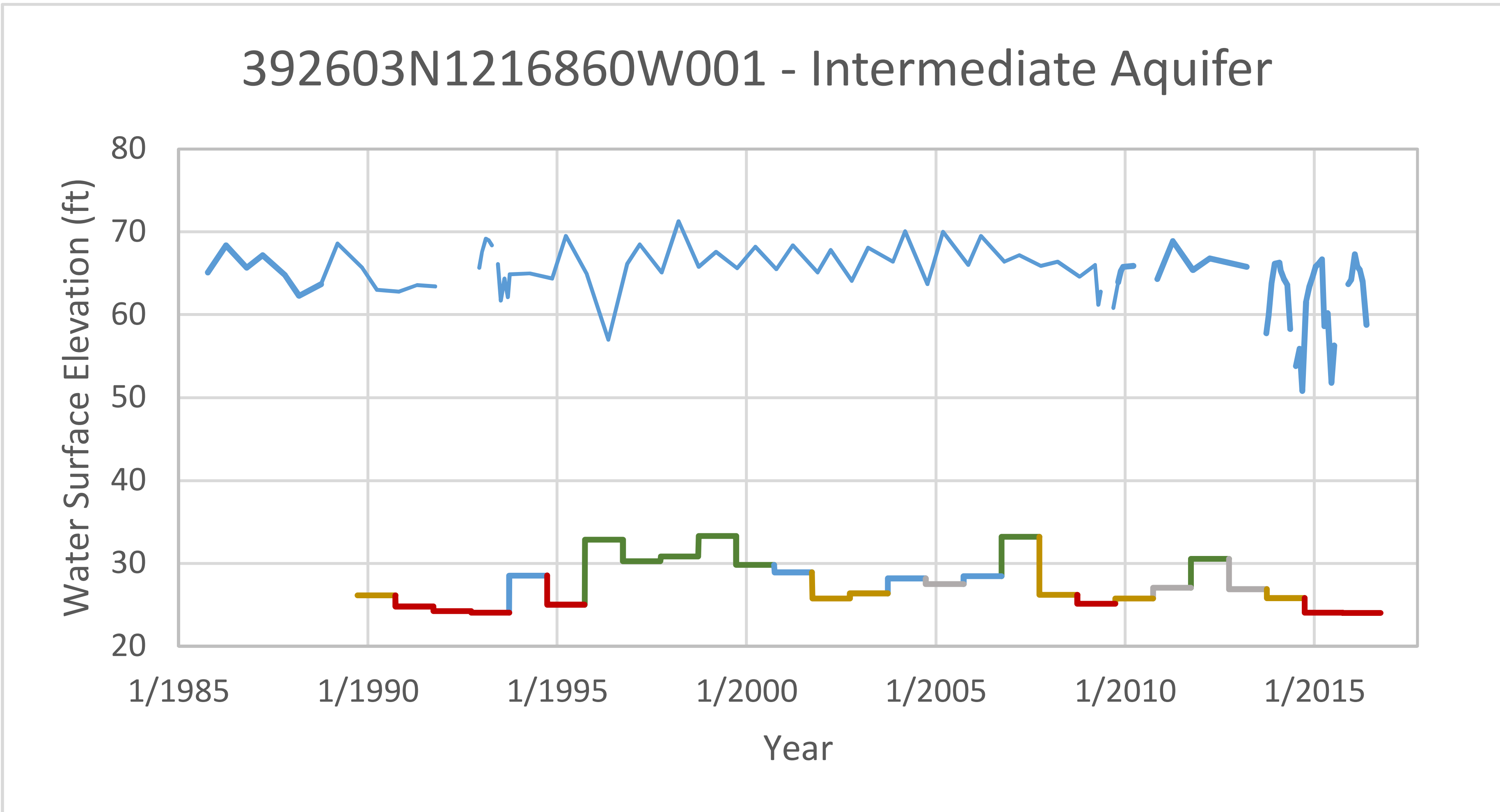

391658N1217070W002 - Intermediate Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2006
1/2008
1/2010
1/2012
1/2014
1/2016
Year



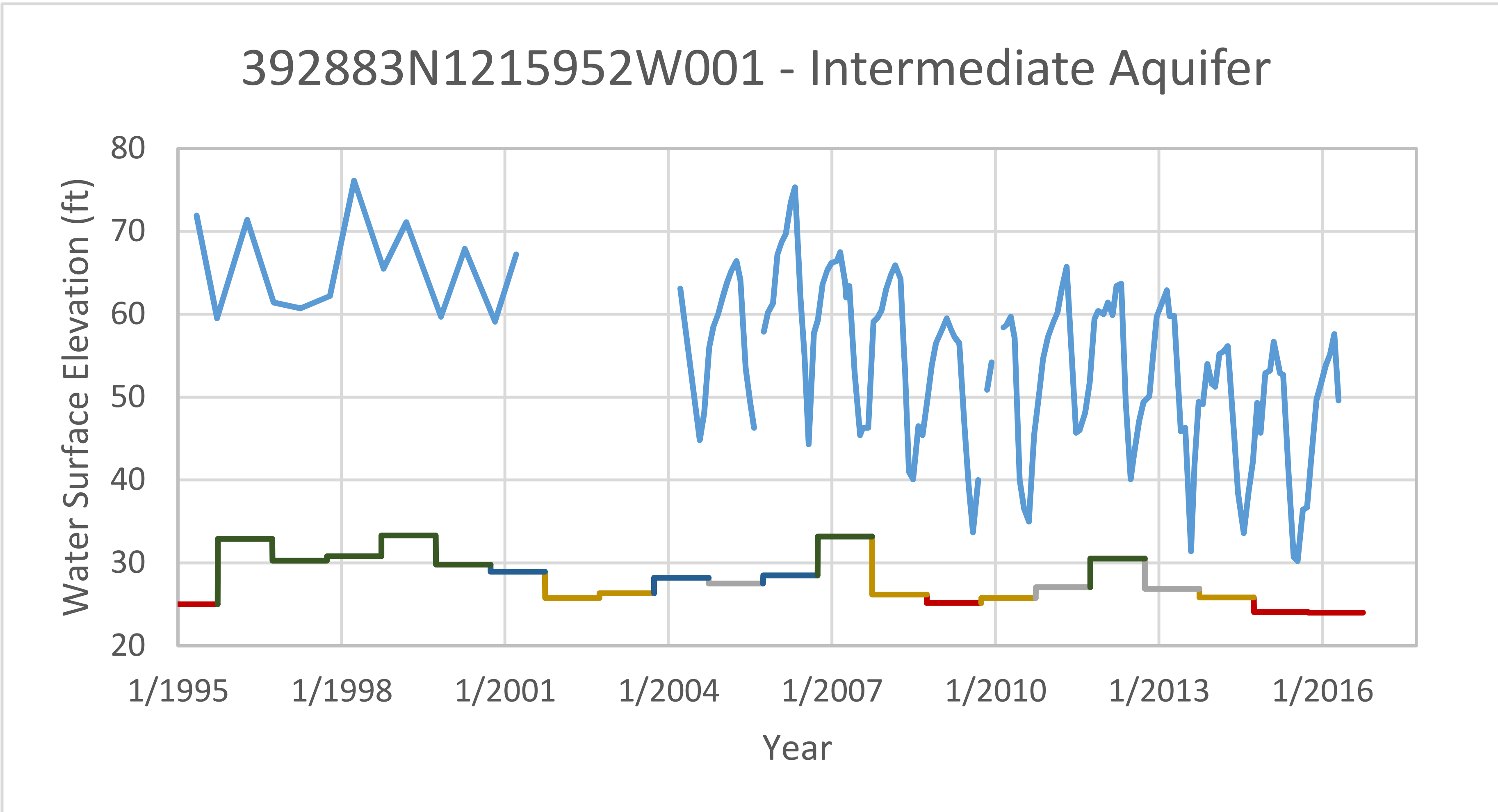
391975N1215940W001 - Intermediate Aquifer
Water Surface Elevation (ft)
80
70
60
50
40
30
20
1/1995
1/1998
1/2001
1/2004
1/2007
1/2010
1/2013
1/2016
Year

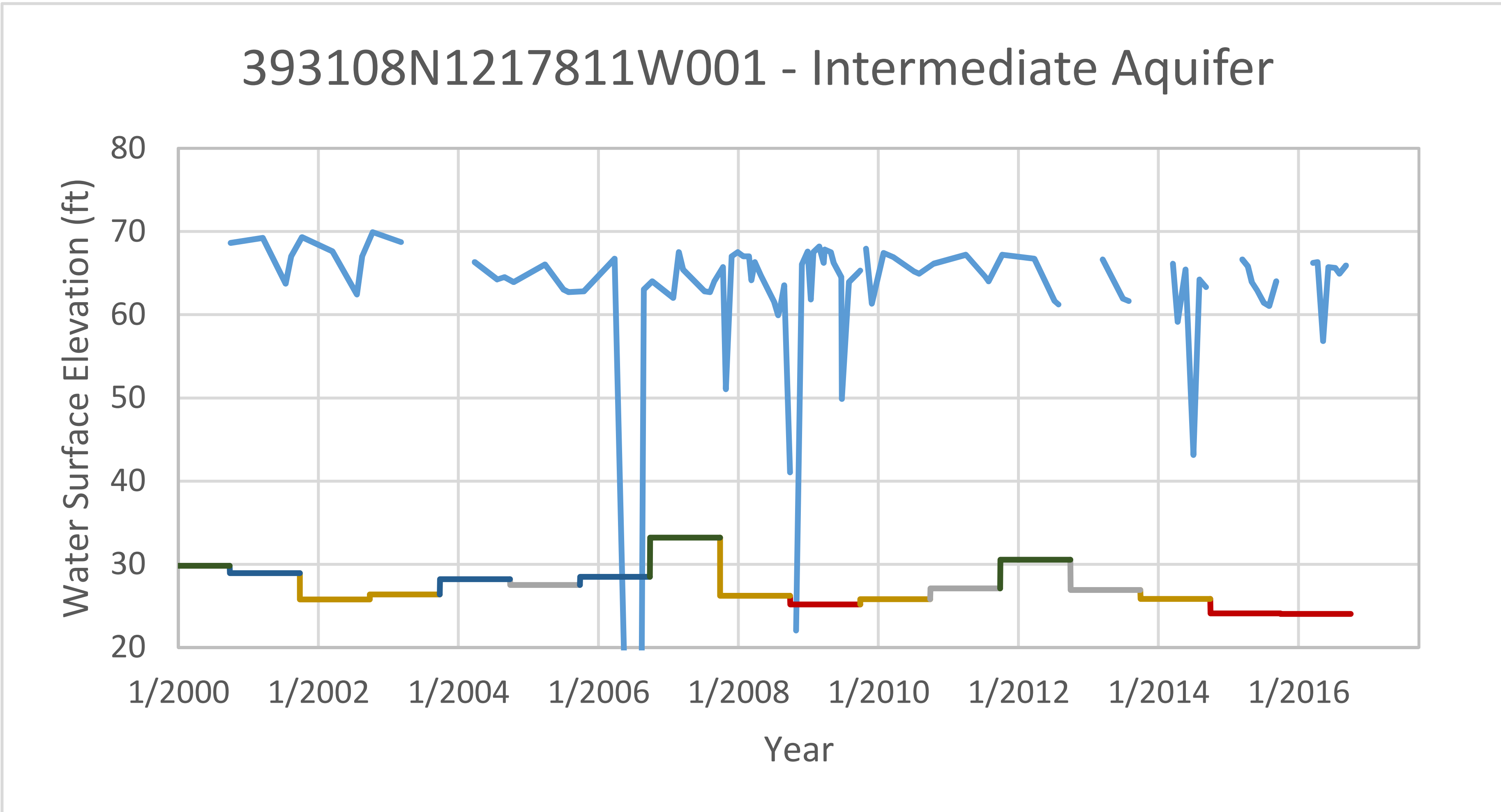


392475N1216005W001 - Intermediate Aquifer
Water Surface Elevation (ft)
80
70
60
50
40
30
20
1/1995
1/2000
1/2005
1/2010
1/2015
Year

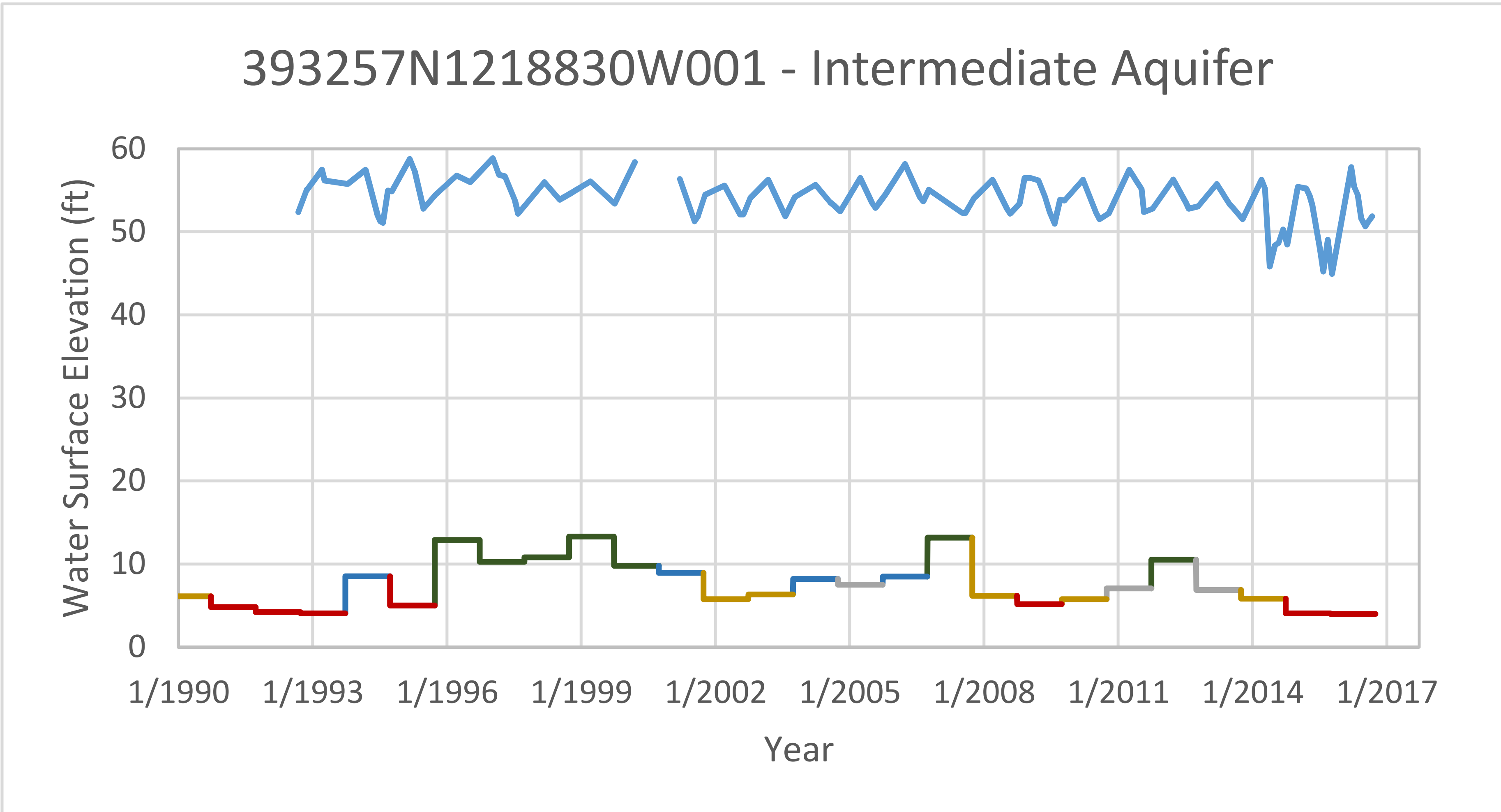


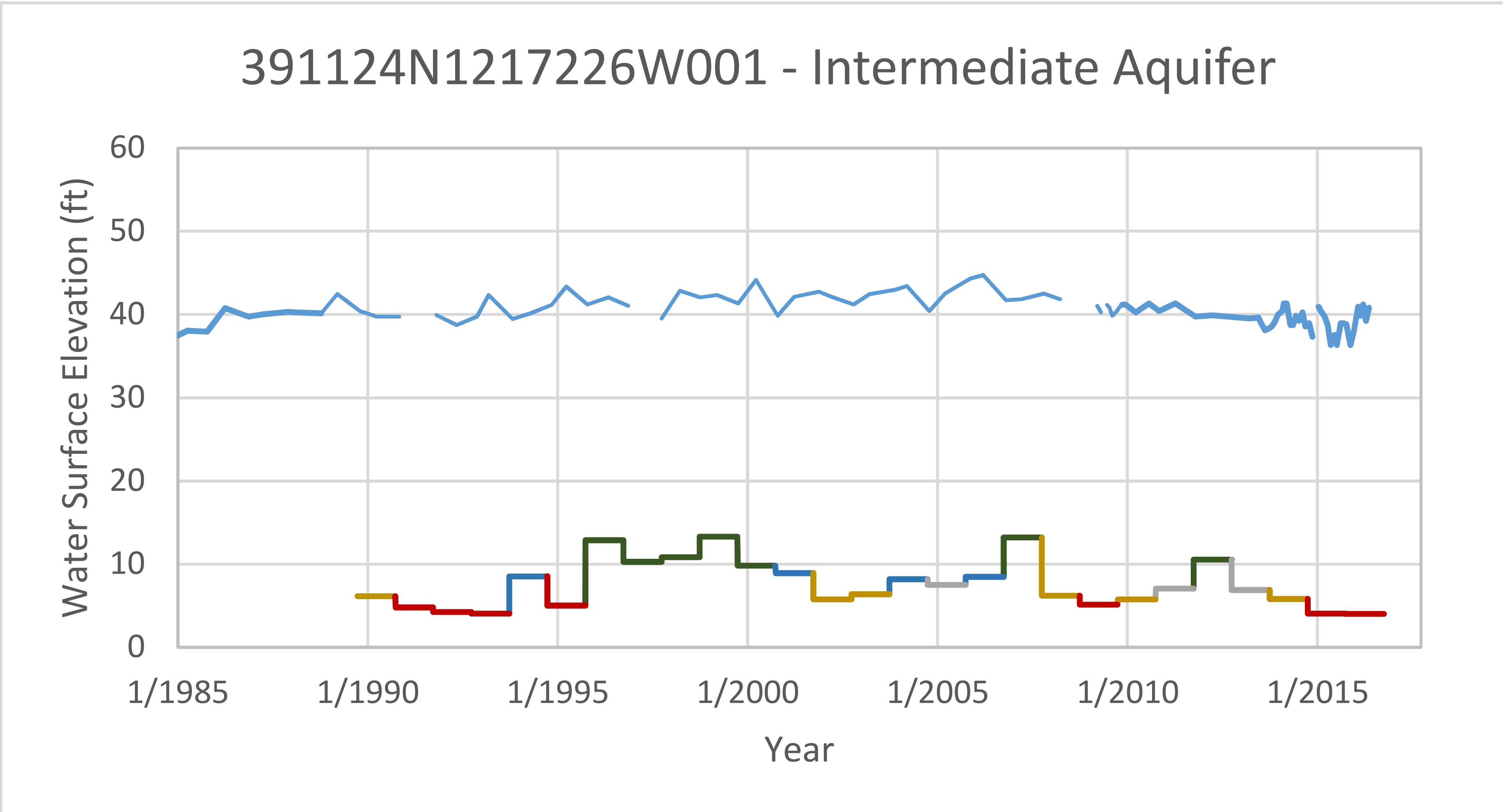
392603N1216860W001 - Intermediate Aquifer
Water Surface Elevation (ft)
80
70
60
50
40
30
20
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year


392883N1215952W001 - Intermediate Aquifer
Water Surface Elevation (ft)
80
70
60
50
40
30
20
1/1995
1/1998
1/2001
1/2004
1/2007
1/2010
1/2013
1/2016
Year



393108N1217811W001 - Intermediate Aquifer
Water Surface Elevation (ft)
80
70
60
50
40
30
20
1/2000
1/2002
1/2004
1/2006
1/2008
1/2010
1/2012
1/2014
1/2016
Year


393257N1218830W001 - Intermediate Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1990
1/1993
1/1996
1/1999
1/2002
1/2005
1/2008
1/2011
1/2014
1/2017
Year



391124N1217226W001 - Intermediate Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

DEEP AQUIFER

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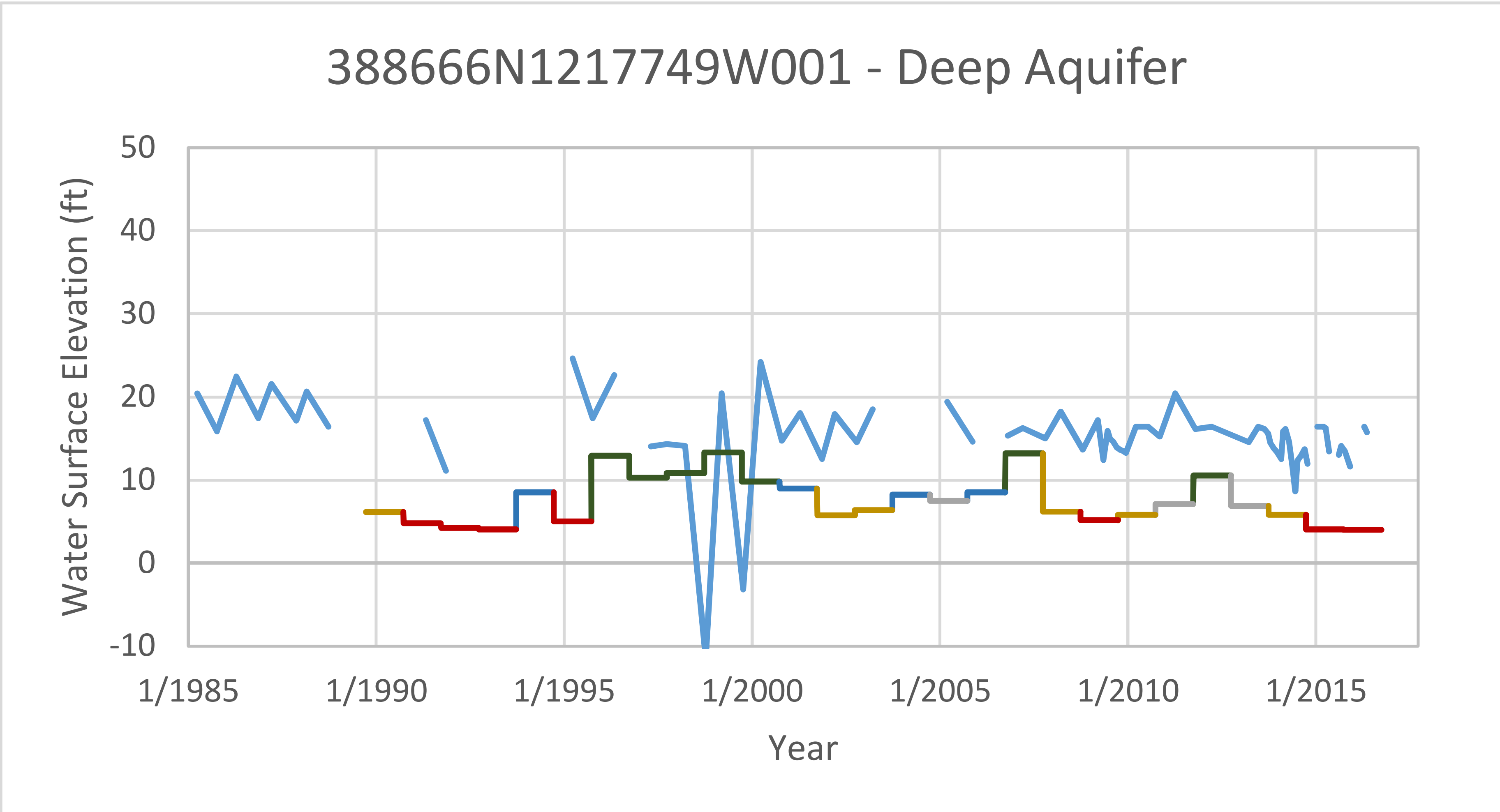
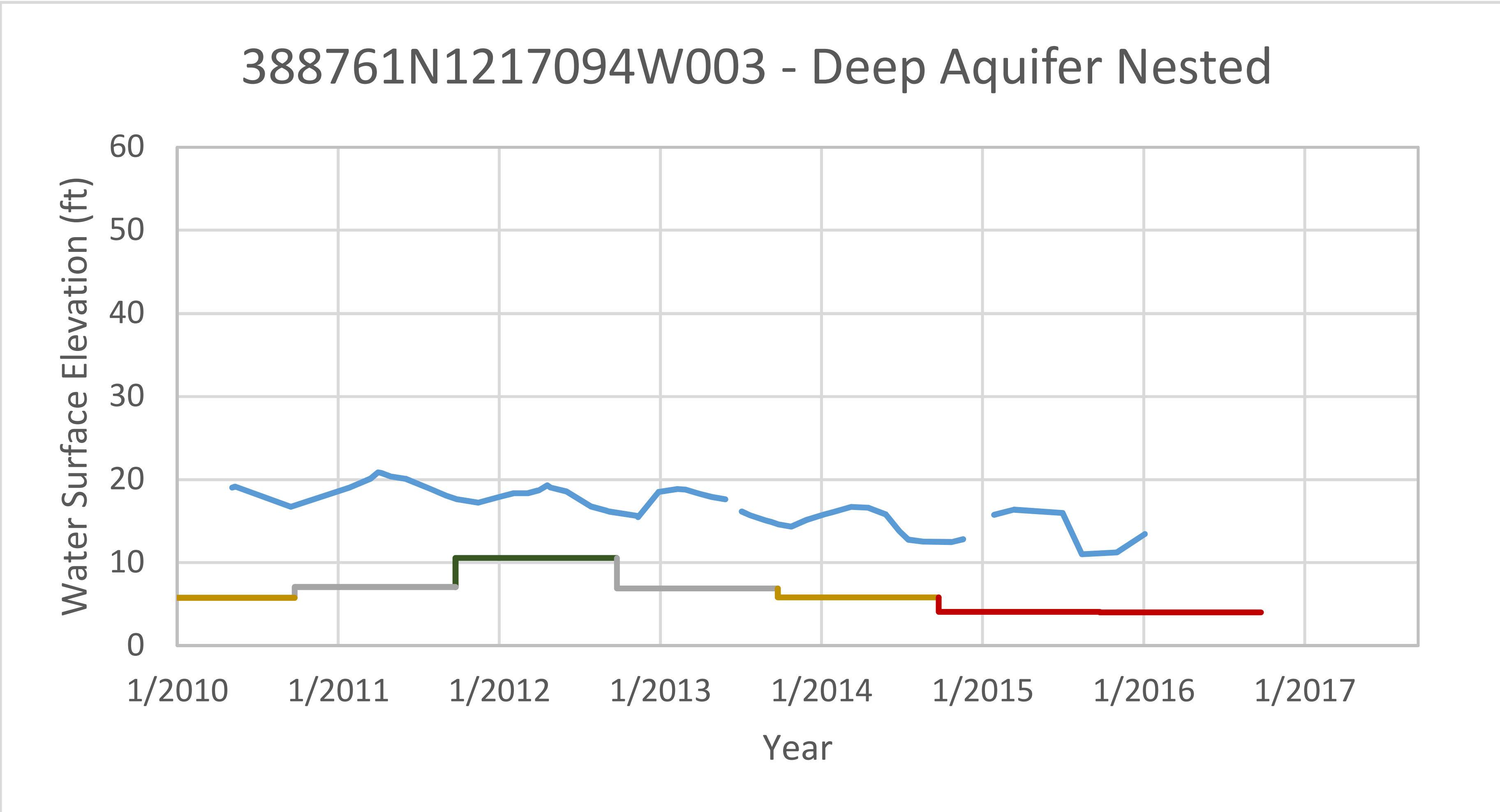
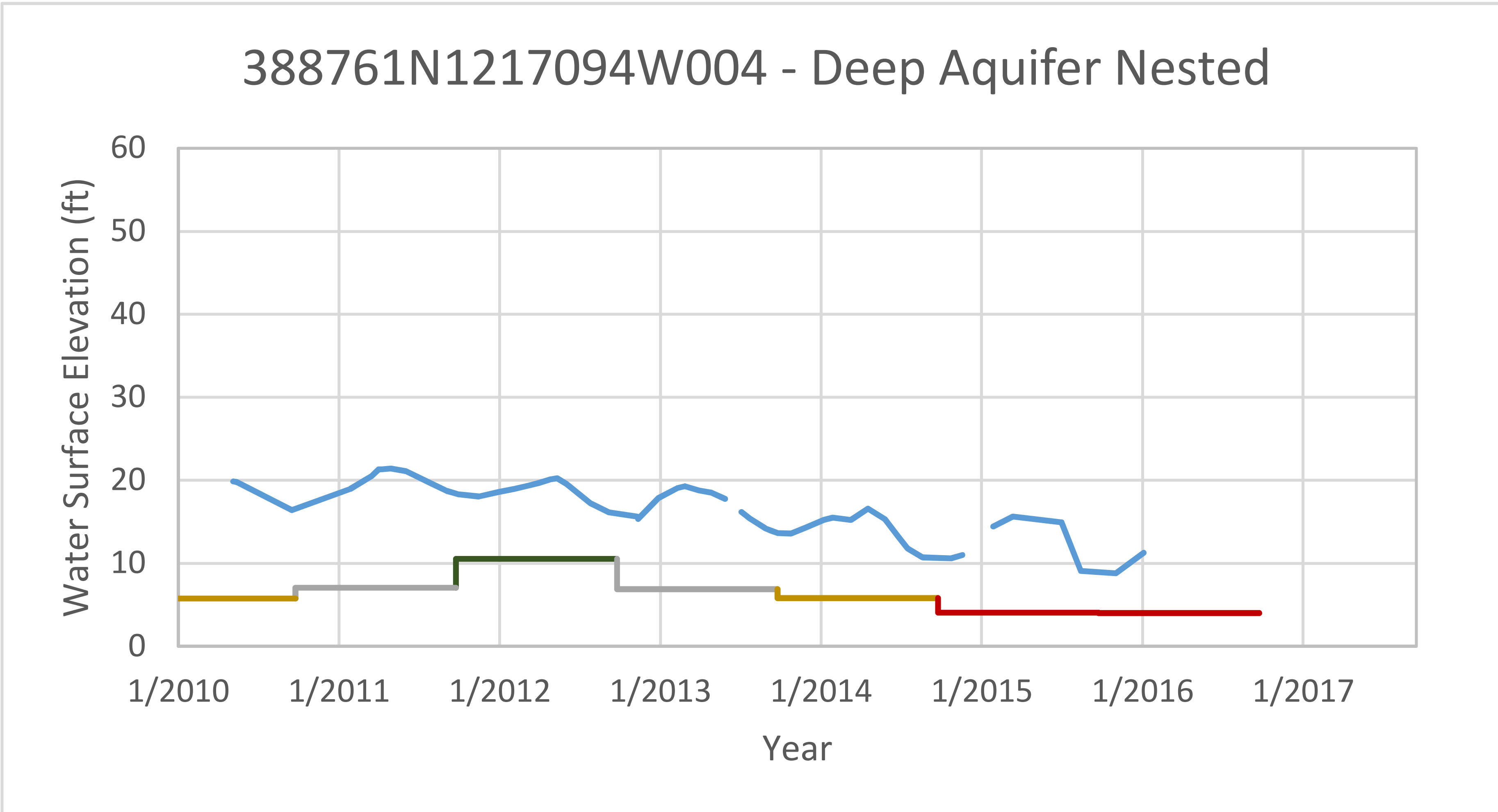
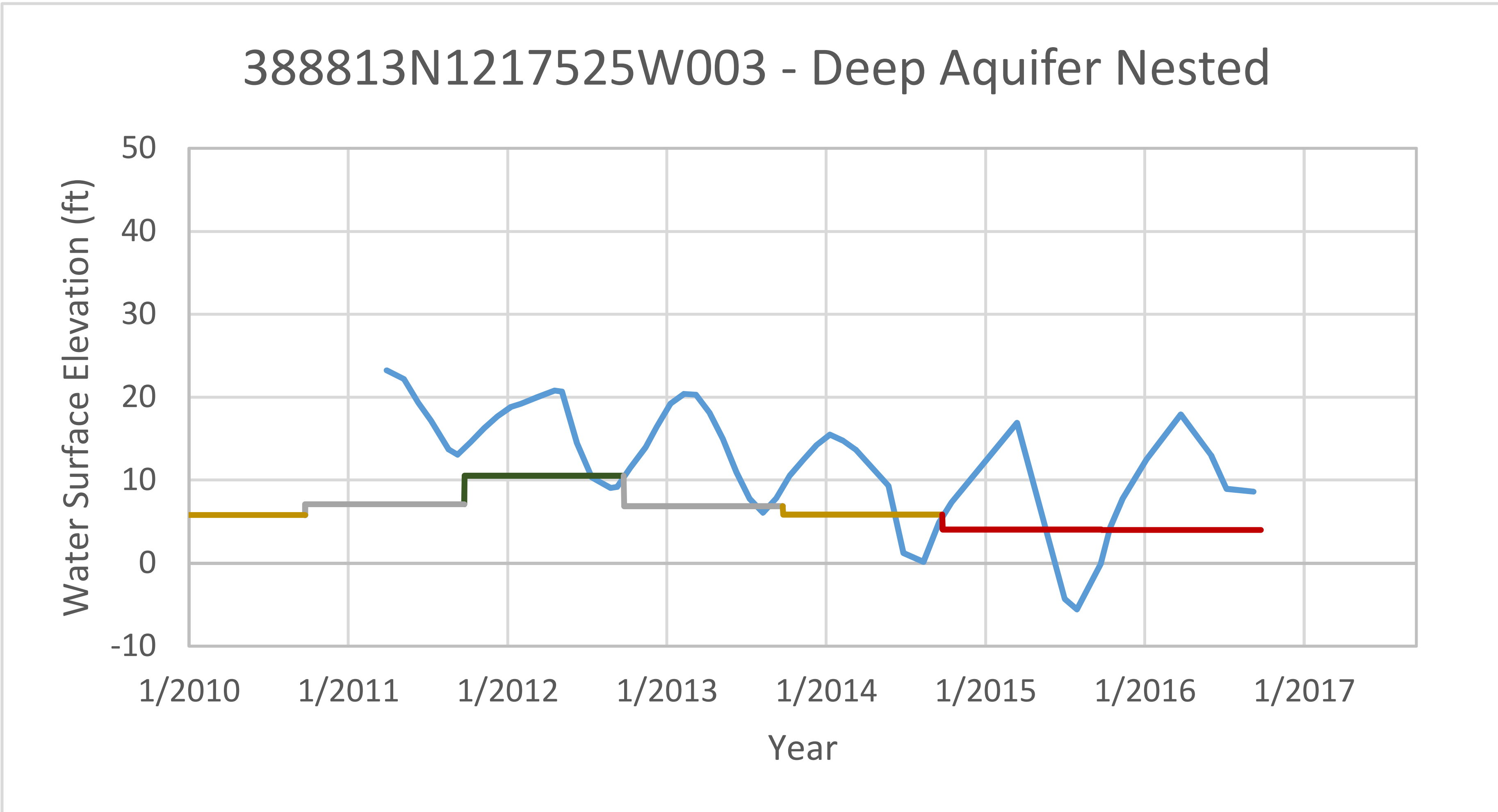


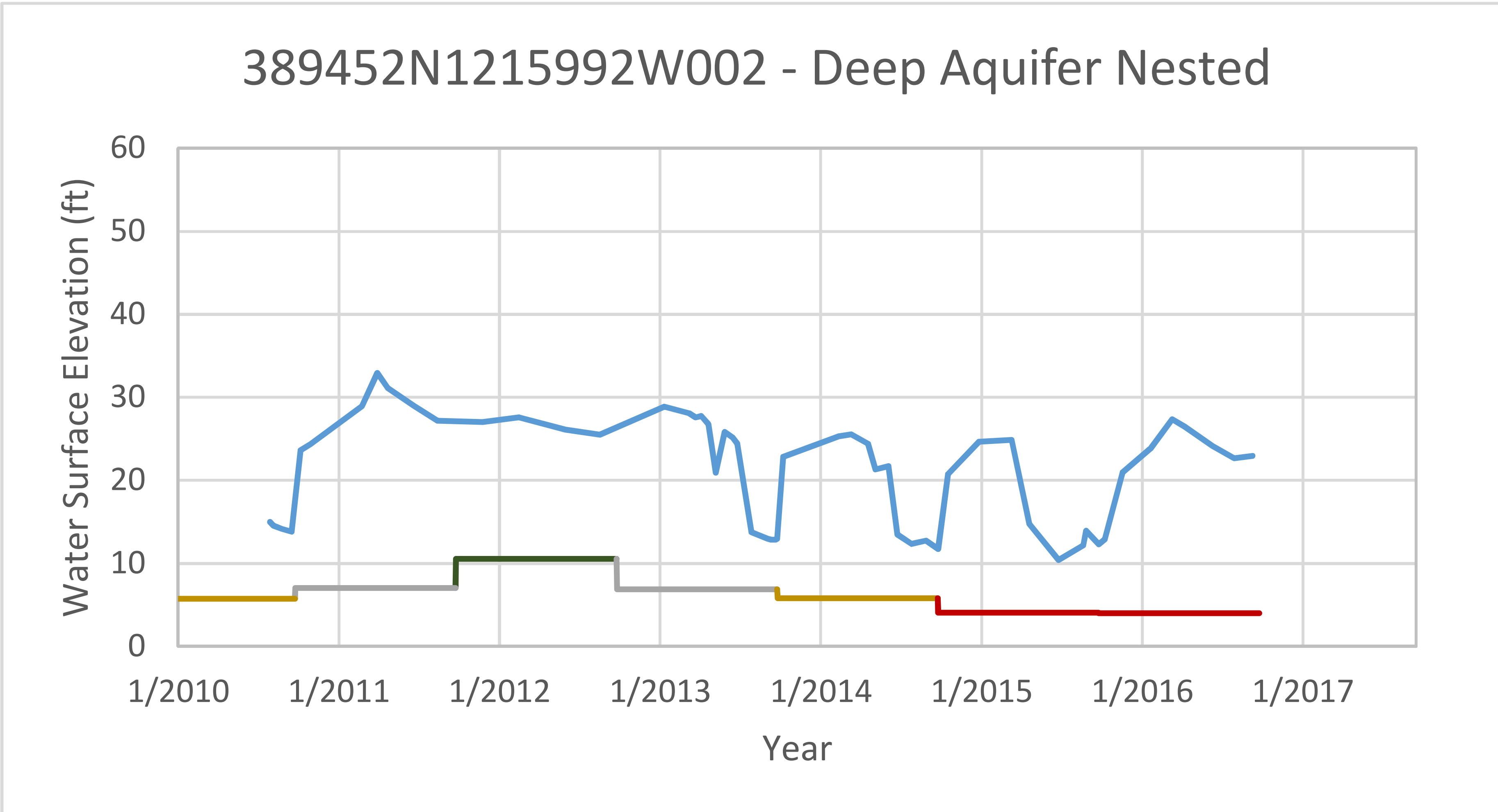
388666N1217749W001 - Deep Aquifer
Water Surface Elevation (ft)
50
40
30
20
10
0
-10
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

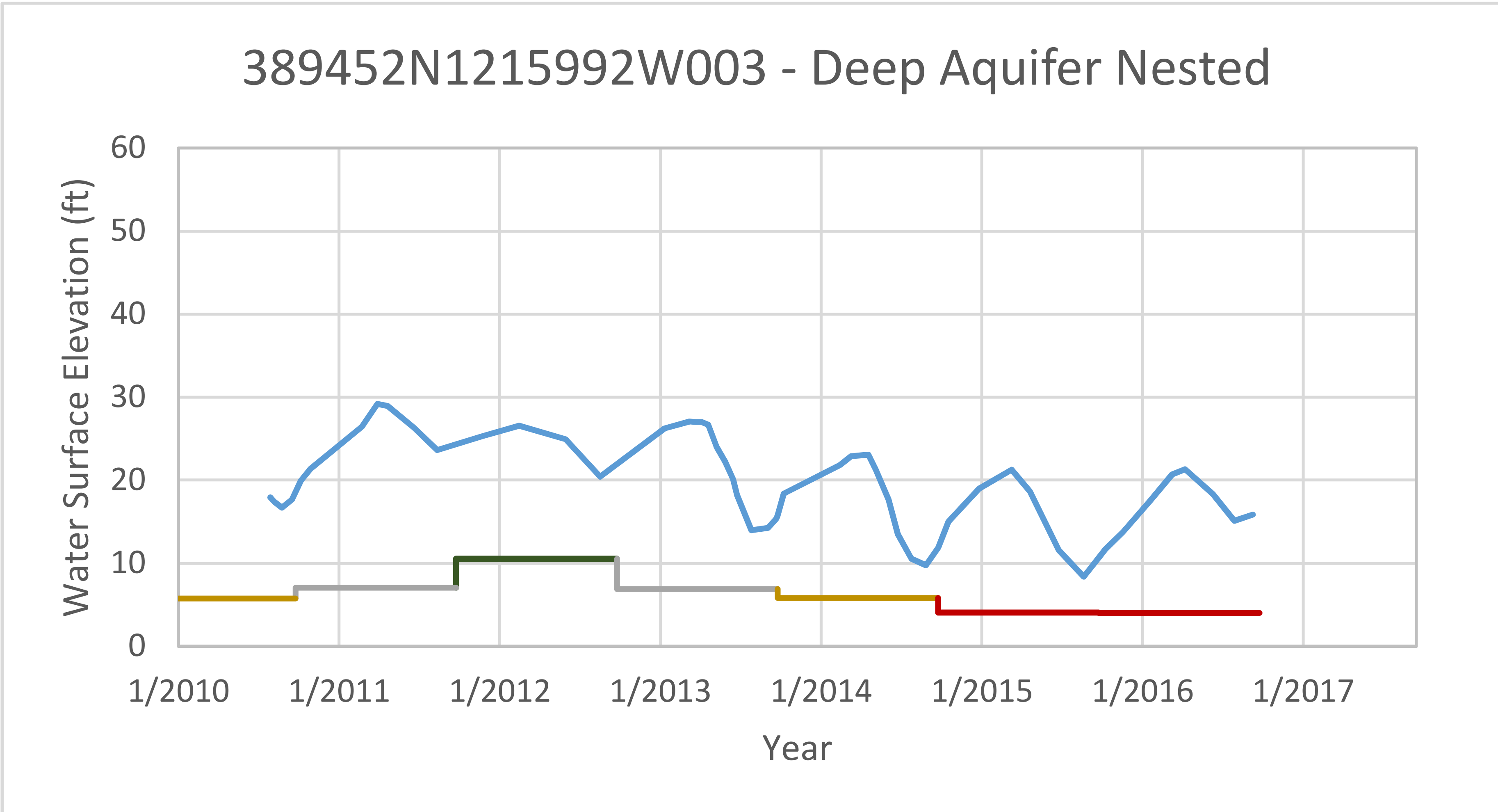

388761N1217094W003 - Deep Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

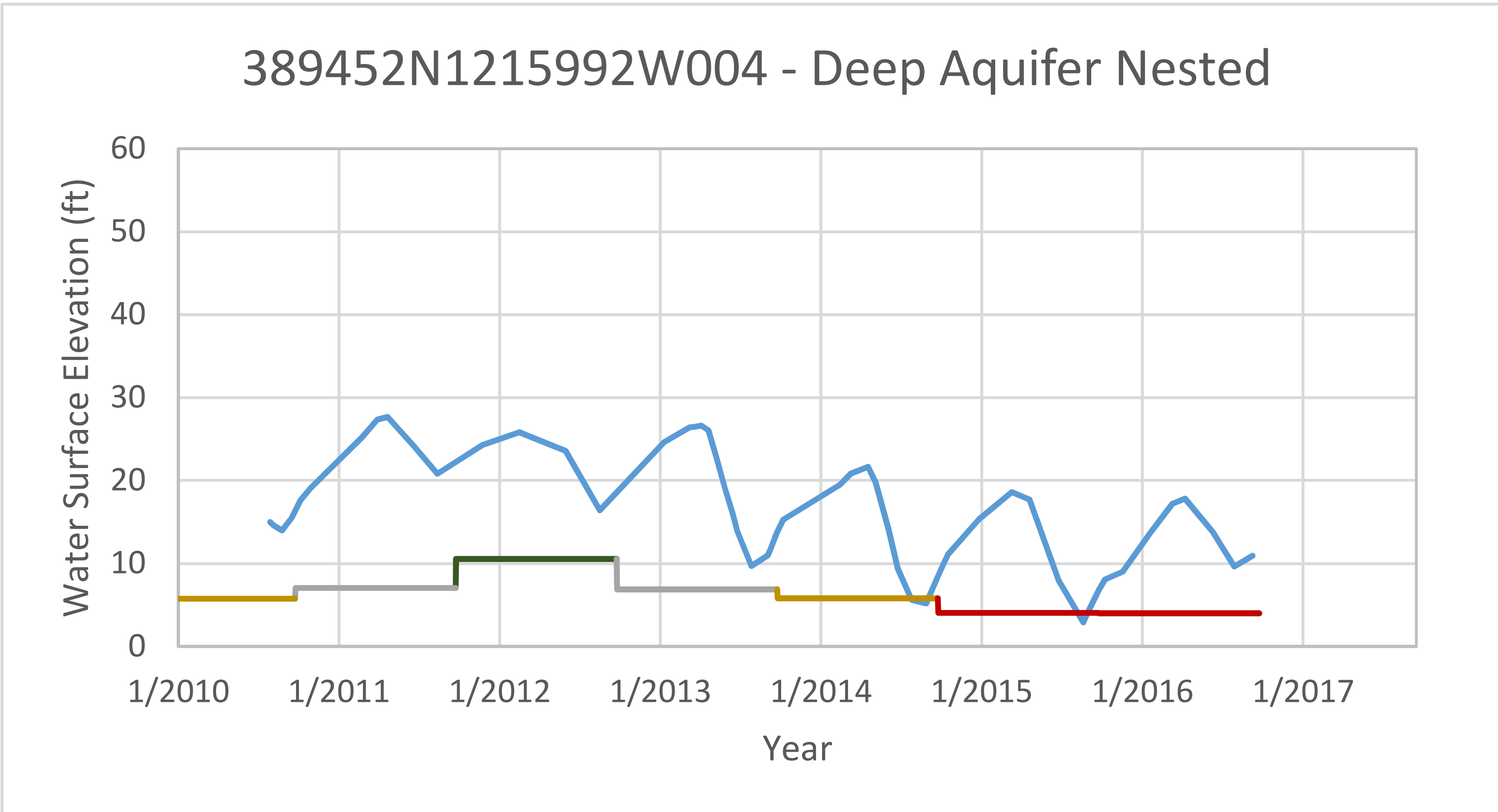


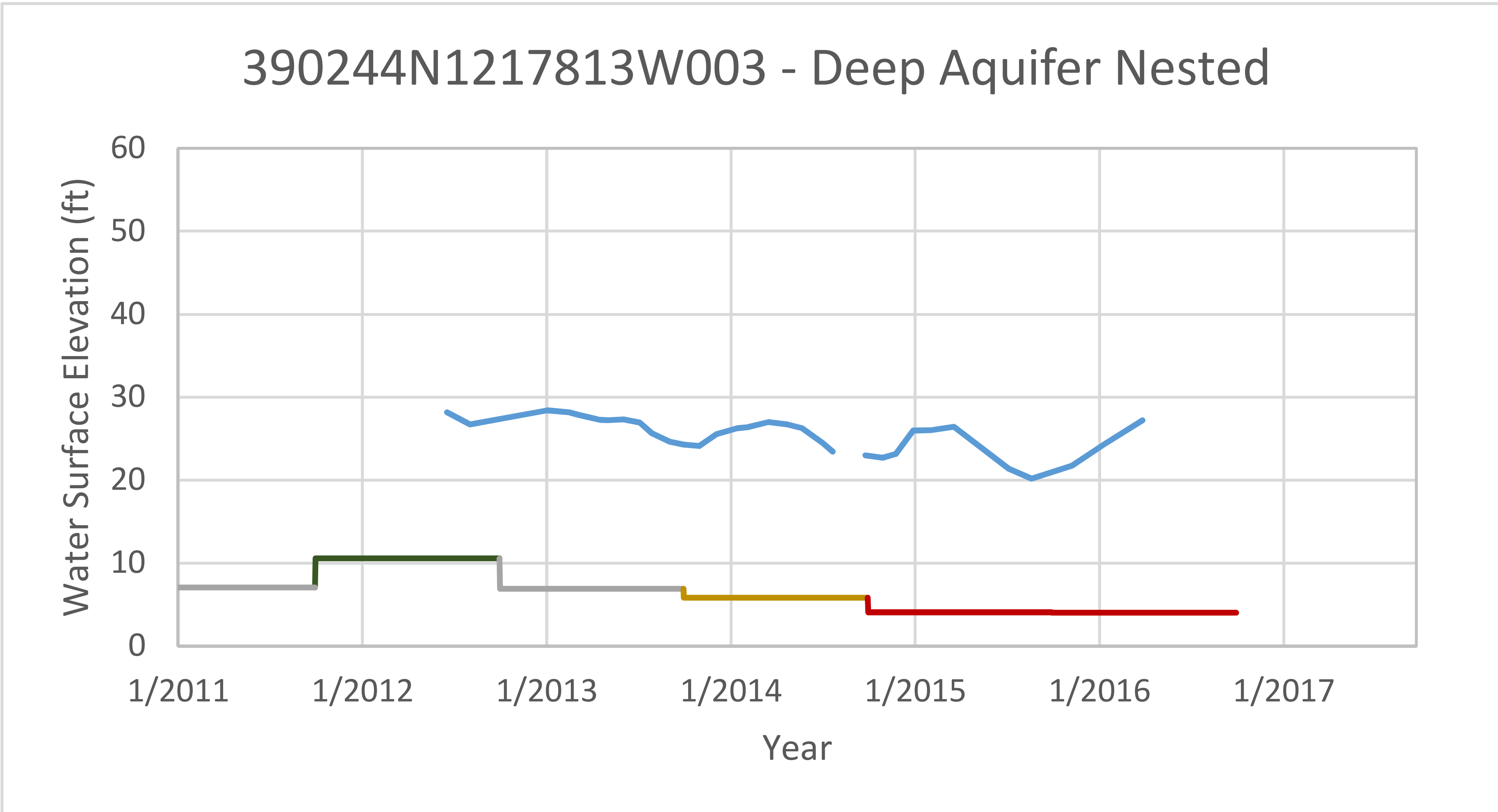
388761N1217094W004 - Deep Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year


388813N1217525W003 - Deep Aquifer Nested
Water Surface Elevation (ft)
50
40
30
20
10
0
-10
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

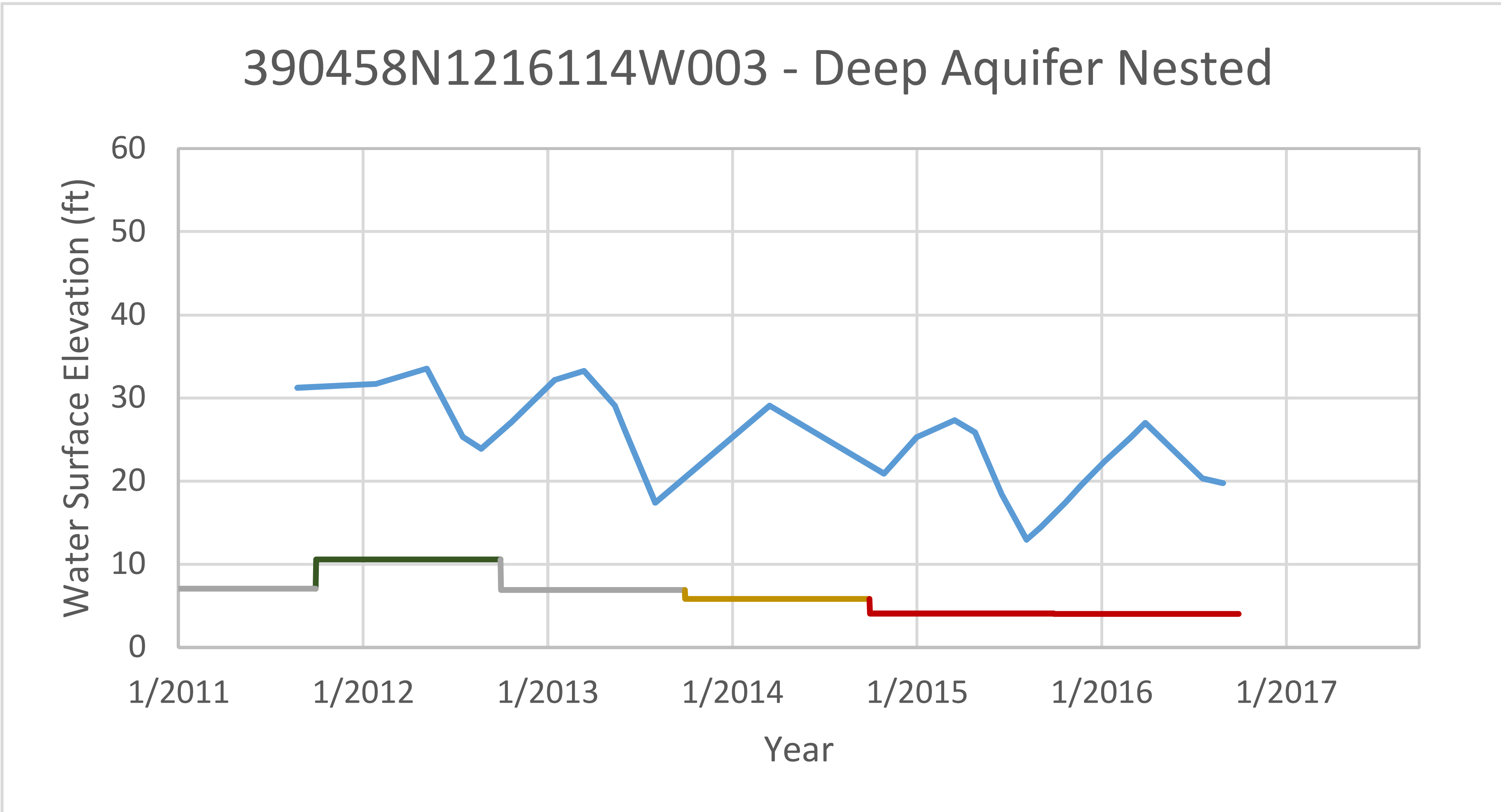

389452N1215992W002 - Deep Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year


389452N1215992W003 - Deep Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

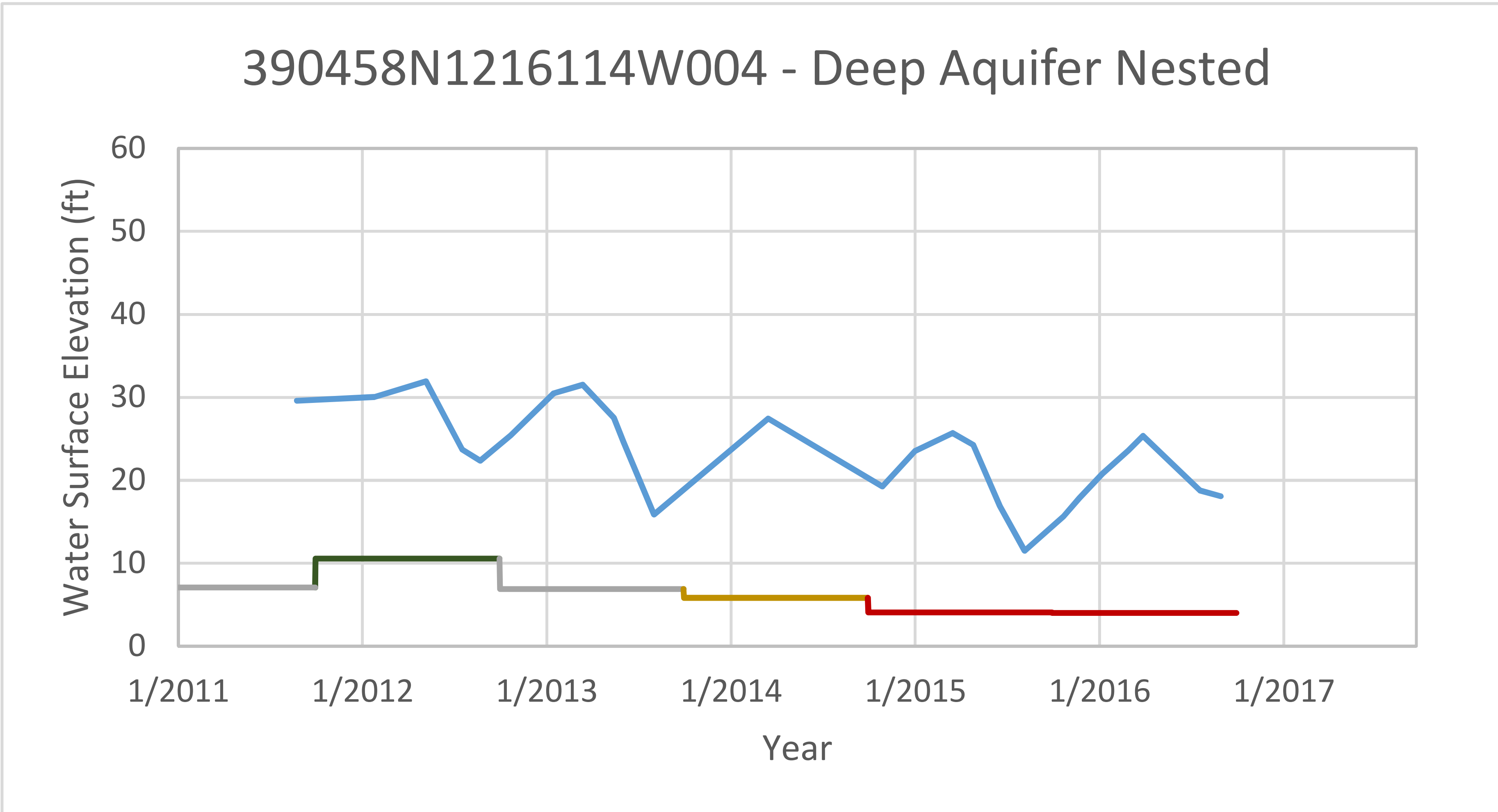

389452N1215992W004 - Deep Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

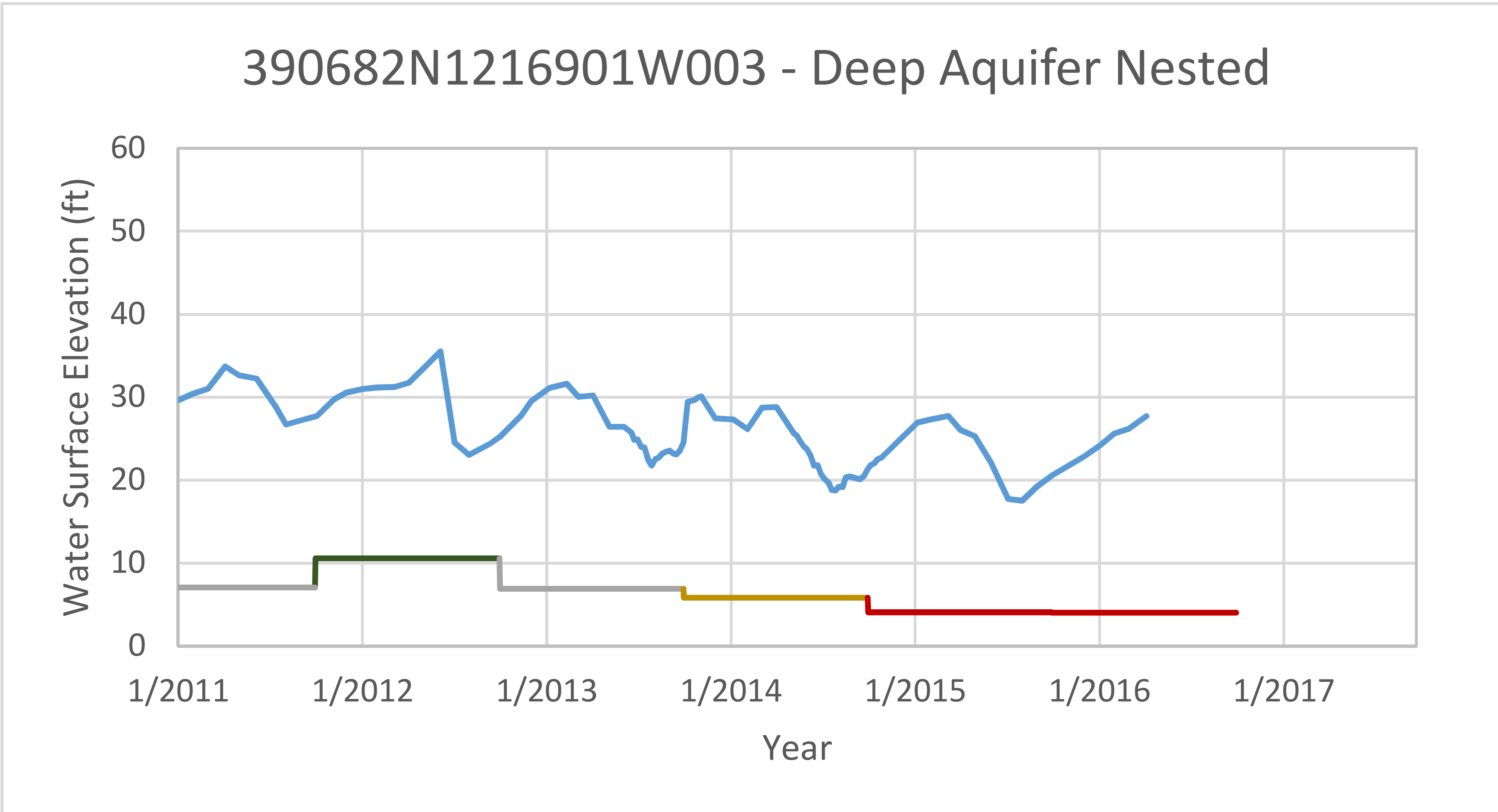


390244N1217813W003 - Deep Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

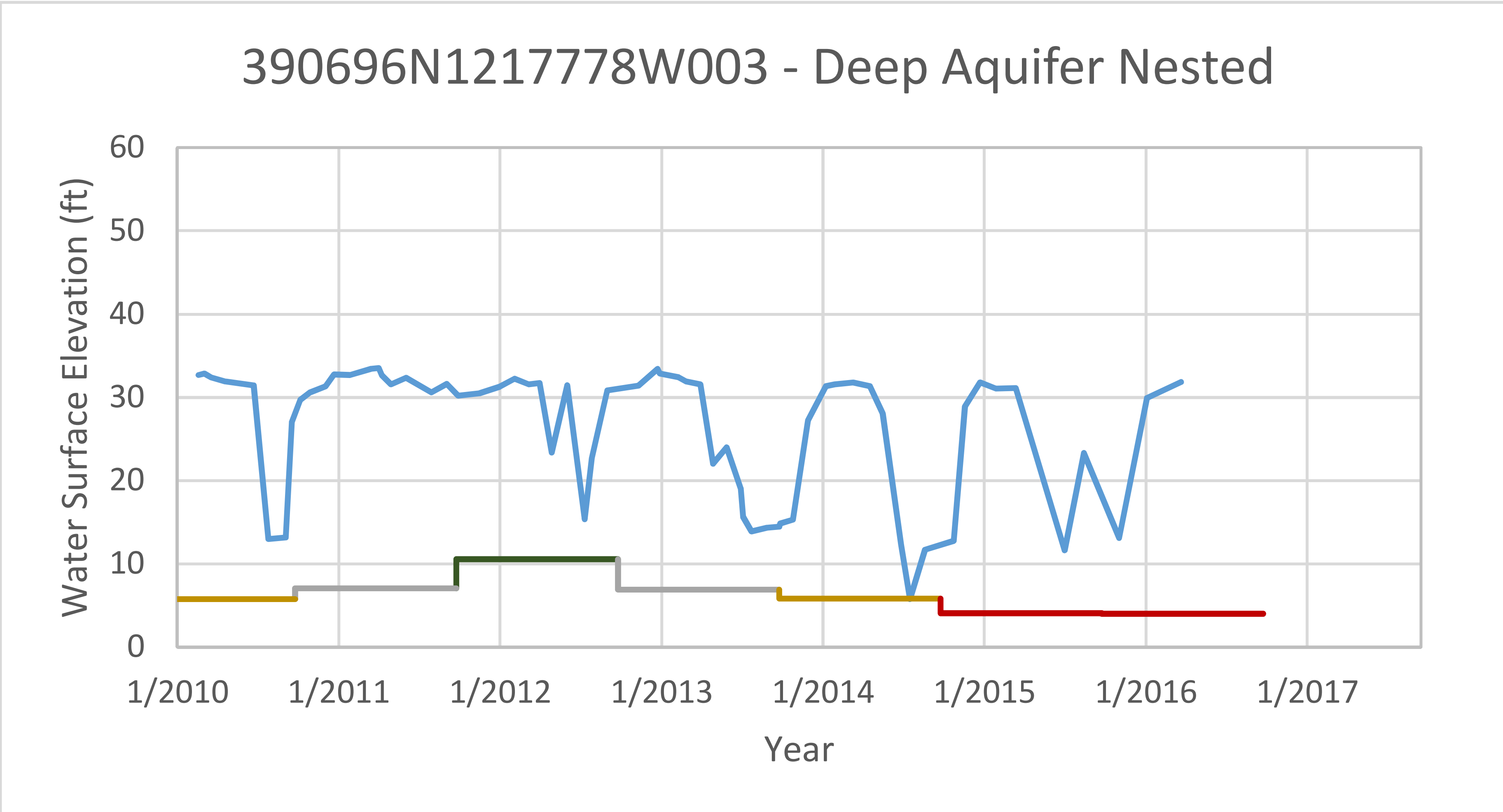


390458N1216114W003 - Deep Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

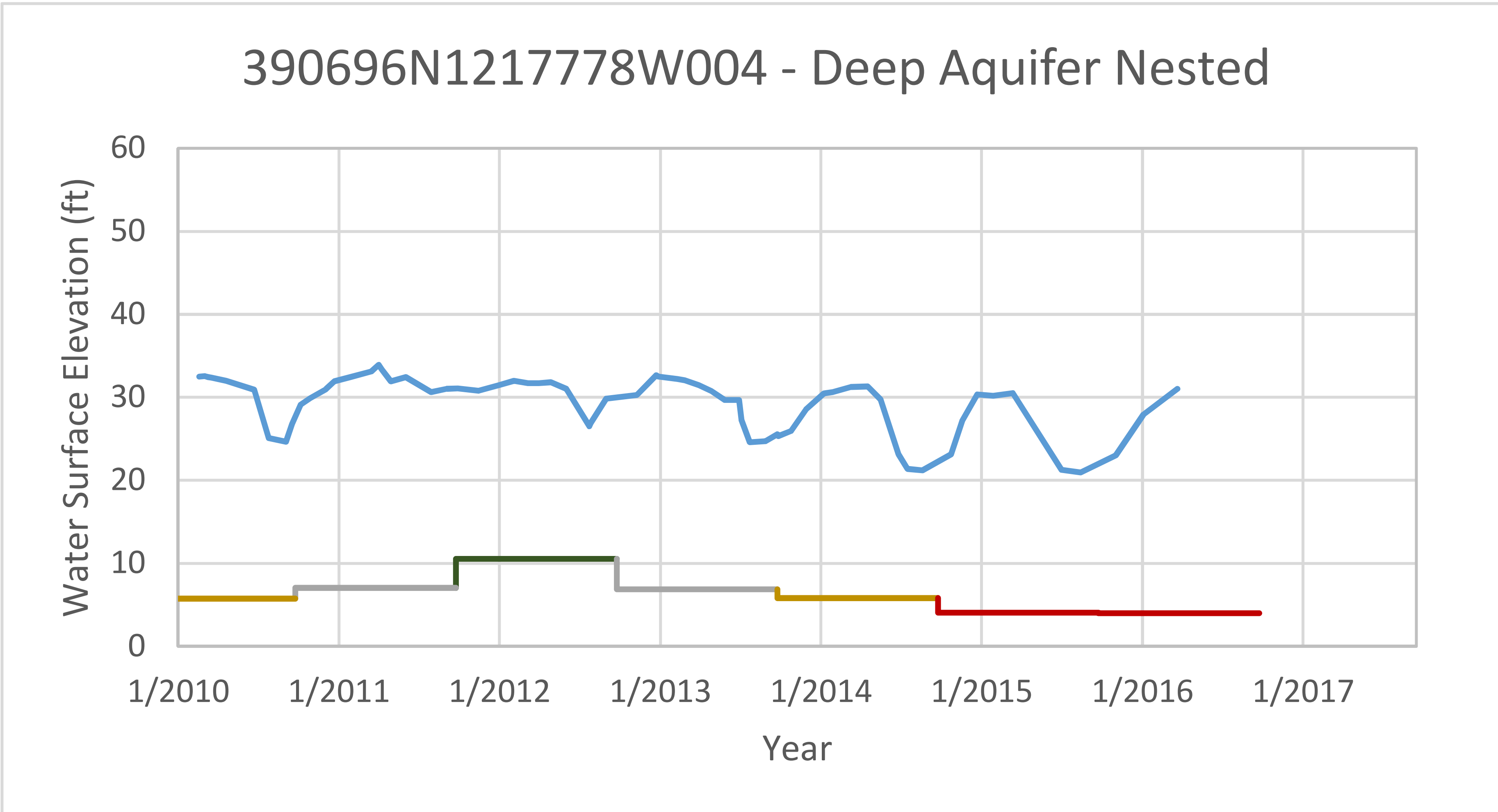

390458N1216114W004 - Deep Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

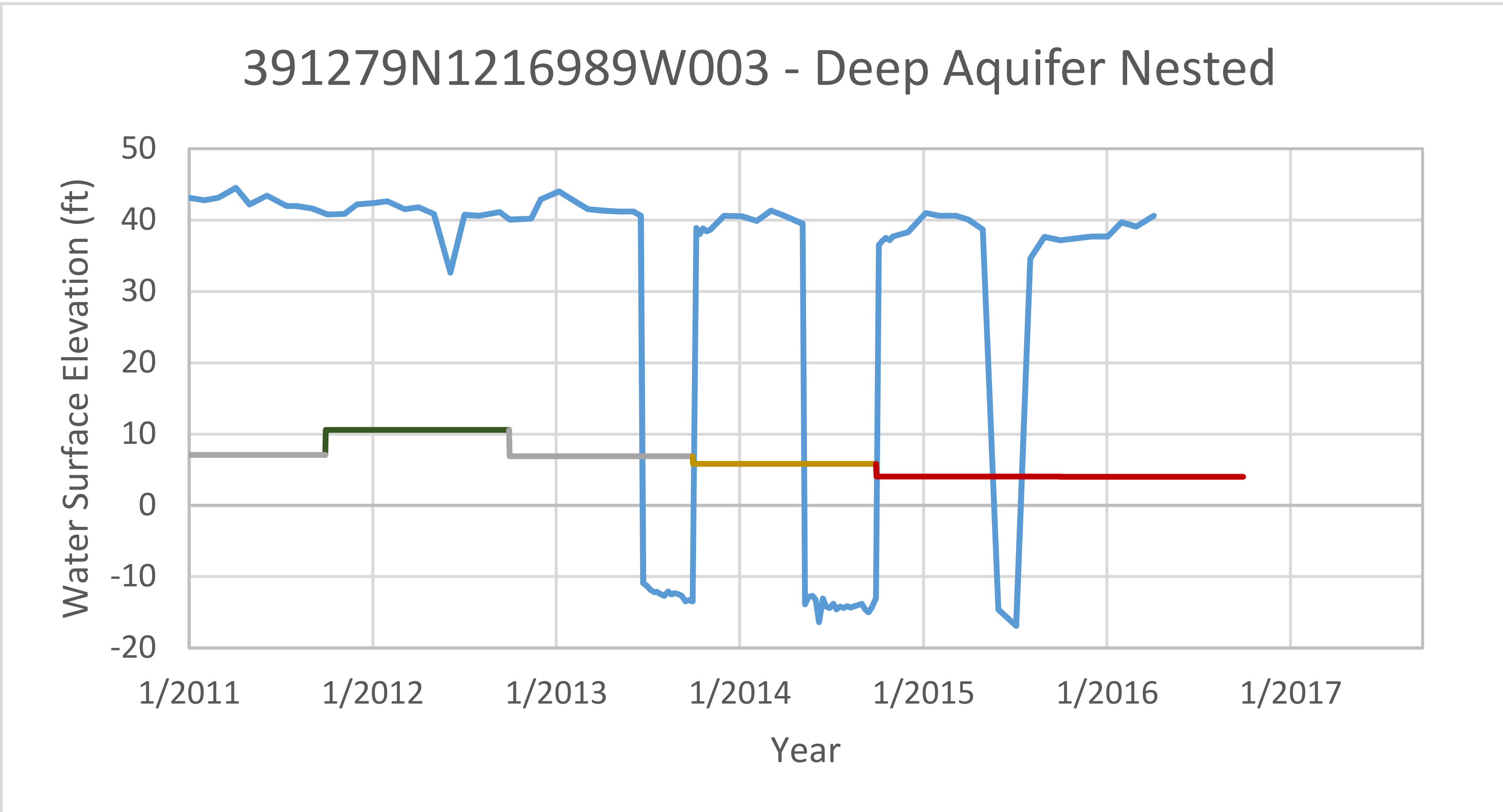


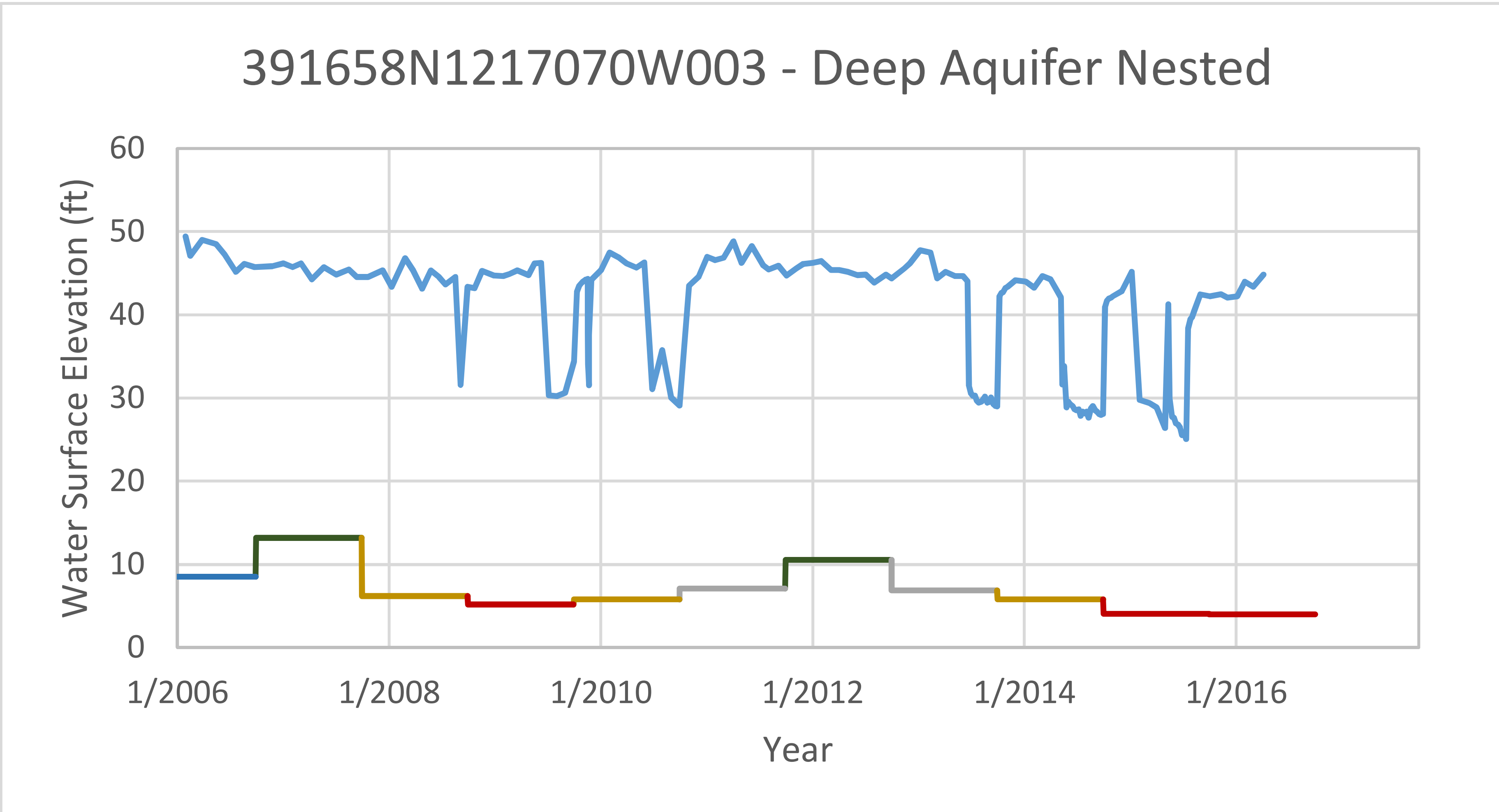
390682N1216901W003 - Deep Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year

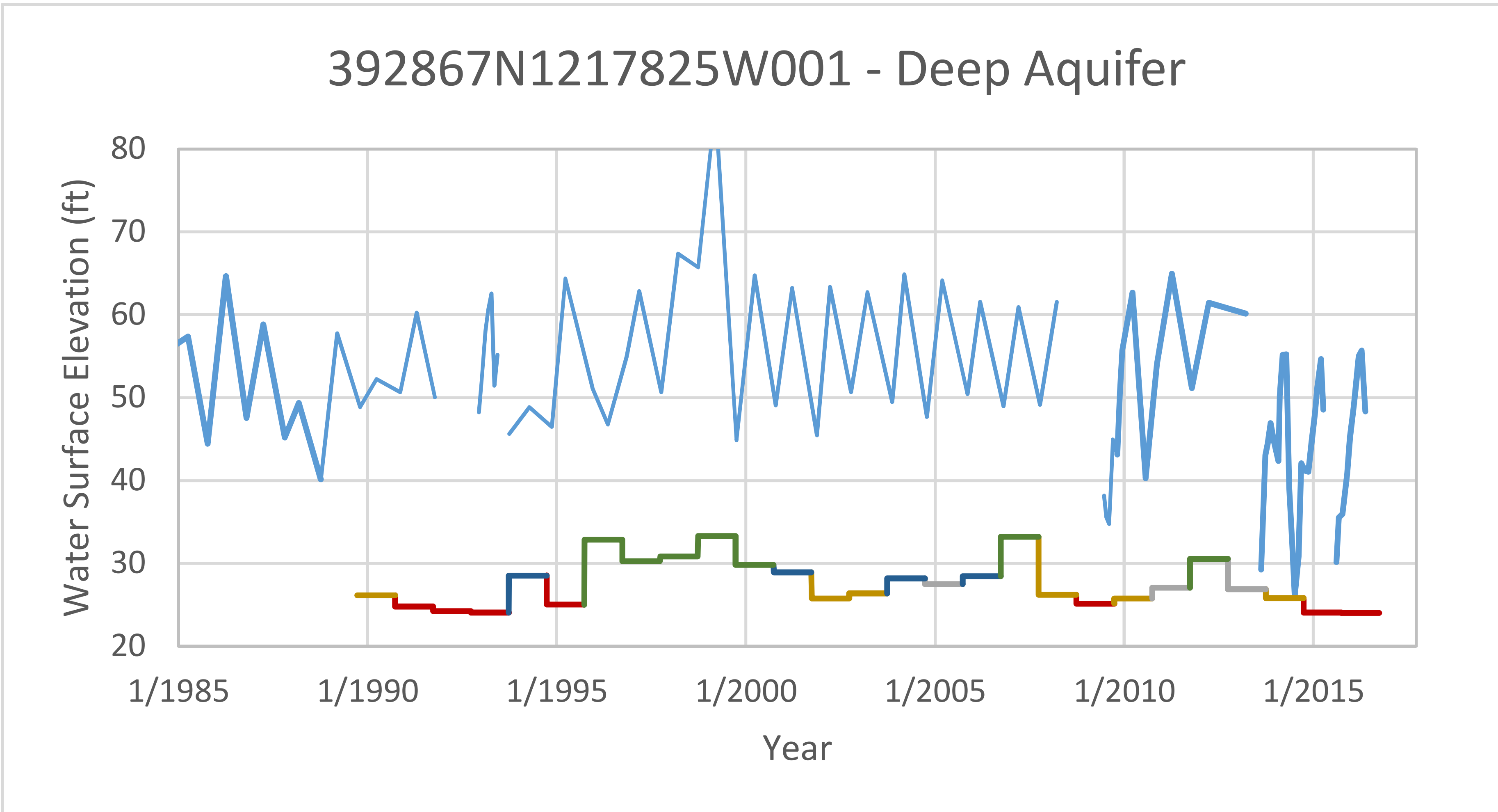


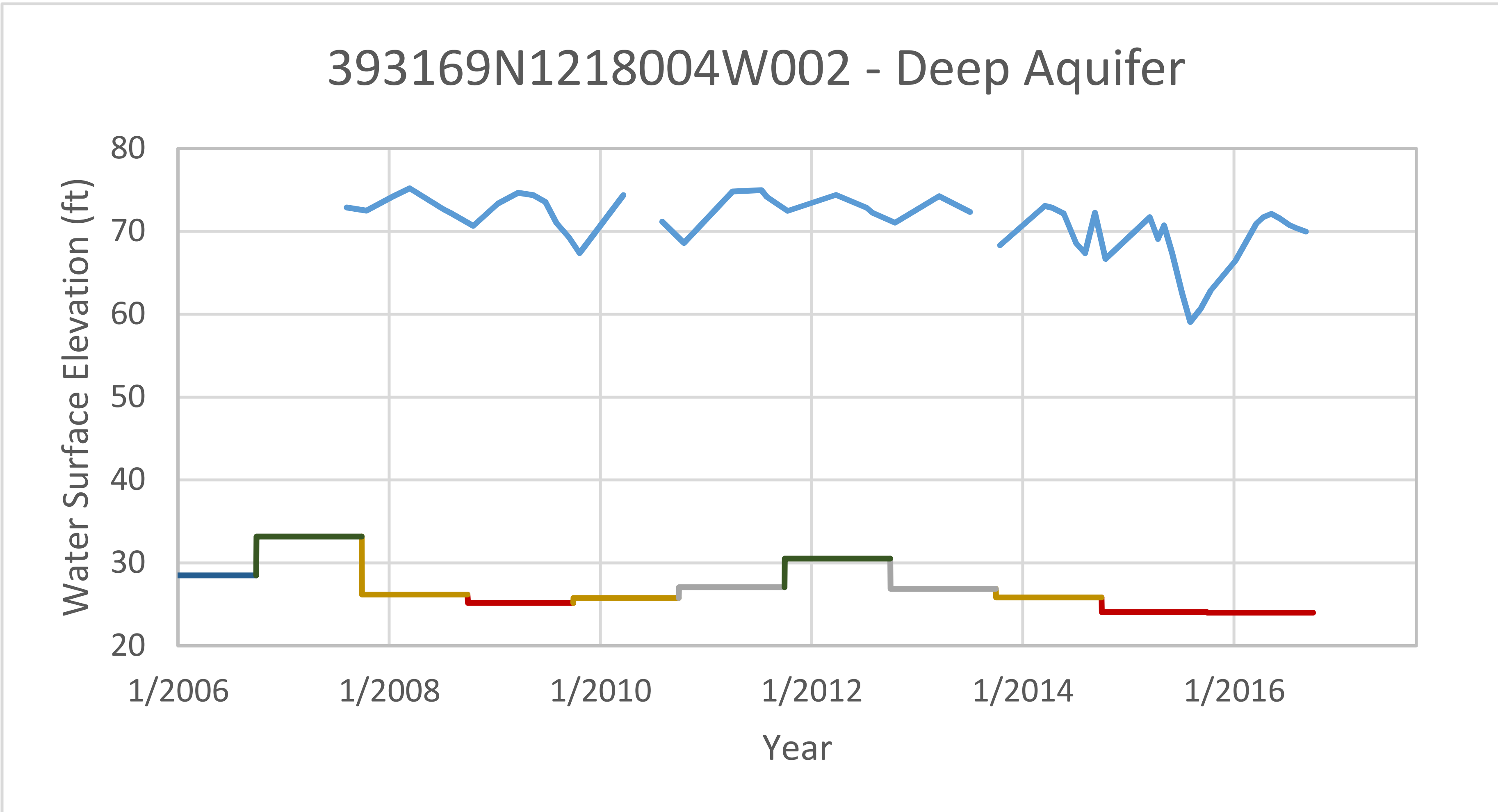
390696N1217778W003 - Deep Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year


390696N1217778W004 - Deep Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year


391279N1216989W003 - Deep Aquifer Nested
Water Surface Elevation (ft)
50
40
30
20
10
0
-10
-20
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year


391658N1217070W003 - Deep Aquifer Nested
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2006
1/2008
1/2010
1/2012
1/2014
1/2016
Year


392867N1217825W001 - Deep Aquifer
Water Surface Elevation (ft)
80
70
60
50
40
30
20
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year


393169N1218004W002 - Deep Aquifer
80
70
60
50
40
30
20
Water Surface Elevation (ft)
1/2006
1/2008
1/2010
1/2012
1/2014
1/2016
Year

UNKOWN AQUIFER

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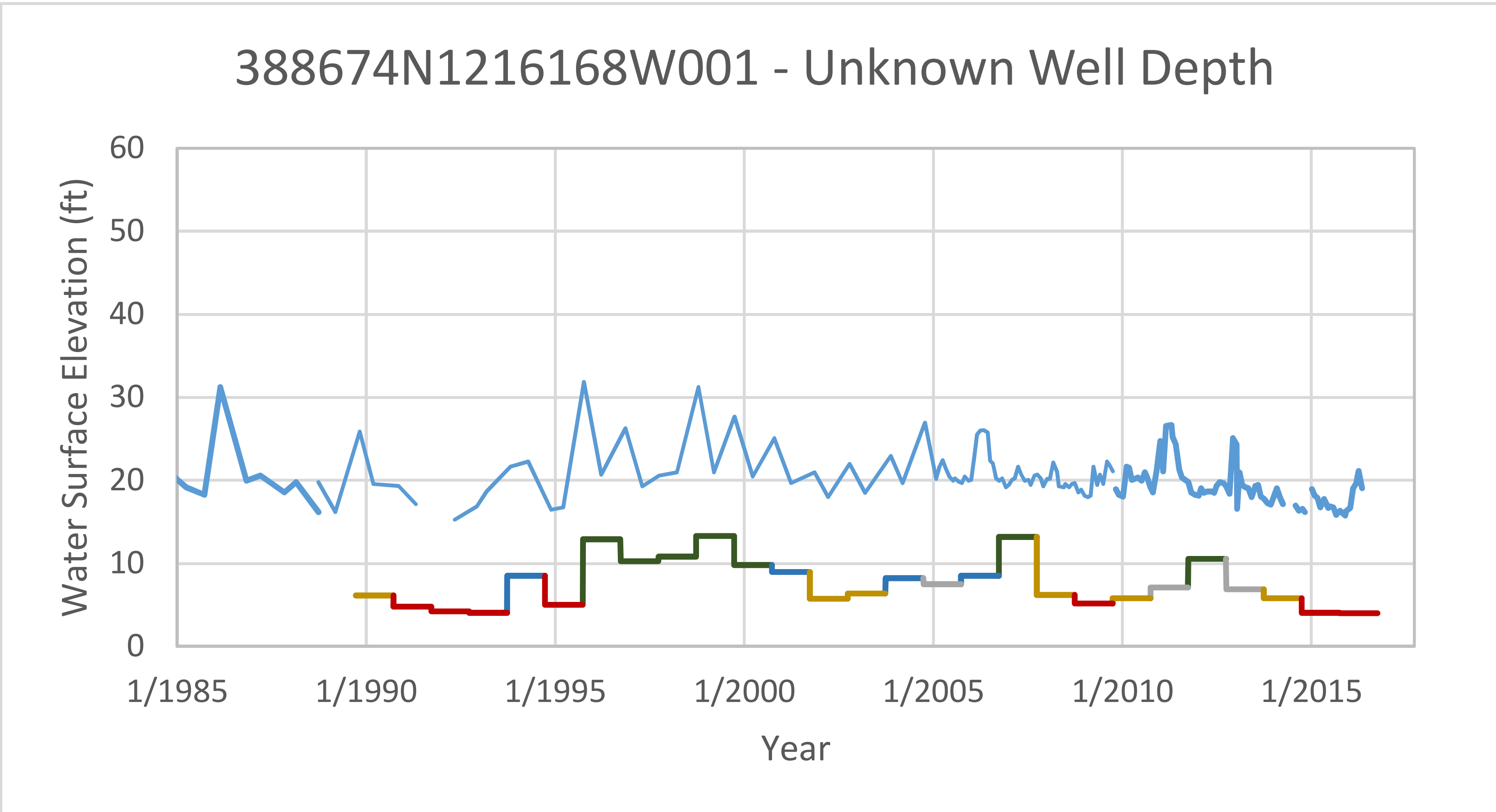
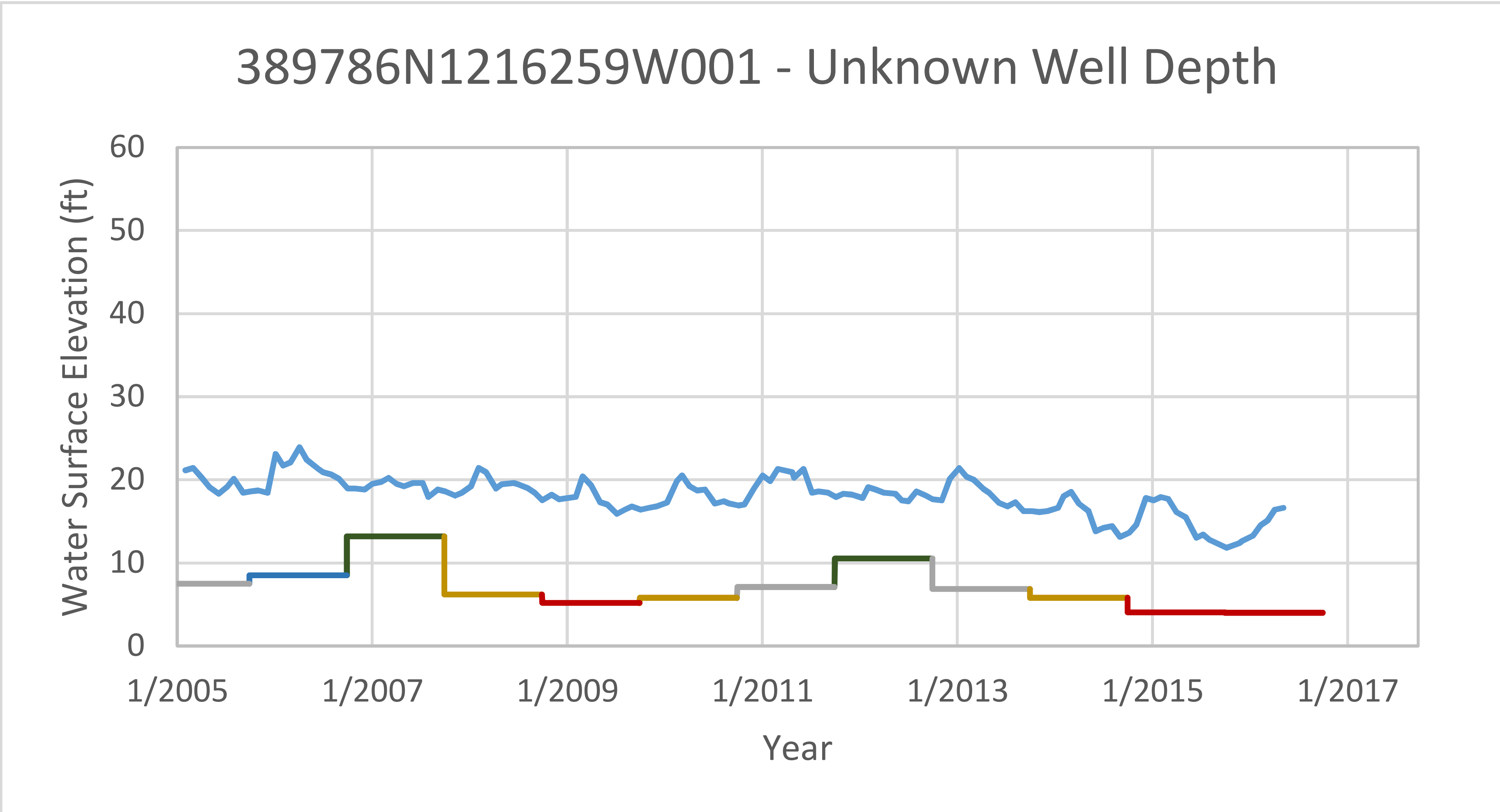
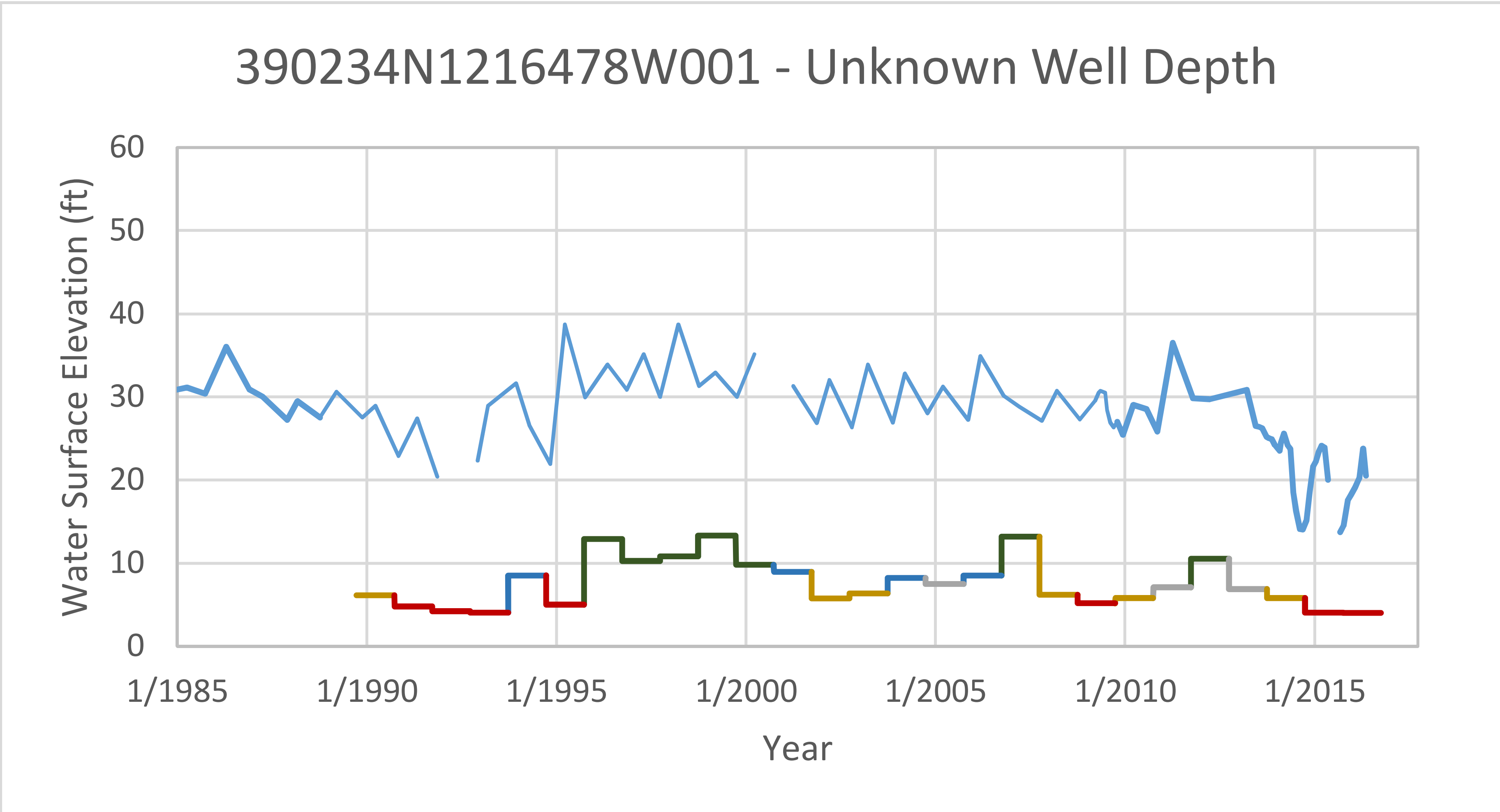
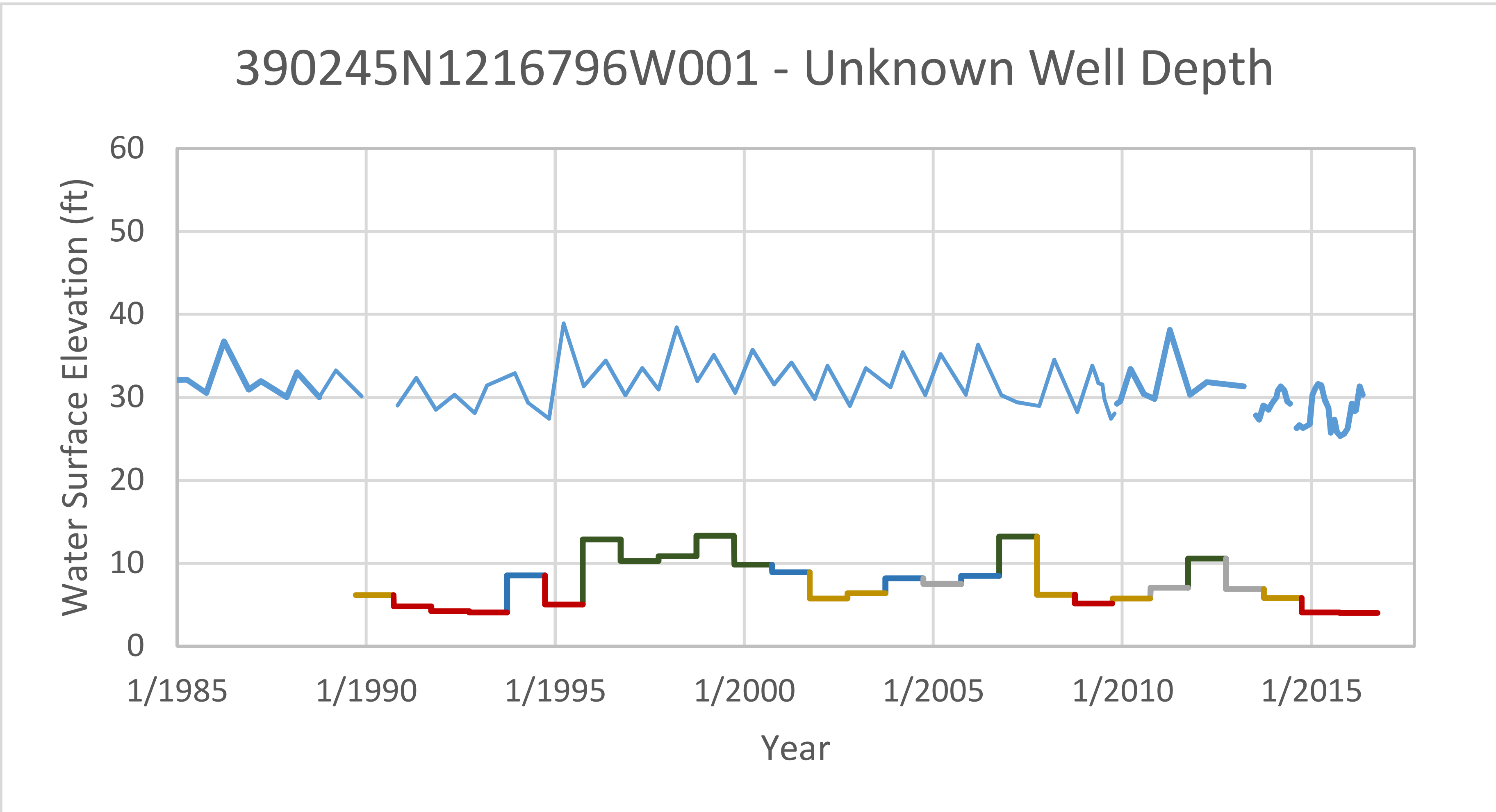


388674N1216168W001 - Unknown Well Depth
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

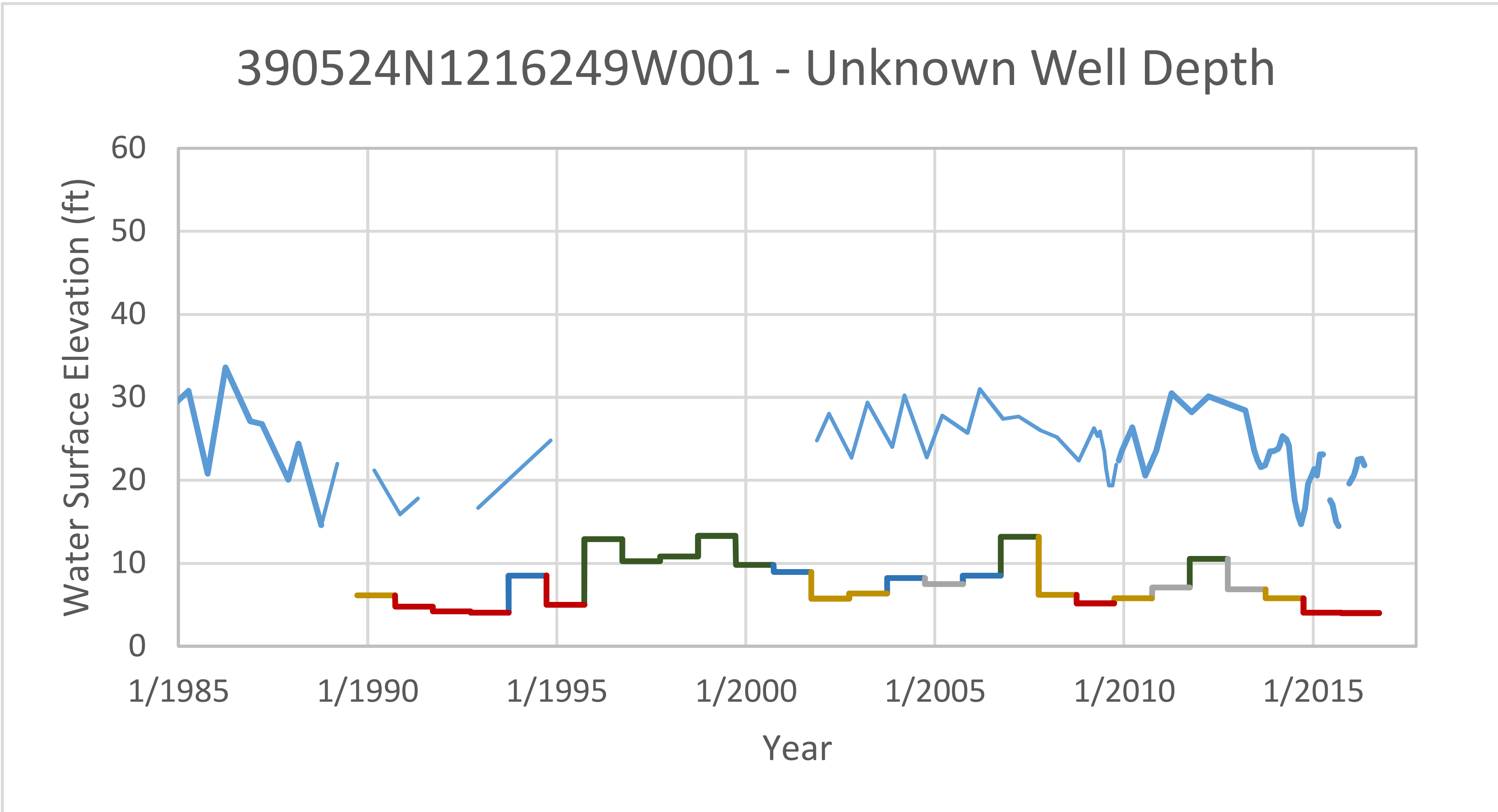


389786N1216259W001 - Unknown Well Depth
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2005
1/2007
1/2009
1/2011
1/2013
1/2015
1/2017
Year

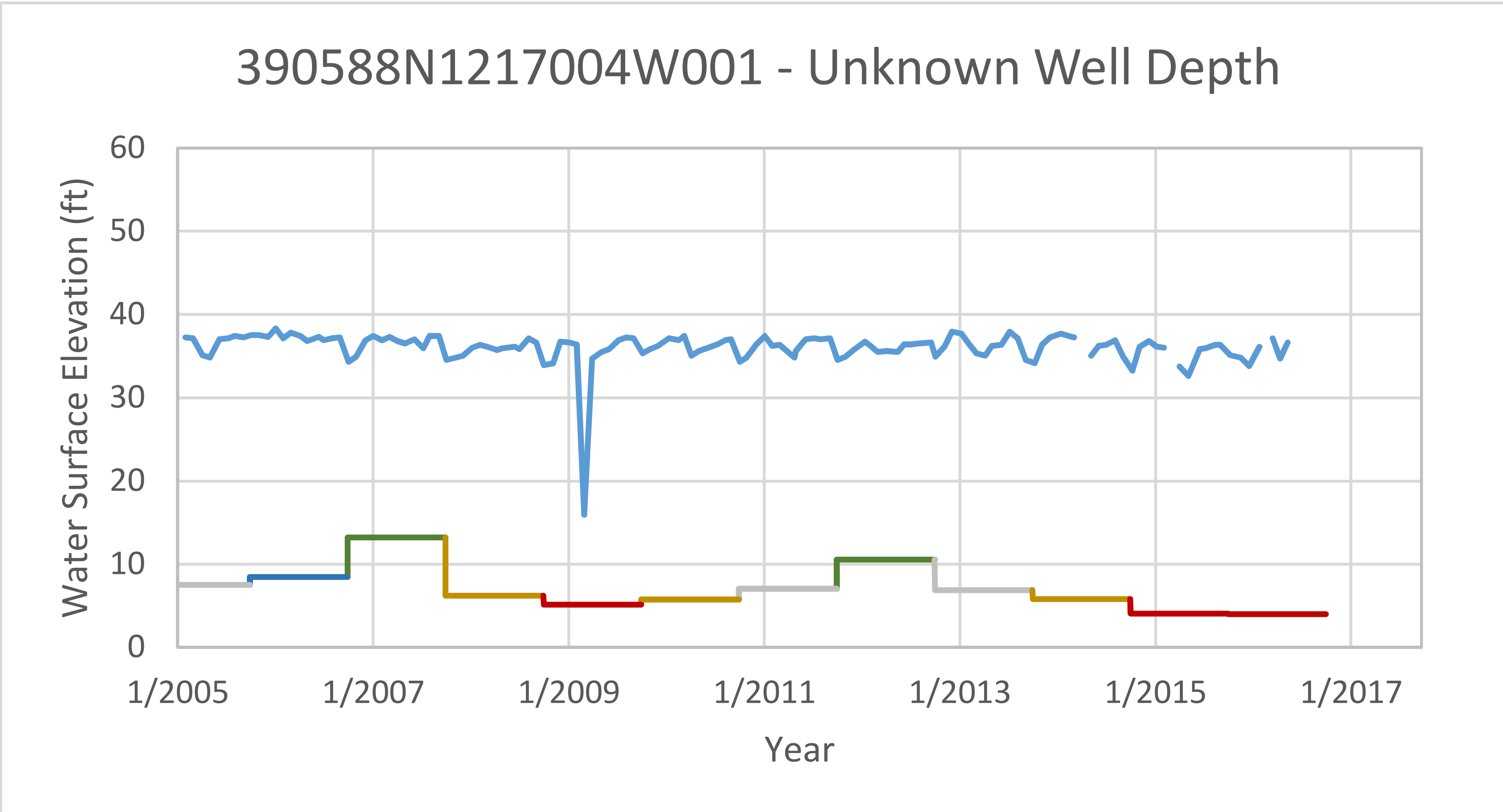

390234N1216478W001 - Unknown Well Depth
Water Surface Elevation (ft)
0
10
20
30
40
50
60
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year



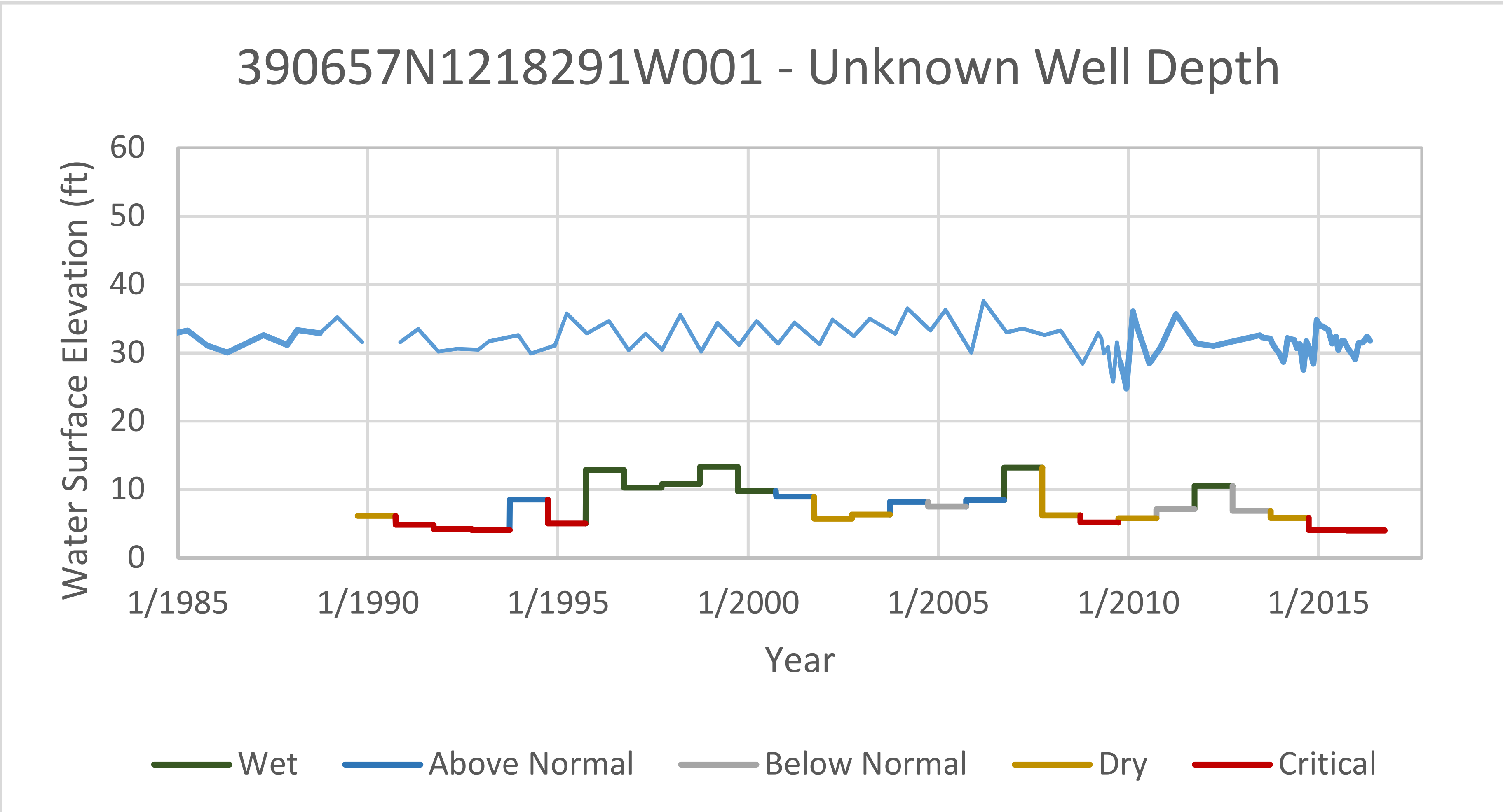
390245N1216796W001 - Unknown Well Depth
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year



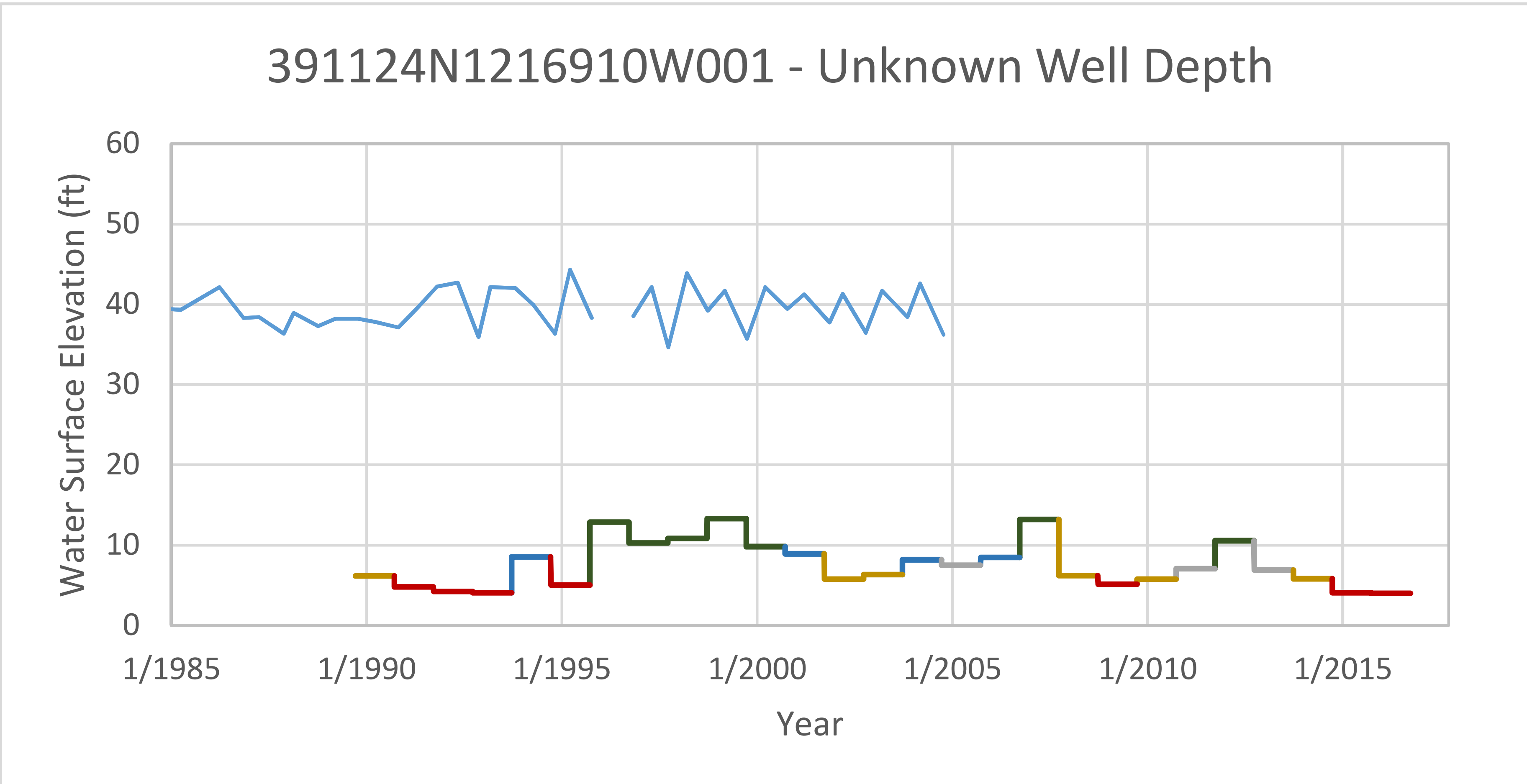
390524N1216249W001 - Unknown Well Depth
Water Surface Elevation (ft)
0
10
20
30
40
50
60
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year



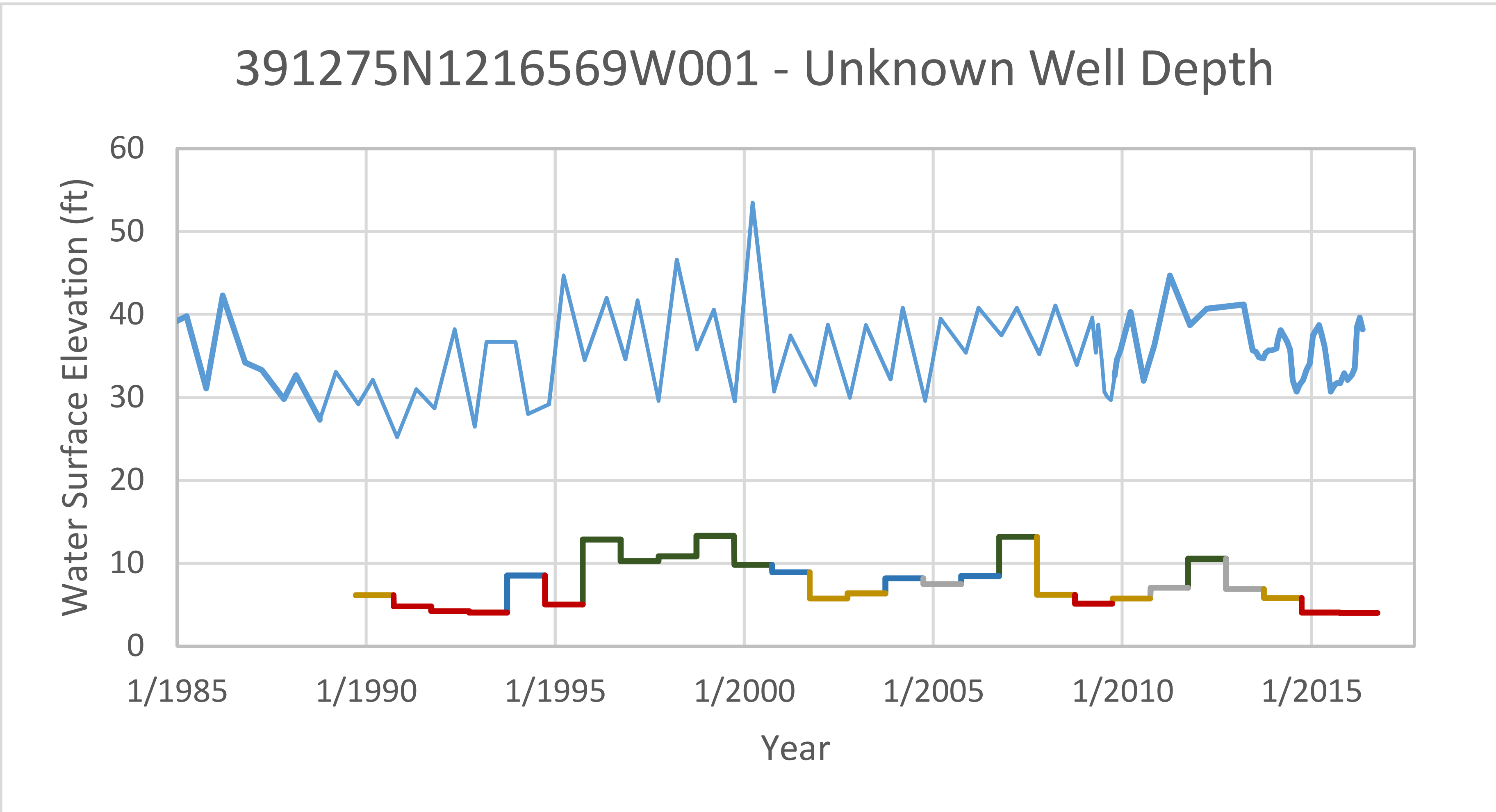
390588N1217004W001 - Unknown Well Depth
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2005
1/2007
1/2009
1/2011
1/2013
1/2015
1/2017
Year

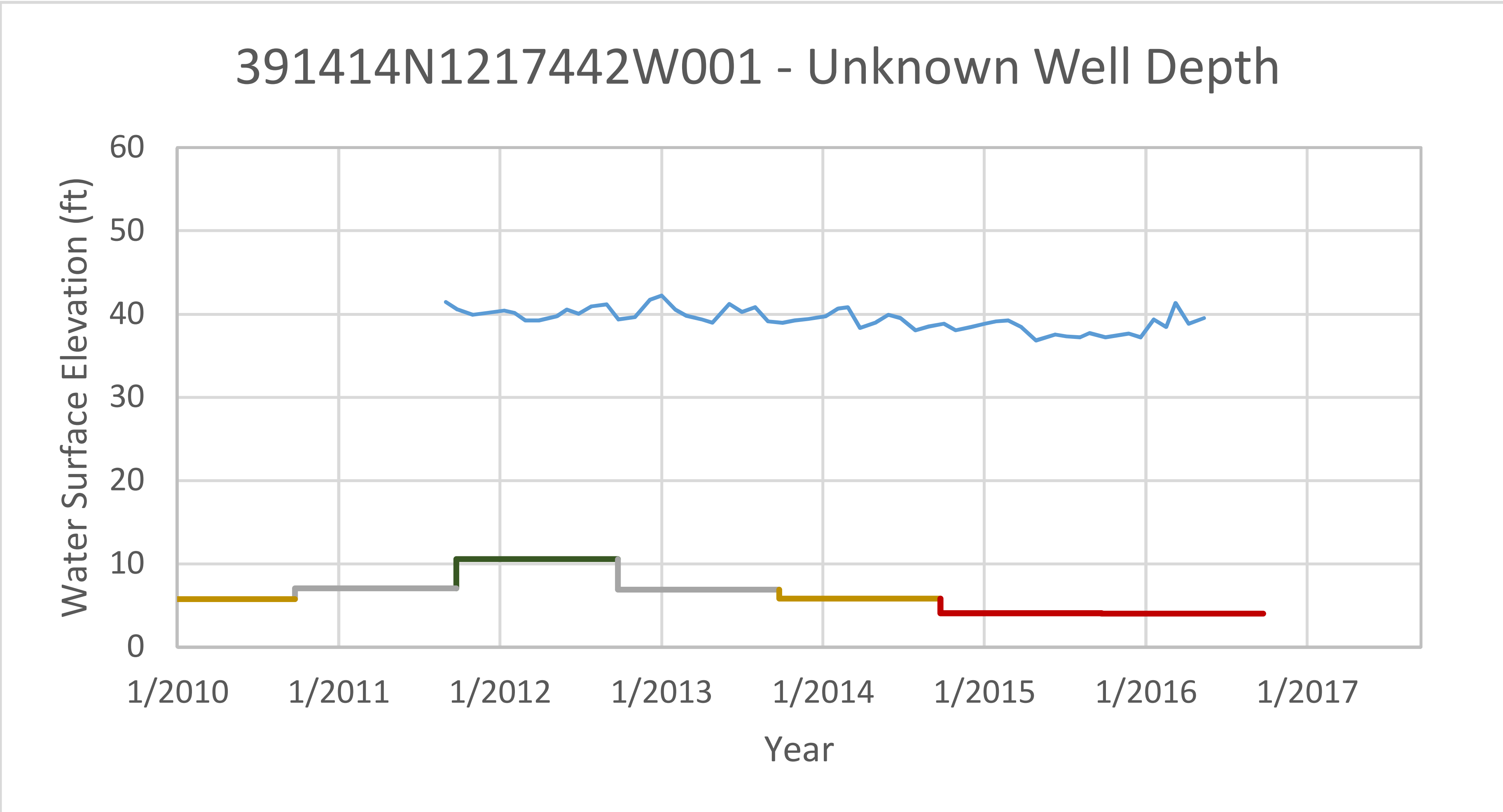


390657N1218291W001 - Unknown Well Depth
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year
Wet
Above Normal
Below Normal
Dry
Critical

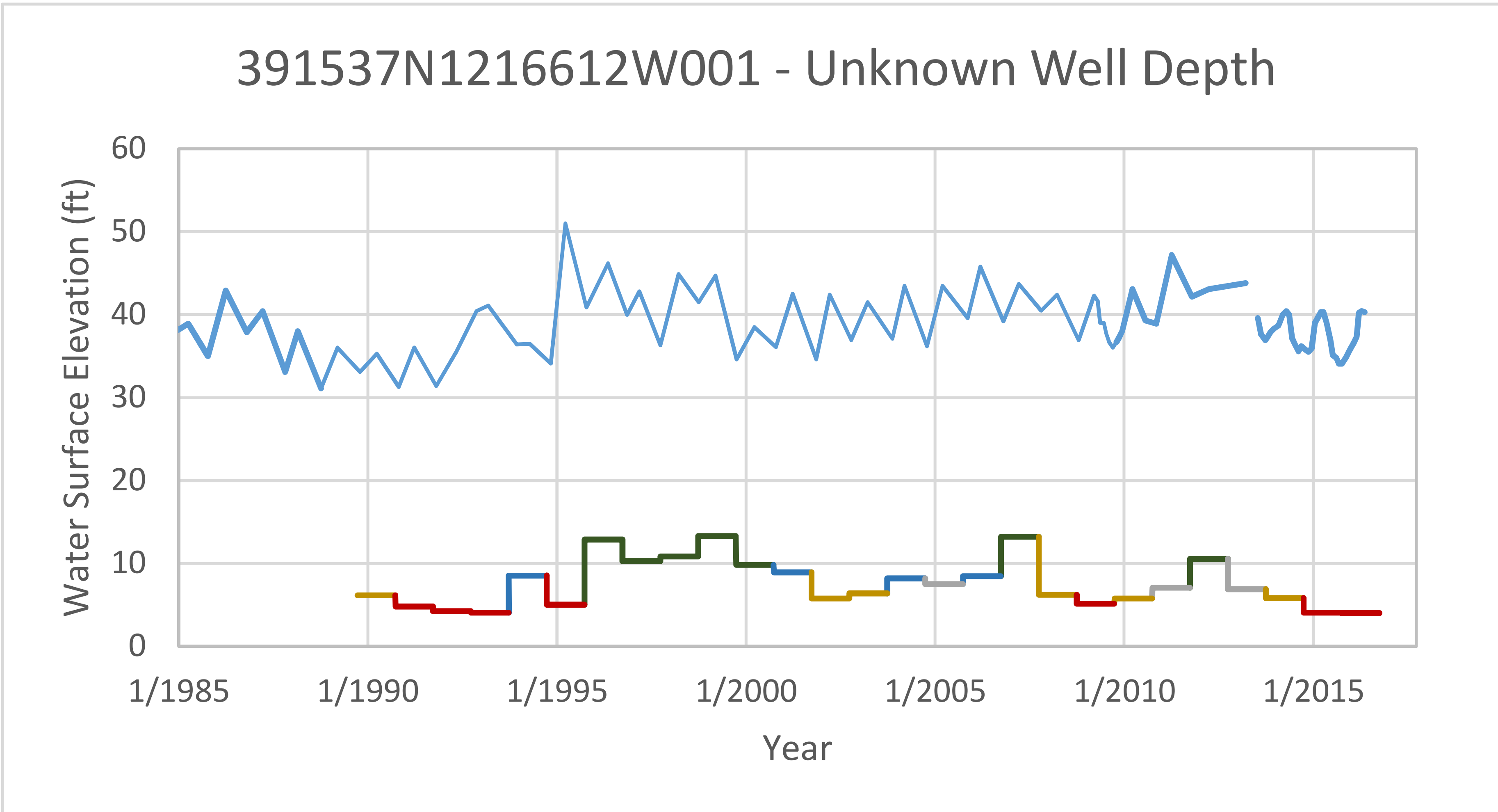


391124N1216910W001 - Unknown Well Depth
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

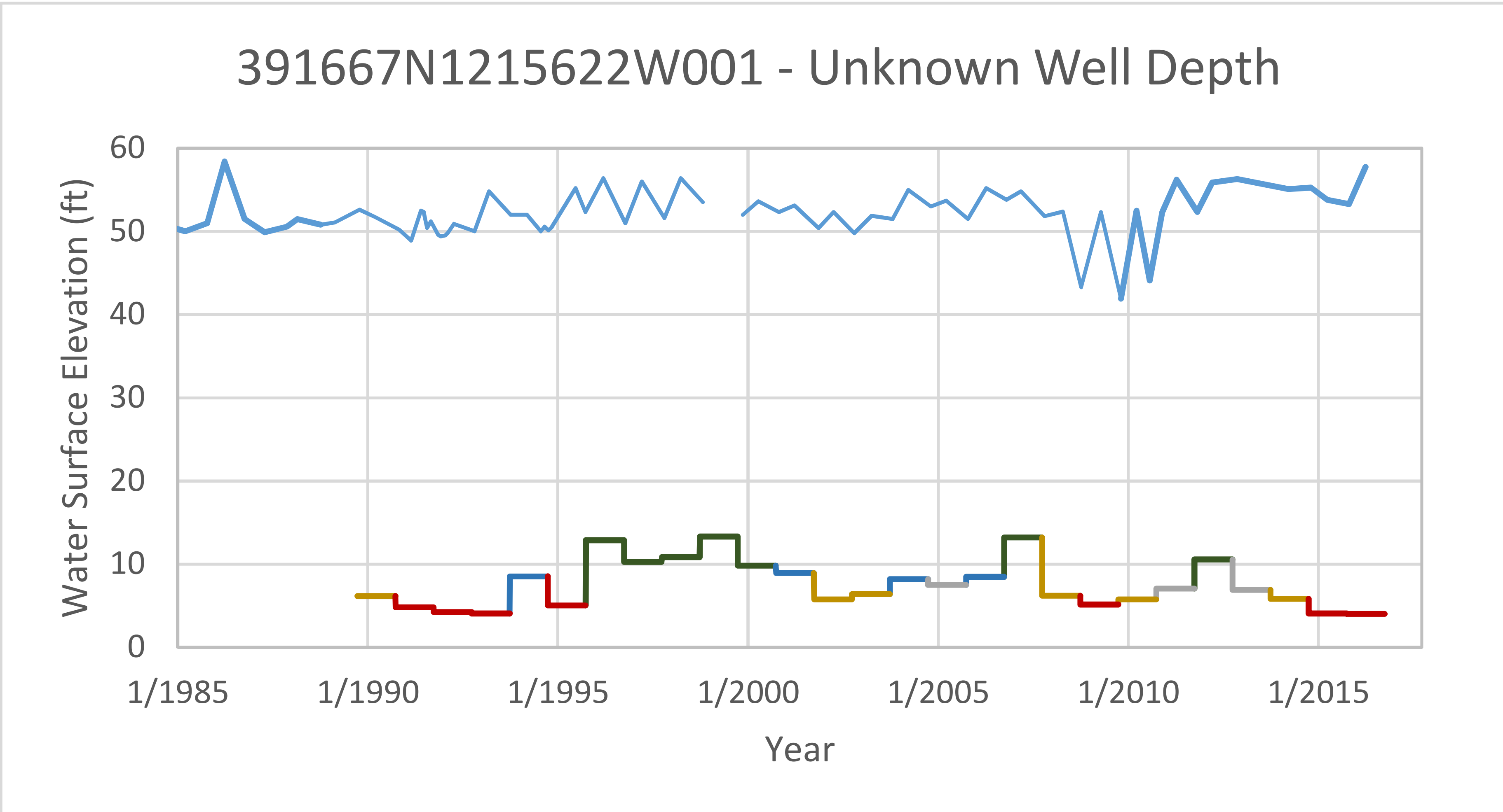

391275N1216569W001 - Unknown Well Depth
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year



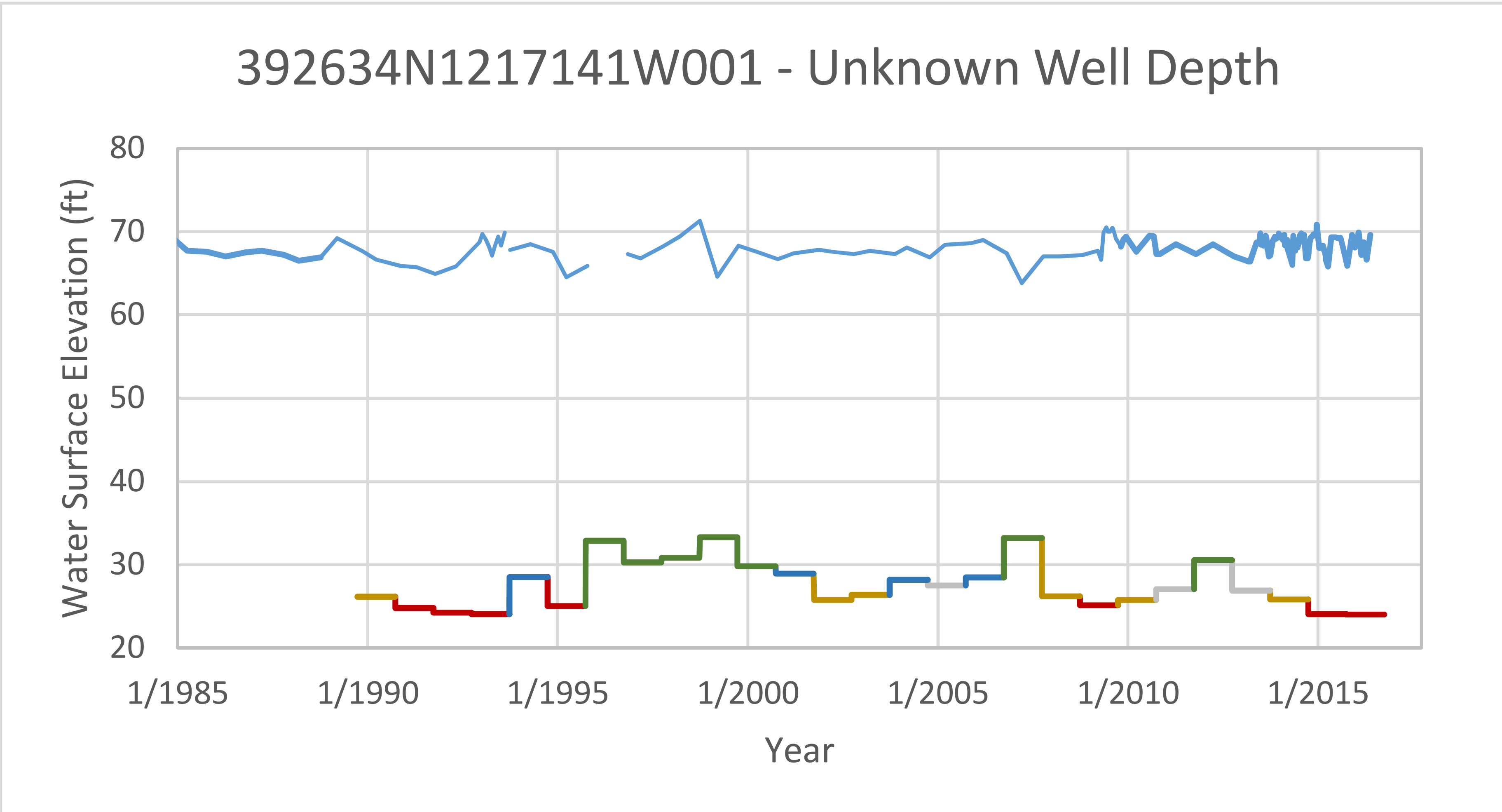
391414N1217442W001 - Unknown Well Depth
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
1/2017
Year



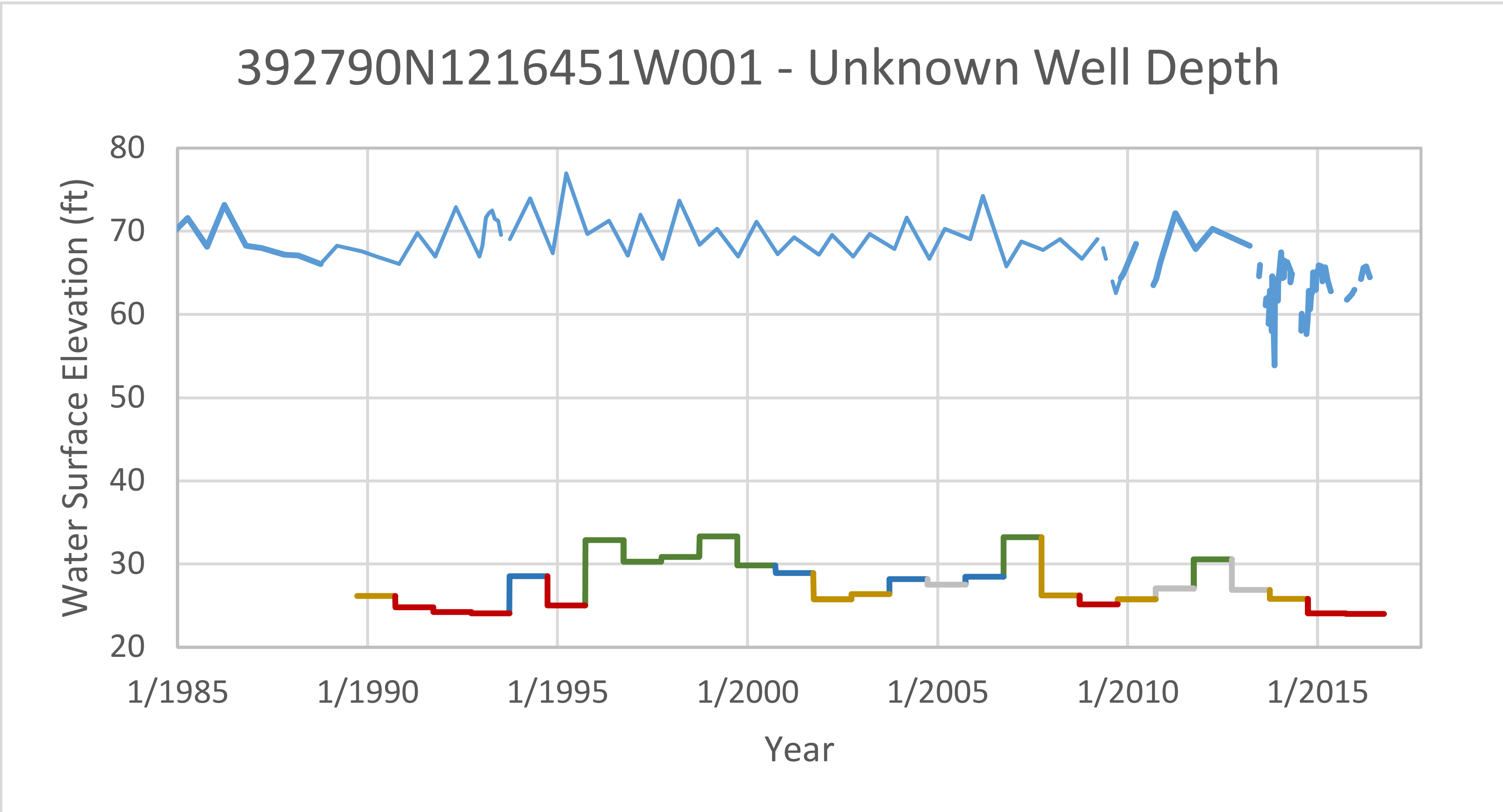
391537N1216612W001 - Unknown Well Depth
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

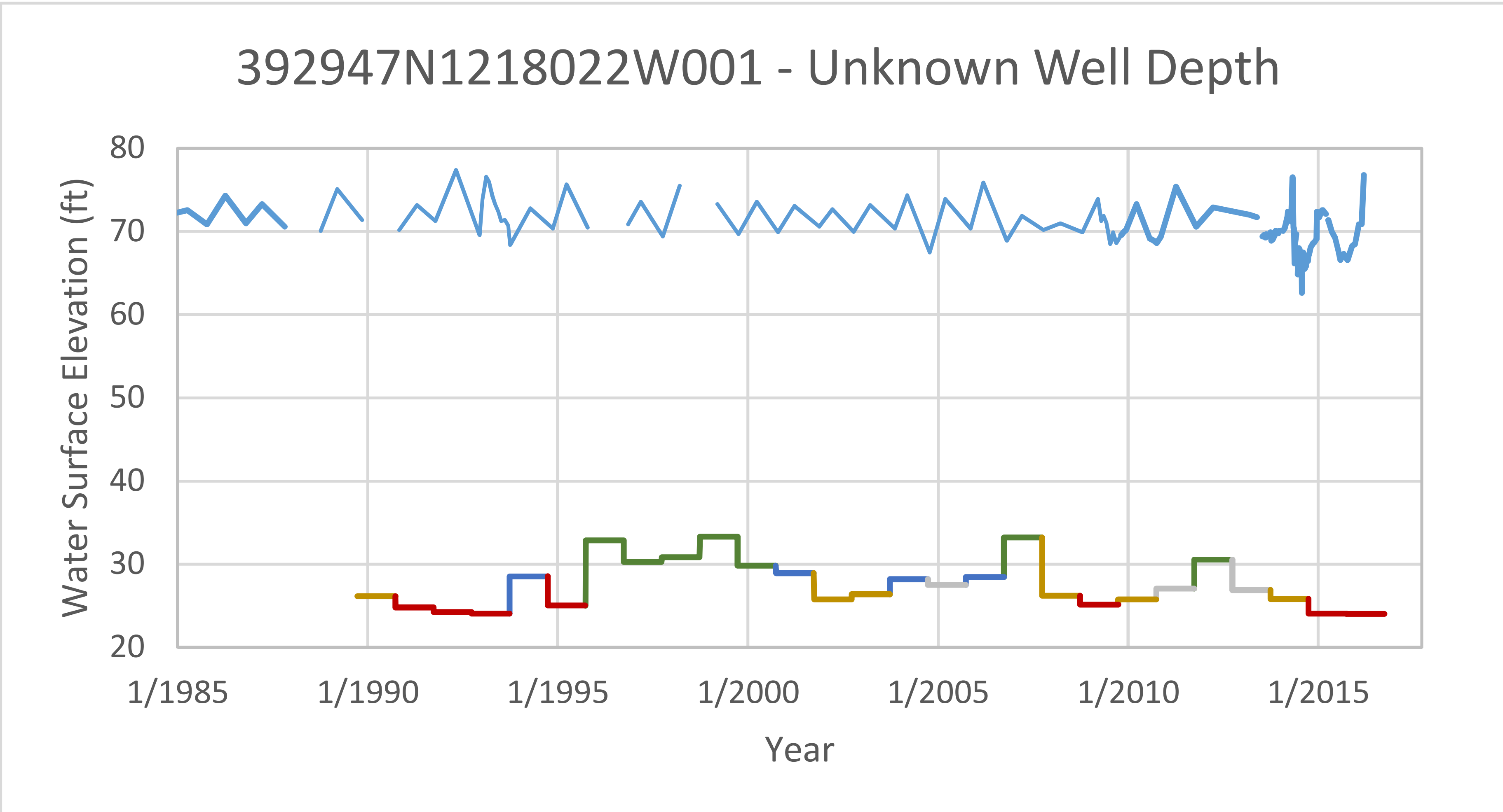


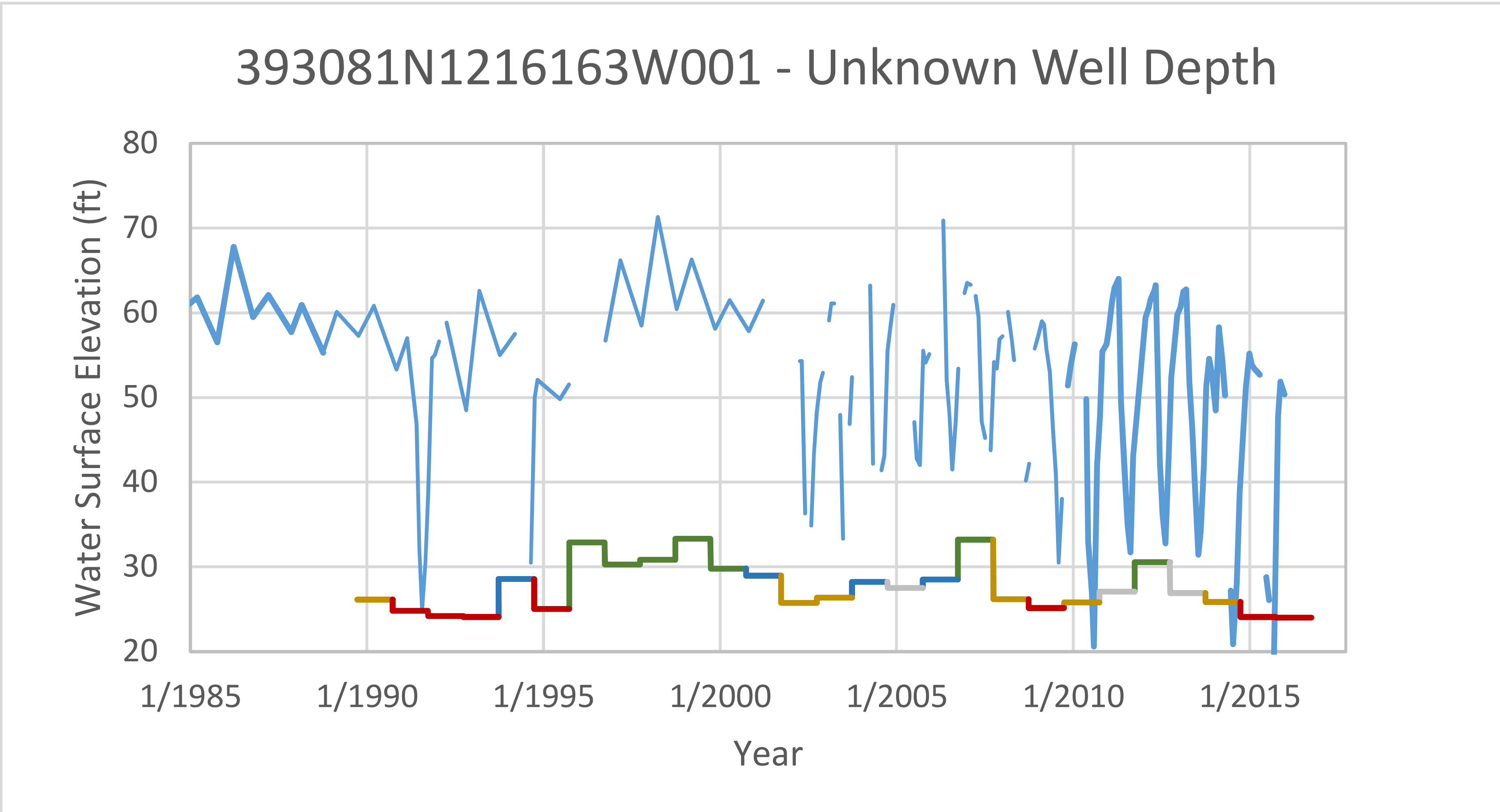
391667N1215622W001 - Unknown Well Depth
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year



392634N1217141W001 - Unknown Well Depth
Water Surface Elevation (ft)
80
70
60
50
40
30
20
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year


392790N1216451W001 - Unknown Well Depth
Water Surface Elevation (ft)
80
70
60
50
40
30
20
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year


392947N1218022W001 - Unknown Well Depth
Water Surface Elevation (ft)
80
70
60
50
40
30
20
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year


393081N1216163W001 - Unknown Well Depth
Water Surface Elevation (ft)
80
70
60
50
40
30
20
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

APPENDIX J
GROUNDWATER LEVEL TRENDS

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SHALLOW AQUIFER HYDROGRAPHS

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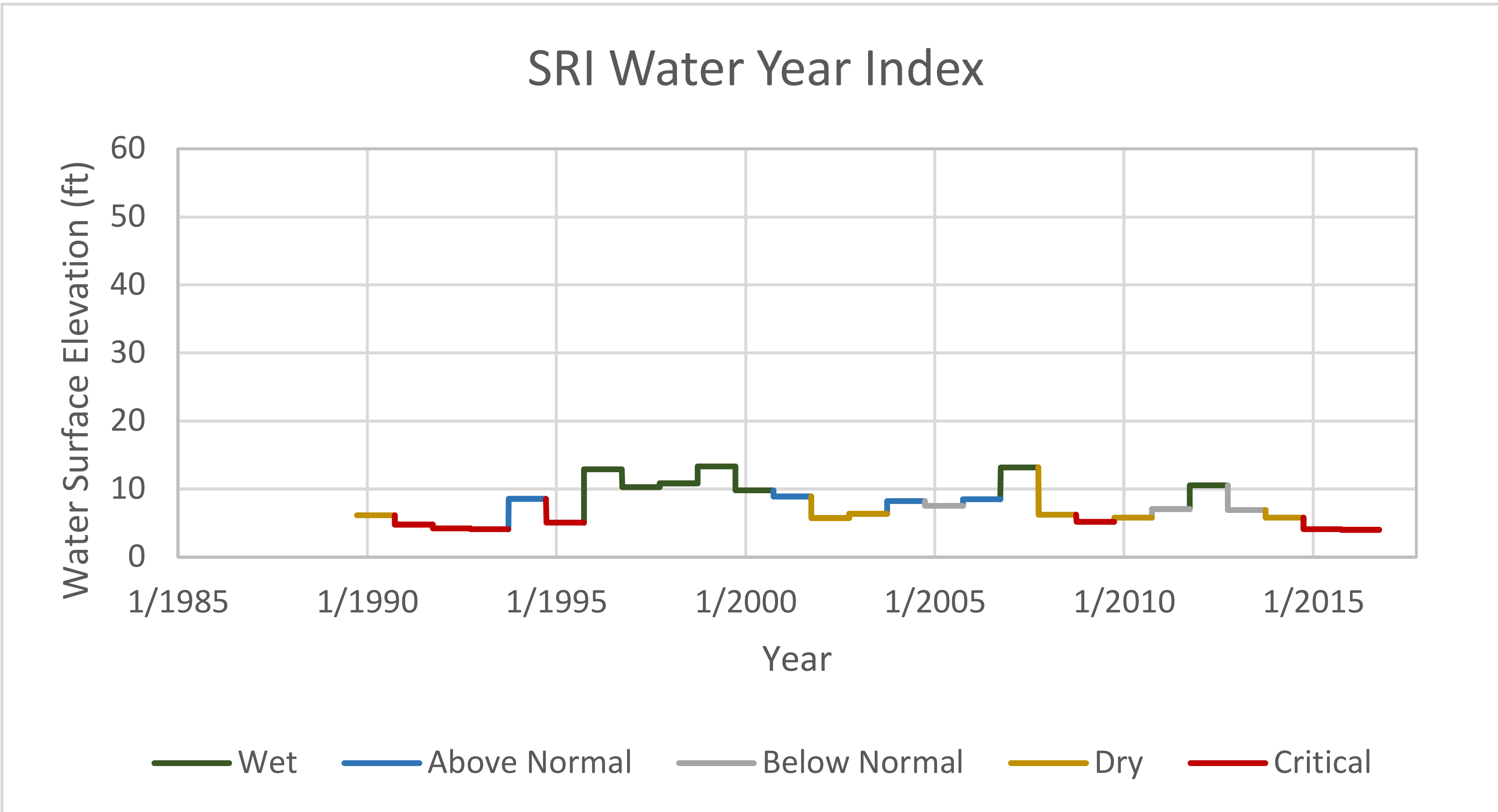
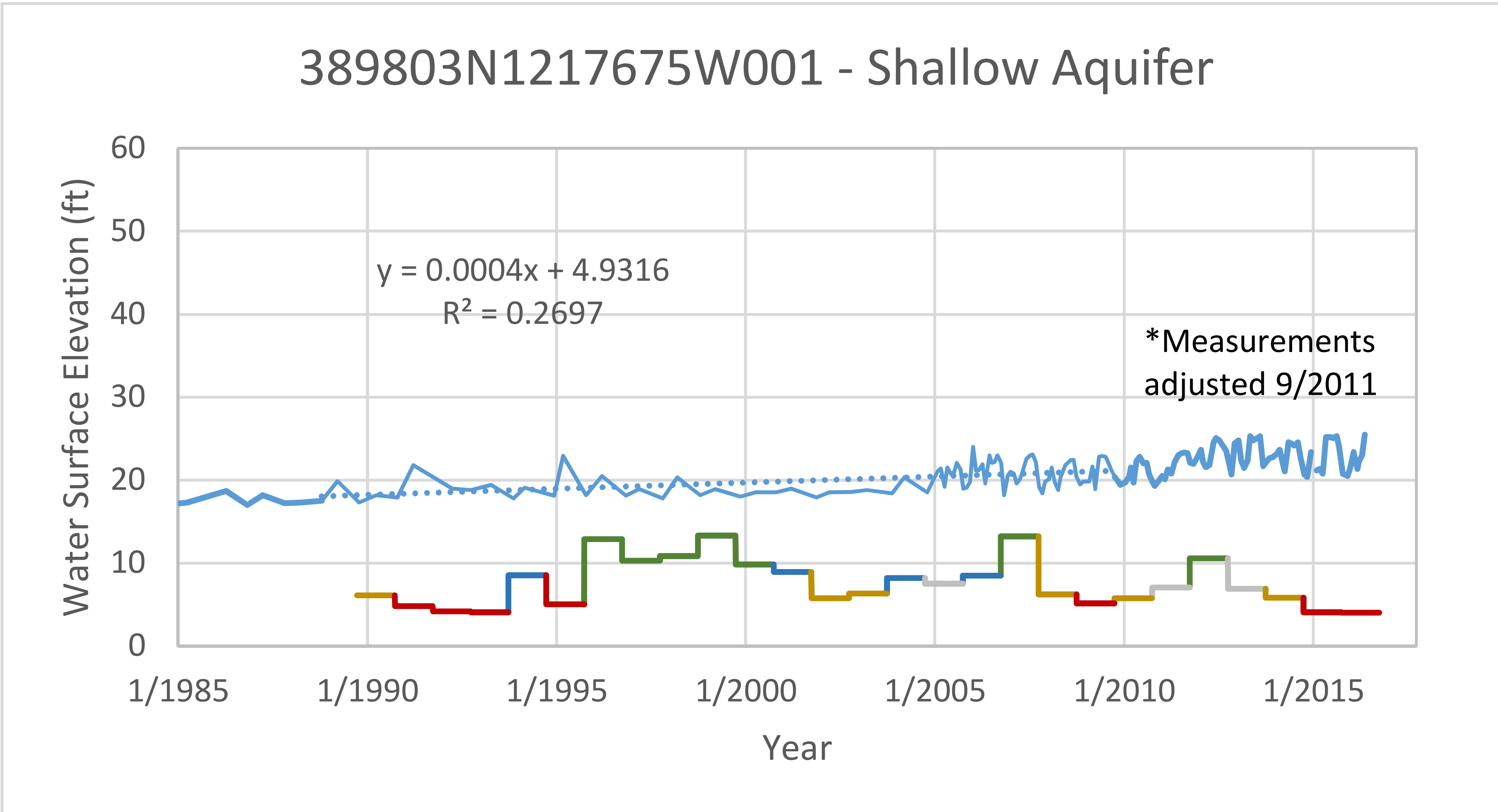
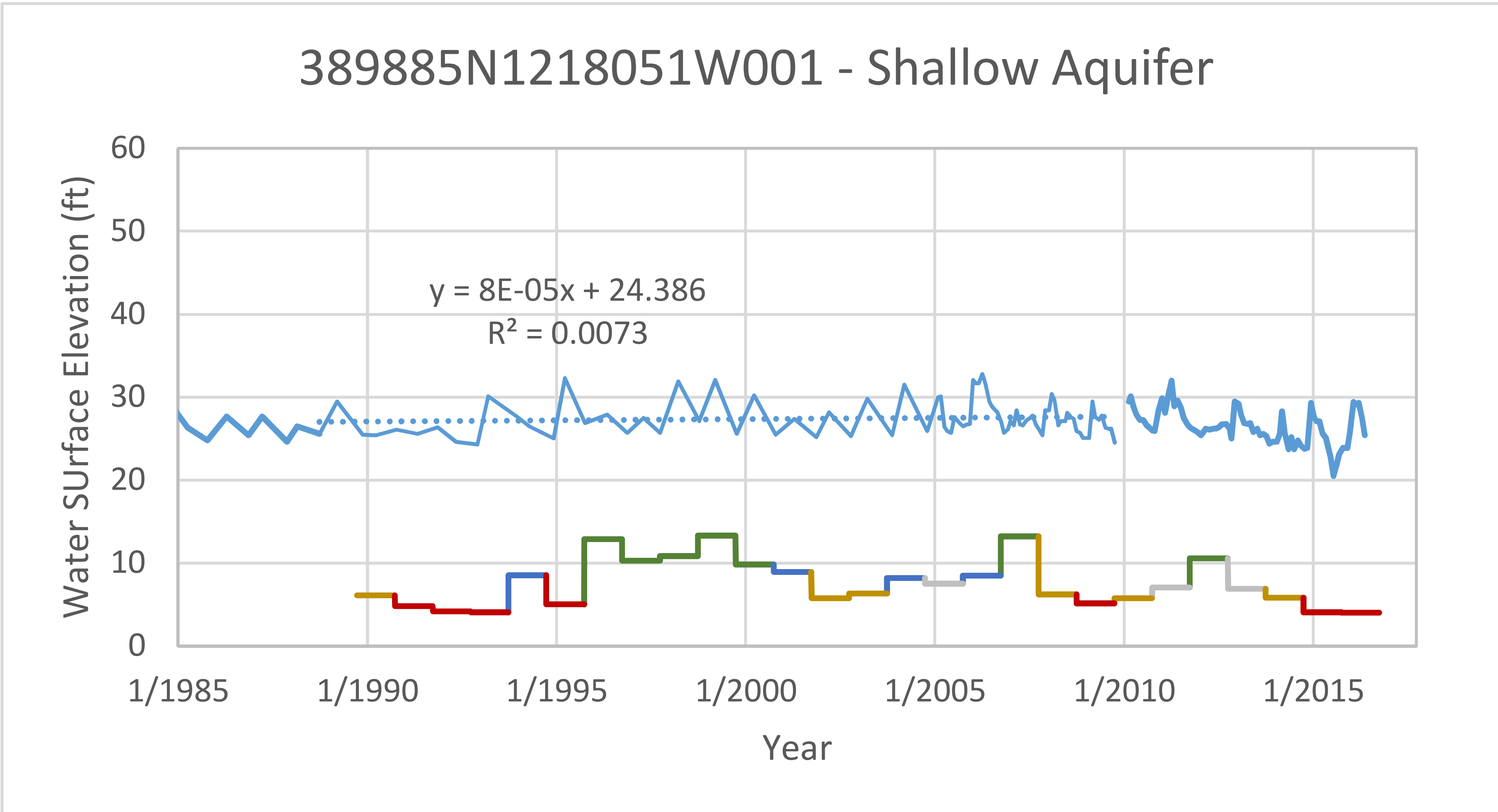
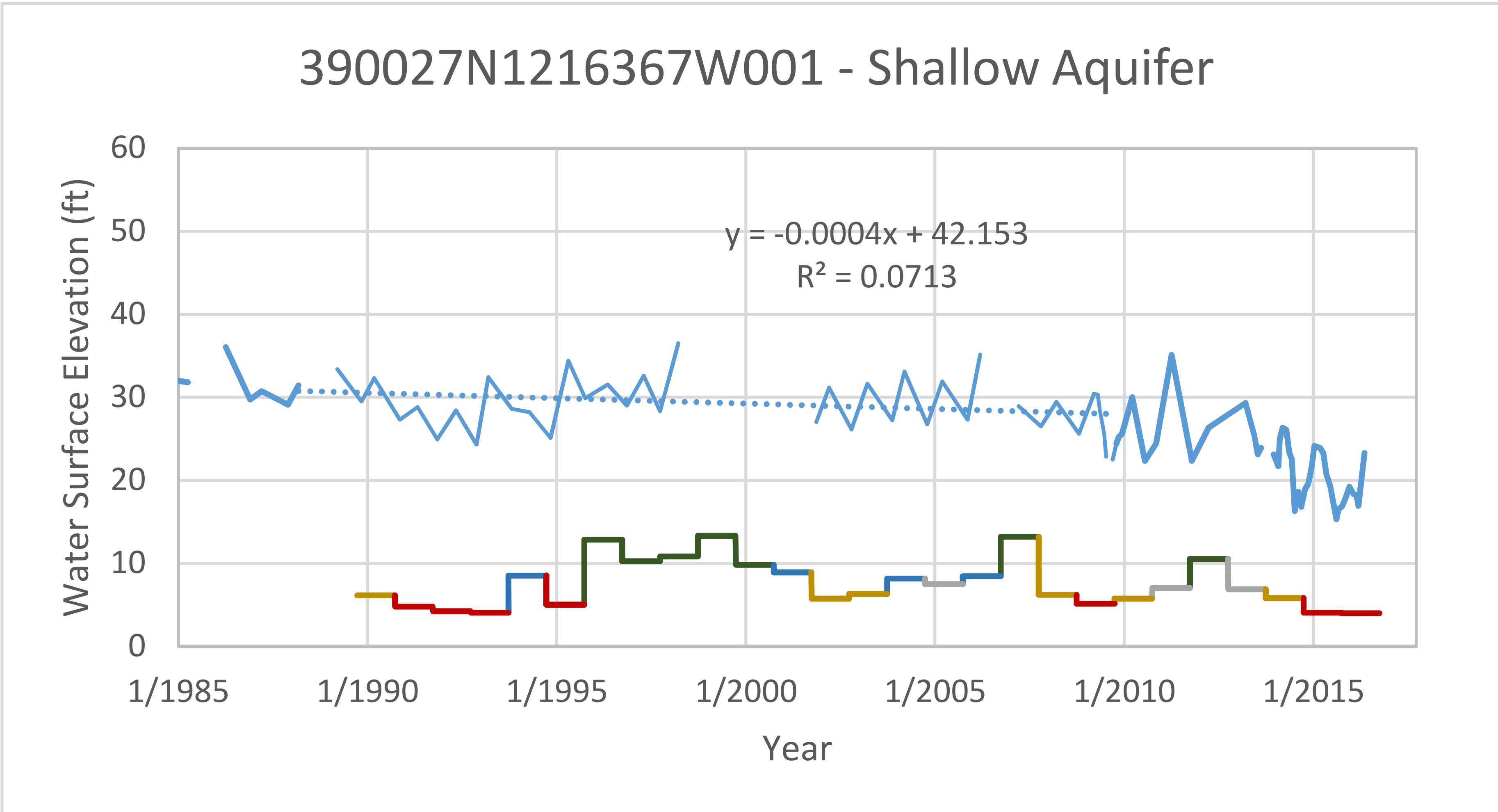


SRI Water Year Index
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year
Wet
Above Normal
Below Normal
Dry
Critical

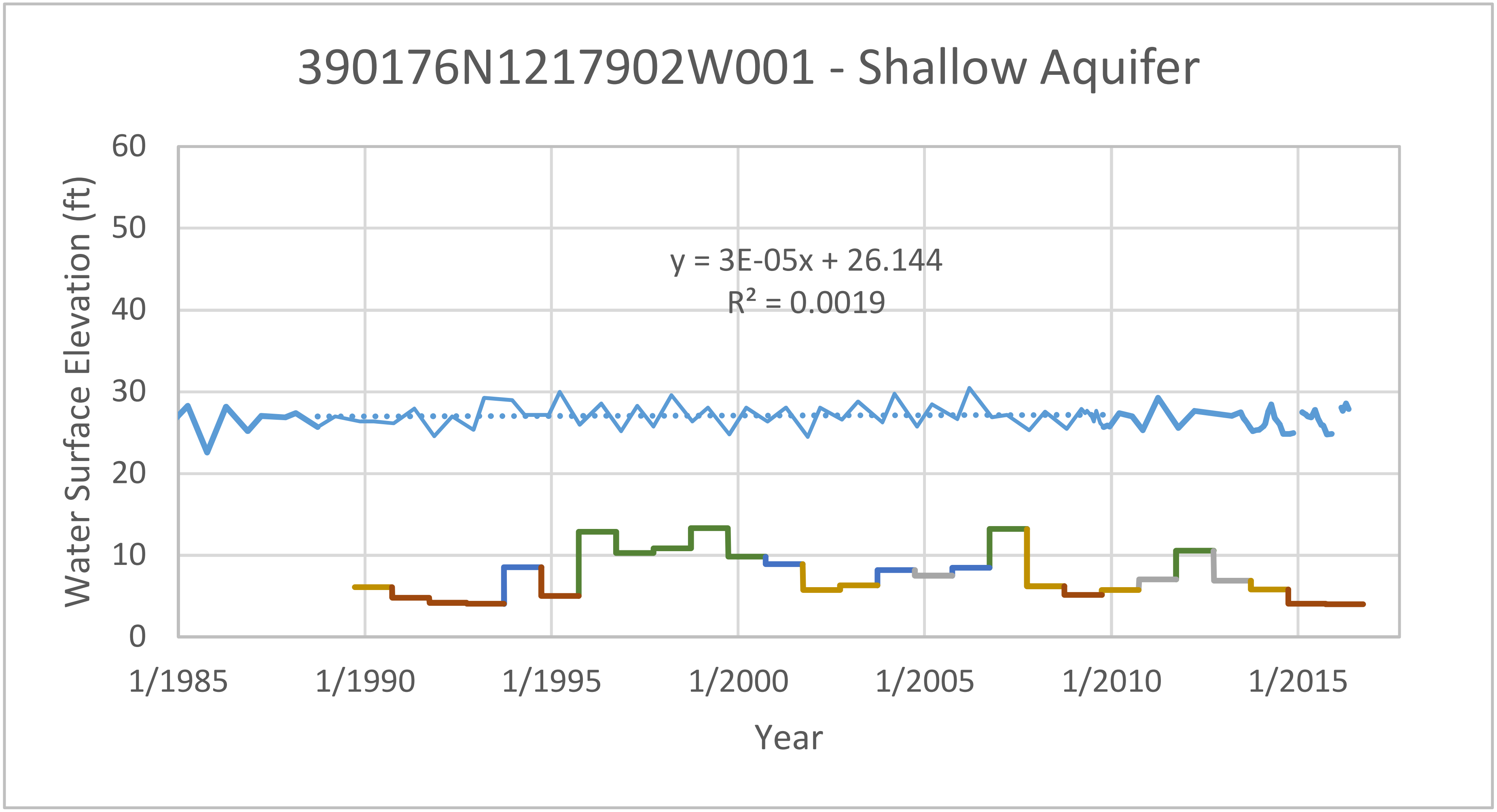


389803N1217675W001 - Shallow Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
y = 0.0004x + 4.9316
R² = 0.2697
*Measurements
adjusted 9/2011
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

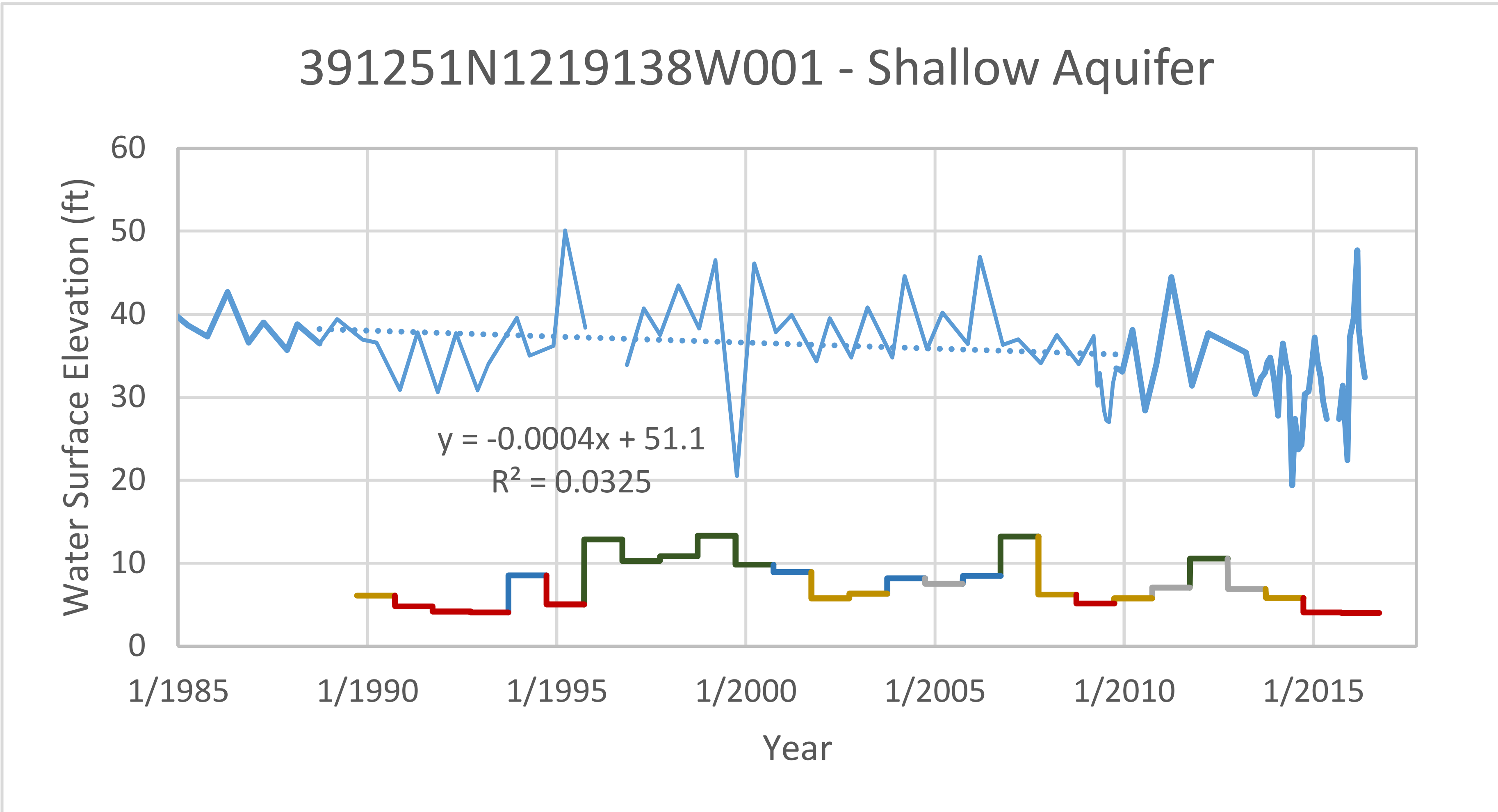

389885N1218051W001 - Shallow Aquifer
Water SUrface Elevation (ft)
60
50
40
30
20
10
0
y = 8E-05x + 24.386
R² = 0.0073
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

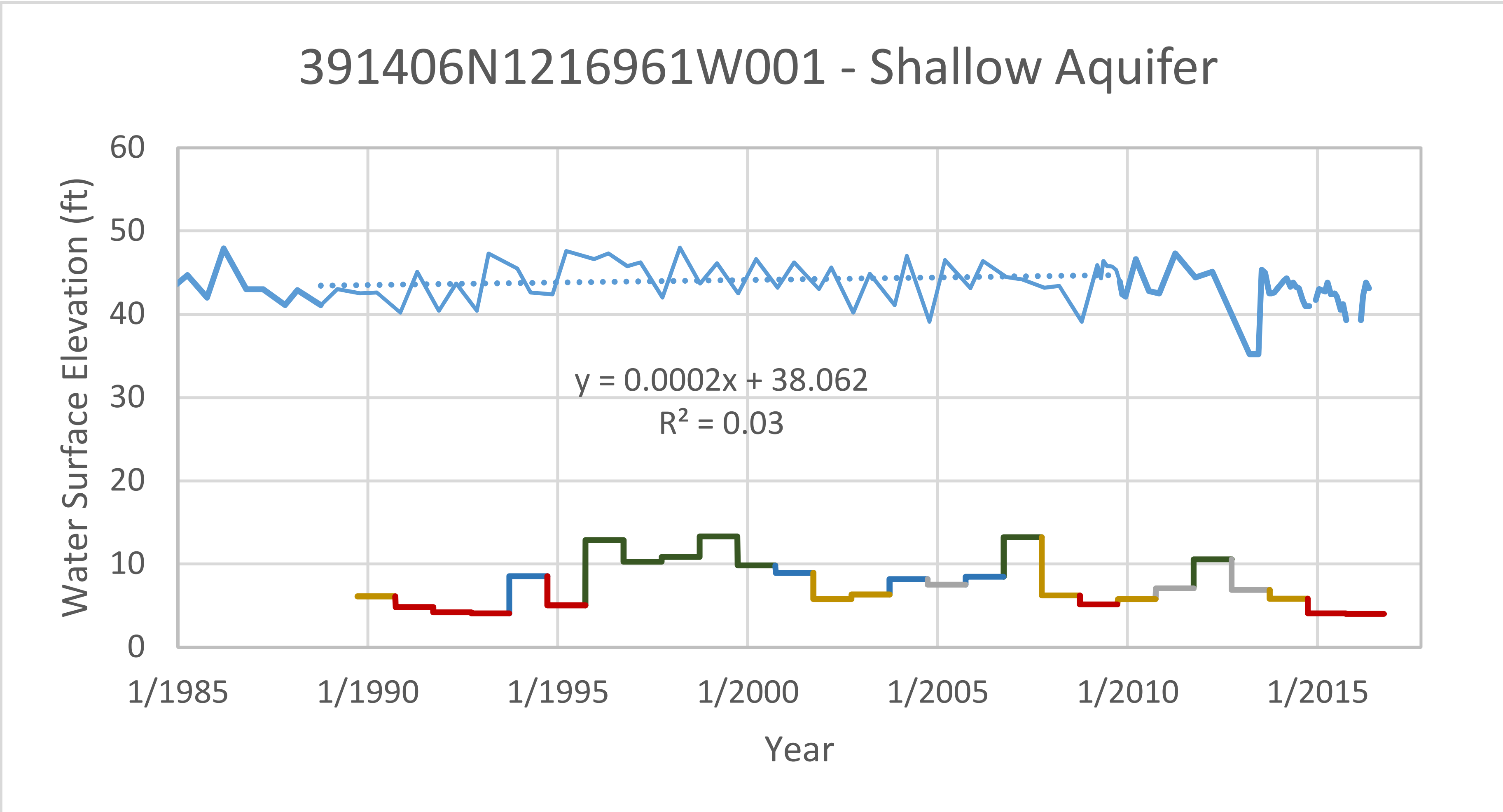


390027N1216367W001 - Shallow Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
y = -0.0004x + 42.153
R² = 0.0713
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

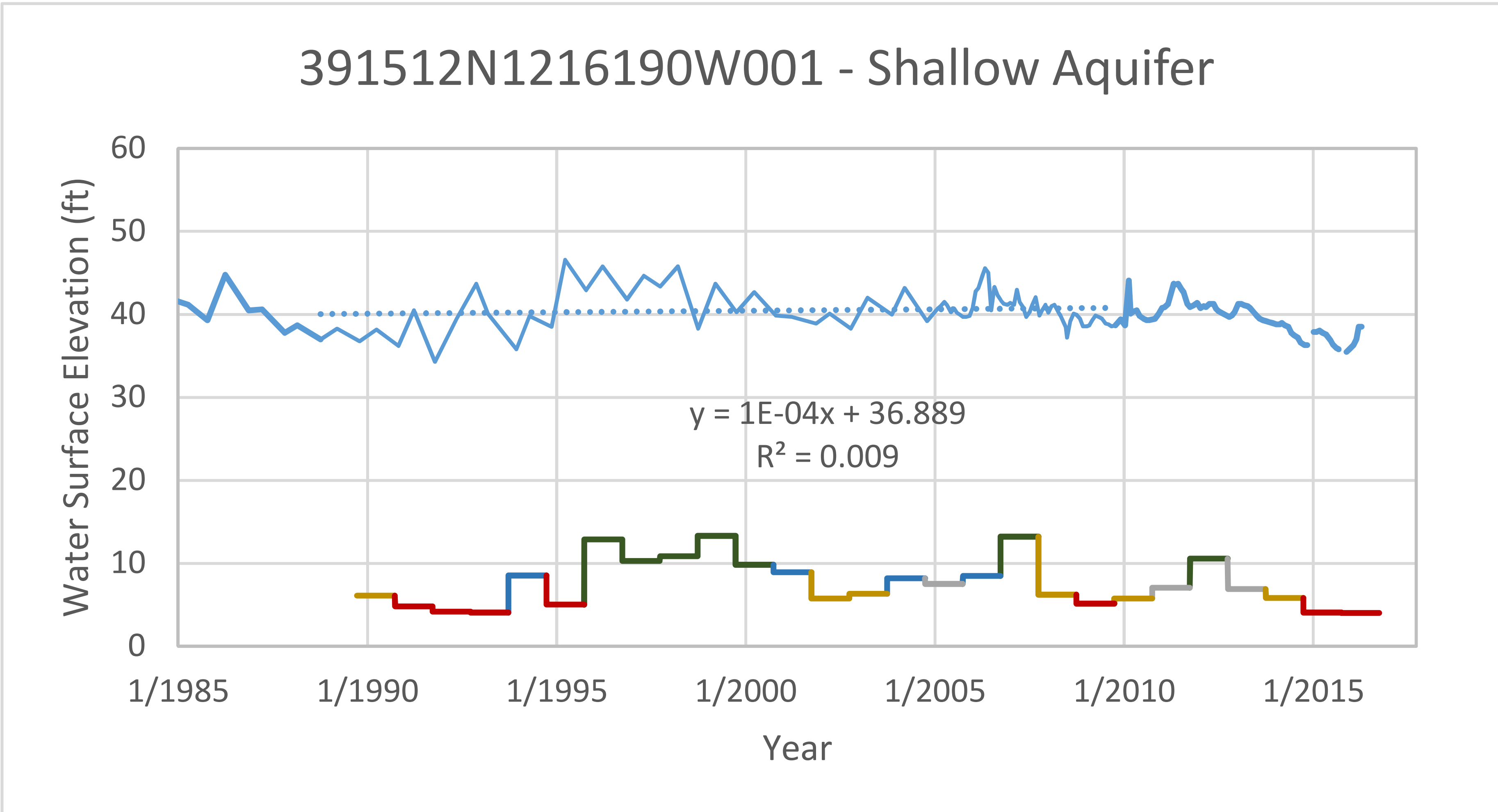


390176N1217902W001 - Shallow Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
y = 3E-05x + 26.144
R² = 0.0019
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

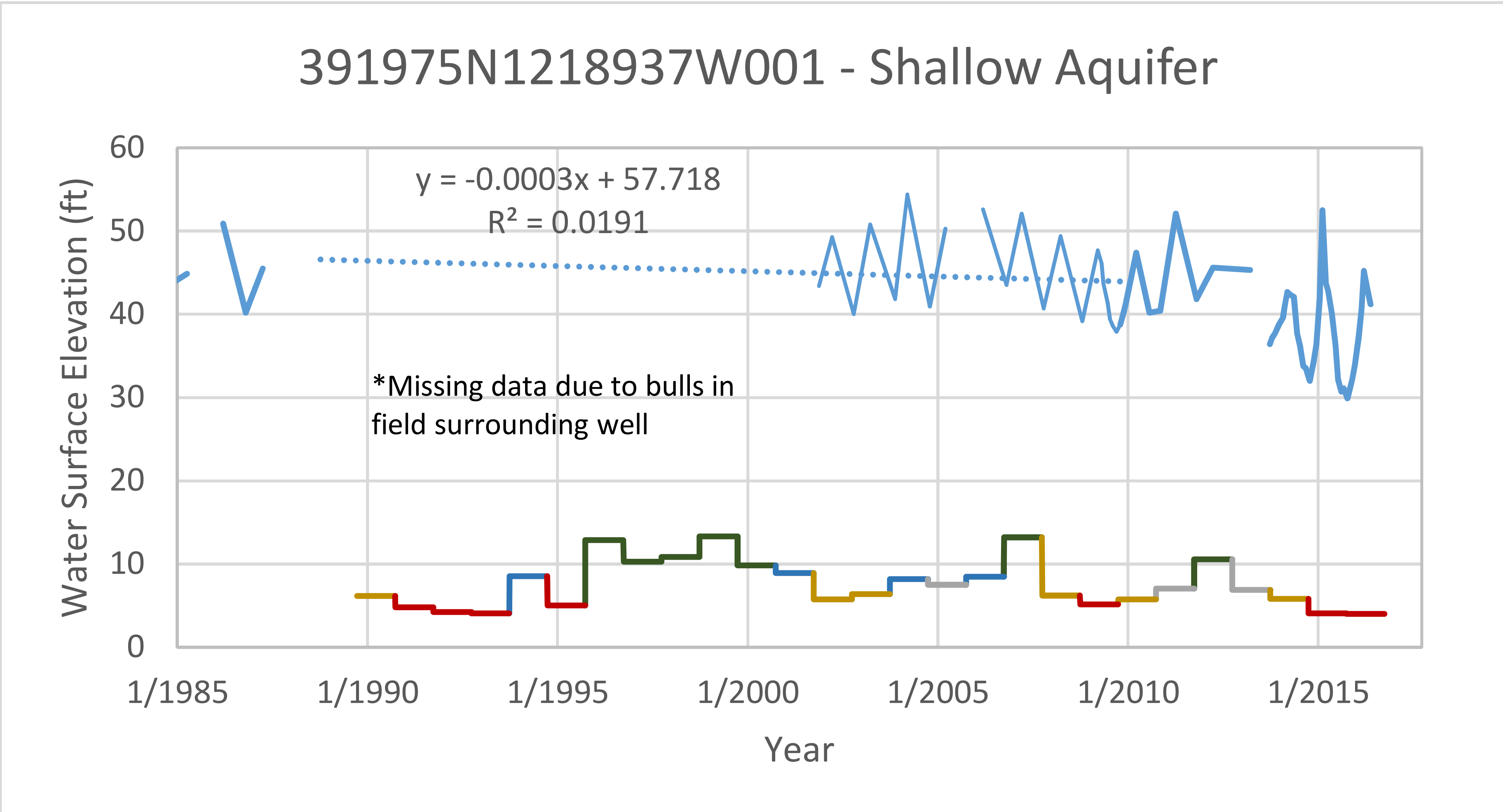

391251N1219138W001 - Shallow Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
y = -0.0004x + 51.1
R² = 0.0325
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

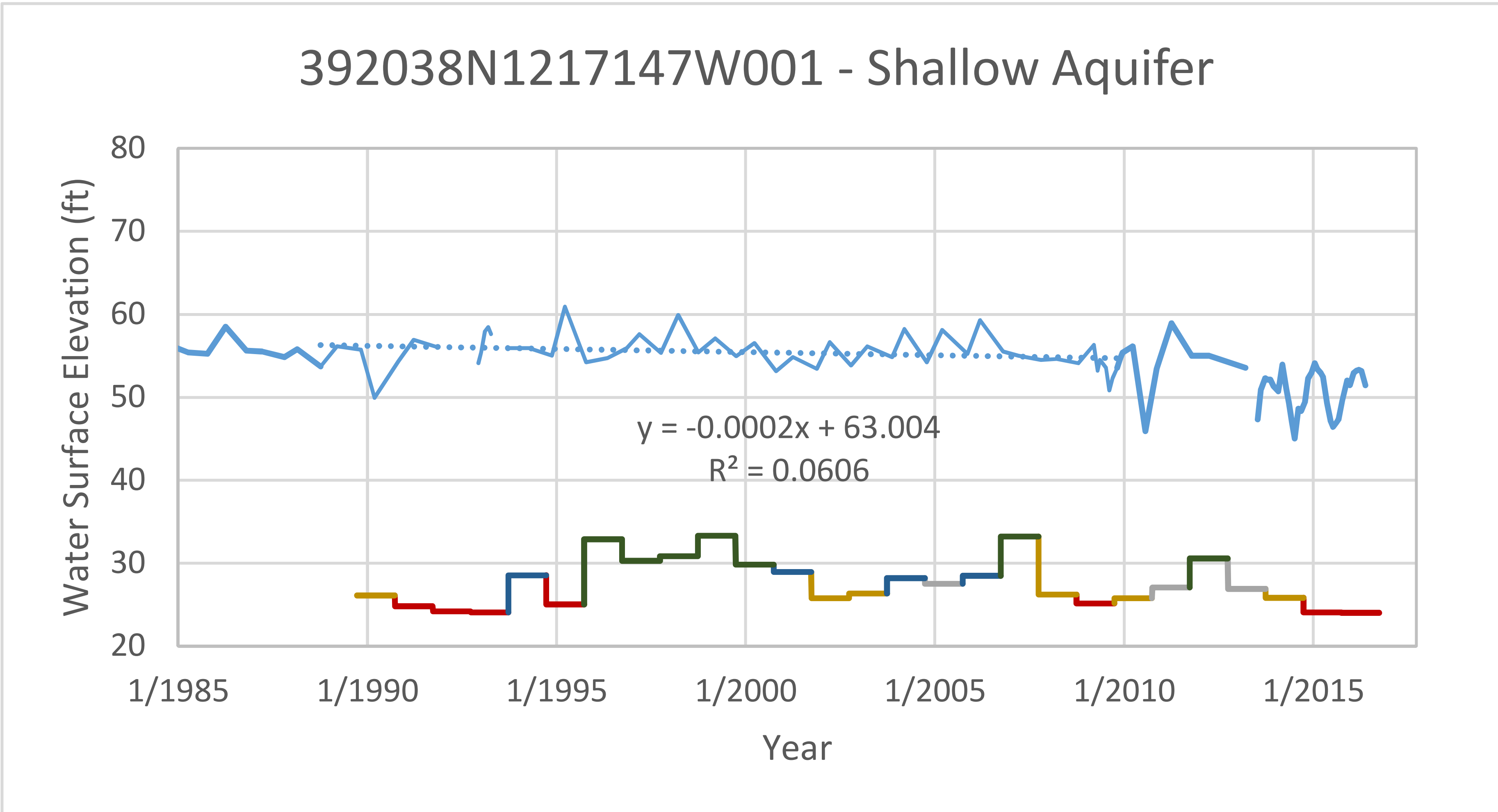


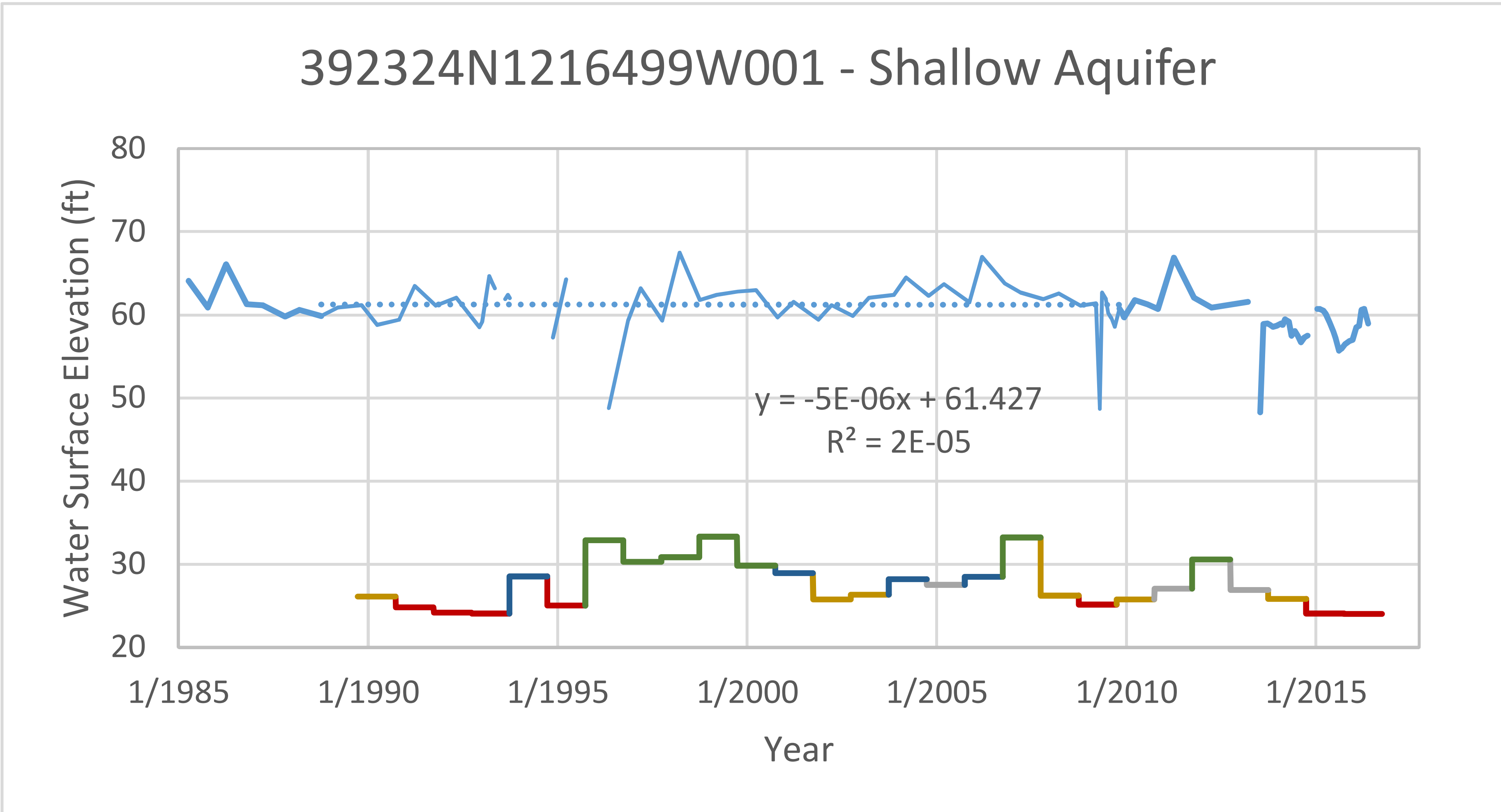
391406N1216961W001 - Shallow Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
y = 0.0002x + 38.062
R² = 0.03
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

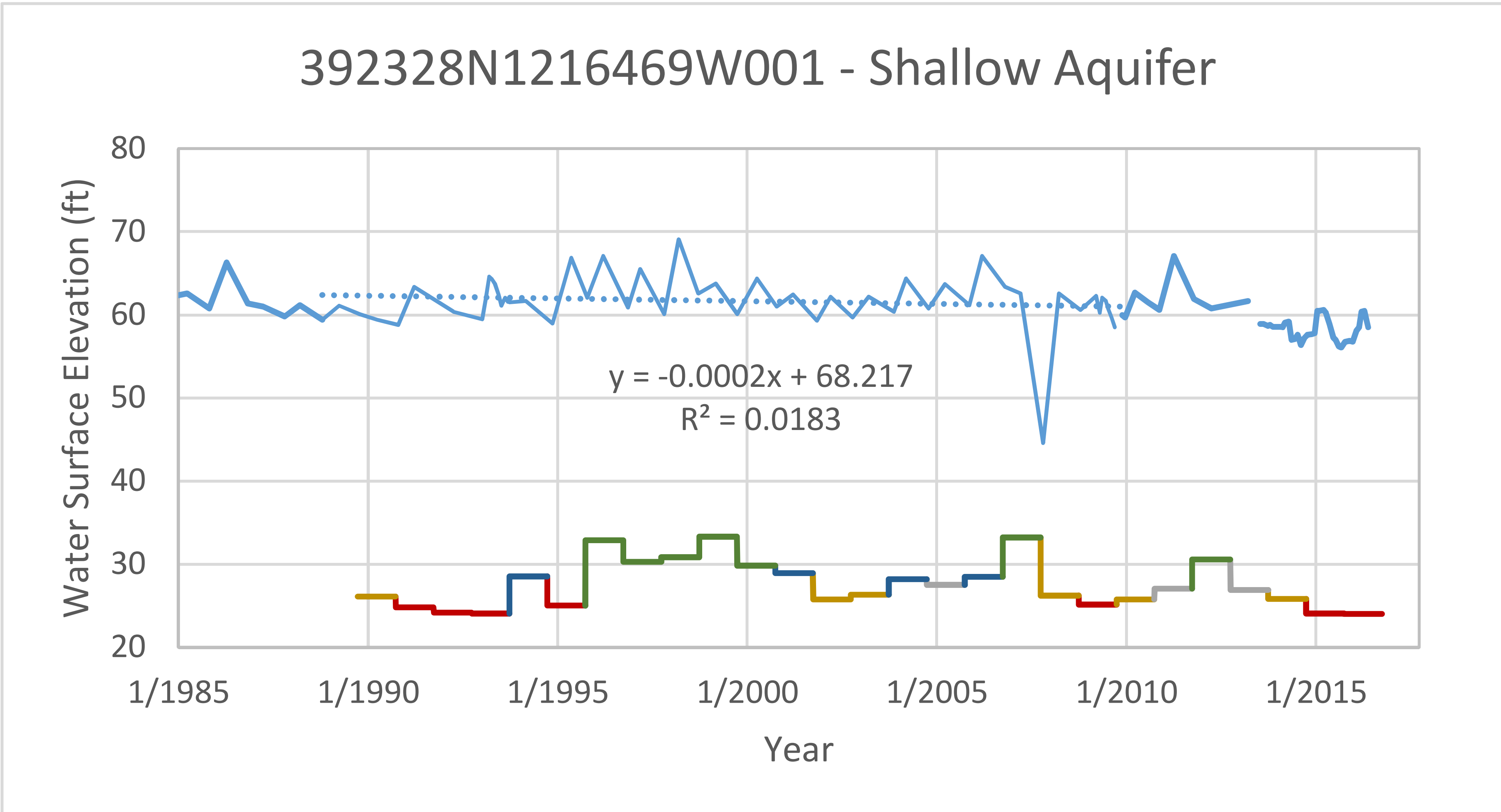


391512N1216190W001 - Shallow Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
y = 1E-04x + 36.889
R² = 0.009
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

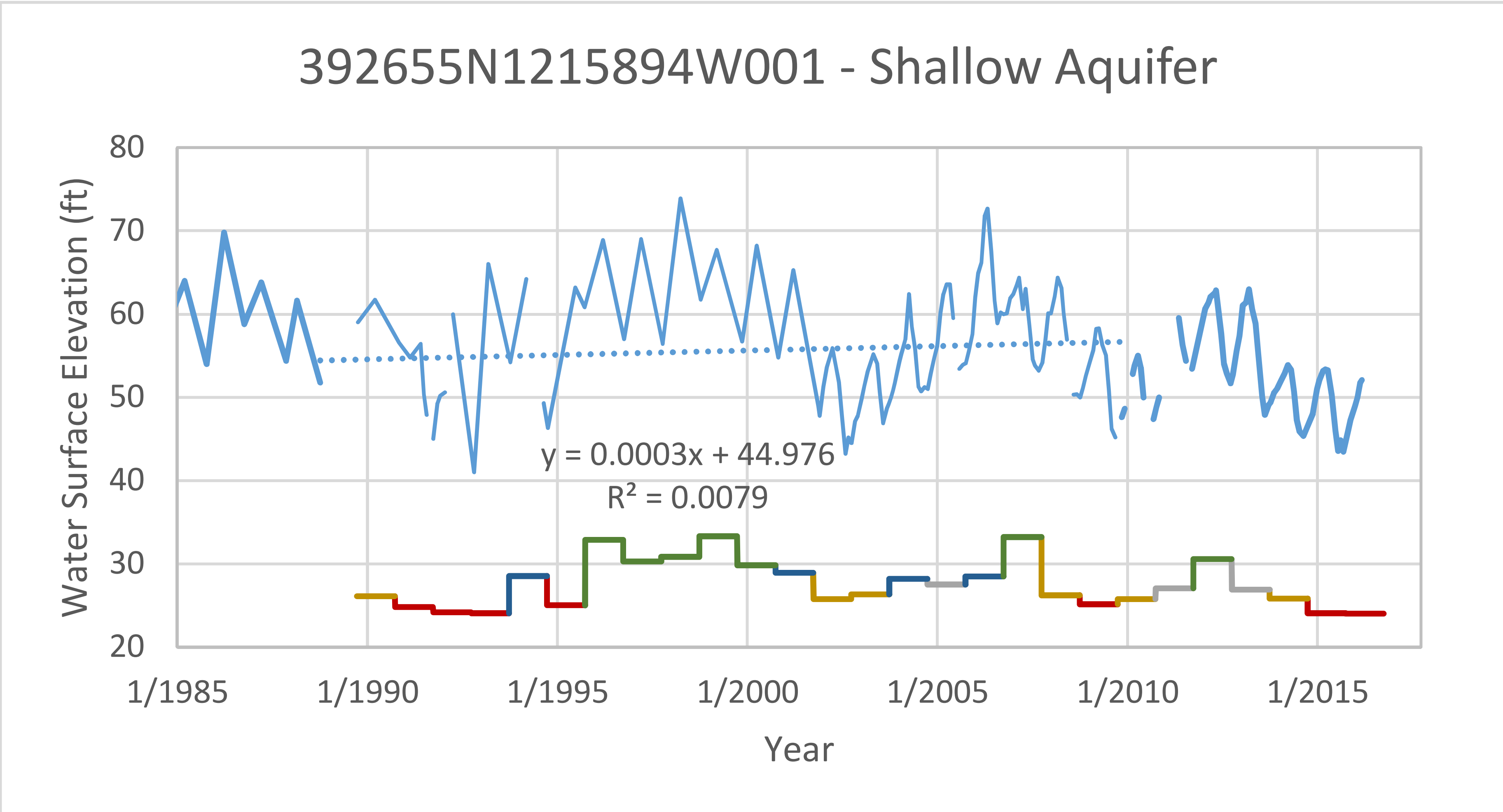

391975N1218937W001 - Shallow Aquifer
y = -0.0003x + 57.718
R² = 0.0191
*Missing data due to bulls in field surrounding well
60
50
40
30
20
10
0
Water Surface Elevation (ft)
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year


392038N1217147W001 - Shallow Aquifer
Water Surface Elevation (ft)
80
70
60
50
40
30
20
y = -0.0002x + 63.004
R² = 0.0606
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

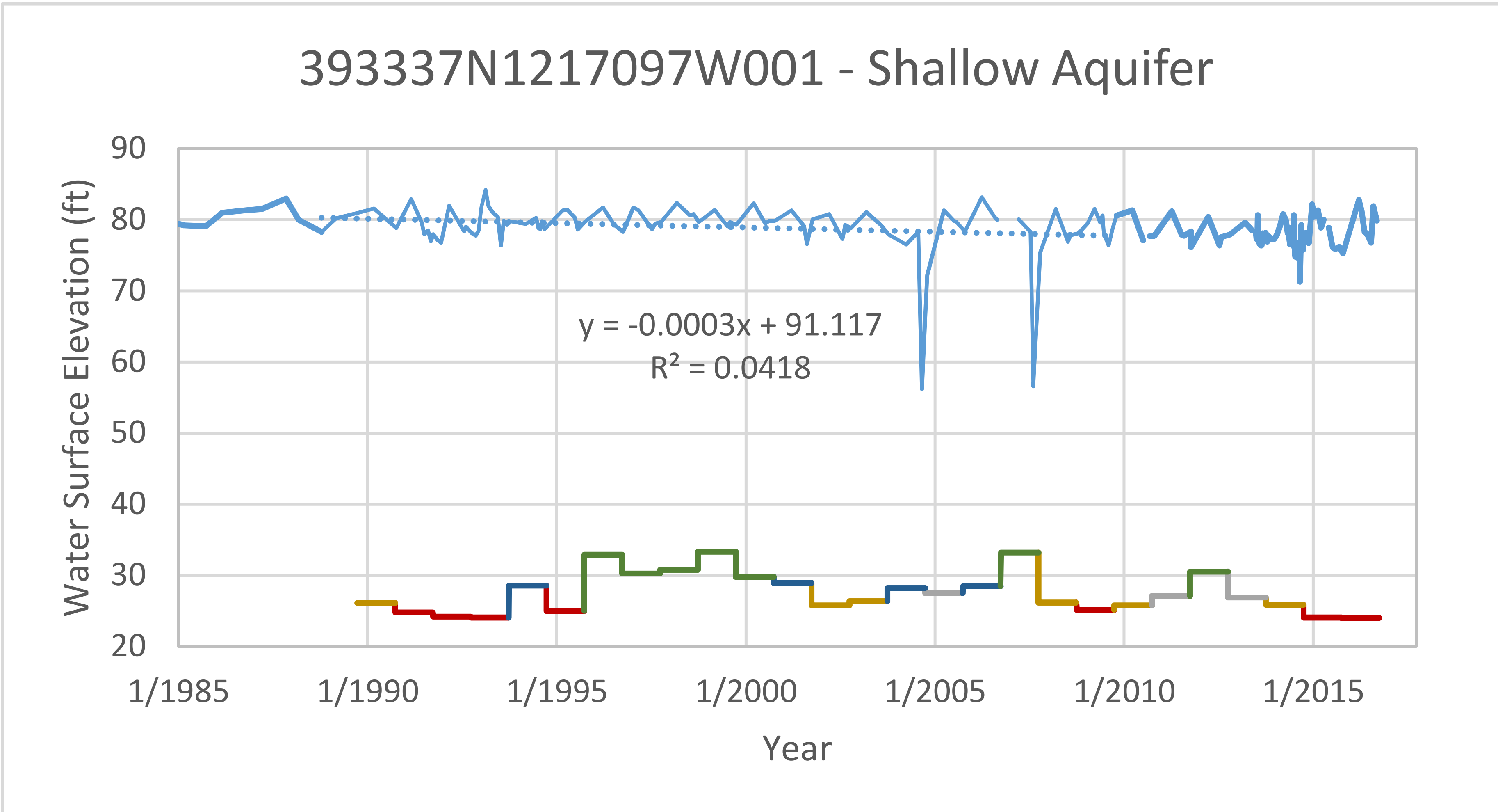

392324N1216499W001 - Shallow Aquifer
Water Surface Elevation (ft)
80
70
60
50
40
30
20
y = -5E-06x + 61.427
R² = 2E-05
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year



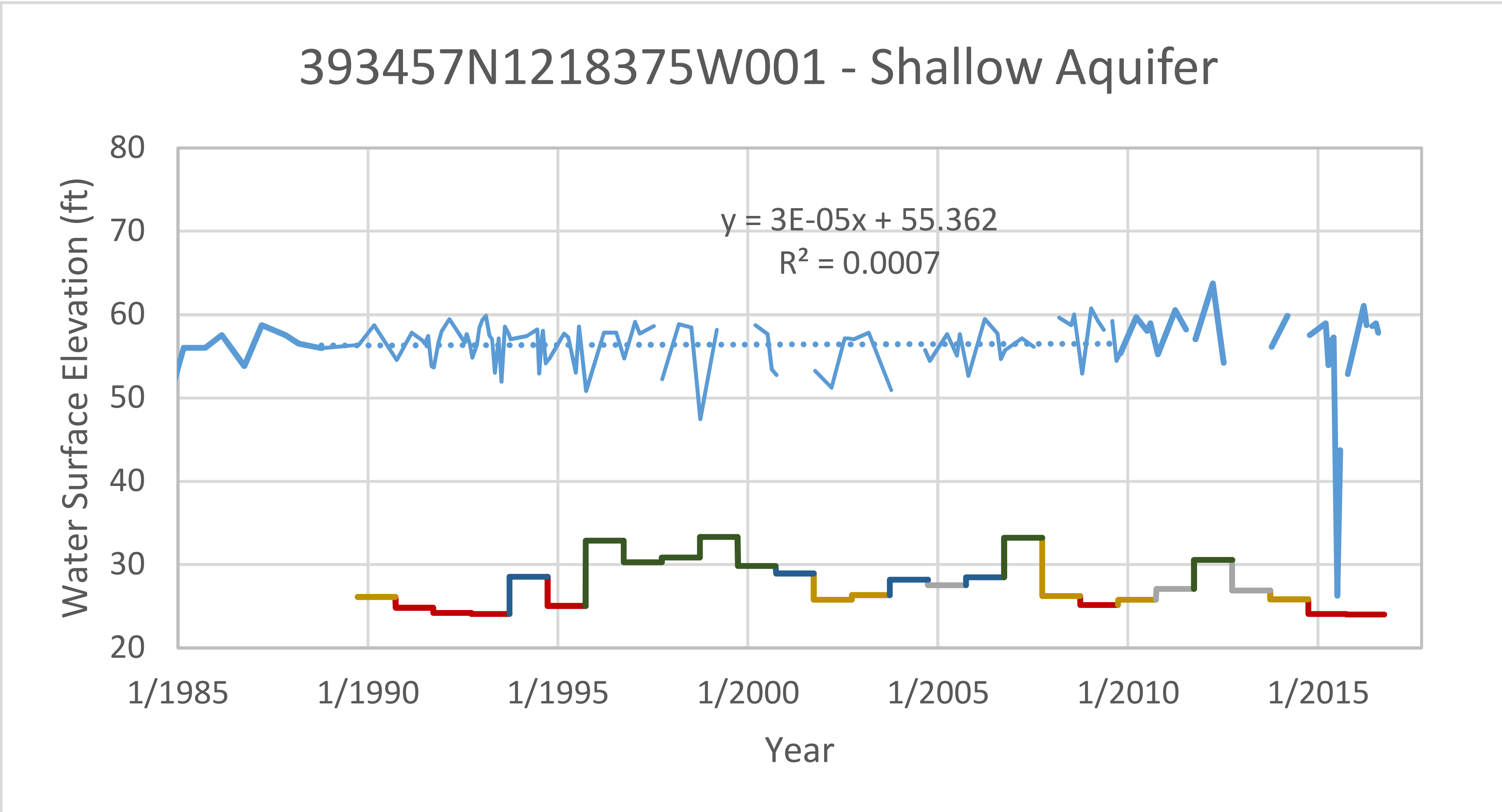
392328N1216469W001 - Shallow Aquifer
Water Surface Elevation (ft)
80
70
60
50
40
30
20
y = -0.0002x + 68.217
R² = 0.0183
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year



392655N1215894W001 - Shallow Aquifer
Water Surface Elevation (ft)
80
70
60
50
40
30
20
y = 0.0003x + 44.976
R² = 0.0079
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year



393337N1217097W001 - Shallow Aquifer
90
80
70
60
50
40
30
20
Water Surface Elevation (ft)
y = -0.0003x + 91.117
R² = 0.0418
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year


393457N1218375W001 - Shallow Aquifer
Water Surface Elevation (ft)
80
70
60
50
40
30
20
y = 3E-05x + 55.362
R² = 0.0007
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

INTERMEDIATE AQUIFER

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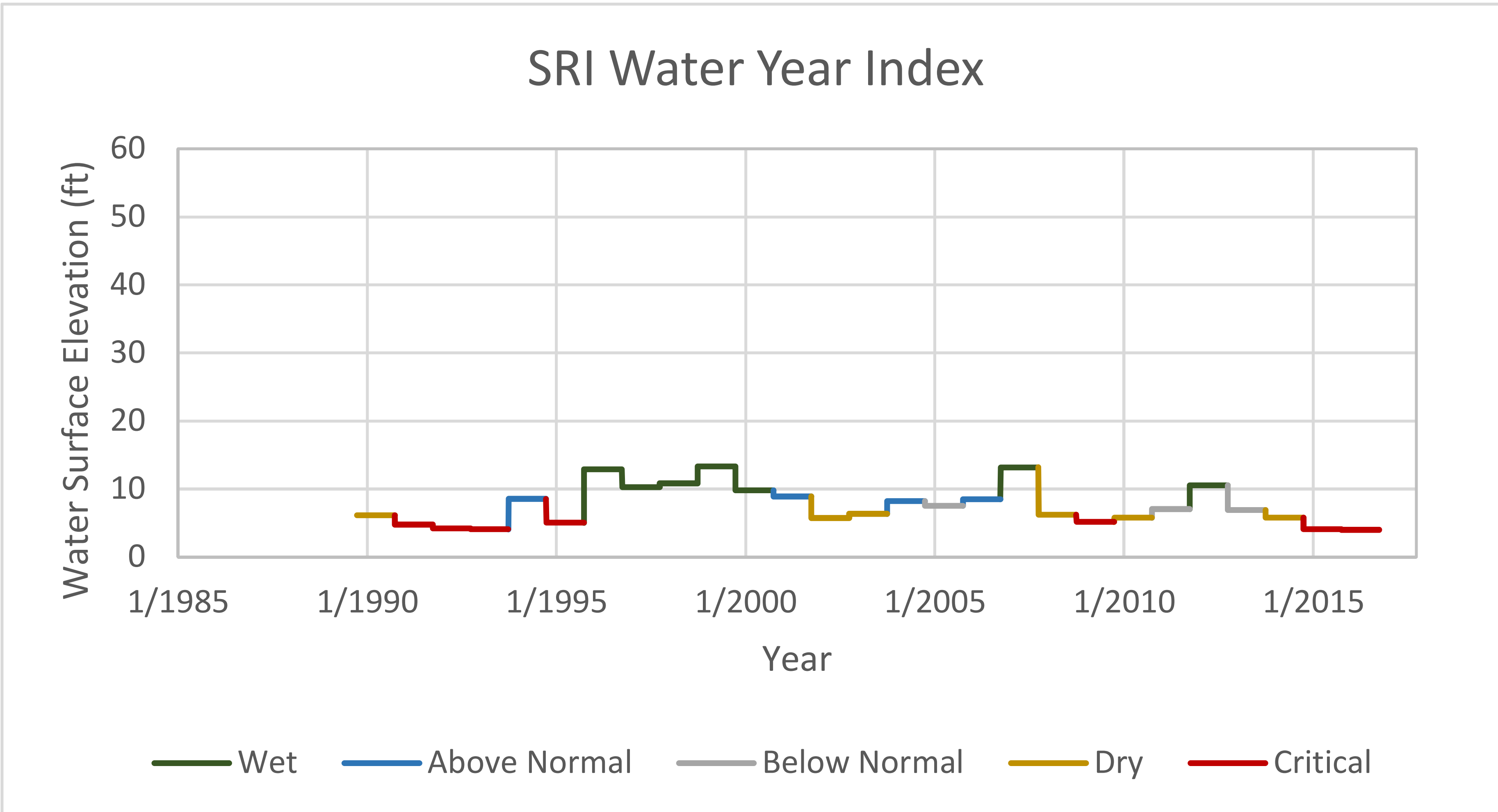
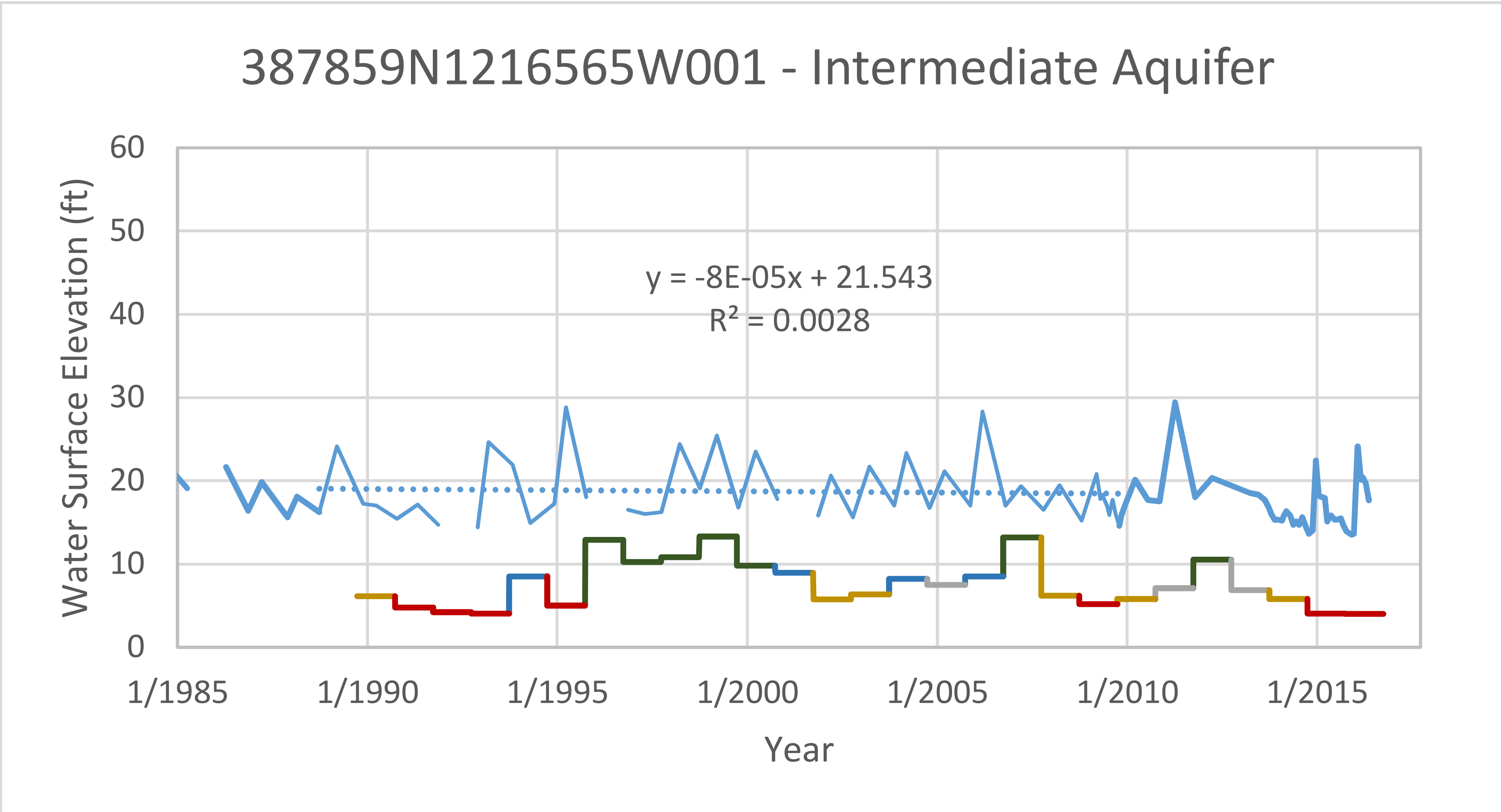
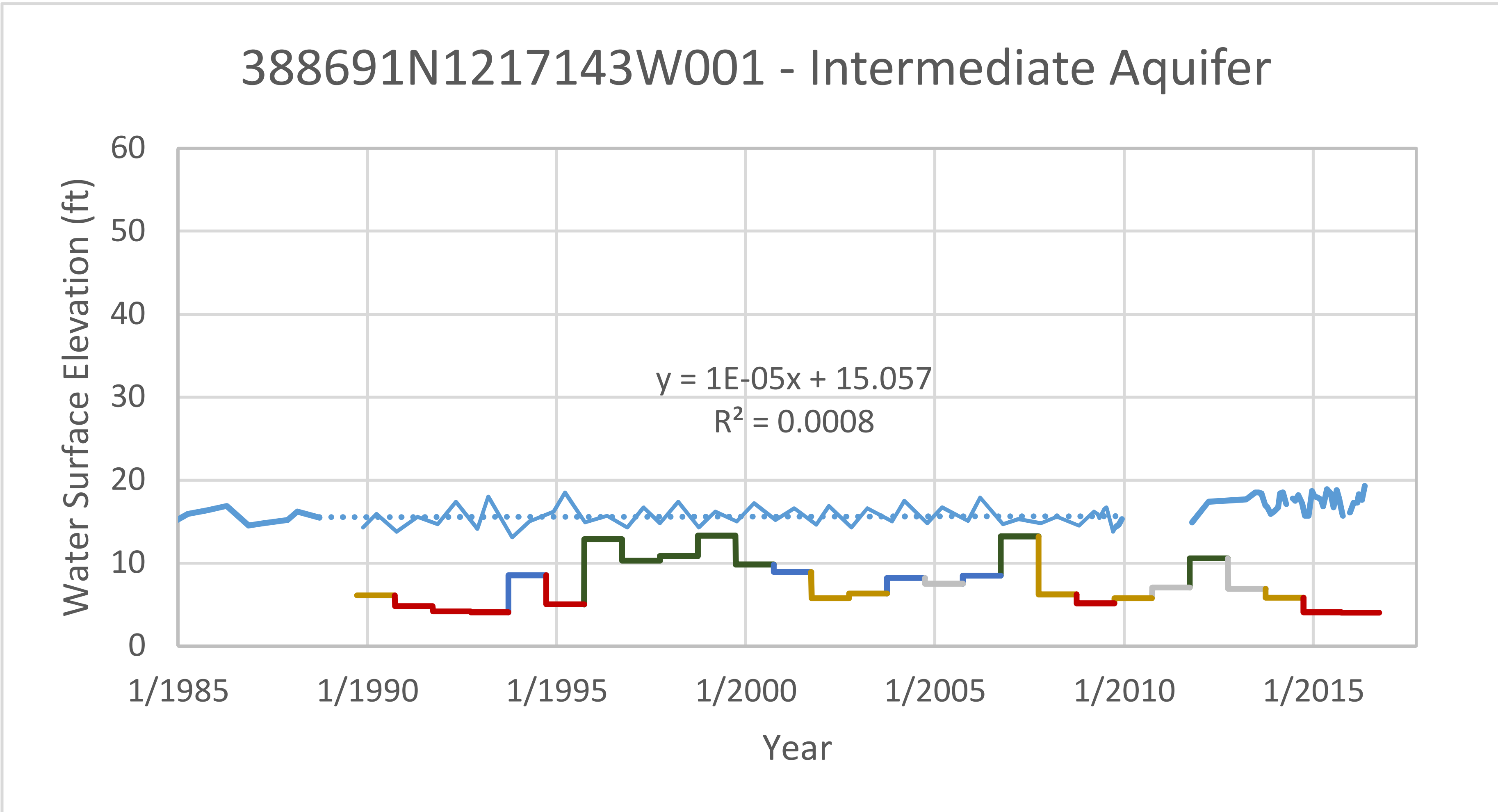


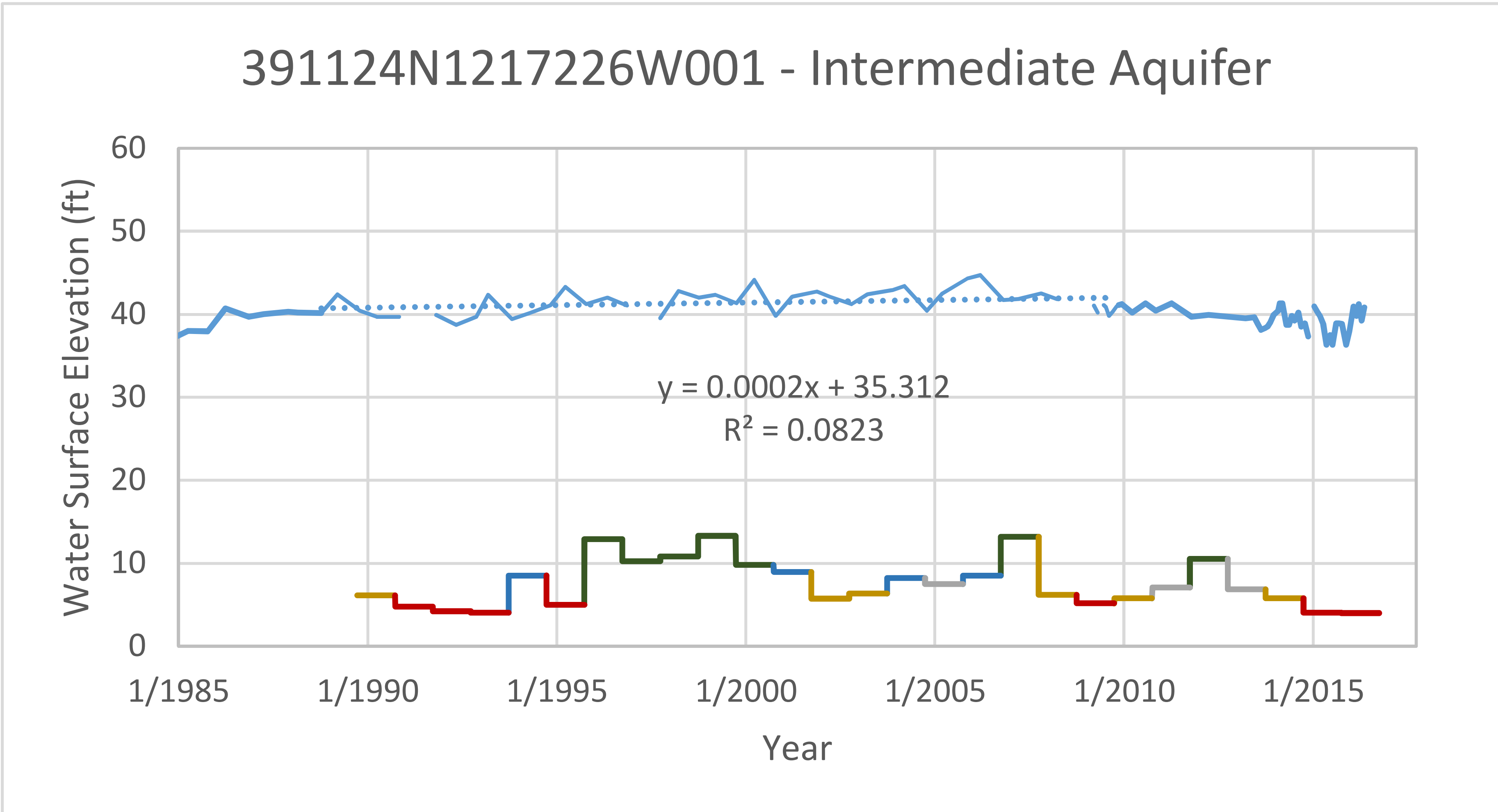
SRI Water Year Index
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year
Wet
Above Normal
Below Normal
Dry
Critical



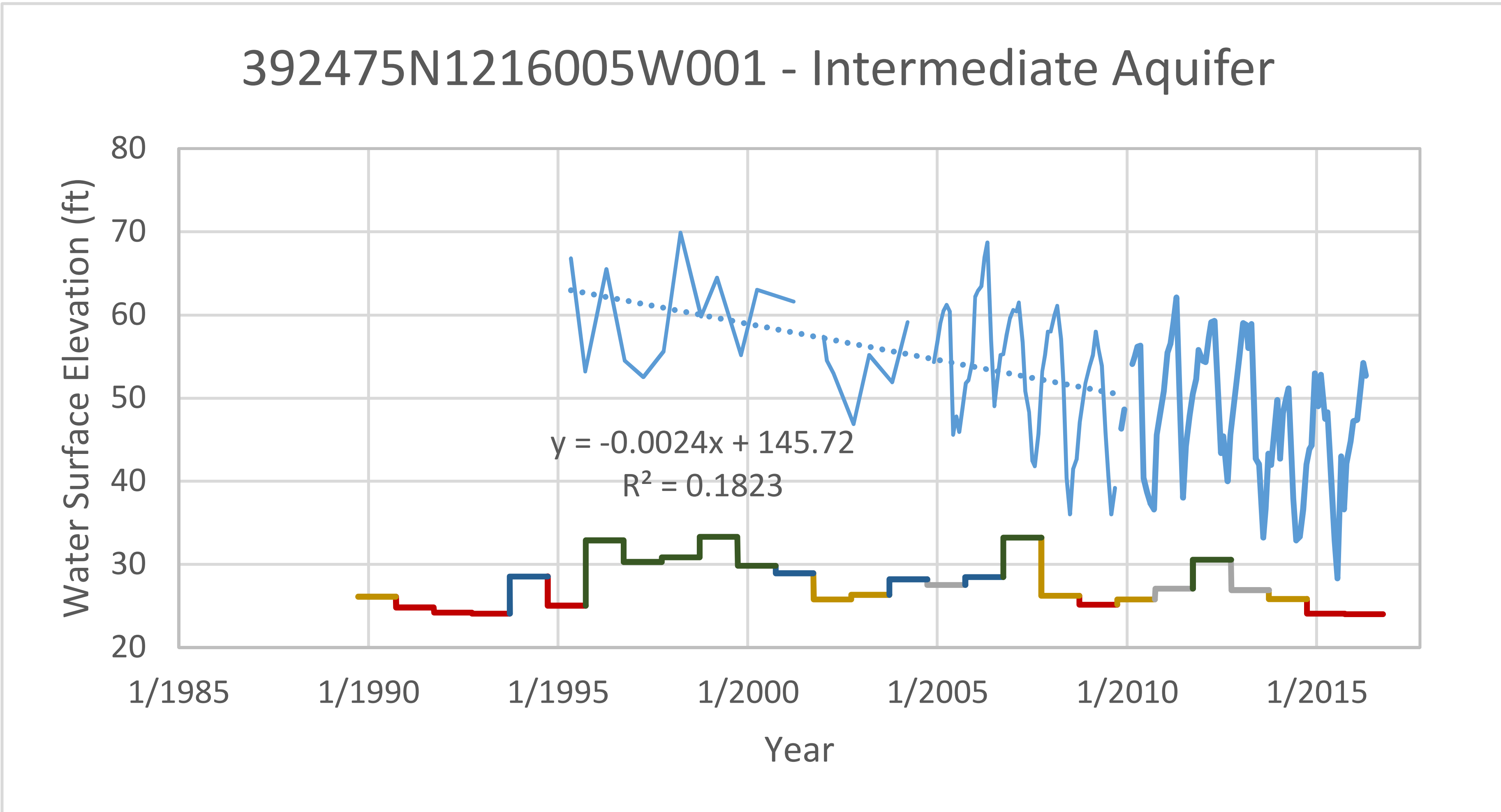
387859N1216565W001 - Intermediate Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
y = -8E-05x + 21.543
R^2 = 0.0028
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year



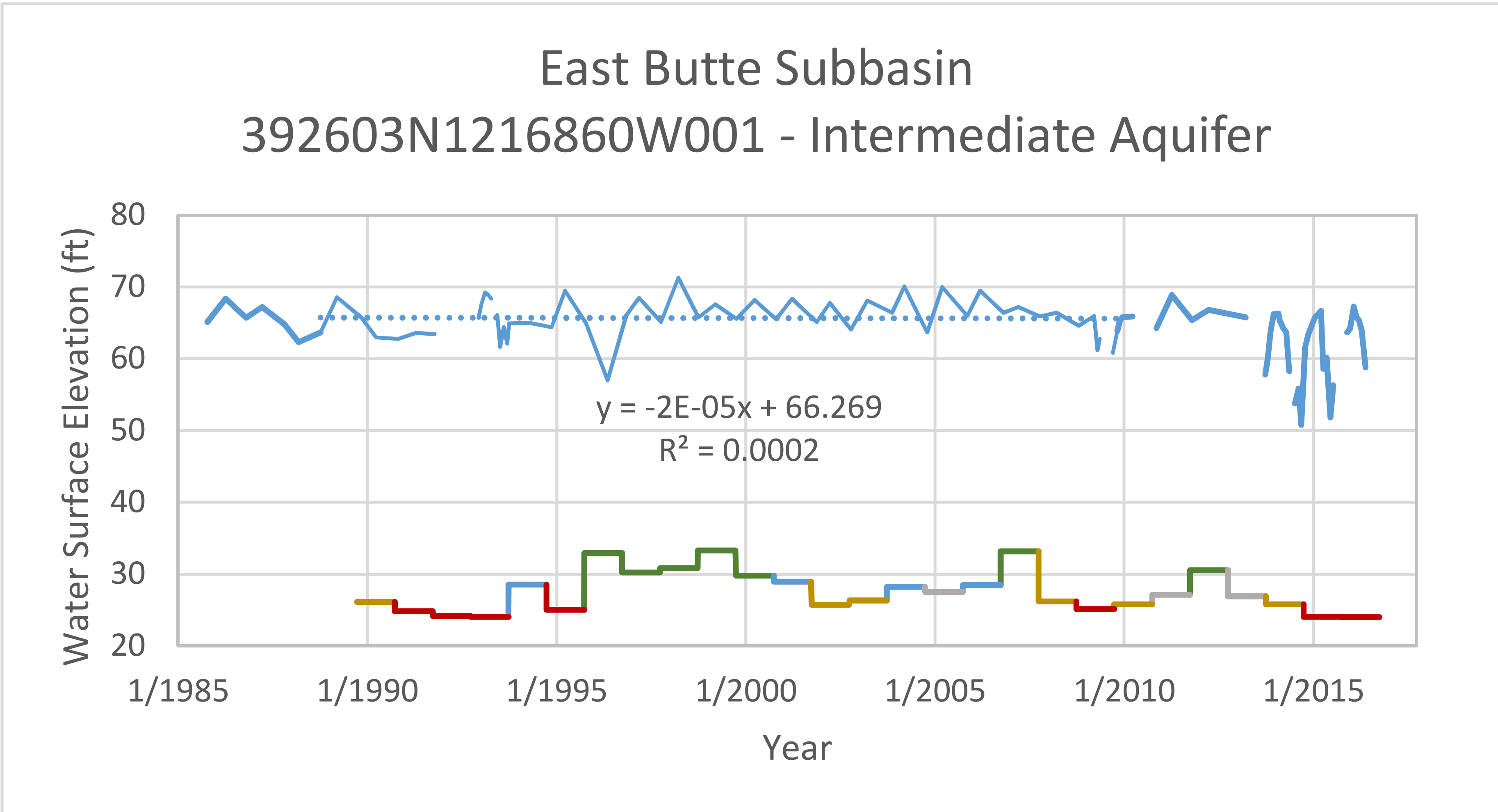
388691N1217143W001 - Intermediate Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
y = 1E-05x + 15.057
R² = 0.0008
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

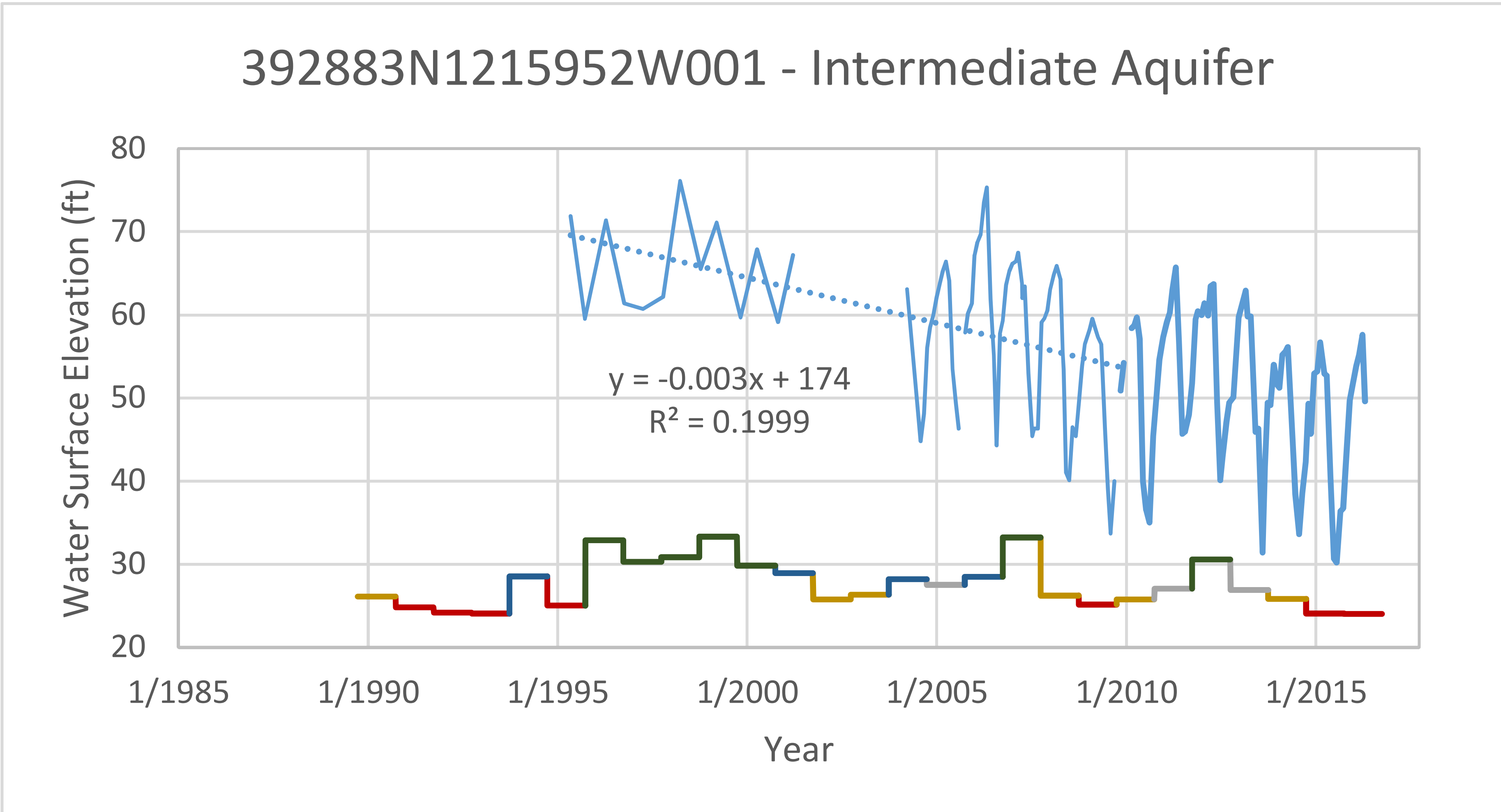


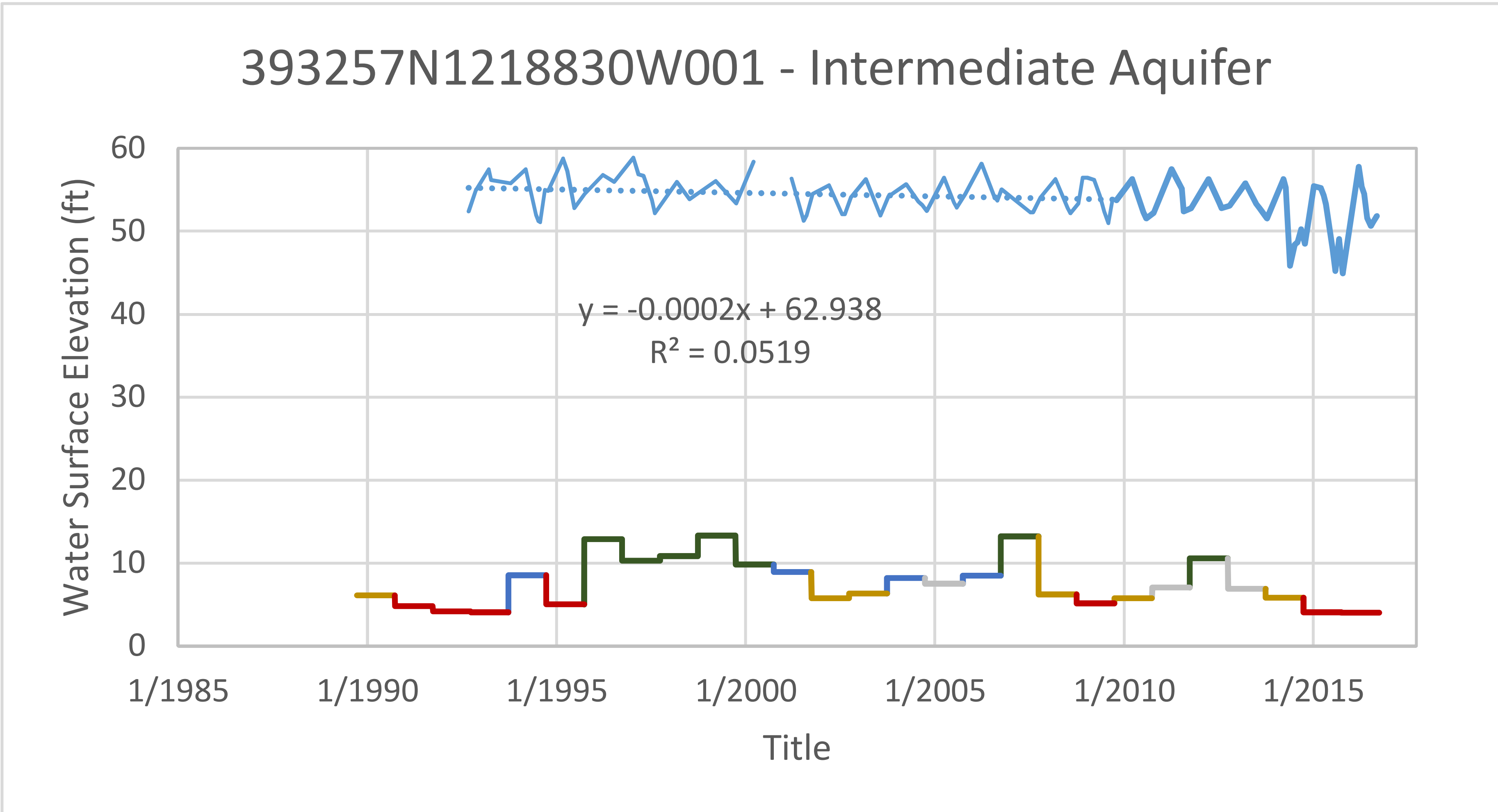
391124N1217226W001 - Intermediate Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
y = 0.0002x + 35.312
R² = 0.0823
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year



392475N1216005W001 - Intermediate Aquifer
80
70
60
50
40
30
20
Water Surface Elevation (ft)
y = -0.0024x + 145.72
R² = 0.1823
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year


East Butte Subbasin
392603N1216860W001 - Intermediate Aquifer
Water Surface Elevation (ft)
80
70
60
50
40
30
20
y = -2E-05x + 66.269
R² = 0.0002
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year


392883N1215952W001 - Intermediate Aquifer
Water Surface Elevation (ft)
80
70
60
50
40
30
20
y = -0.003x + 174
R² = 0.1999
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year


393257N1218830W001 - Intermediate Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Title
y = -0.0002x + 62.938
R² = 0.0519

DEEP AQUIFER HYDROGRAPHS

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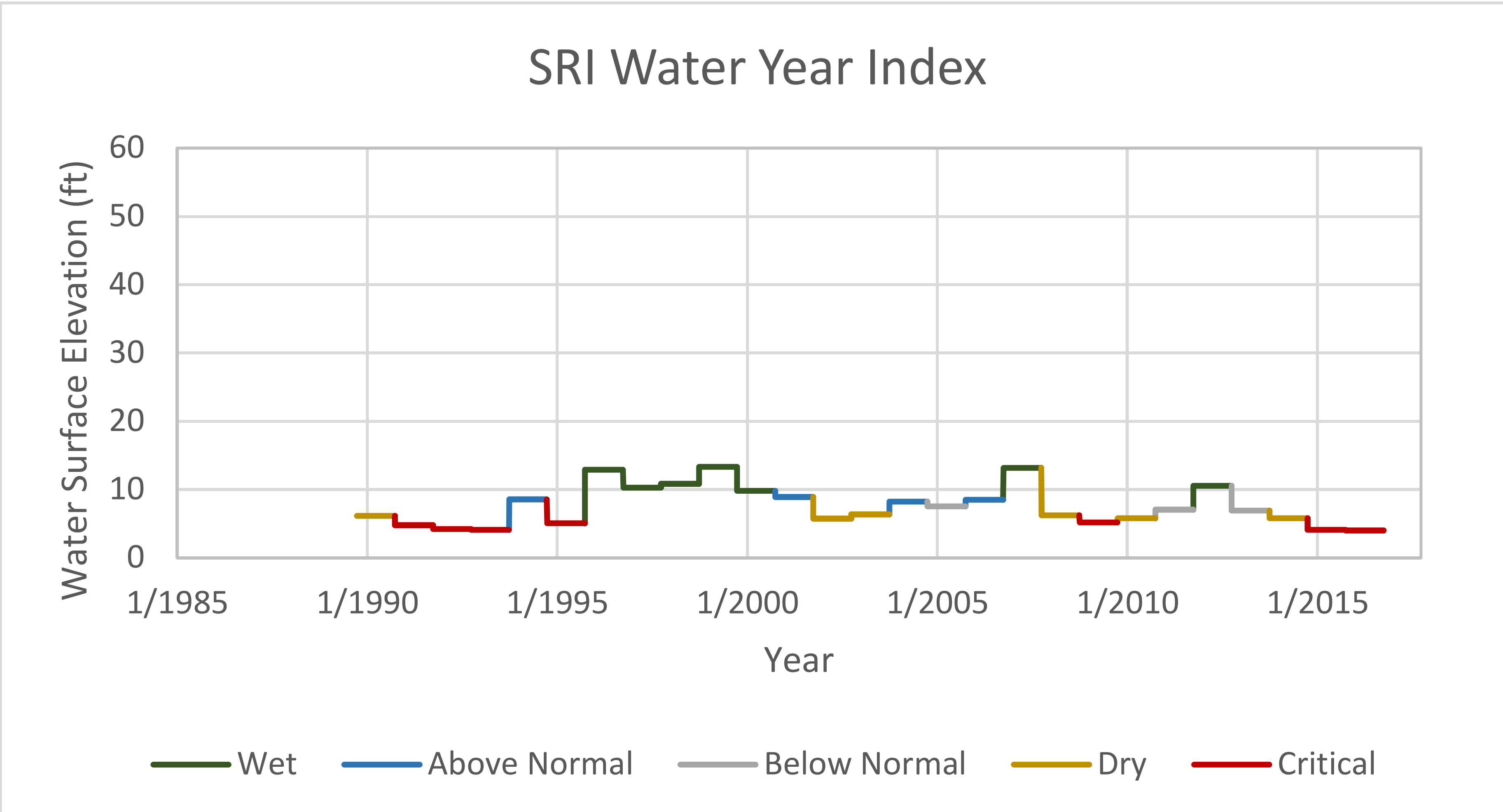
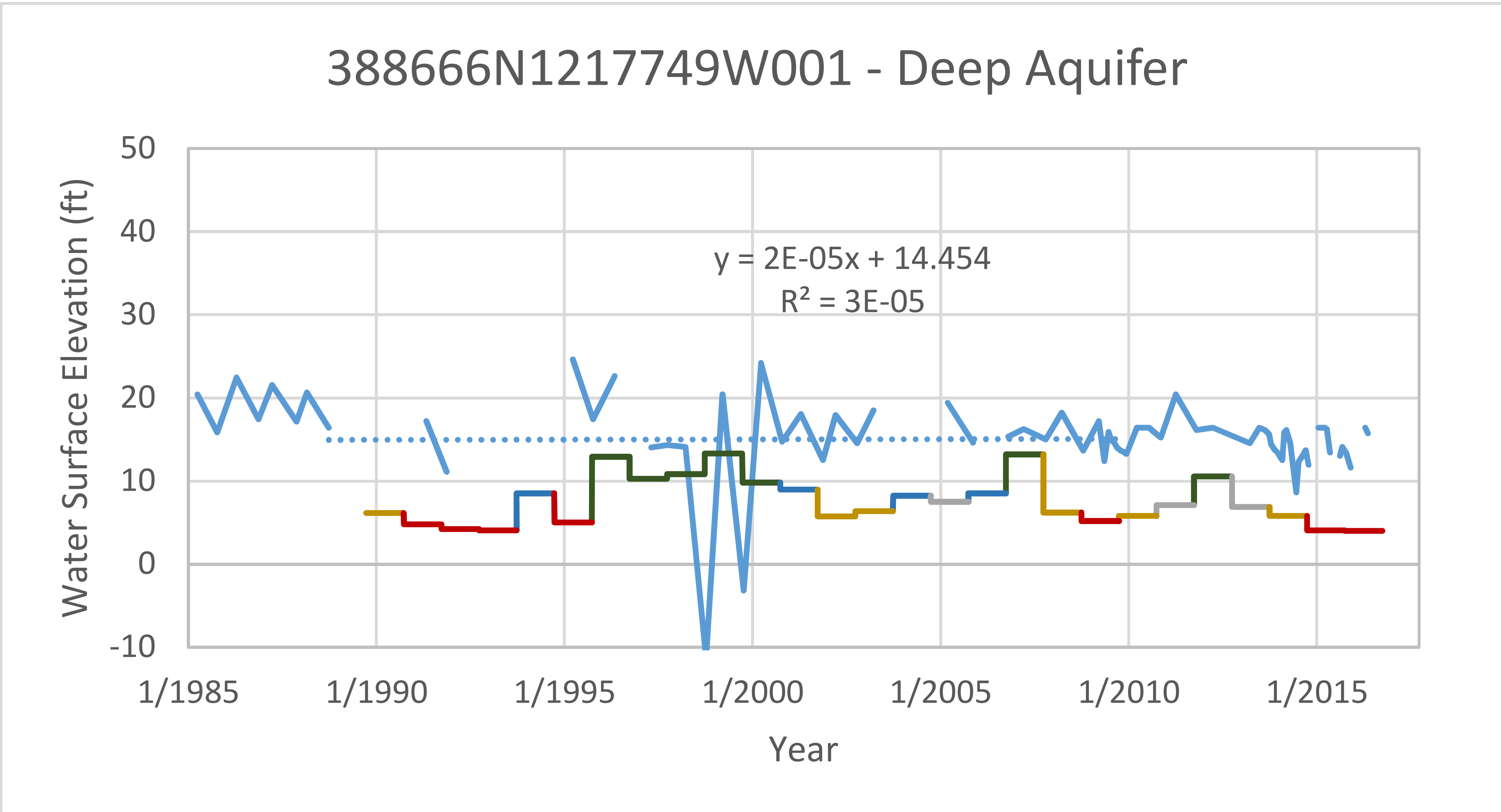
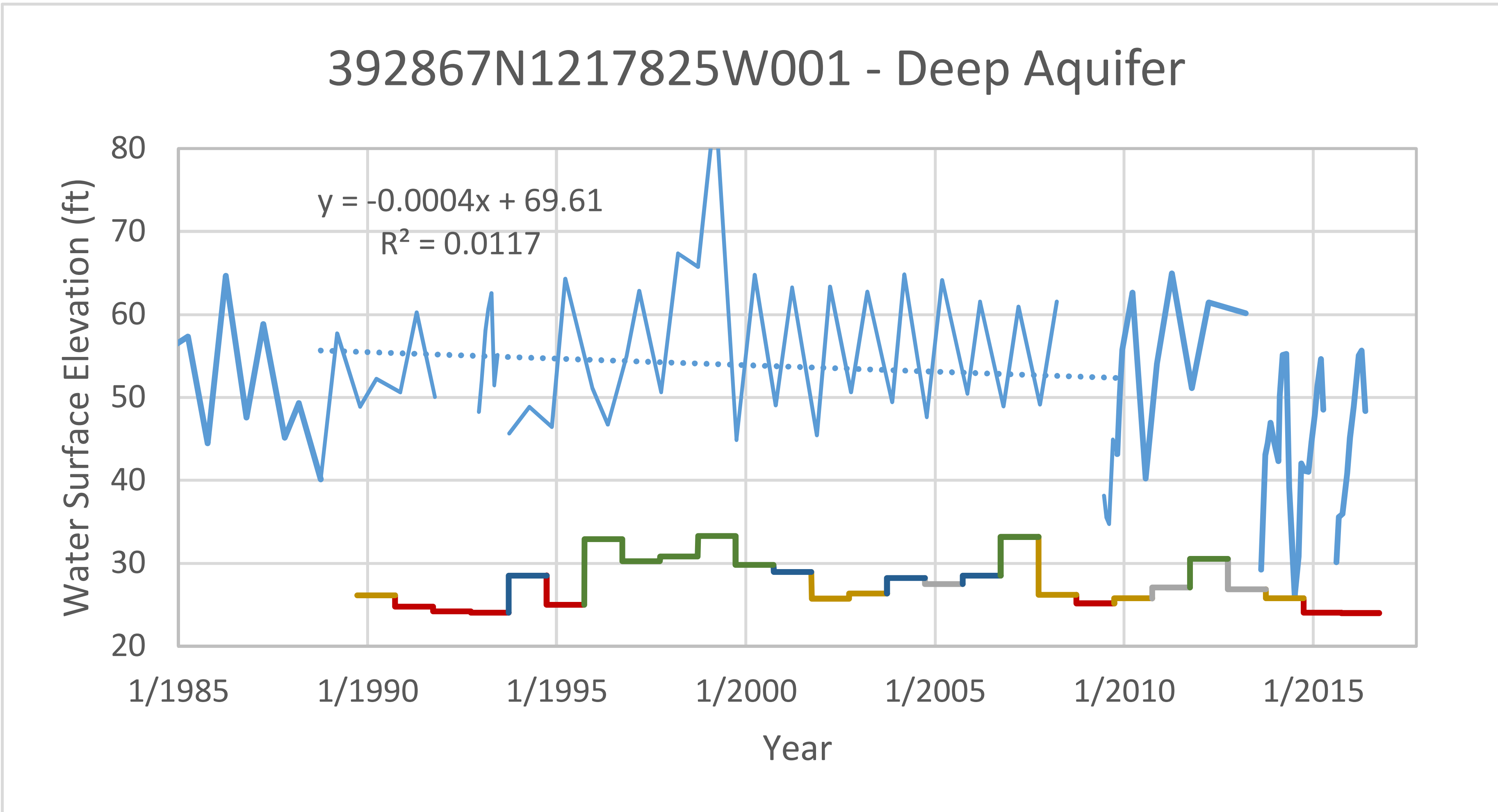


SRI Water Year Index
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year
Wet
Above Normal
Below Normal
Dry
Critical


388666N1217749W001 - Deep Aquifer
y = 2E-05x + 14.454
R² = 3E-05
Water Surface Elevation (ft)
50
40
30
20
10
0
-10
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year


392867N1217825W001 - Deep Aquifer
y = -0.0004x + 69.61
R² = 0.0117
Water Surface Elevation (ft)
80
70
60
50
40
30
20
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

UNKNOW AQUIFER HYDROGRAPHS

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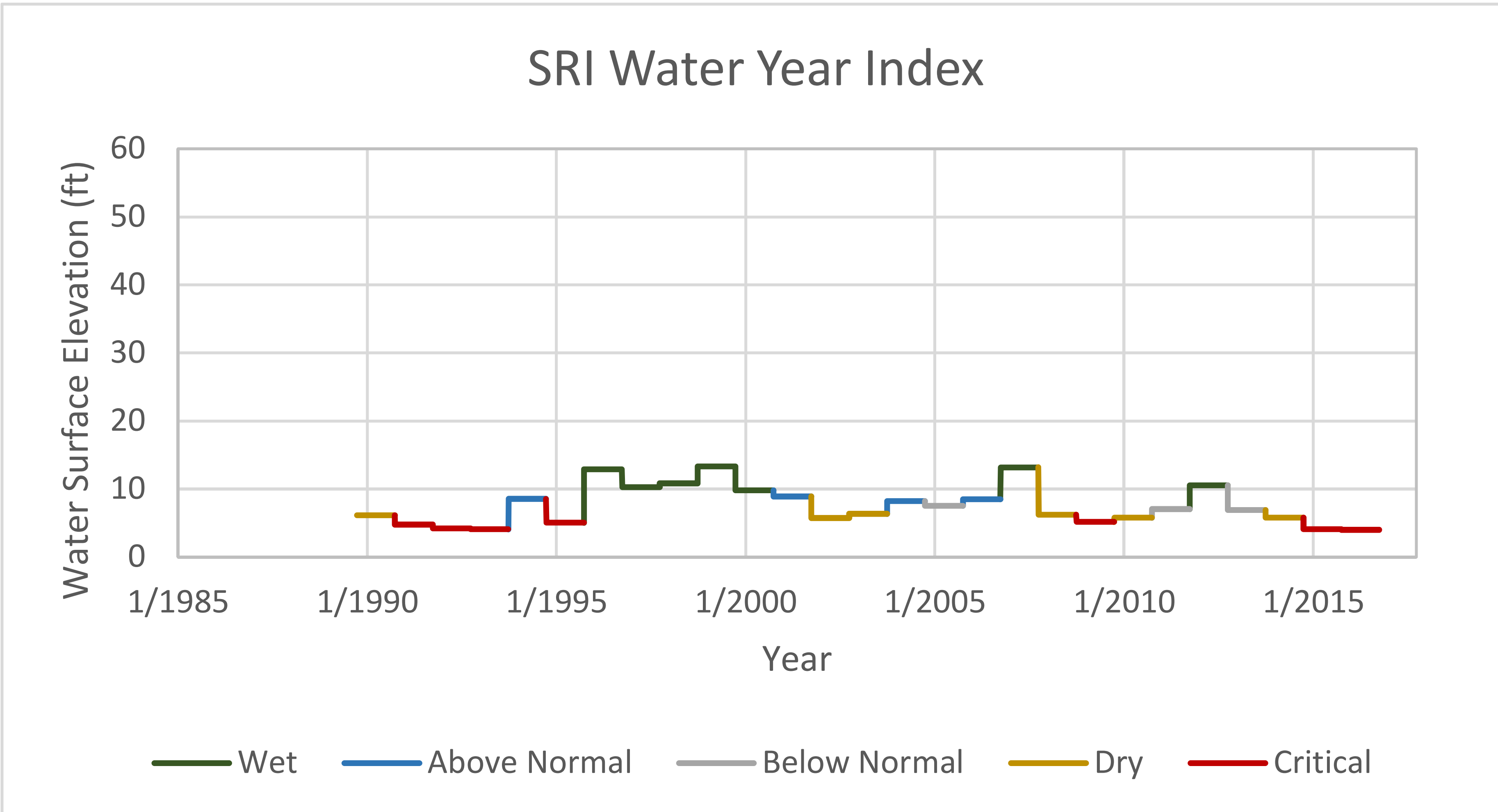
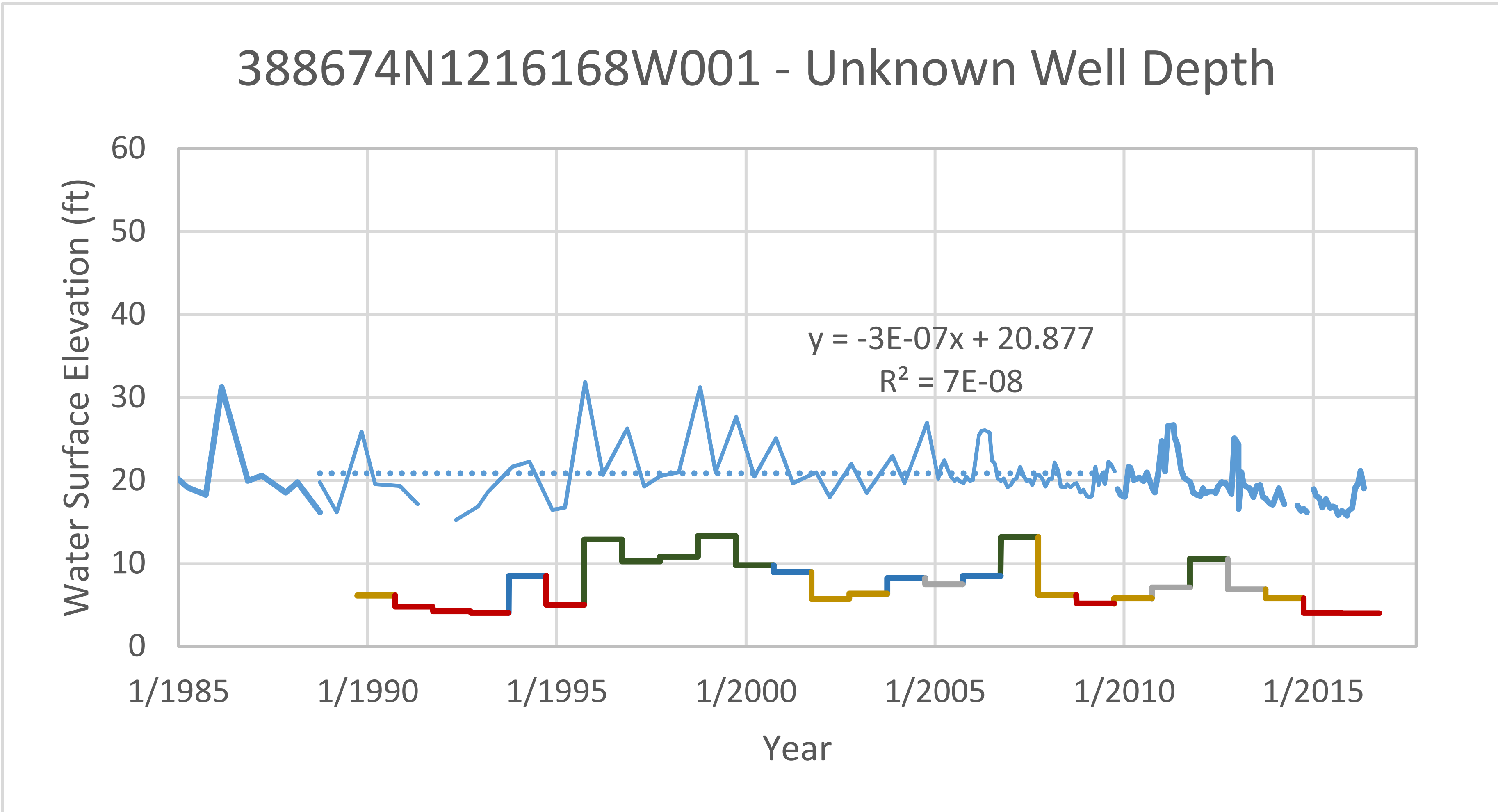
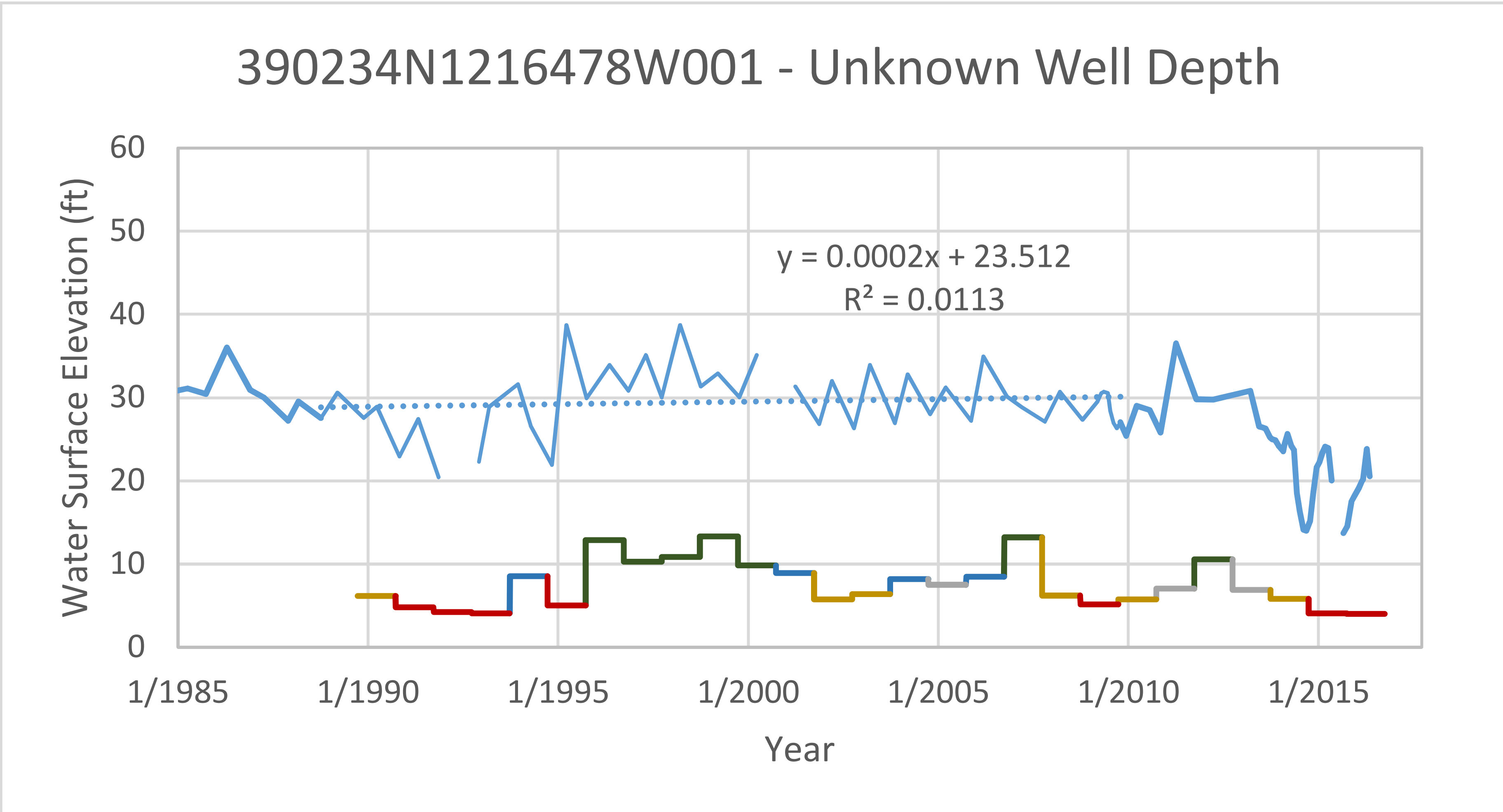
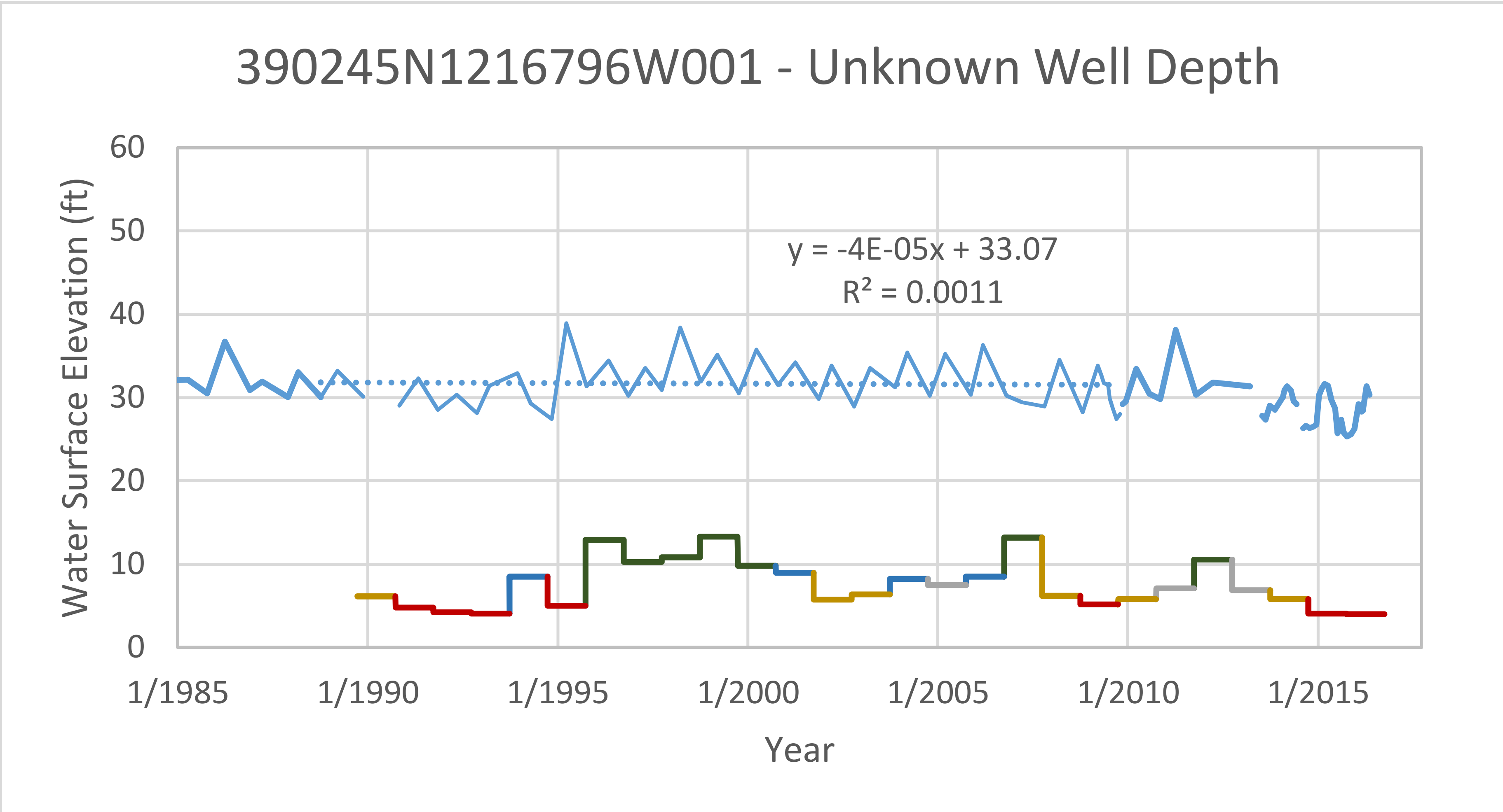

SRI Water Year Index
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year
Wet
Above Normal
Below Normal
Dry
Critical

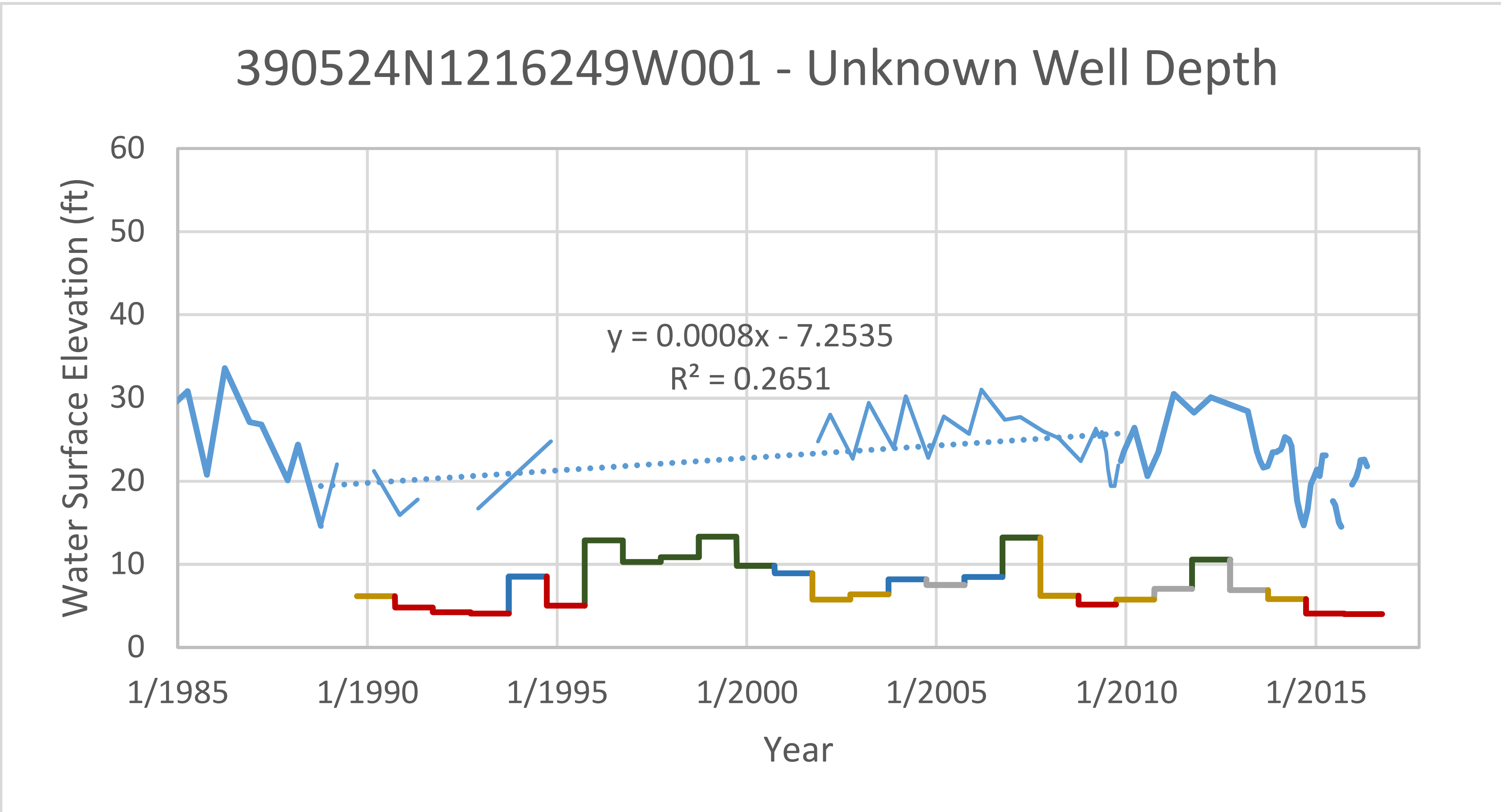


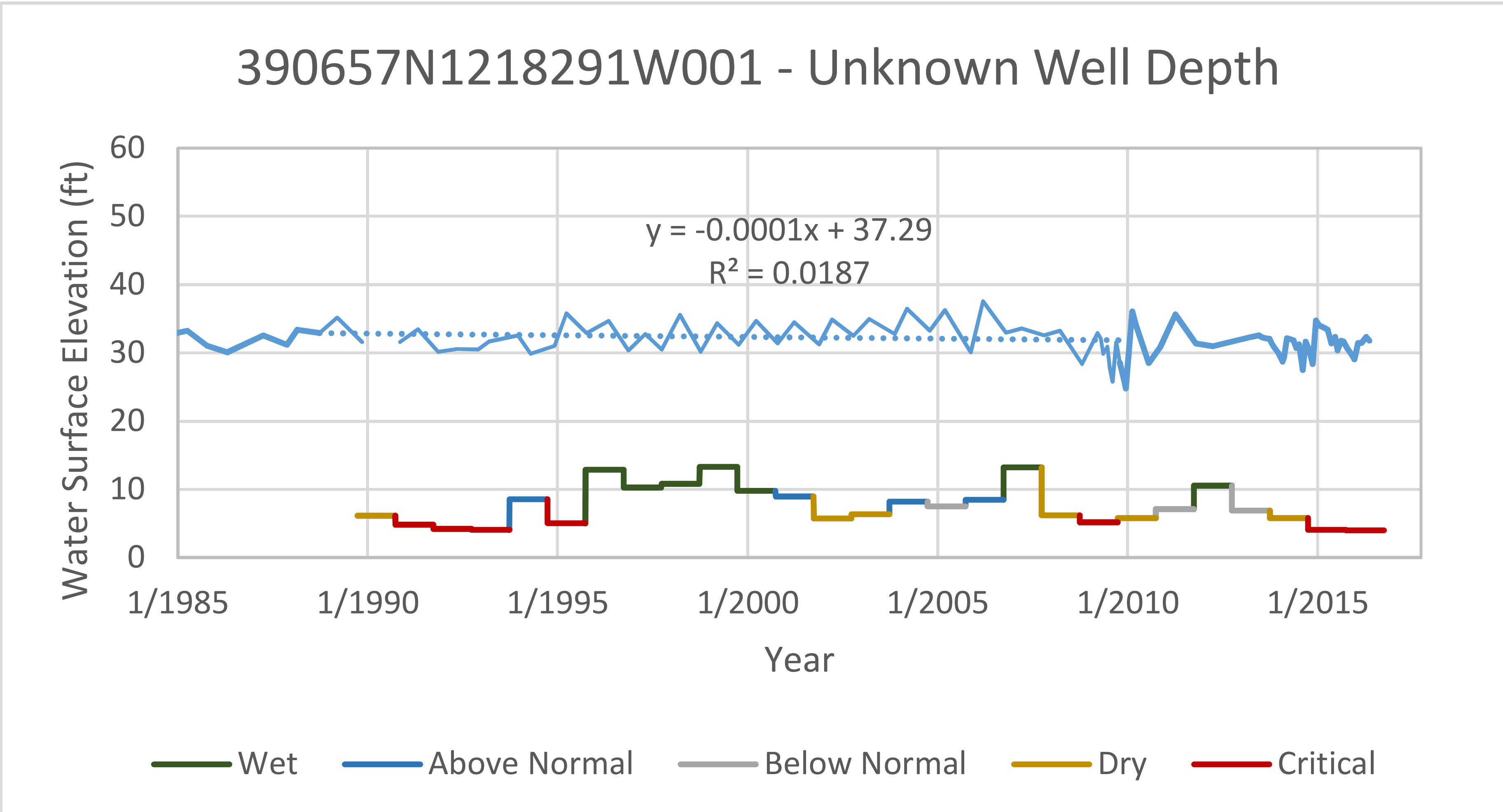
388674N1216168W001 - Unknown Well Depth
Water Surface Elevation (ft)
60
50
40
30
20
10
0
y = -3E-07x + 20.877
R² = 7E-08
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year



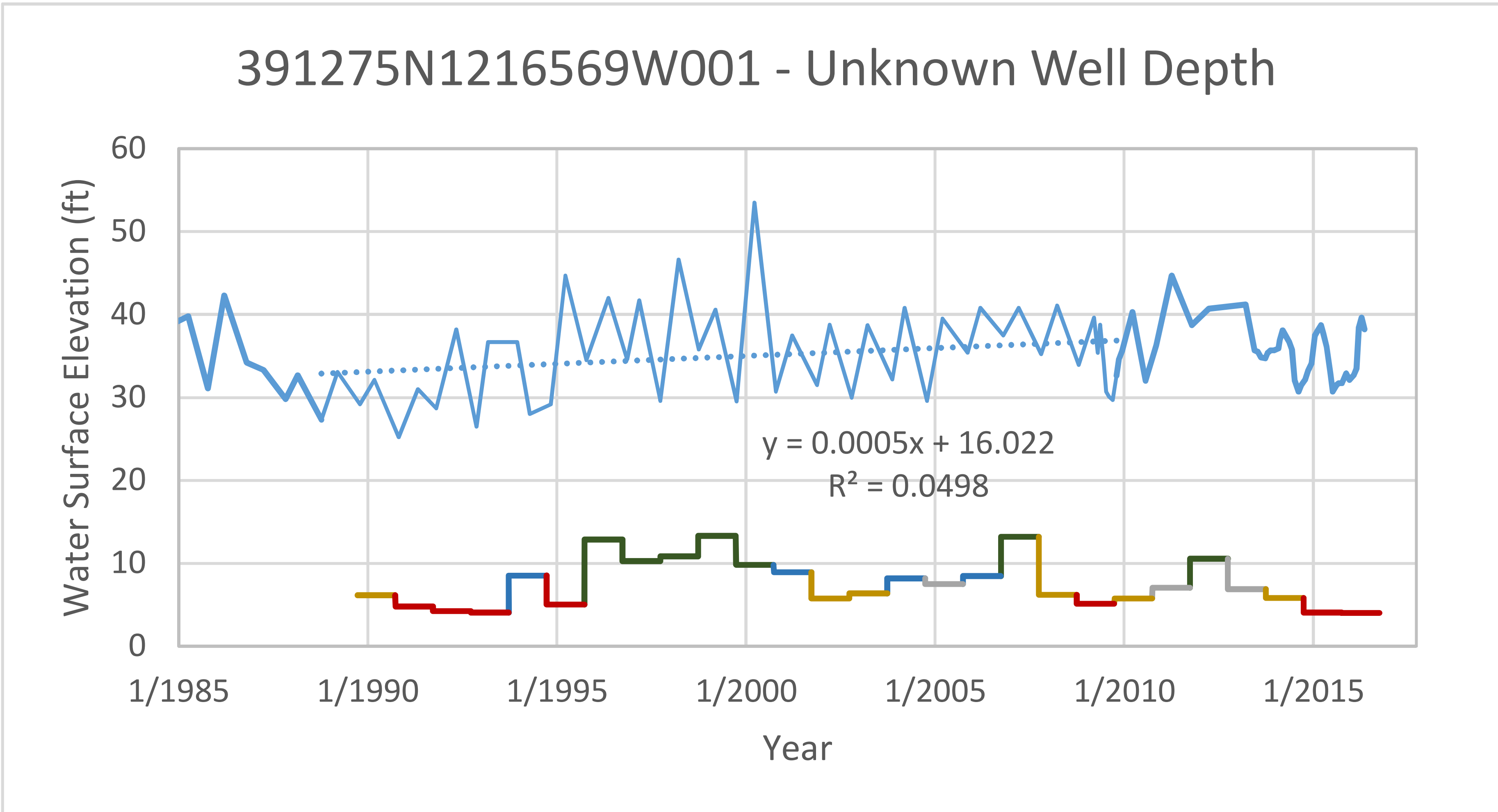
390234N1216478W001 - Unknown Well Depth
y = 0.0002x + 23.512
R² = 0.0113
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

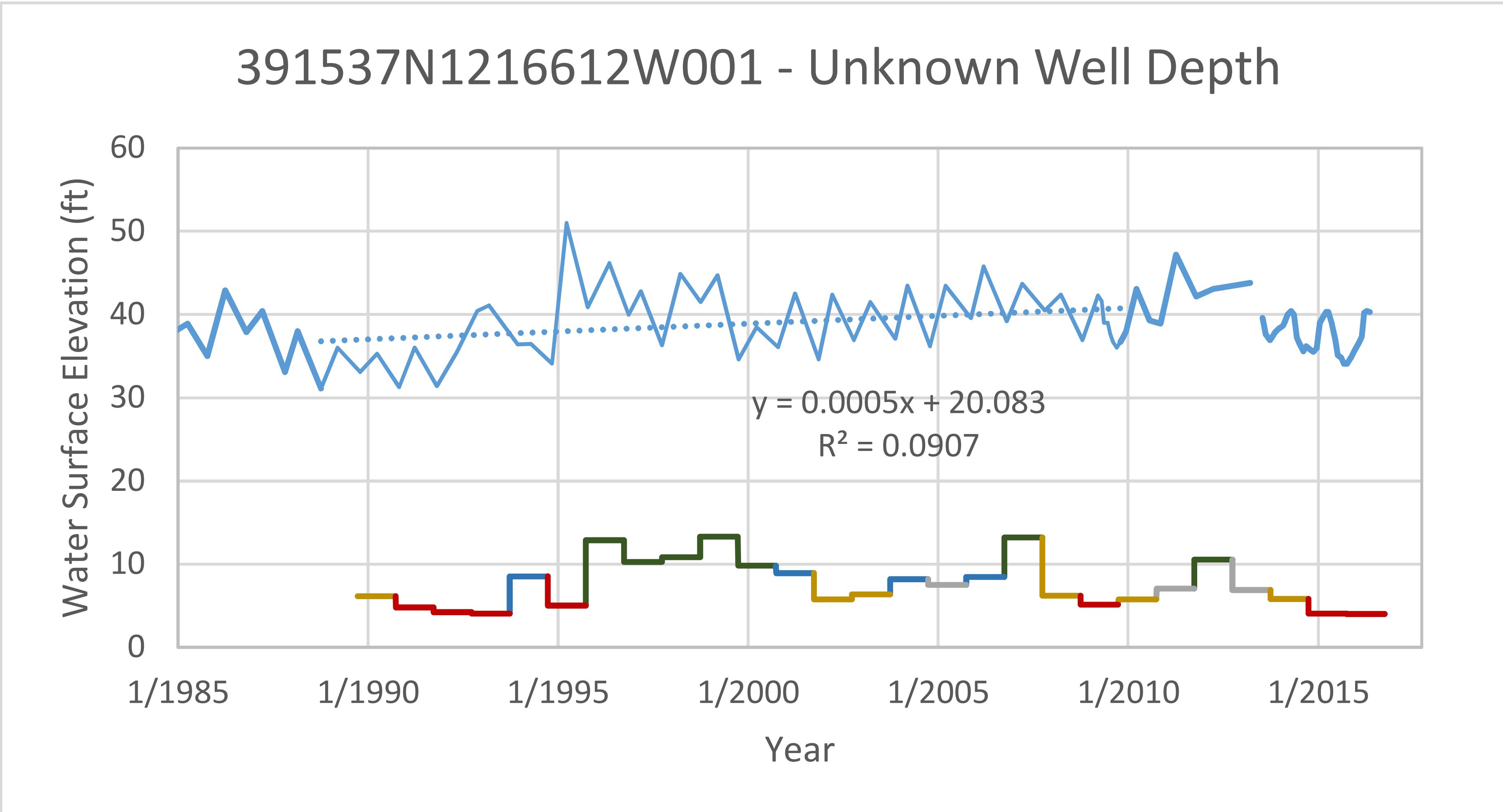

390245N1216796W001 - Unknown Well Depth
Water Surface Elevation (ft)
60
50
40
30
20
10
0
y = -4E-05x + 33.07
R² = 0.0011
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year


390524N1216249W001 - Unknown Well Depth
y = 0.0008x - 7.2535
R² = 0.2651
Water Surface Elevation (ft)
0
10
20
30
40
50
60
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

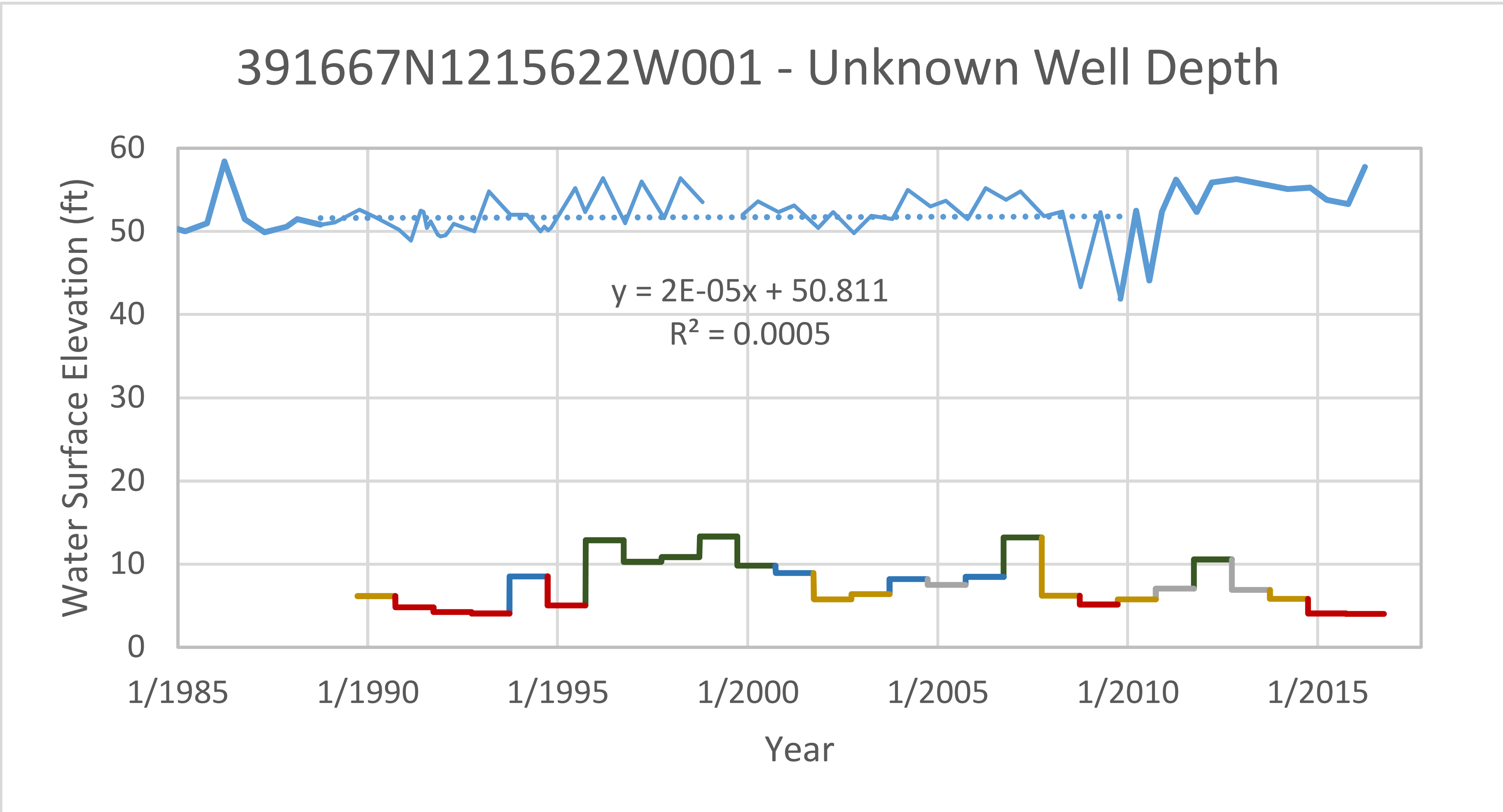


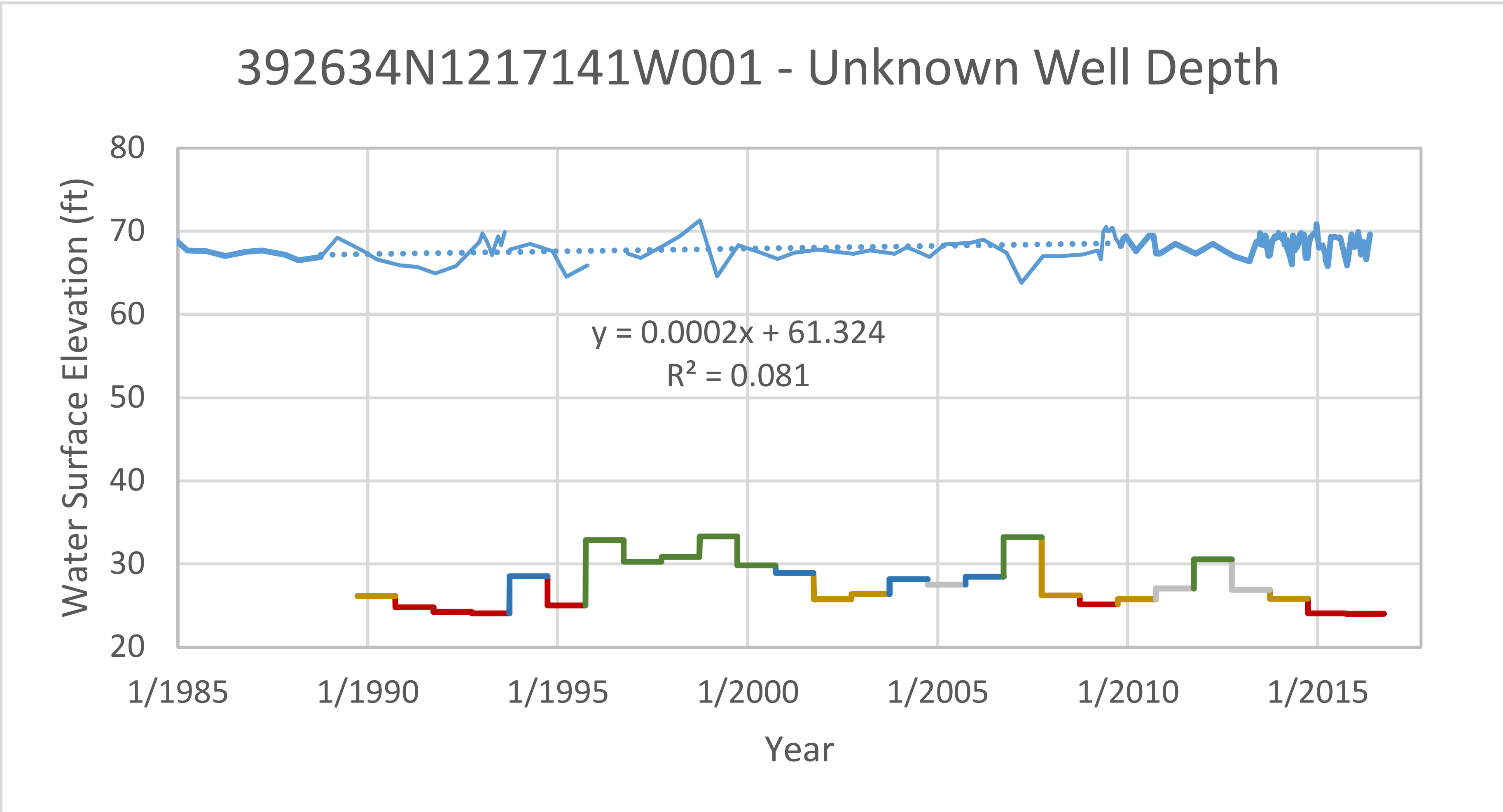
390657N1218291W001 - Unknown Well Depth
y = -0.0001x + 37.29
R² = 0.0187
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year
Wet
Above Normal
Below Normal
Dry
Critical

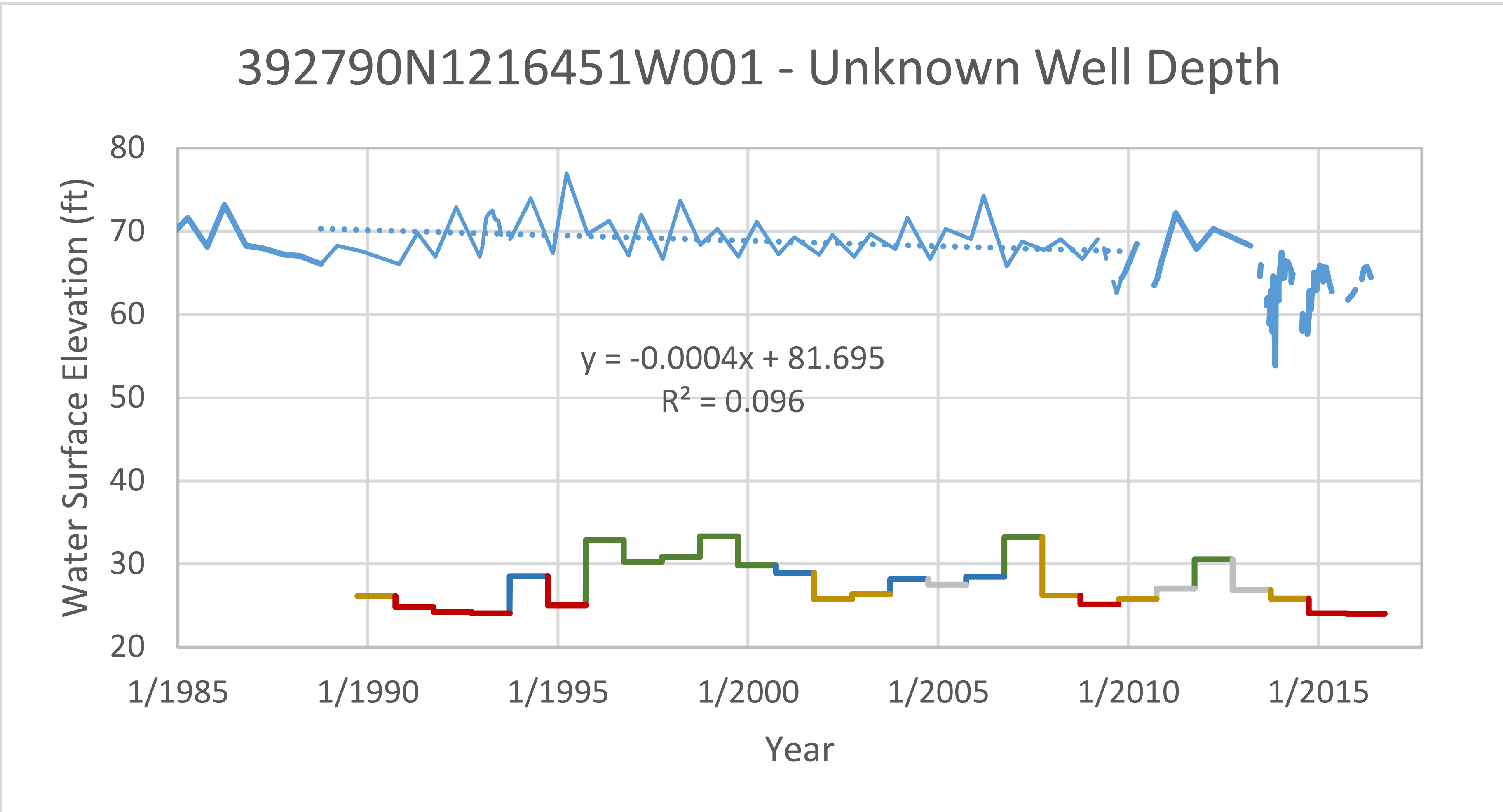

391275N1216569W001 - Unknown Well Depth
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year
y = 0.0005x + 16.022
R² = 0.0498



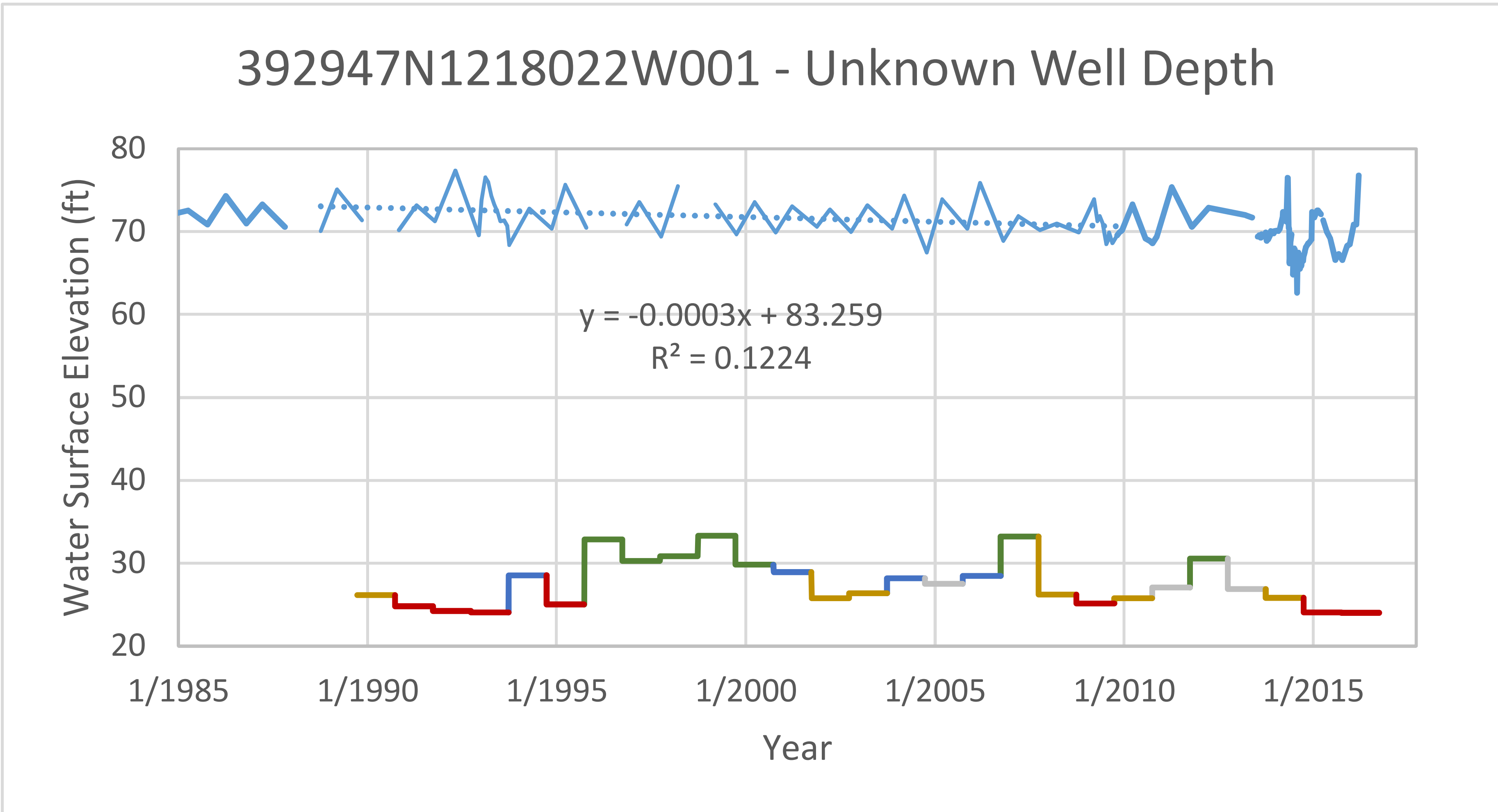
391537N1216612W001 - Unknown Well Depth
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year
y = 0.0005x + 20.083
R² = 0.0907


391667N1215622W001 - Unknown Well Depth
Water Surface Elevation (ft)
60
50
40
30
20
10
0
y = 2E-05x + 50.811
R² = 0.0005
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

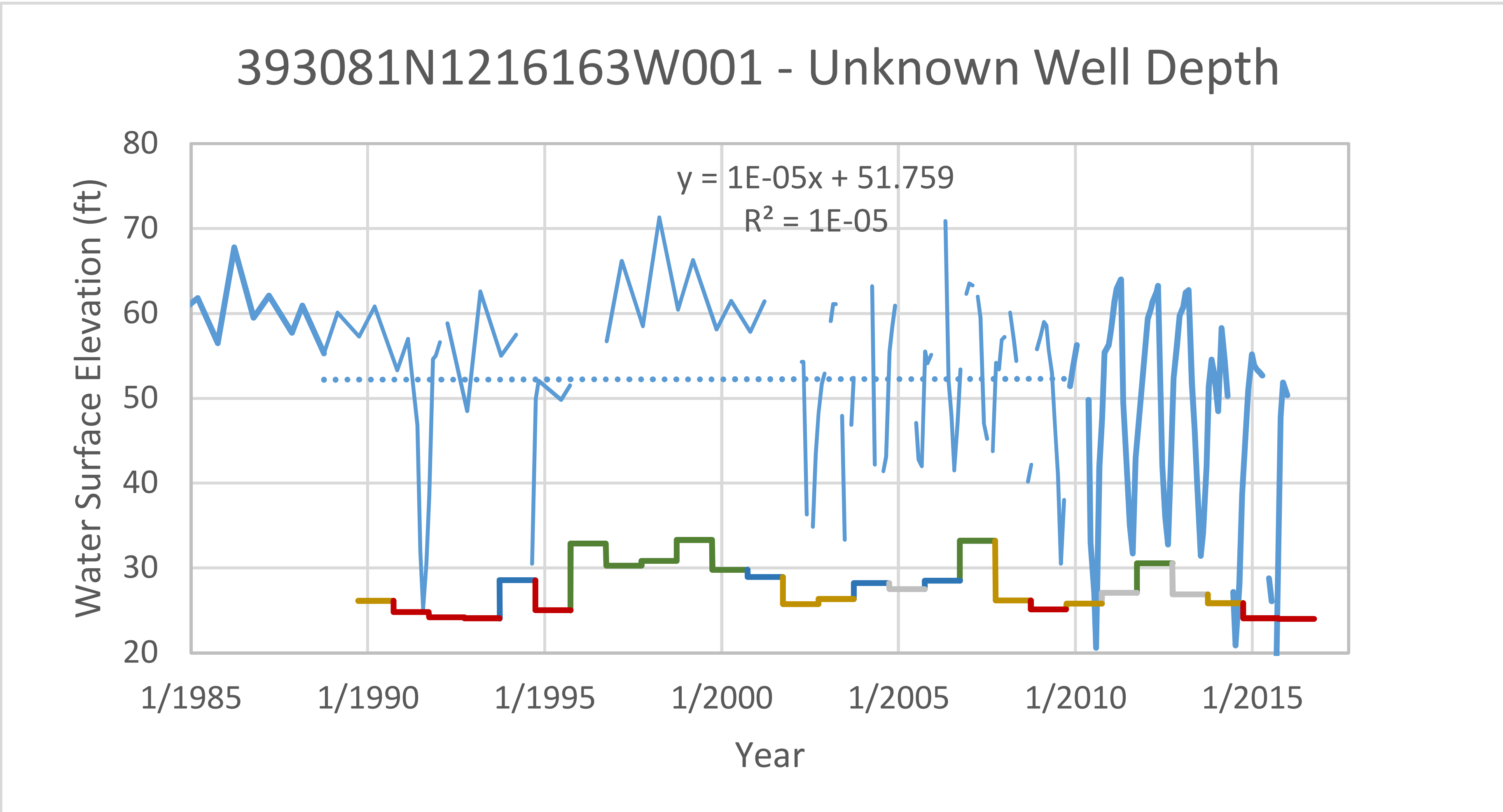

392634N1217141W001 - Unknown Well Depth
Water Surface Elevation (ft)
80
70
60
50
40
30
20
y = 0.0002x + 61.324
R² = 0.081
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year



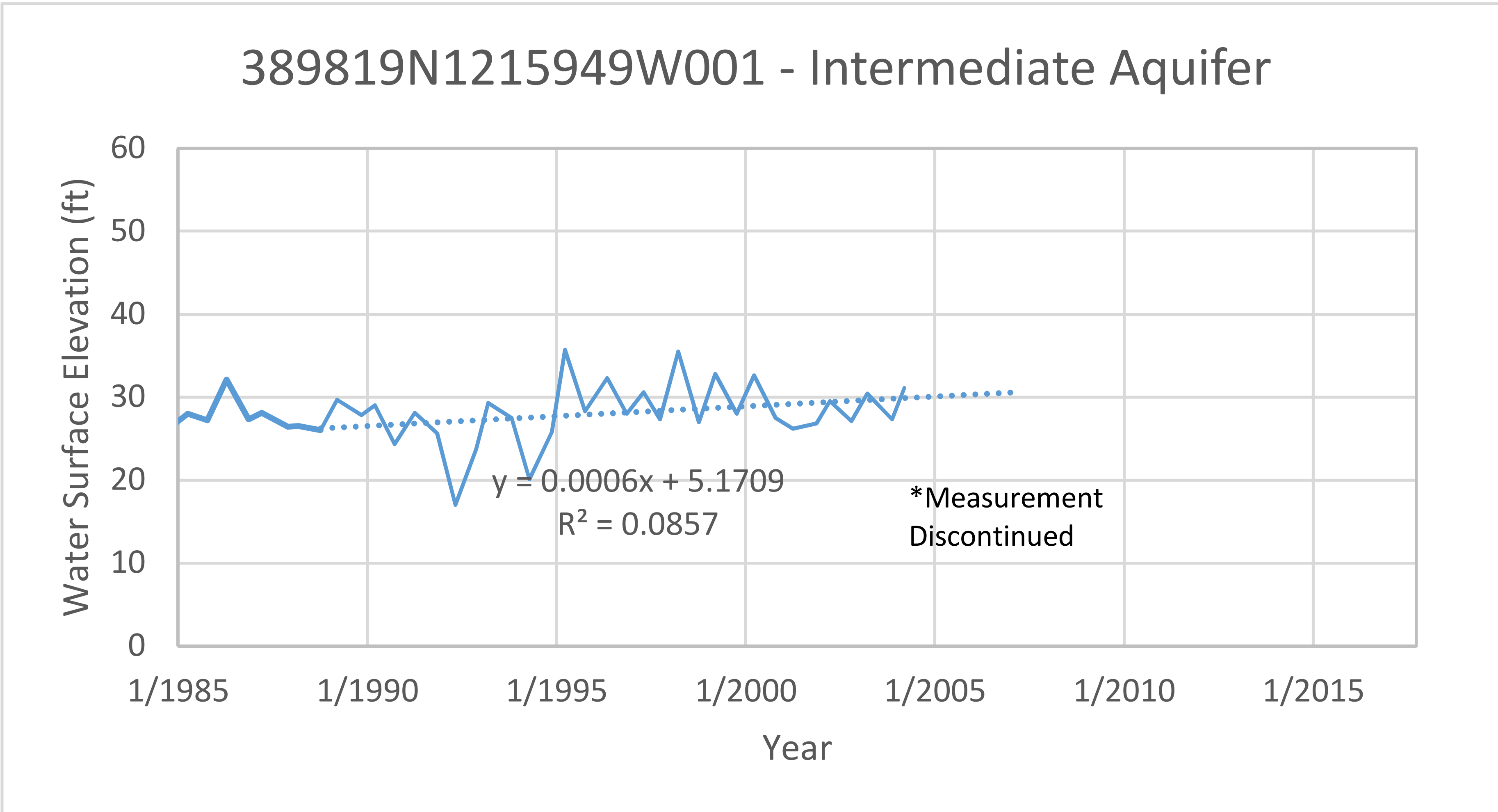
392790N1216451W001 - Unknown Well Depth
80
70
60
50
40
30
20
Water Surface Elevation (ft)
y = -0.0004x + 81.695
R² = 0.096
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year



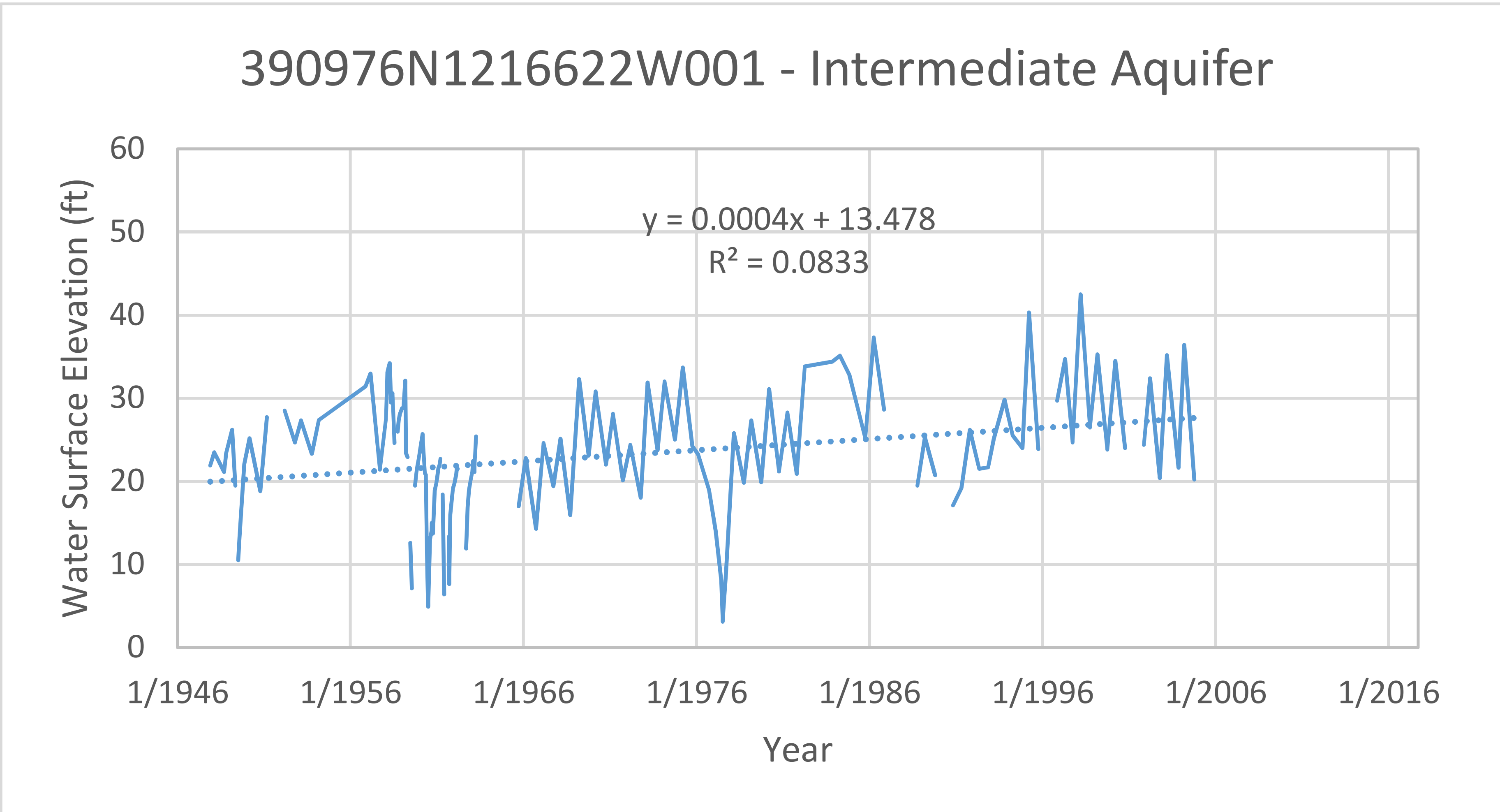
392947N1218022W001 - Unknown Well Depth
Water Surface Elevation (ft)
80
70
60
50
40
30
20
y = -0.0003x + 83.259
R² = 0.1224
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

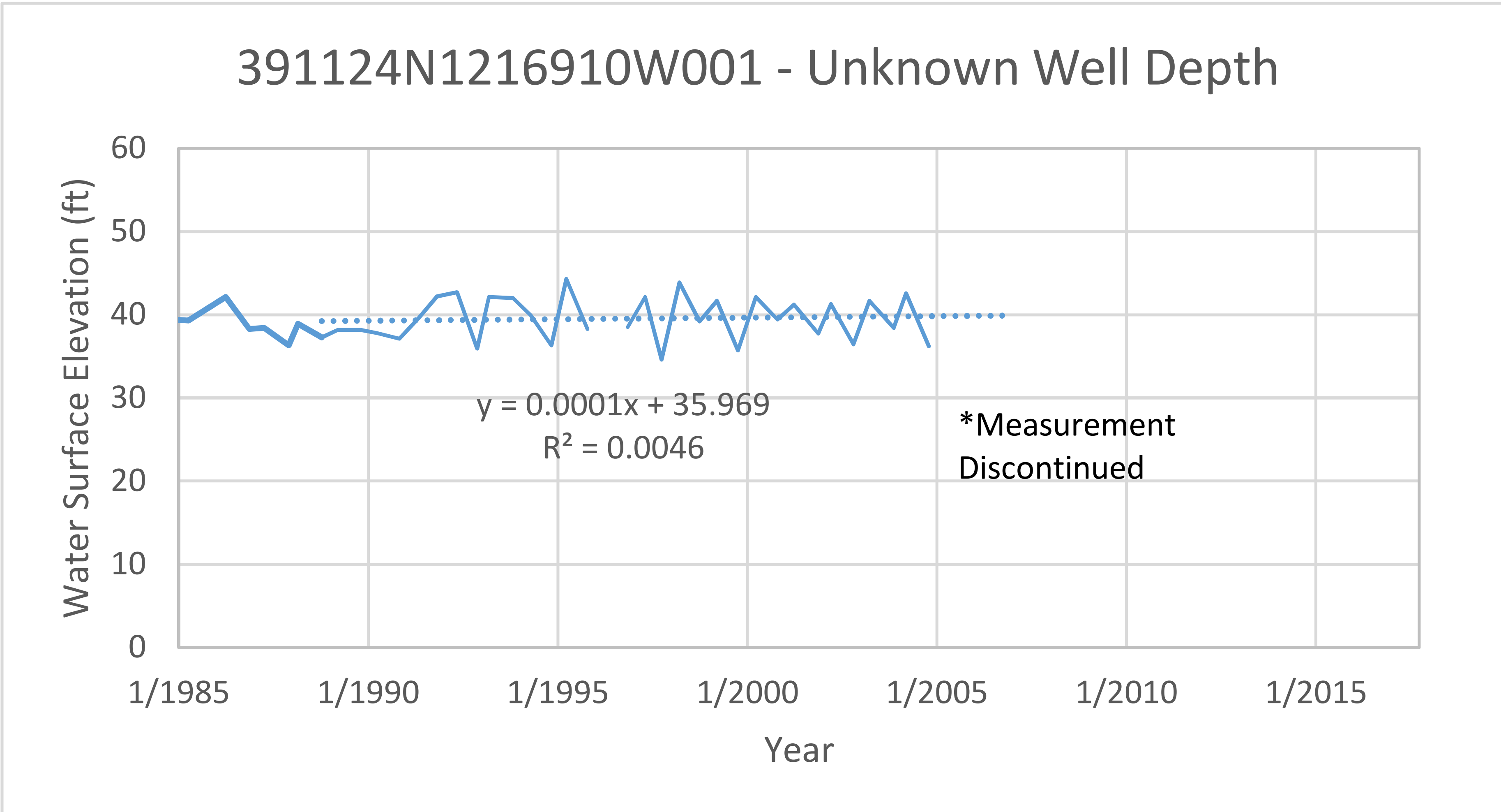


393081N1216163W001 - Unknown Well Depth
y = 1E-05x + 51.759
R² = 1E-05
Water Surface Elevation (ft)
80
70
60
50
40
30
20
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year

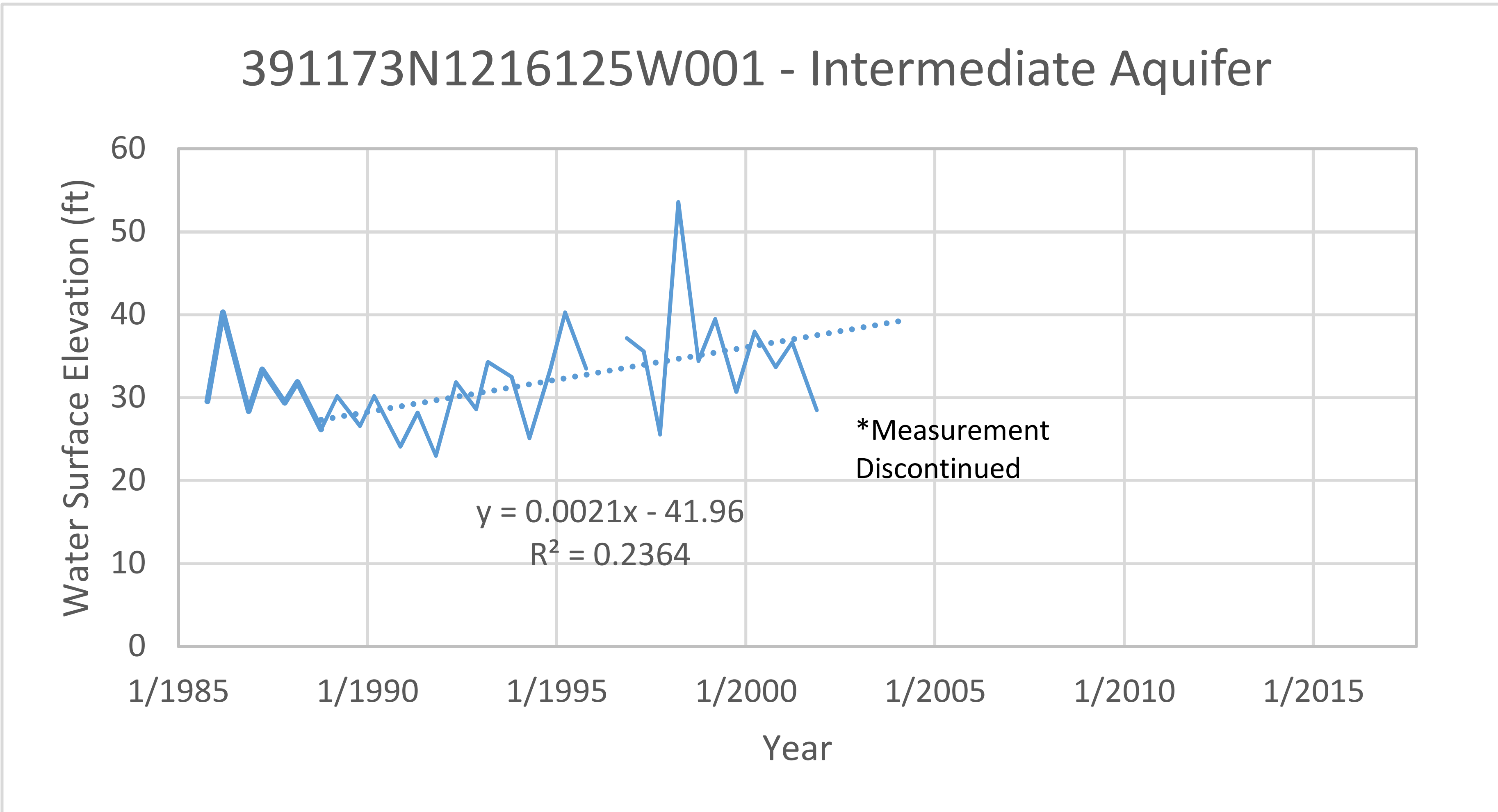


389819N1215949W001 - Intermediate Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
y = 0.0006x + 5.1709
R² = 0.0857
*Measurement
Discontinued
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year


390976N1216622W001 - Intermediate Aquifer
y = 0.0004x + 13.478
R² = 0.0833
Water Surface Elevation (ft)
0
10
20
30
40
50
60
1/1946
1/1956
1/1966
1/1976
1/1986
1/1996
1/2006
1/2016
Year



391124N1216910W001 - Unknown Well Depth
60
50
40
30
20
10
0
Water Surface Elevation (ft)
y = 0.0001x + 35.969
R² = 0.0046
*Measurement
Discontinued
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year



391173N1216125W001 - Intermediate Aquifer
Water Surface Elevation (ft)
60
50
40
30
20
10
0
1/1985
1/1990
1/1995
1/2000
1/2005
1/2010
1/2015
Year
y = 0.0021x - 41.96
R² = 0.2364
*Measurement Discontinued

APPENDIX K
VERTICAL HYDRAULIC GRADIENTS FROM NESTED OR CLUSTERED MONITORING WELLS

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VERTICAL GRADIENTS WITH SHALLOW AQUIFER HEADS GREATER THAN INTERMEDIATE OR DEEP AQUIFERS

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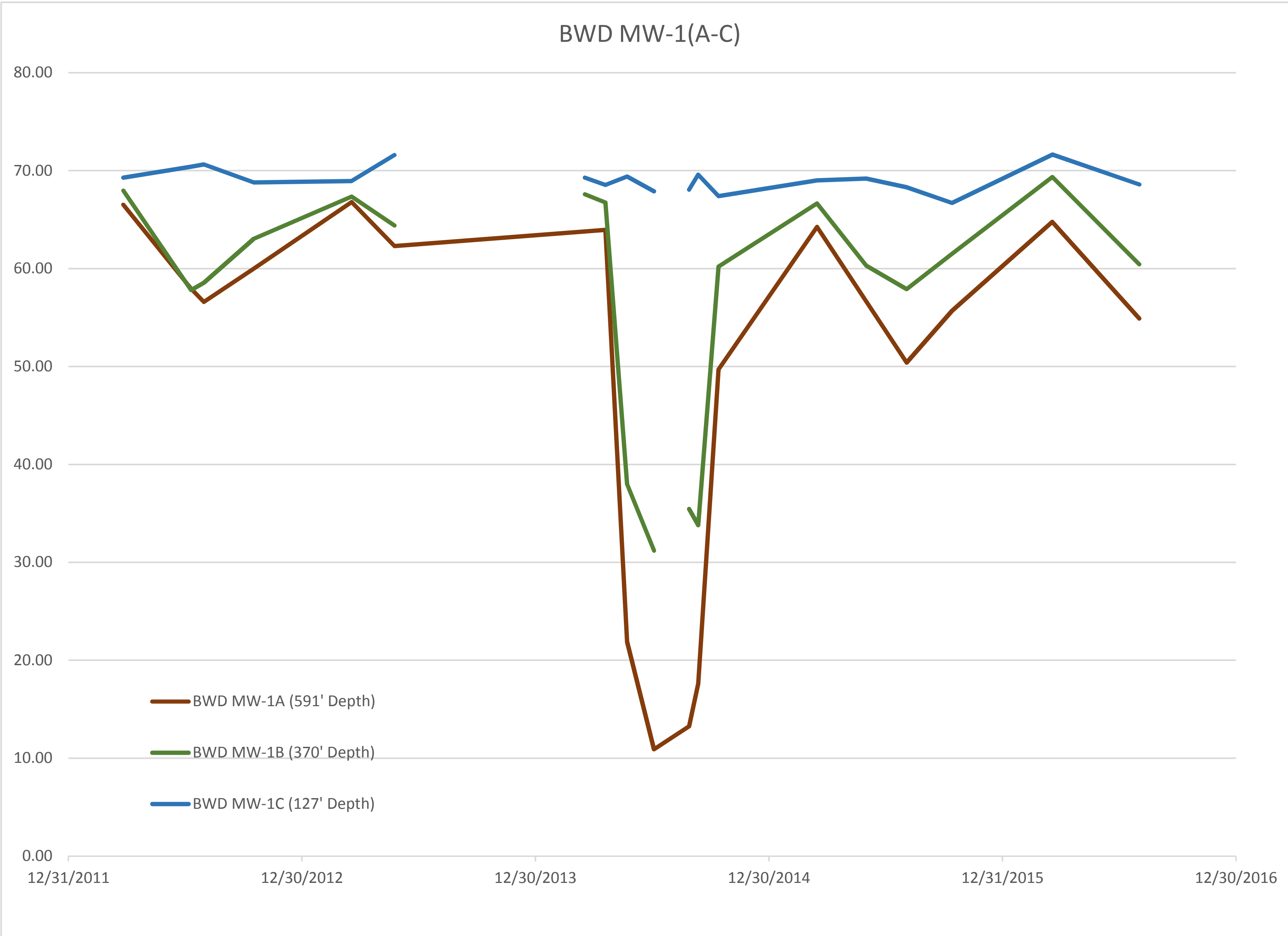
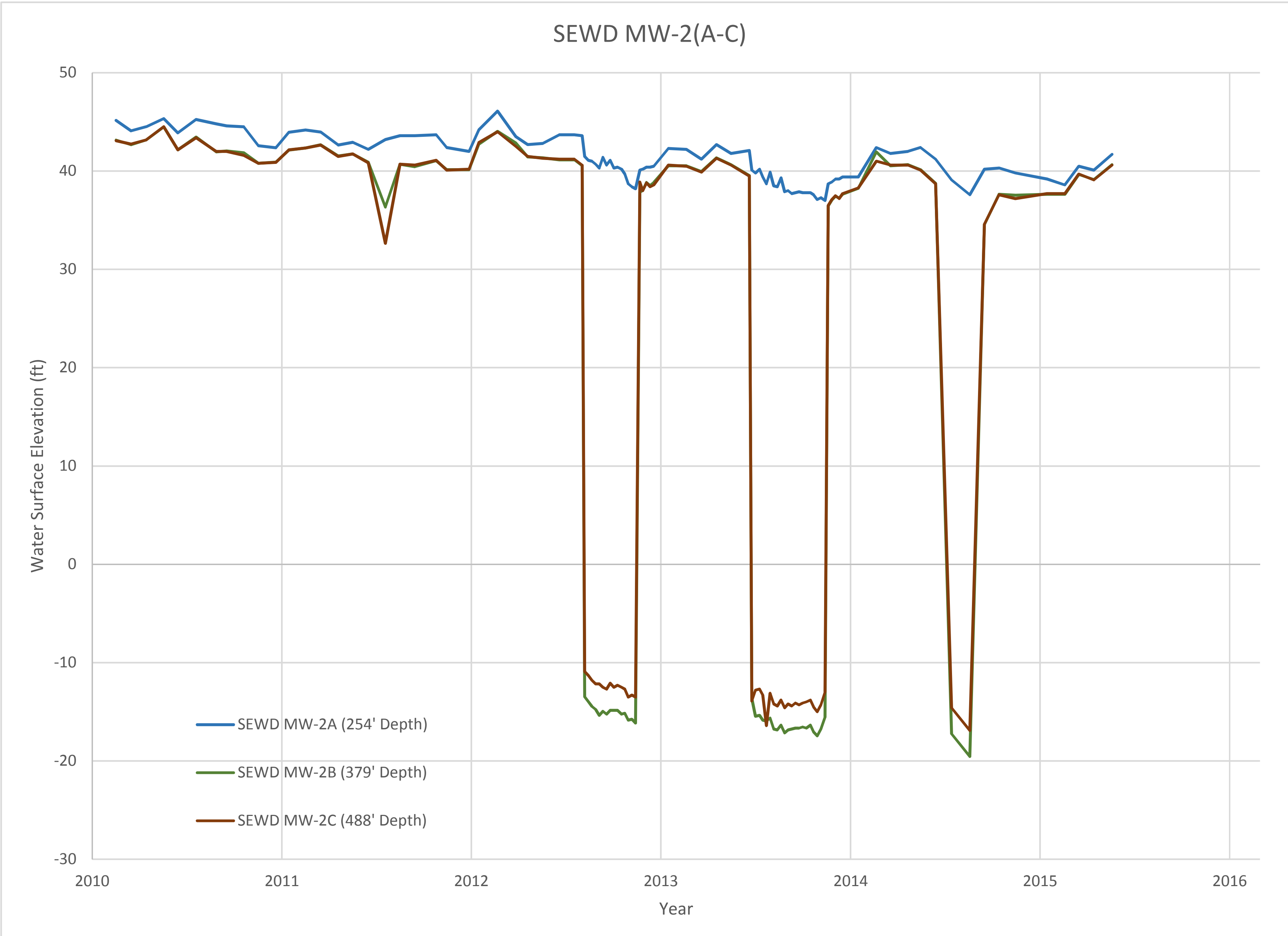
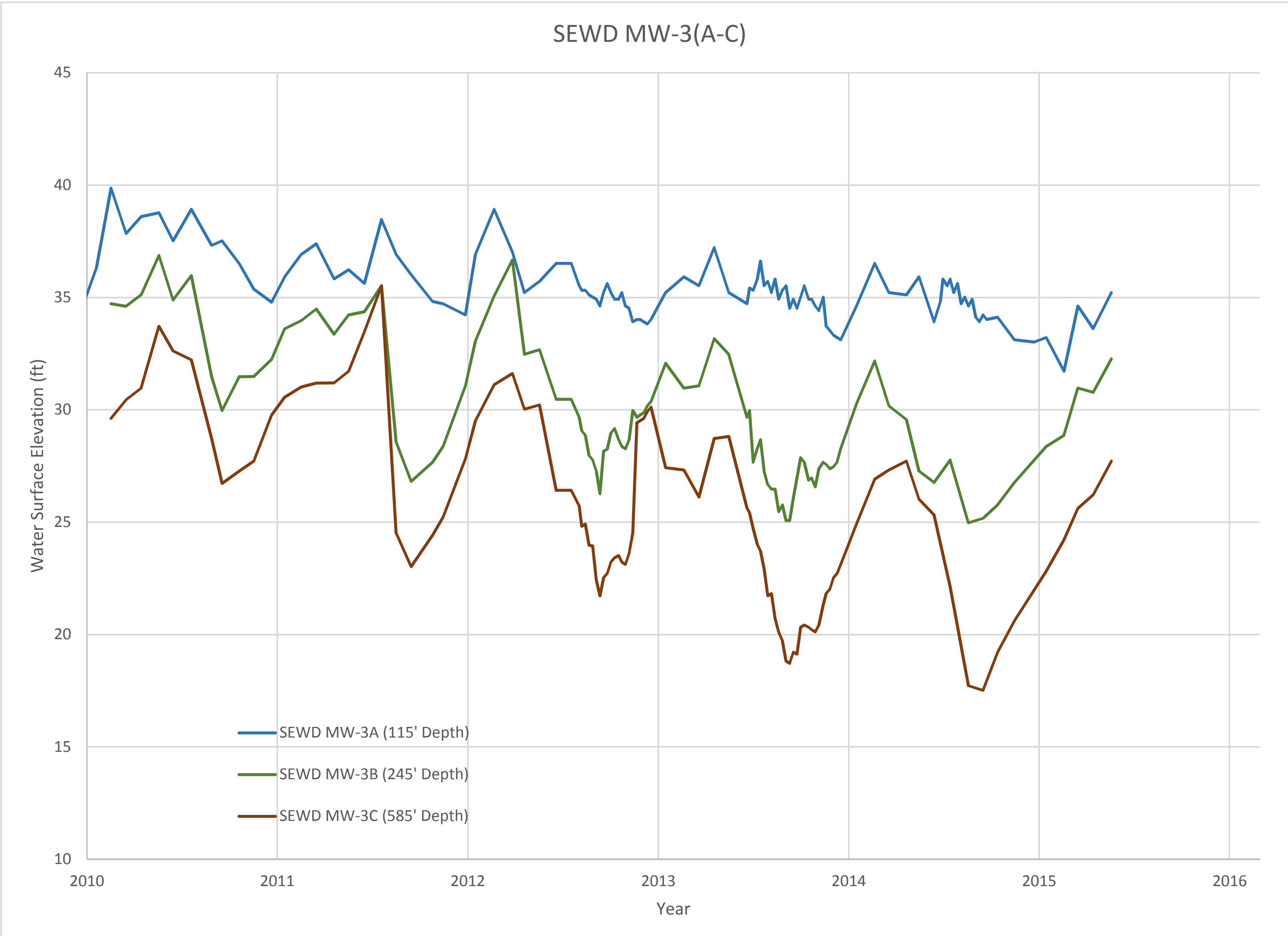
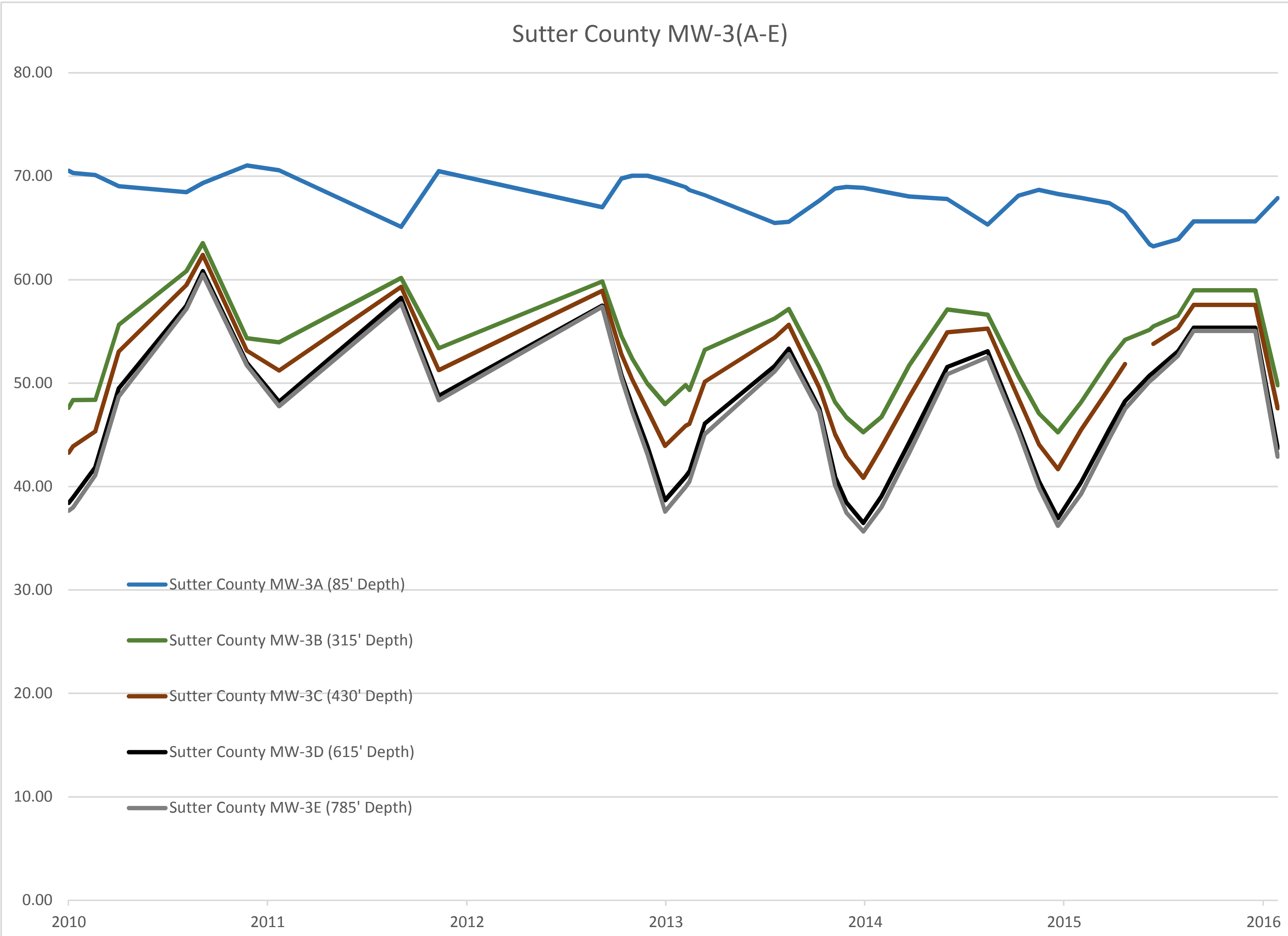


BWD MW-1(A-C)
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
12/31/2011
12/30/2012
12/30/2013
12/30/2014
12/31/2015
12/30/2016
BWD MW-1A (591' Depth)
BWD MW-1B (370' Depth)
BWD MW-1C (127' Depth)

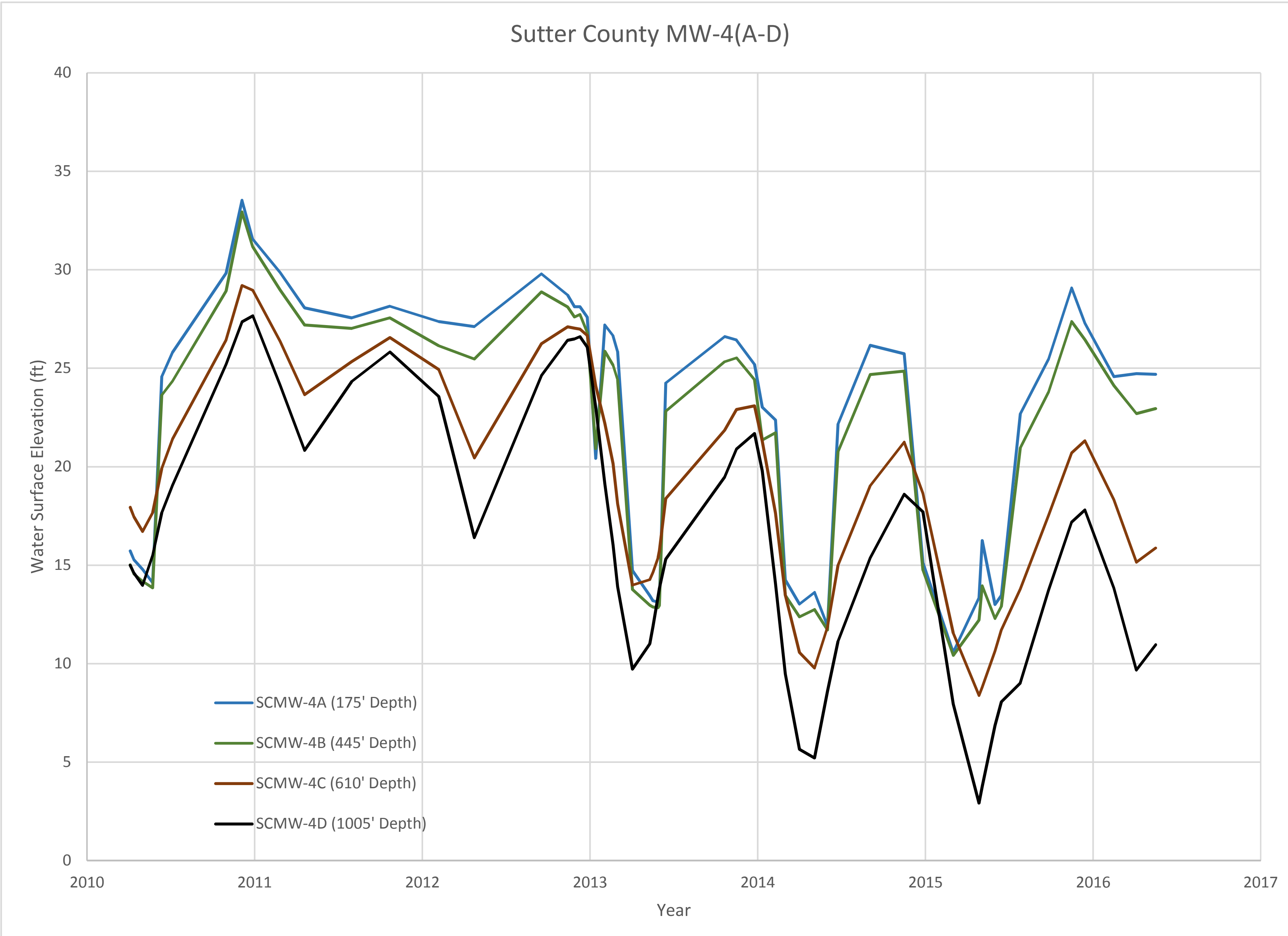
Flood MW-1(A-C)
Water Surface Elevation (ft)
40
30
20
10
0
-10
-20
-30
2010
2011
2012
2013
2014
2015
2016
Year
Flood MW-1C (Shallow 100' Depth)
Flood MW-1B (Intermediate 160' Depth)
Flood MW-1A (Deep 310' Depth)

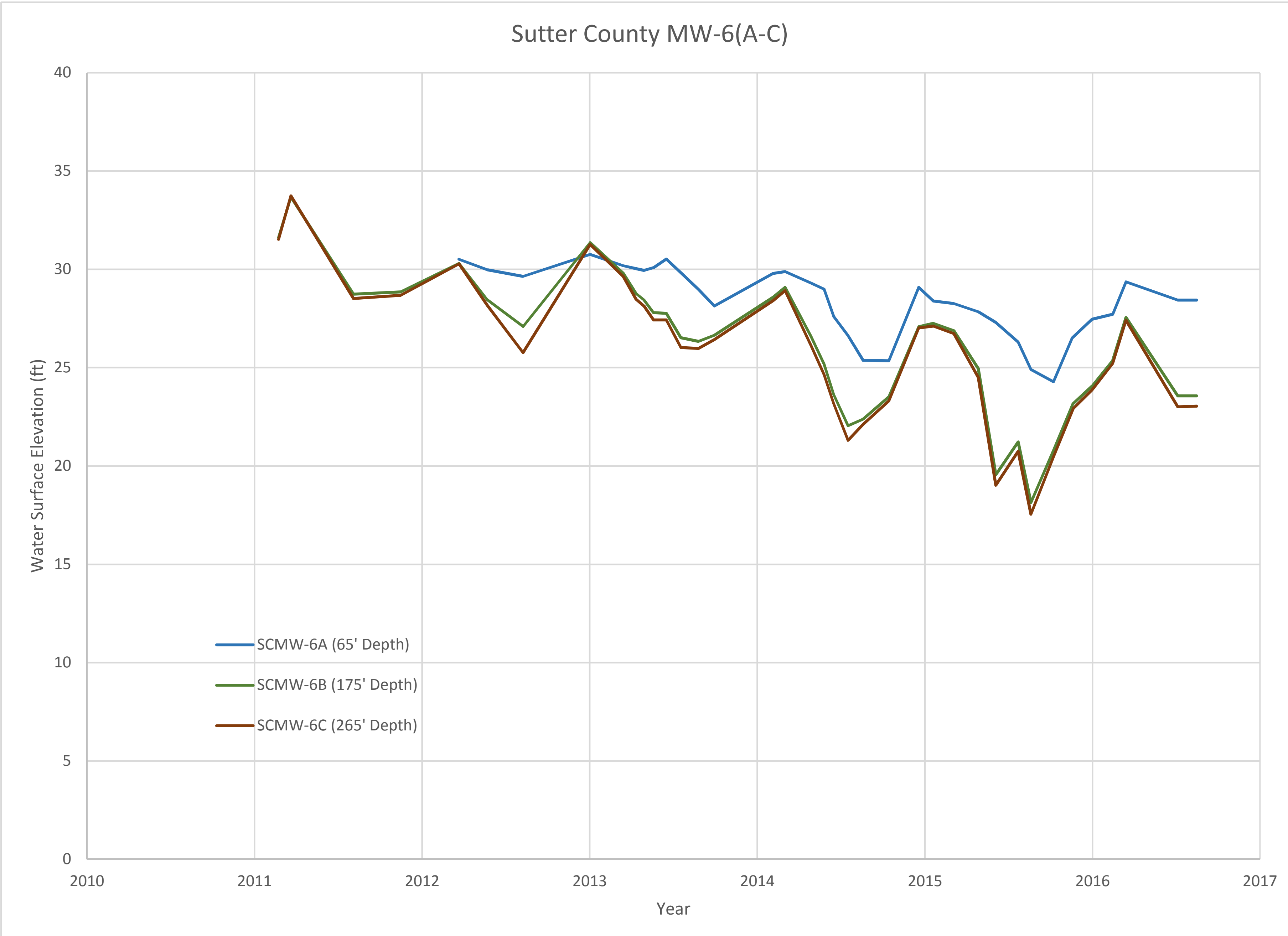

SEWD MW-2(A-C)
Water Surface Elevation (ft)
50
40
30
20
10
0
-10
-20
-30
2010
2011
2012
2013
2014
2015
2016
Year
SEWD MW-2A (254' Depth)
SEWD MW-2B (379' Depth)
SEWD MW-2C (488' Depth)


SEWD MW-3(A-C)
Water Surface Elevation (ft)
45
40
35
30
25
20
15
10
2010
2011
2012
2013
2014
2015
2016
Year
SEWD MW-3A (115' Depth)
SEWD MW-3B (245' Depth)
SEWD MW-3C (585' Depth)



Sutter County MW-3(A-E)
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
2010
2011
2012
2013
2014
2015
2016
Sutter County MW-3A (85' Depth)
Sutter County MW-3B (315' Depth)
Sutter County MW-3C (430' Depth)
Sutter County MW-3D (615' Depth)
Sutter County MW-3E (785' Depth)


Sutter County MW-4(A-D)
40
35
30
25
20
15
10
5
0
Water Surface Elevation (ft)
2010
2011
2012
2013
2014
2015
2016
2017
Year
SCMW-4A (175' Depth)
SCMW-4B (445' Depth)
SCMW-4C (610' Depth)
SCMW-4D (1005' Depth)


Sutter County MW-6(A-C)
Water Surface Elevation (ft)
0
5
10
15
20
25
30
35
40
2010
2011
2012
2013
2014
2015
2016
2017
Year
SCMW-6A (65' Depth)
SCMW-6B (175' Depth)
SCMW-6C (265' Depth)

VERTICAL GRADIENTS WITH SHALLOW AQUIFER HEADS LESS THAN INTERMEDIATE OR DEEP AQUIFERS

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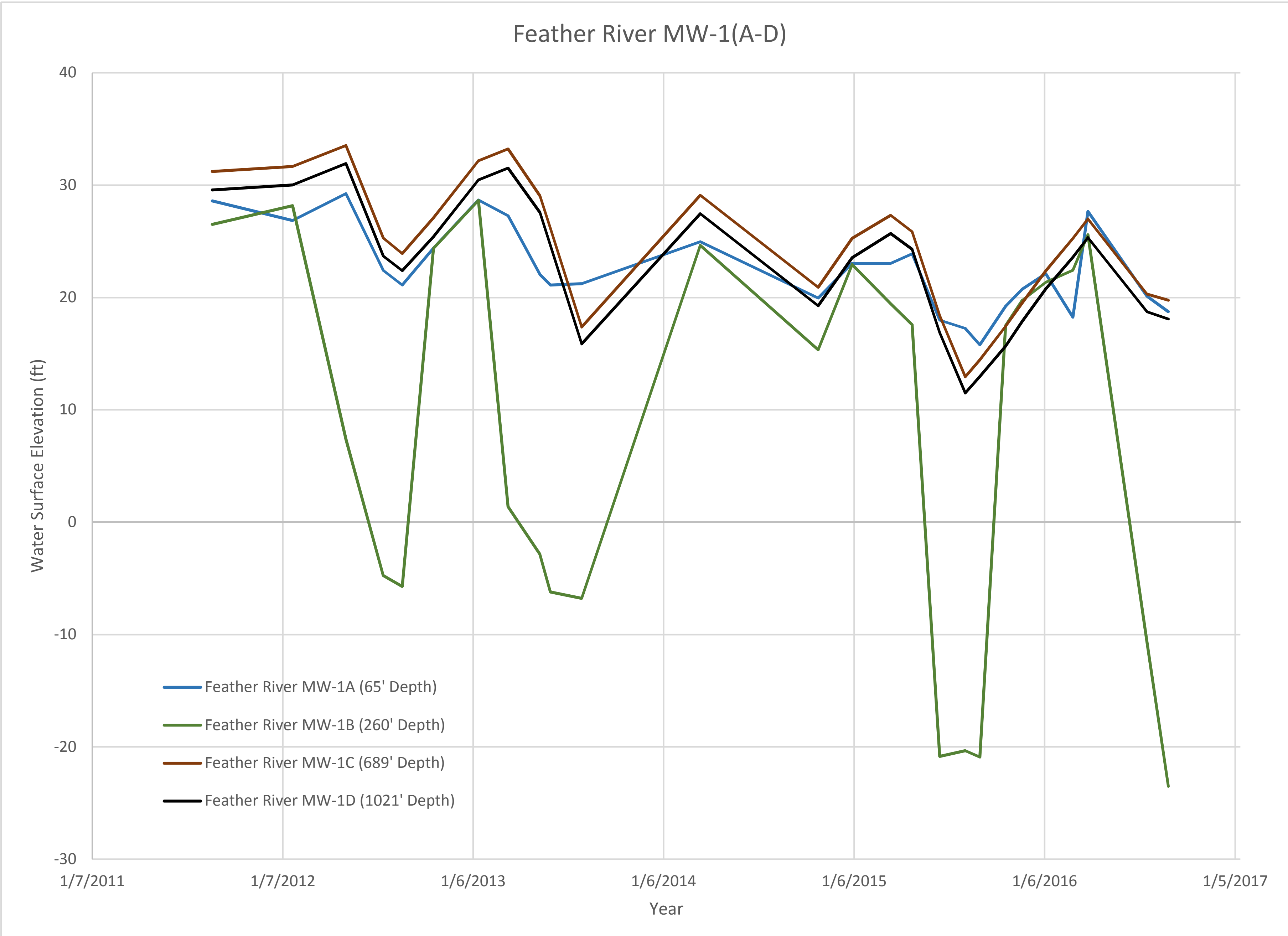
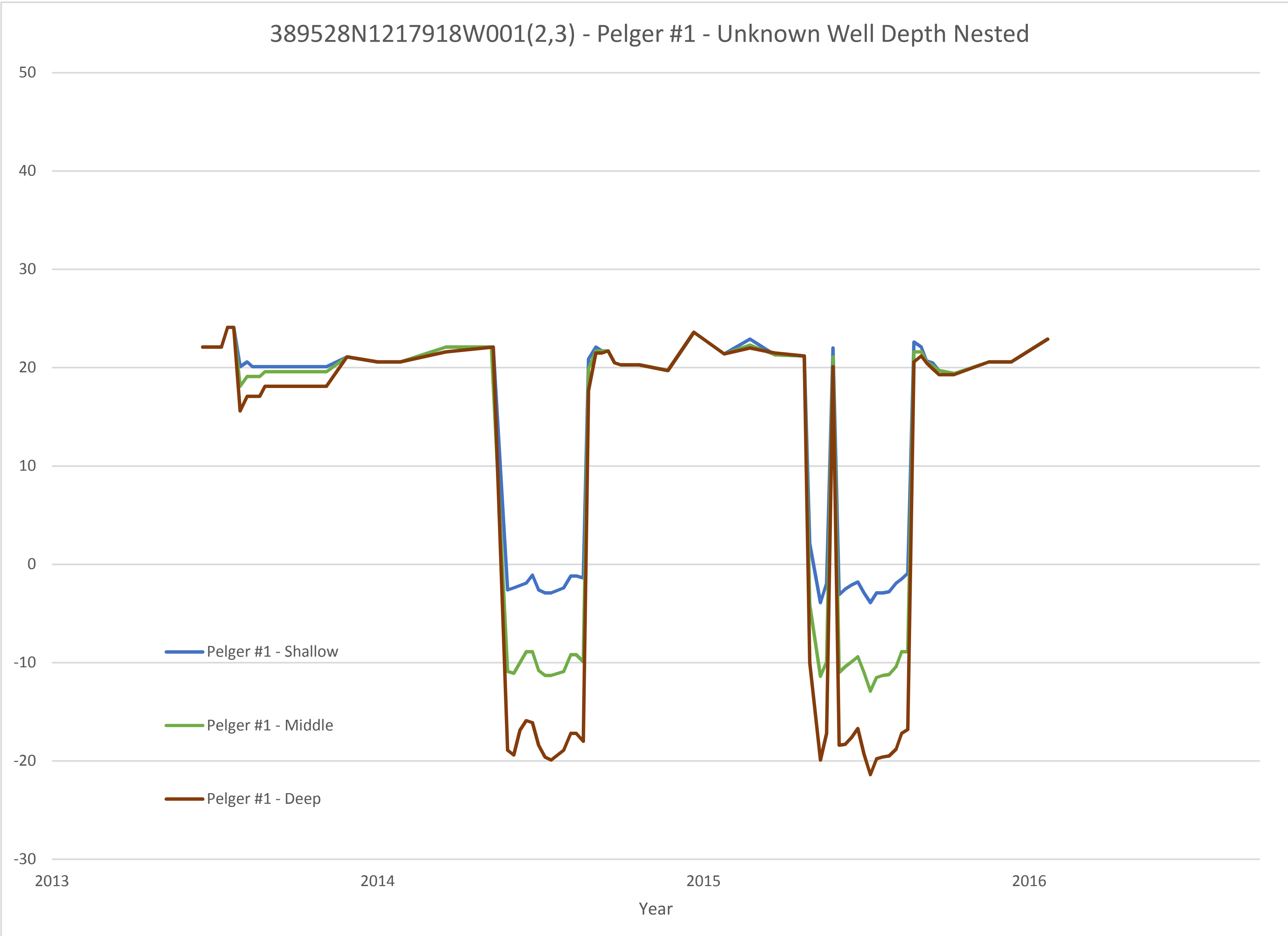
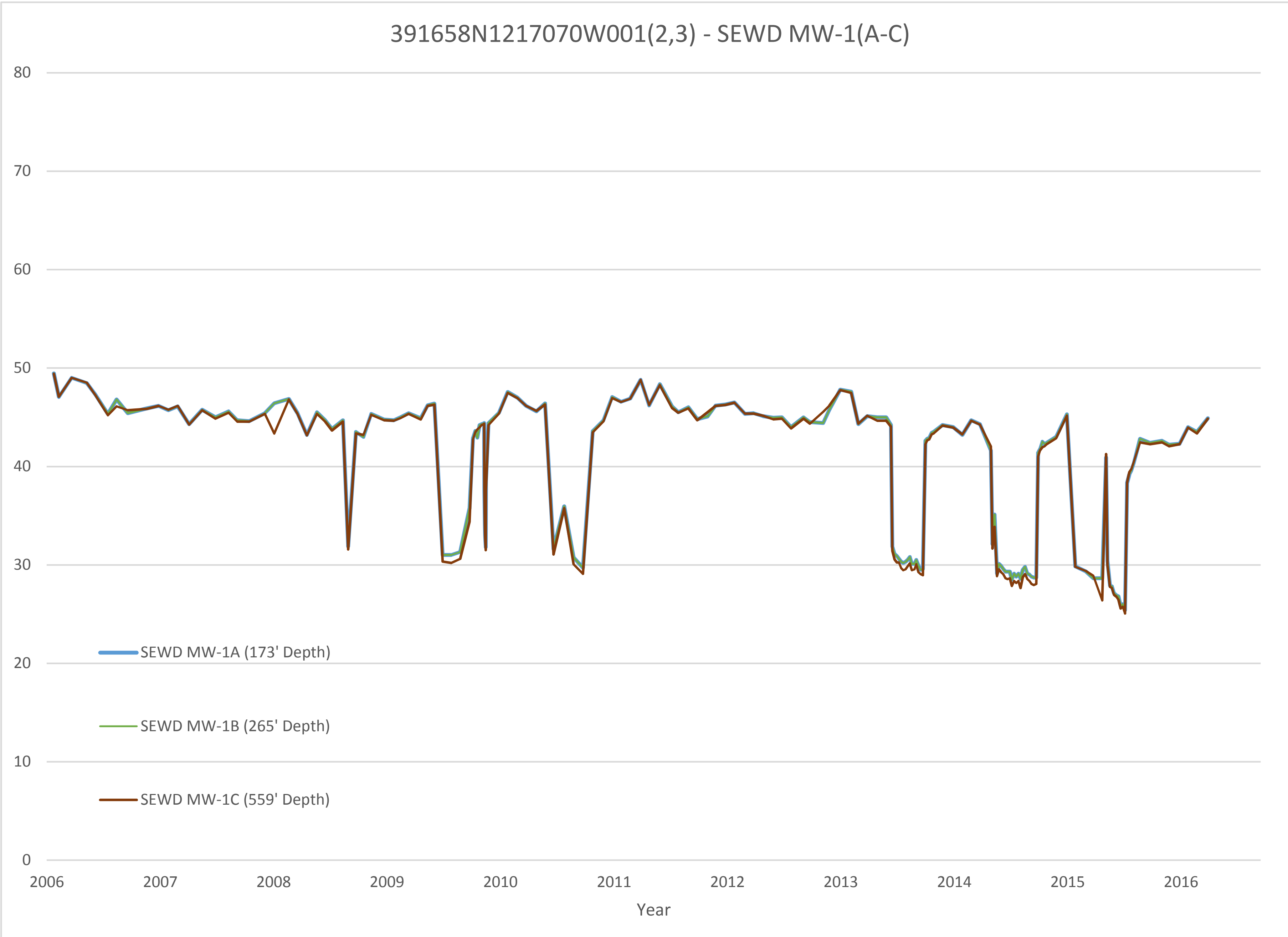


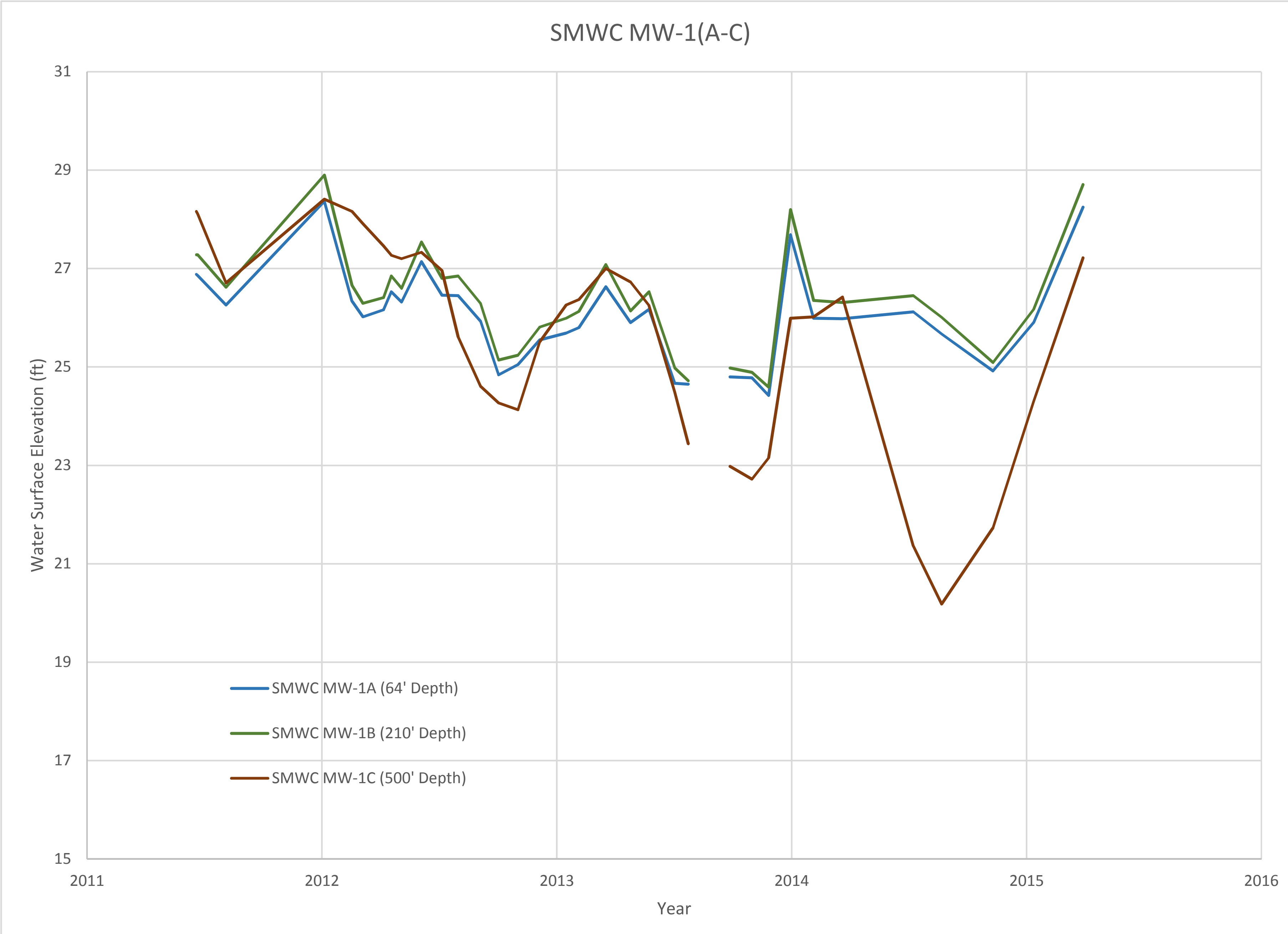
Feather River MW-1(A-D)
40
30
20
10
0
-10
-20
-30
Water Surface Elevation (ft)
1/7/2011
1/7/2012
1/6/2013
1/6/2014
1/6/2015
1/6/2016
1/5/2017
Year
Feather River MW-1A (65' Depth)
Feather River MW-1B (260' Depth)
Feather River MW-1C (689' Depth)
Feather River MW-1D (1021' Depth)



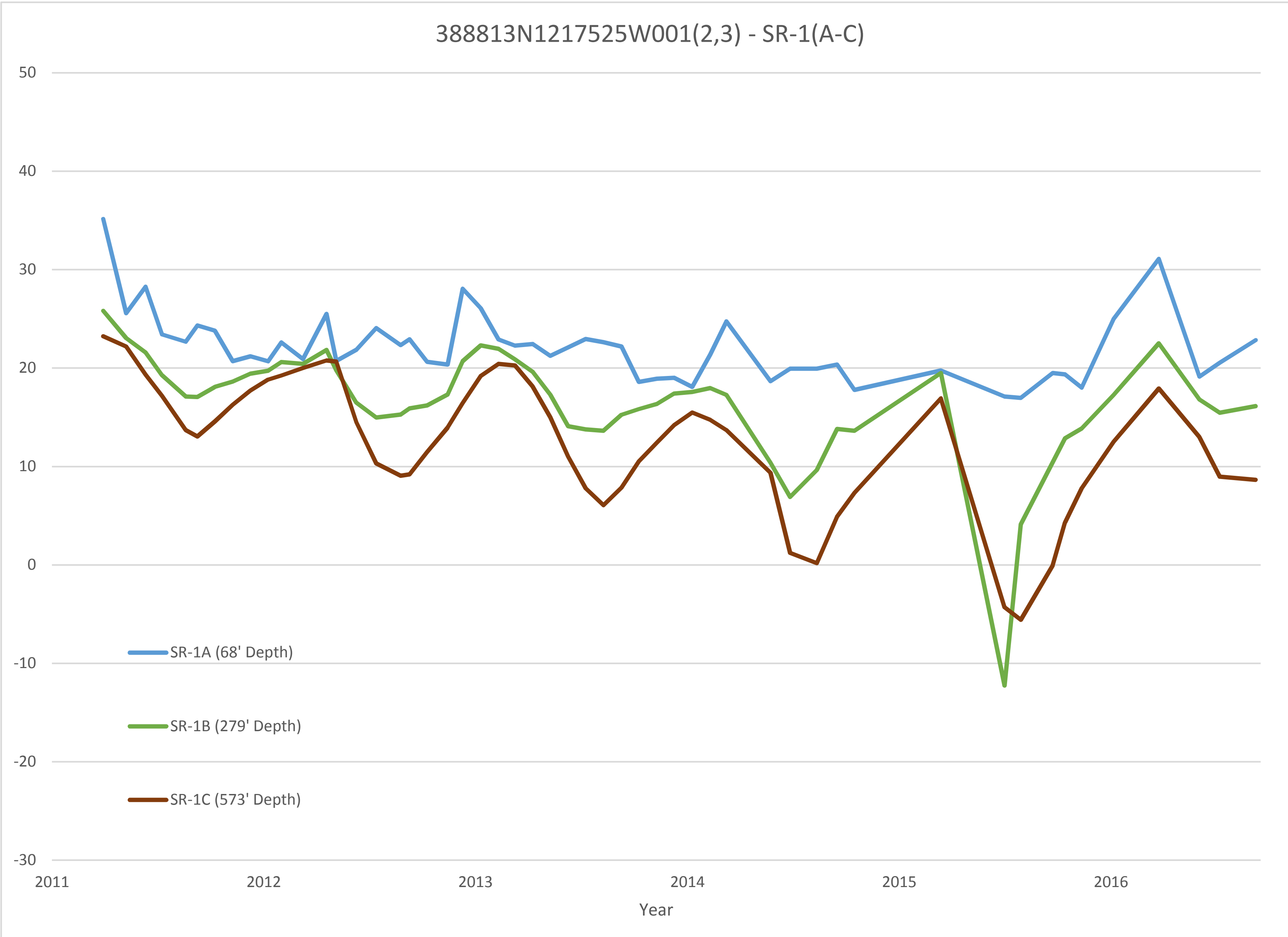
389528N1217918W001(2,3) - Pelger #1 - Unknown Well Depth Nested
50
40
30
20
10
0
-10
-20
-30
2013
2014
2015
2016
Year
Pelger #1 - Shallow
Pelger #1 - Middle
Pelger #1 - Deep

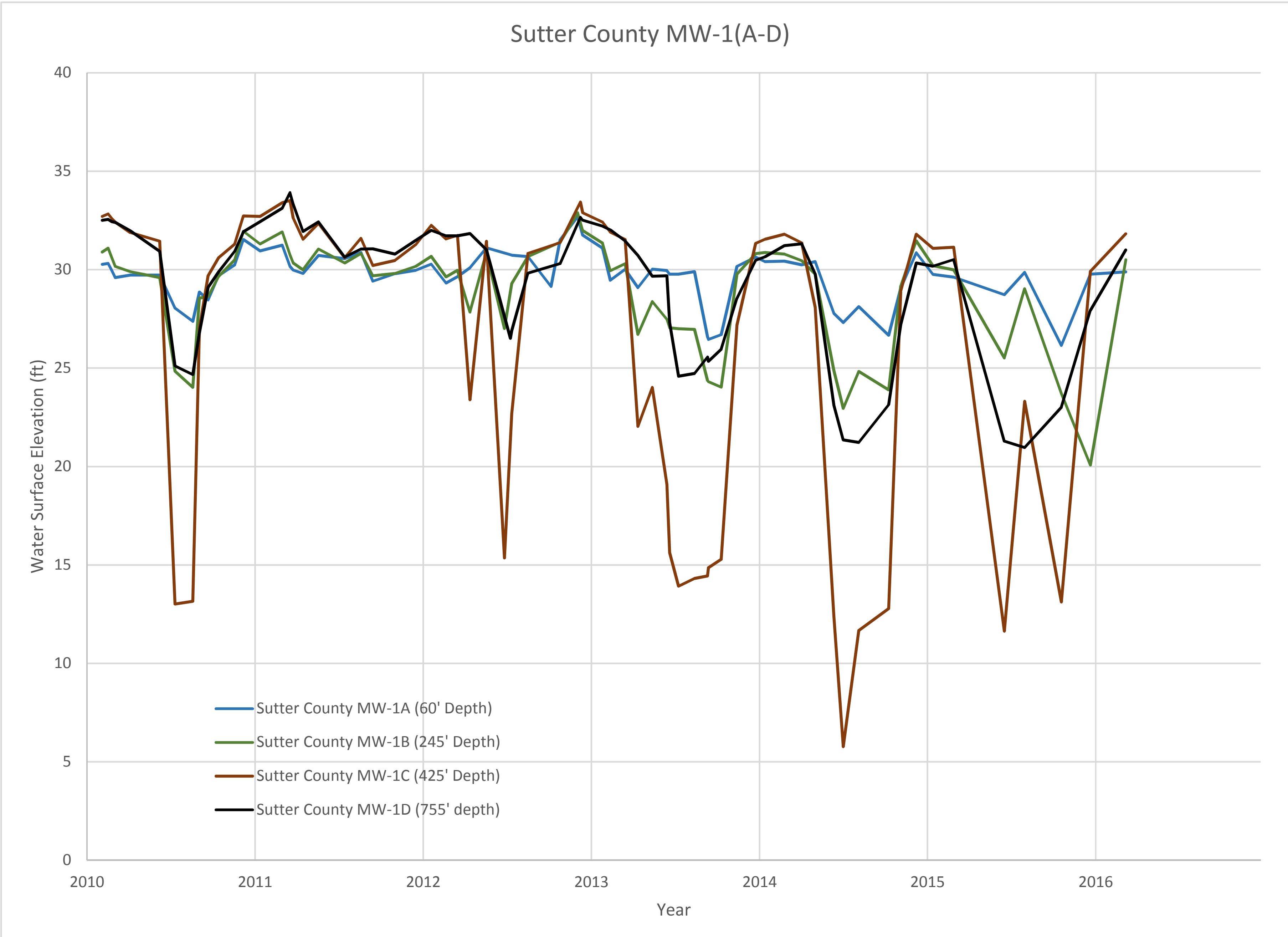


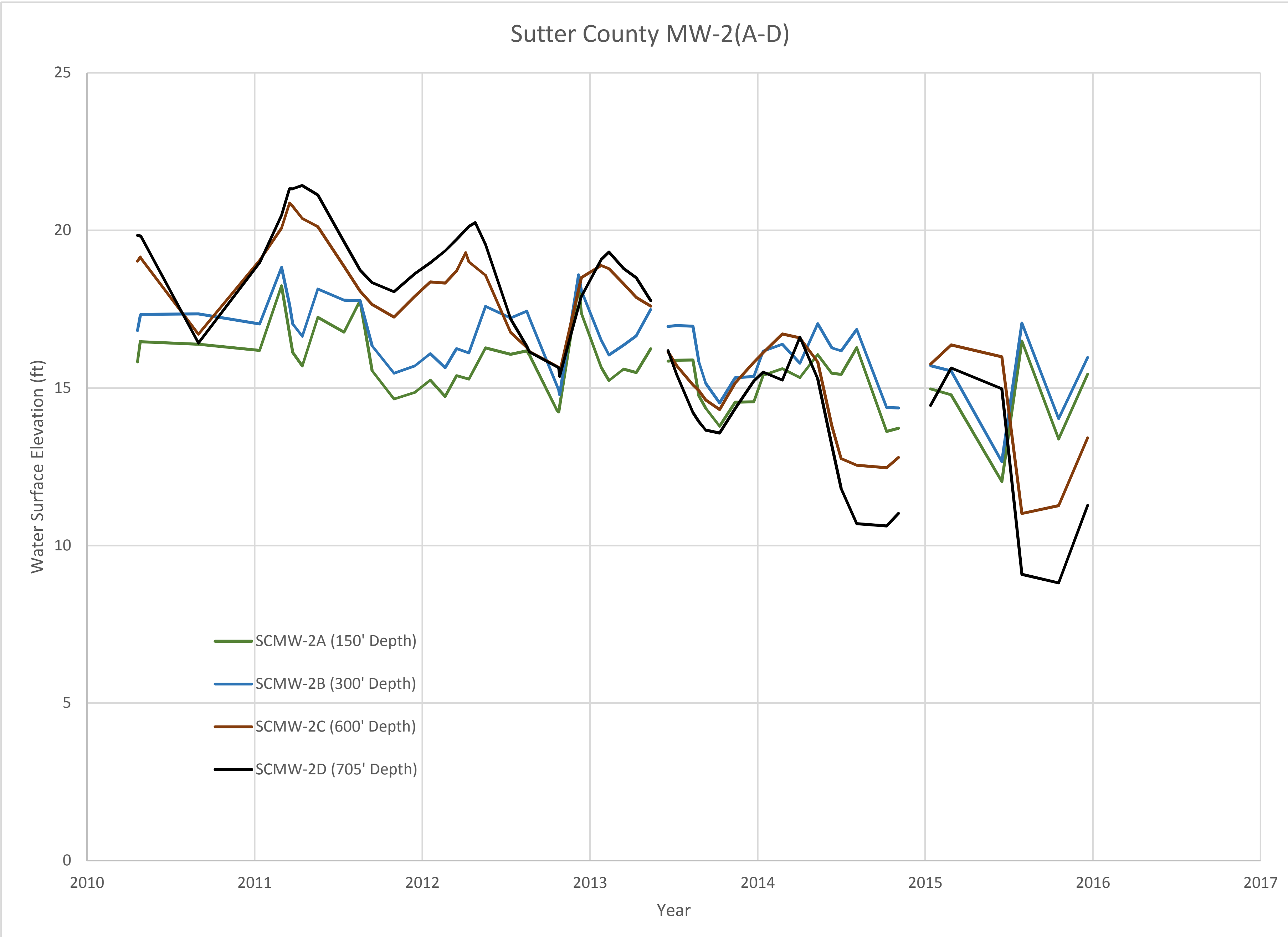
391658N1217070W001(2,3) - SEWD MW-1(A-C)
80
70
60
50
40
30
20
10
0
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year
SEWD MW-1A (173' Depth)
SEWD MW-1B (265' Depth)
SEWD MW-1C (559' Depth)



SMWC MW-1(A-C)
Water Surface Elevation (ft)
31
29
27
25
23
21
19
17
15
2011
2012
2013
2014
2015
2016
Year
SMWC MW-1A (64' Depth)
SMWC MW-1B (210' Depth)
SMWC MW-1C (500' Depth)


388813N1217525W001(2,3) - SR-1(A-C)
50
40
30
20
10
0
-10
-20
-30
2011
2012
2013
2014
2015
2016
Year
SR-1A (68' Depth)
SR-1B (279' Depth)
SR-1C (573' Depth)


Sutter County MW-1(A-D)
40
35
30
25
20
15
10
5
0
Water Surface Elevation (ft)
2010
2011
2012
2013
2014
2015
2016
Year
Sutter County MW-1A (60' Depth)
Sutter County MW-1B (245' Depth)
Sutter County MW-1C (425' Depth)
Sutter County MW-1D (755' depth)


Sutter County MW-2(A-D)
25
20
15
10
5
0
Water Surface Elevation (ft)
2010
2011
2012
2013
2014
2015
2016
2017
Year
SCMW-2A (150' Depth)
SCMW-2B (300' Depth)
SCMW-2C (600' Depth)
SCMW-2D (705' Depth)

APPENDIX L
ADDITIONAL MODEL INFORMATION

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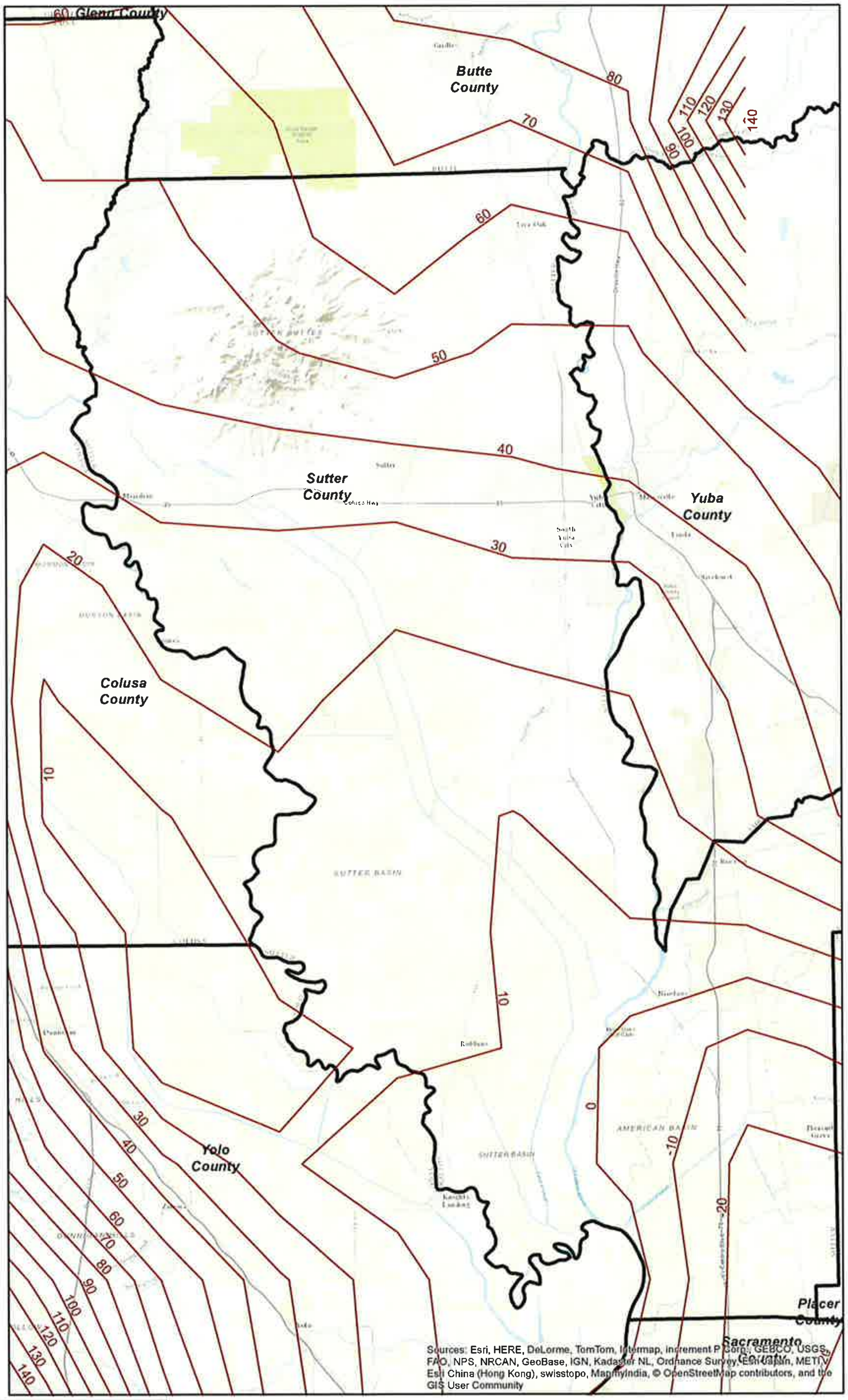
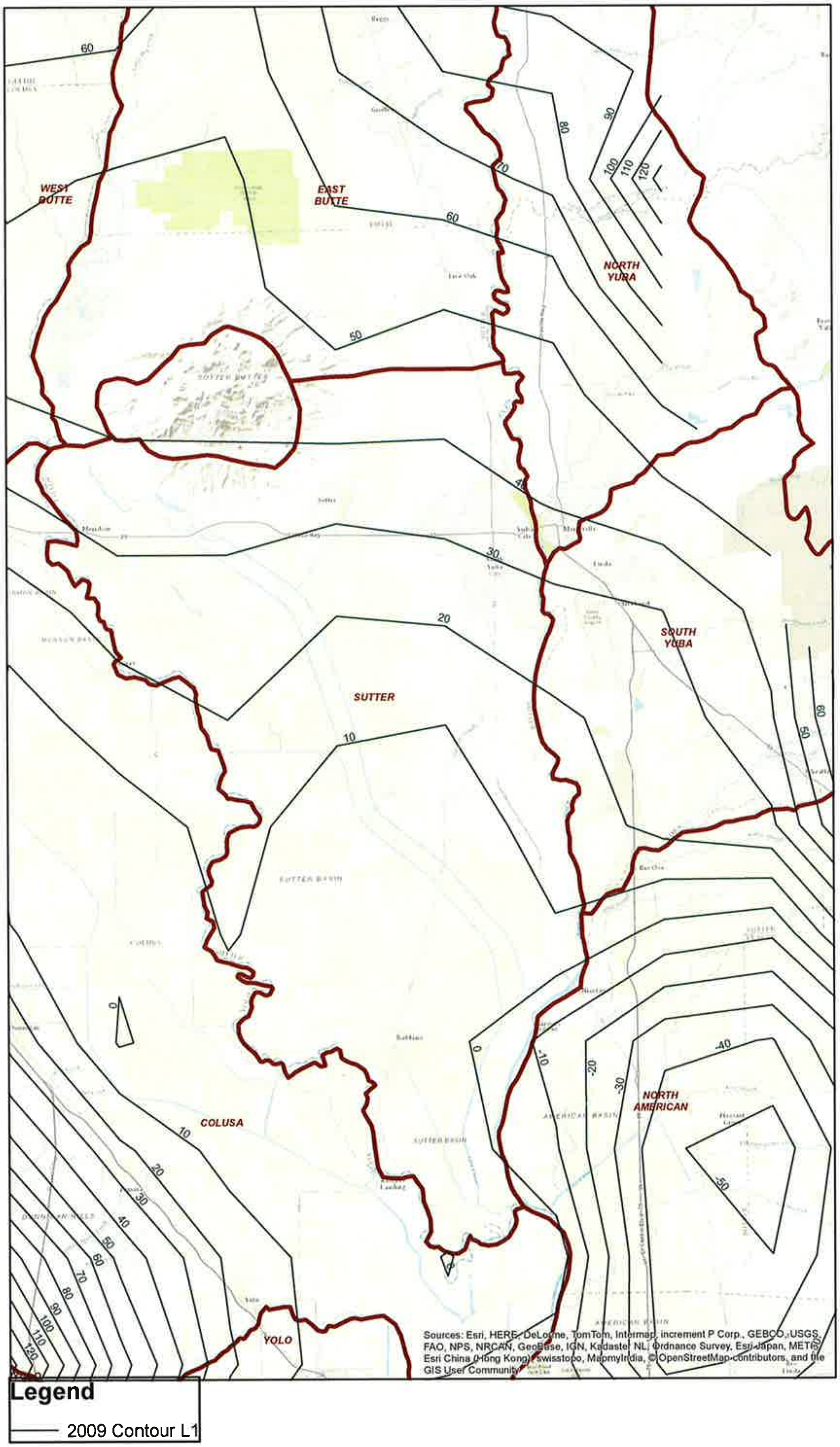
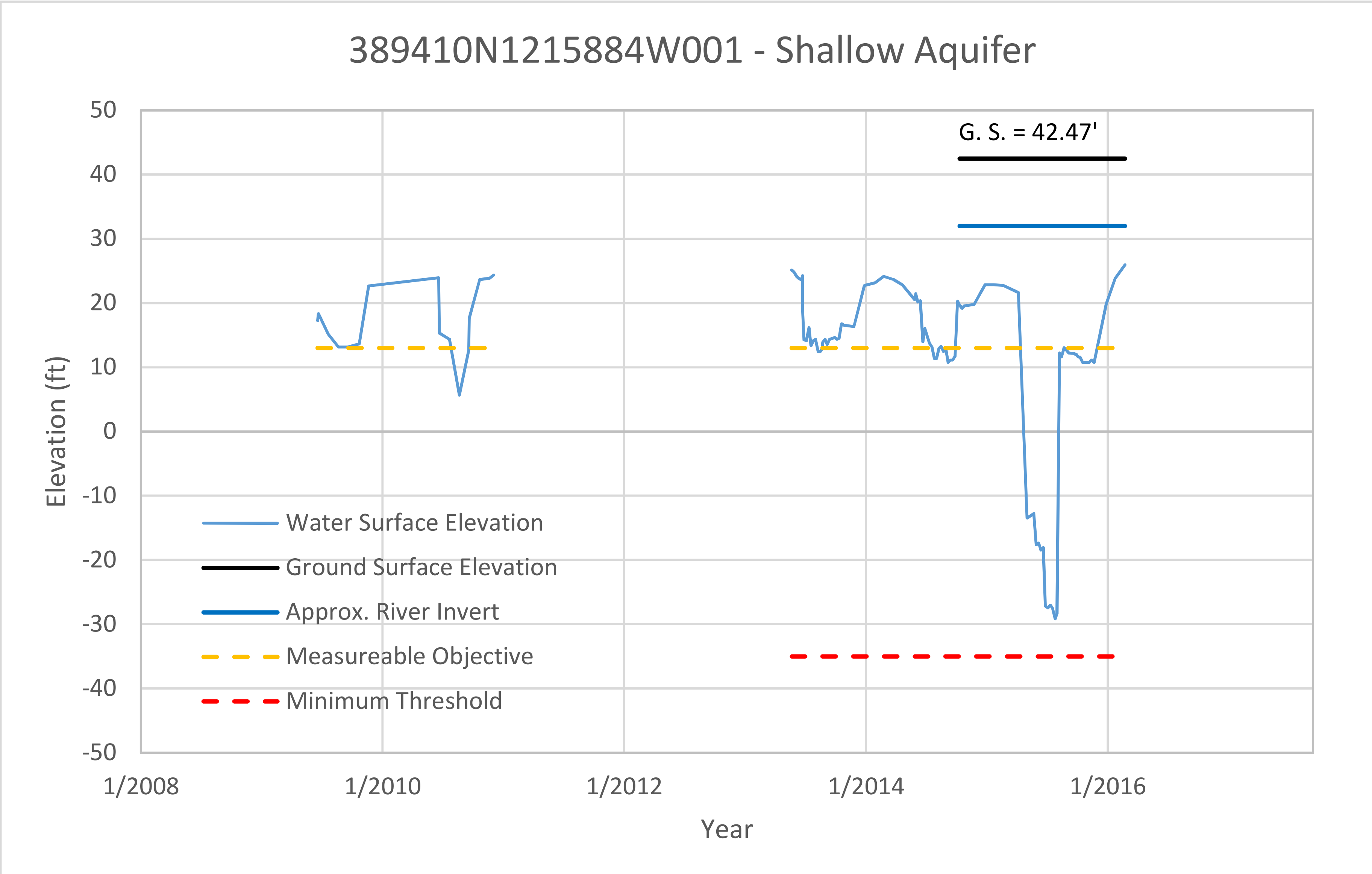


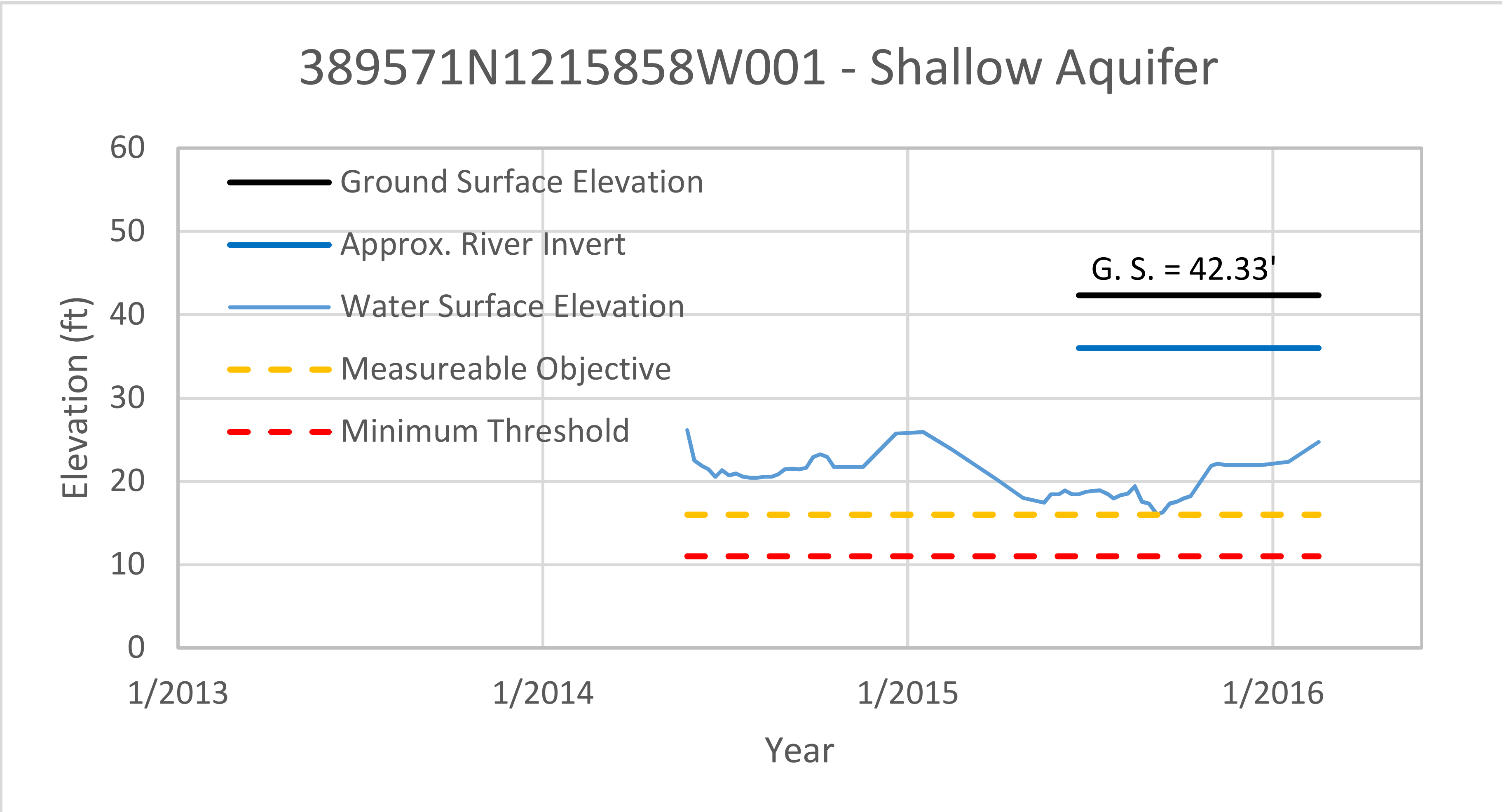
Legend

Contour 1988

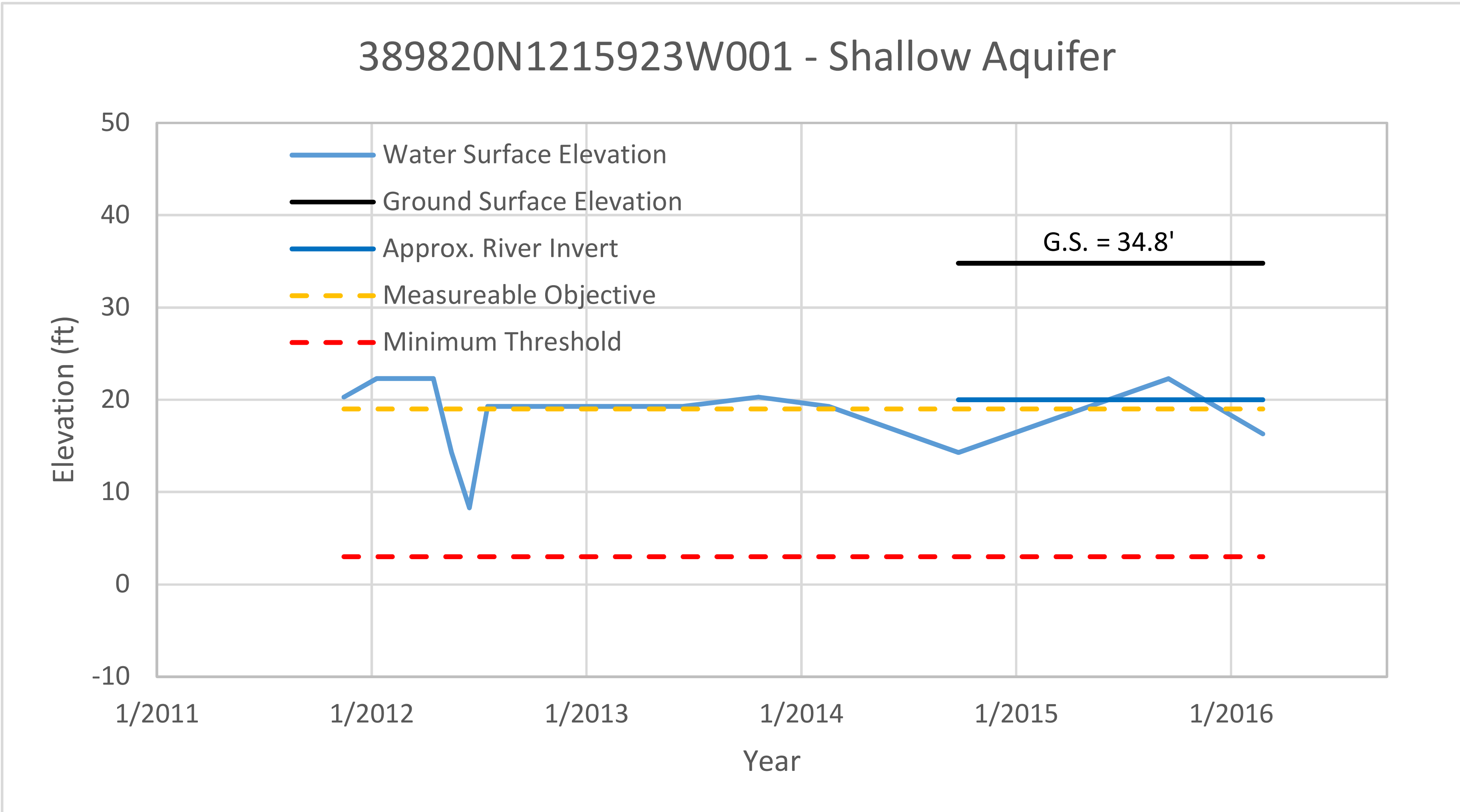

WEST BUTTE
EAST BUTTE
NORTH YUBA
SOUTH YUBA
SUTTER
COLUSA
NORTH AMERICAN
YOLO
60
70
80
90
100
110
120
50
40
30
20
10
0
-10
-20
-30
-40
-50
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Legend
2009 Contour L1

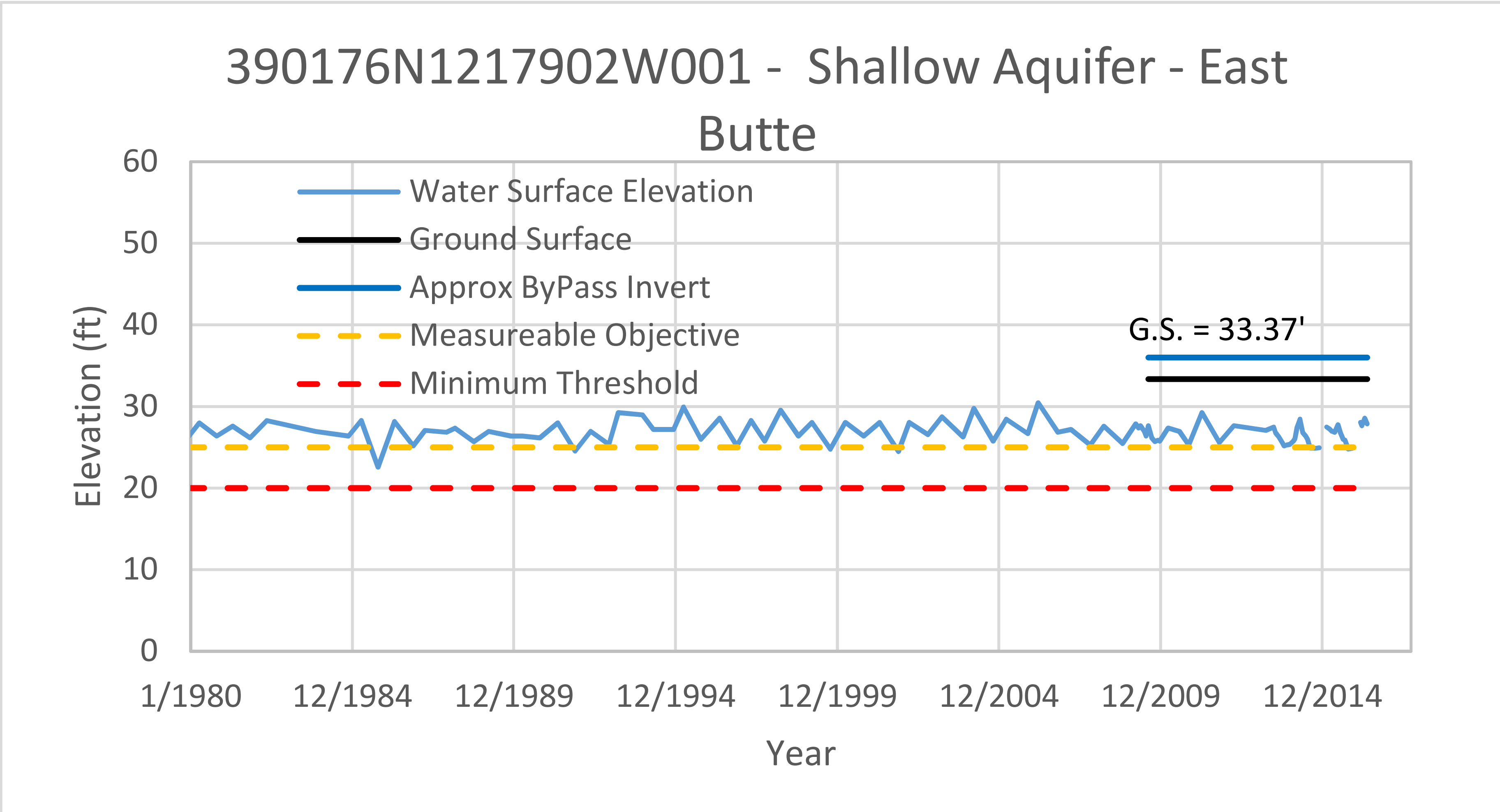
APPENDIX M
SURFACE WATER DEPLETION
SHALLOW AQUIFER
MEASUREABLE OBJECTIVES AND
MINIMUM TRESHOLDS


389410N1215884W001 - Shallow Aquifer
G. S. = 42.47'
50
40
30
20
10
0
-10
-20
-30
-40
-50
Elevation (ft)
1/2008
1/2010
1/2012
1/2014
1/2016
Year
Water Surface Elevation
Ground Surface Elevation
Approx. River Invert
Measureable Objective
Minimum Threshold

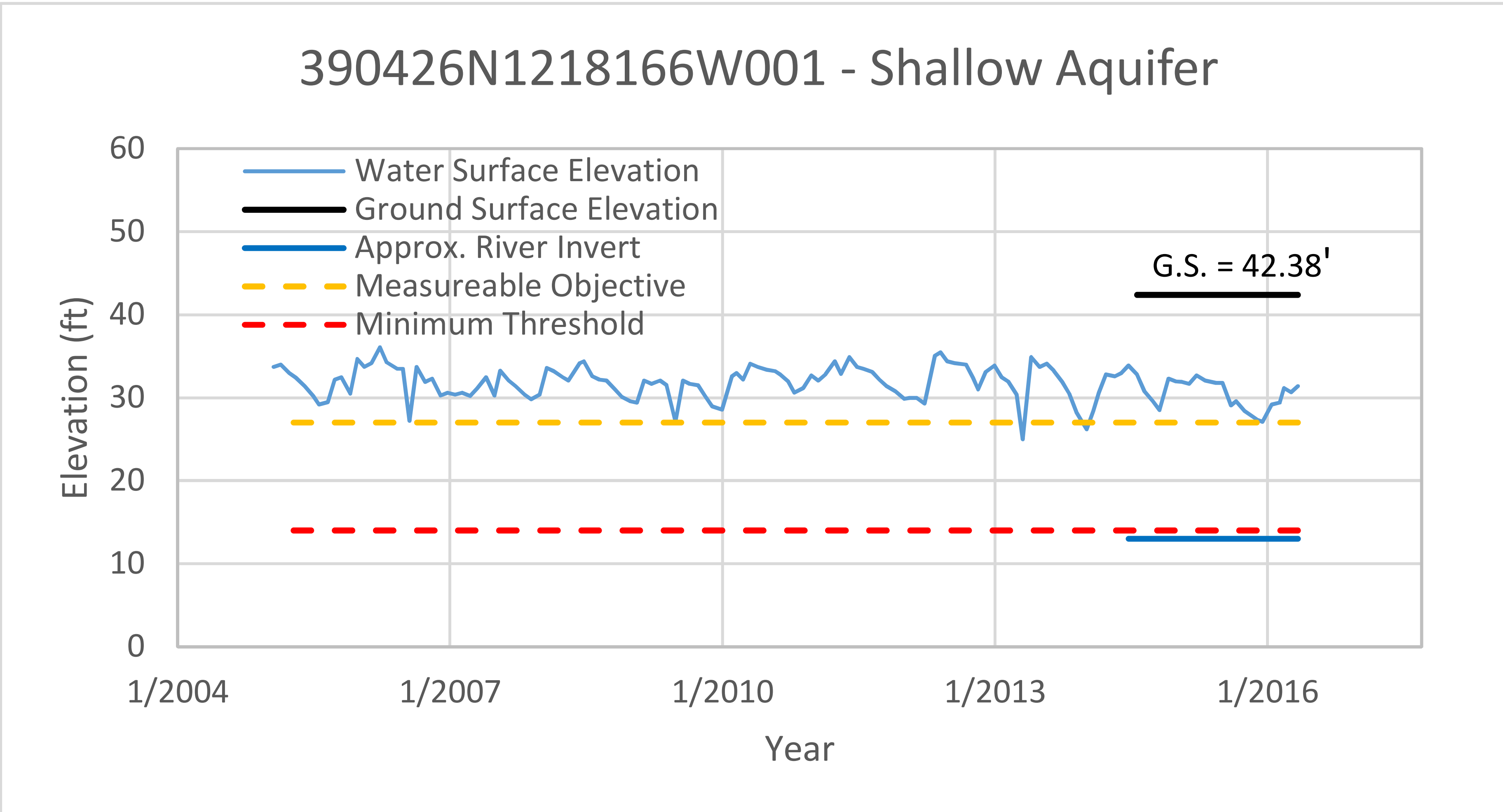


389571N1215858W001 - Shallow Aquifer
Ground Surface Elevation
Approx. River Invert
Water Surface Elevation
Measureable Objective
Minimum Threshold
G. S. = 42.33'
Elevation (ft)
60
50
40
30
20
10
0
1/2013
1/2014
1/2015
1/2016
Year

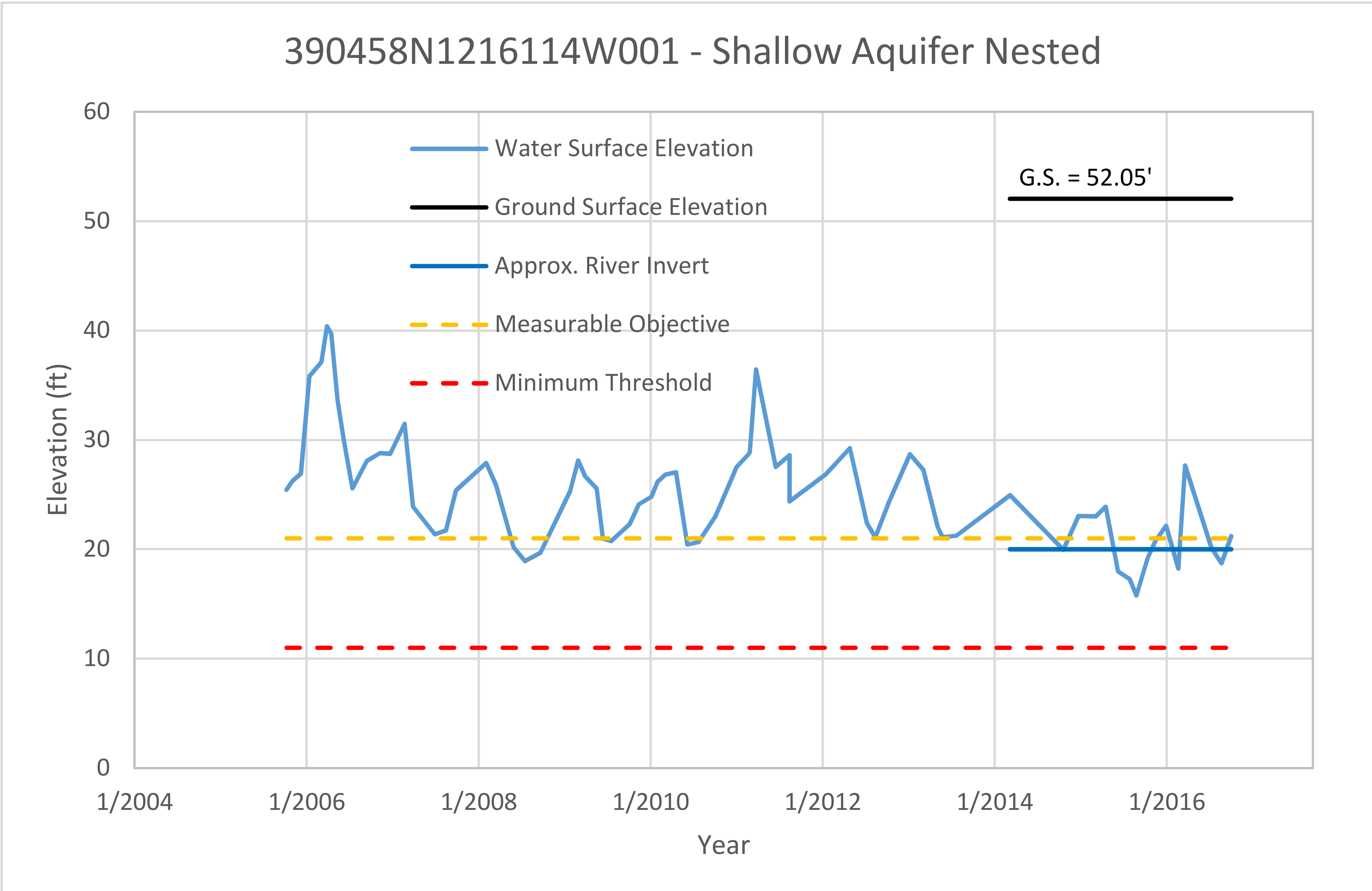

389820N1215923W001 - Shallow Aquifer
Water Surface Elevation
Ground Surface Elevation
Approx. River Invert
Measureable Objective
Minimum Threshold
G.S. = 34.8'
Elevation (ft)
50
40
30
20
10
0
-10
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year



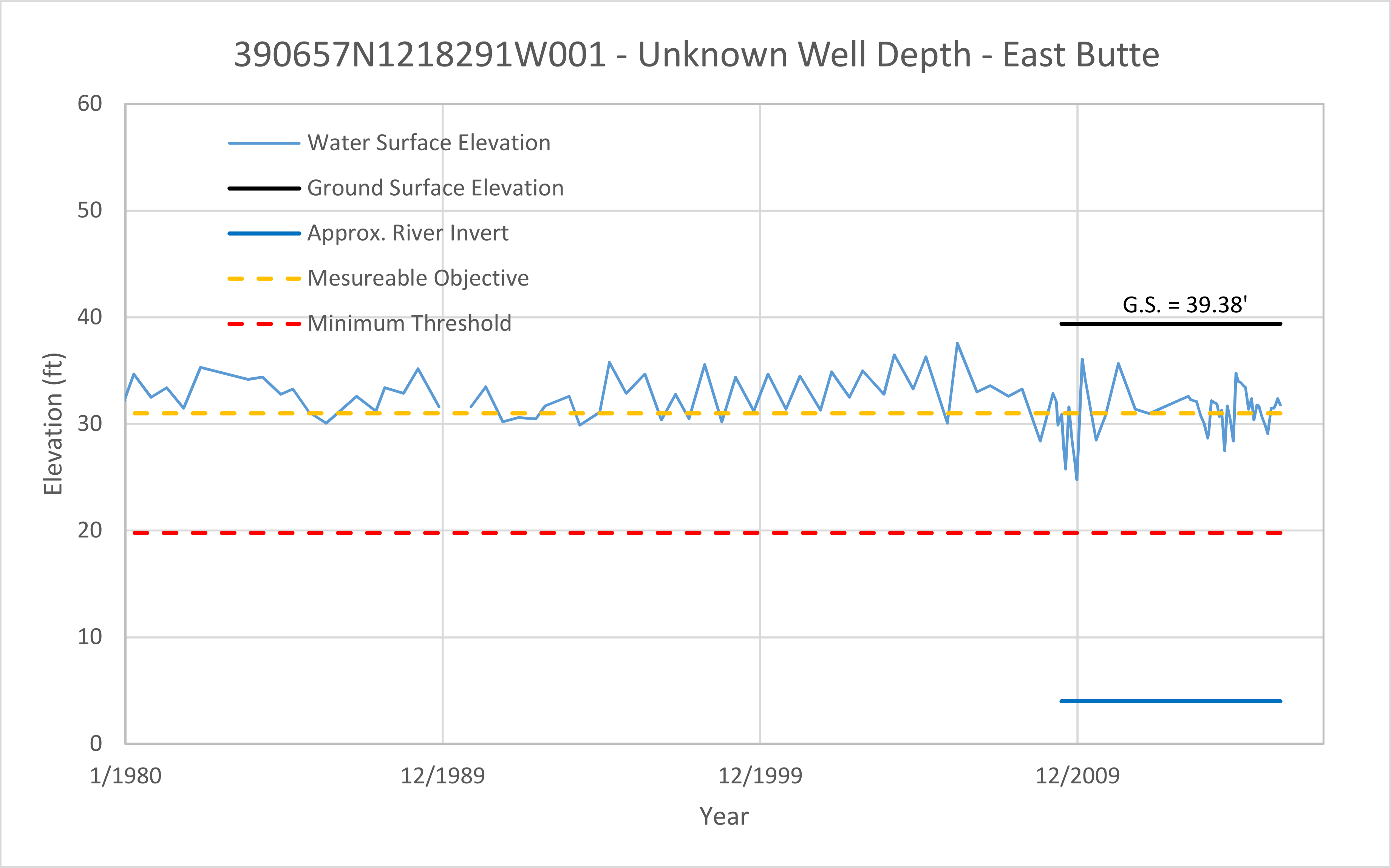
390176N1217902W001 - Shallow Aquifer - East Butte
Water Surface Elevation
Ground Surface
Approx ByPass Invert
Measureable Objective
Minimum Threshold
G.S. = 33.37'
Elevation (ft)
60
50
40
30
20
10
0
1/1980
12/1984
12/1989
12/1994
12/1999
12/2004
12/2009
12/2014
Year



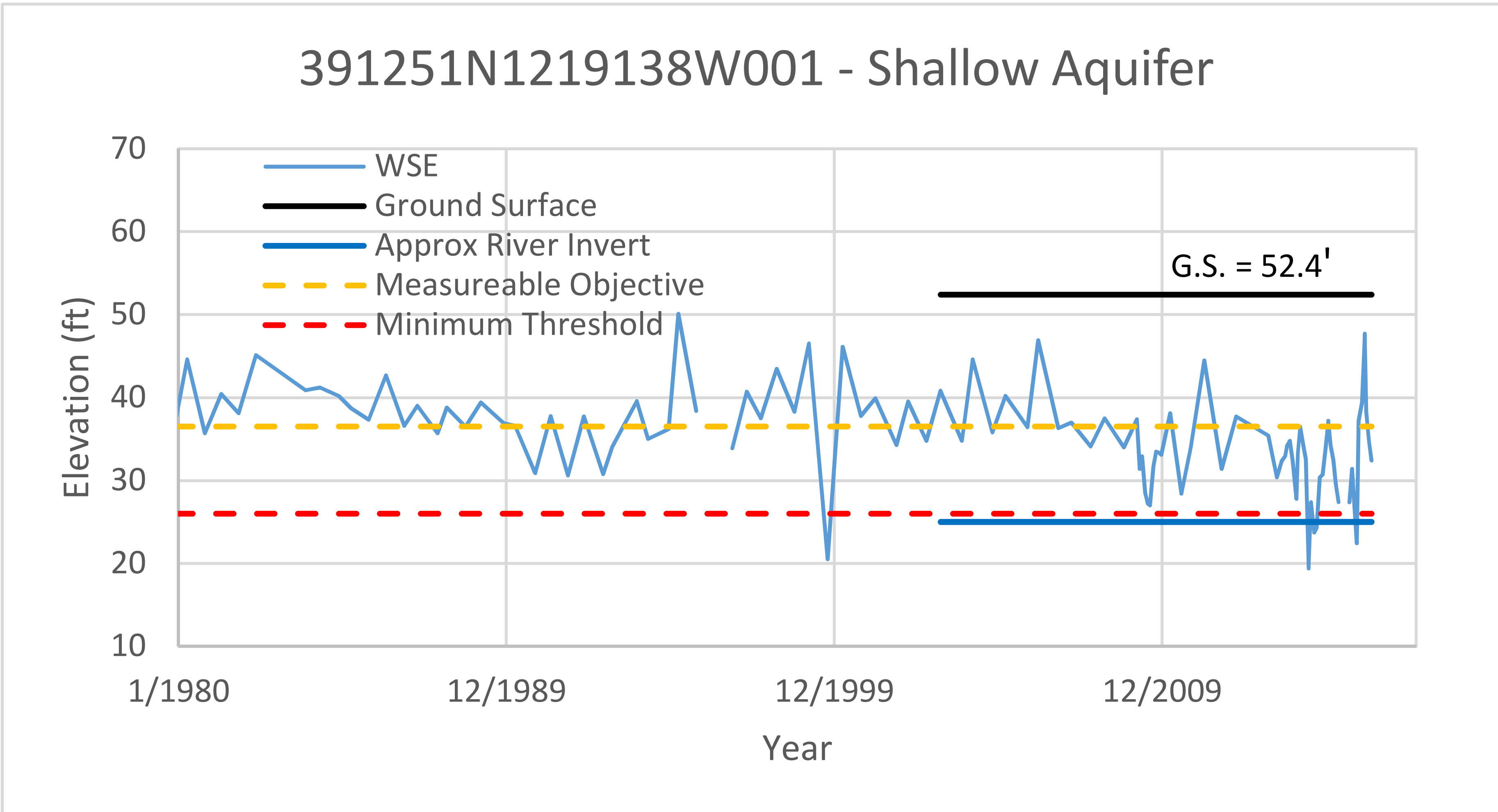
390426N1218166W001 - Shallow Aquifer
Water Surface Elevation
Ground Surface Elevation
Approx. River Invert
Measureable Objective
Minimum Threshold
G.S. = 42.38'
Elevation (ft)
60
50
40
30
20
10
0
1/2004
1/2007
1/2010
1/2013
1/2016
Year



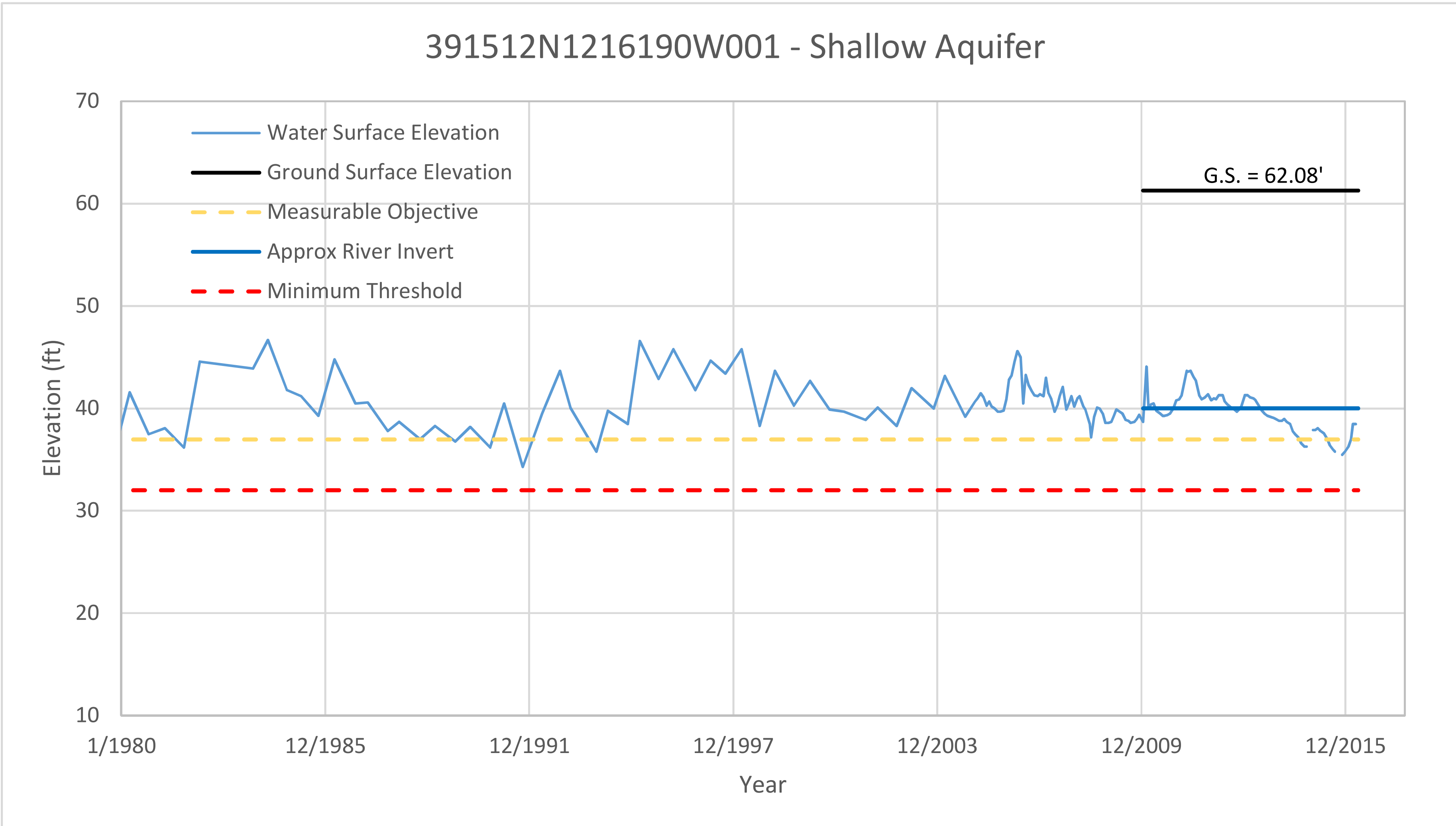
390458N1216114W001 - Shallow Aquifer Nested
60
50
40
30
20
10
0
Elevation (ft)
1/2004
1/2006
1/2008
1/2010
1/2012
1/2014
1/2016
Year
Water Surface Elevation
Ground Surface Elevation
Approx. River Invert
Measurable Objective
Minimum Threshold
G.S. = 52.05'



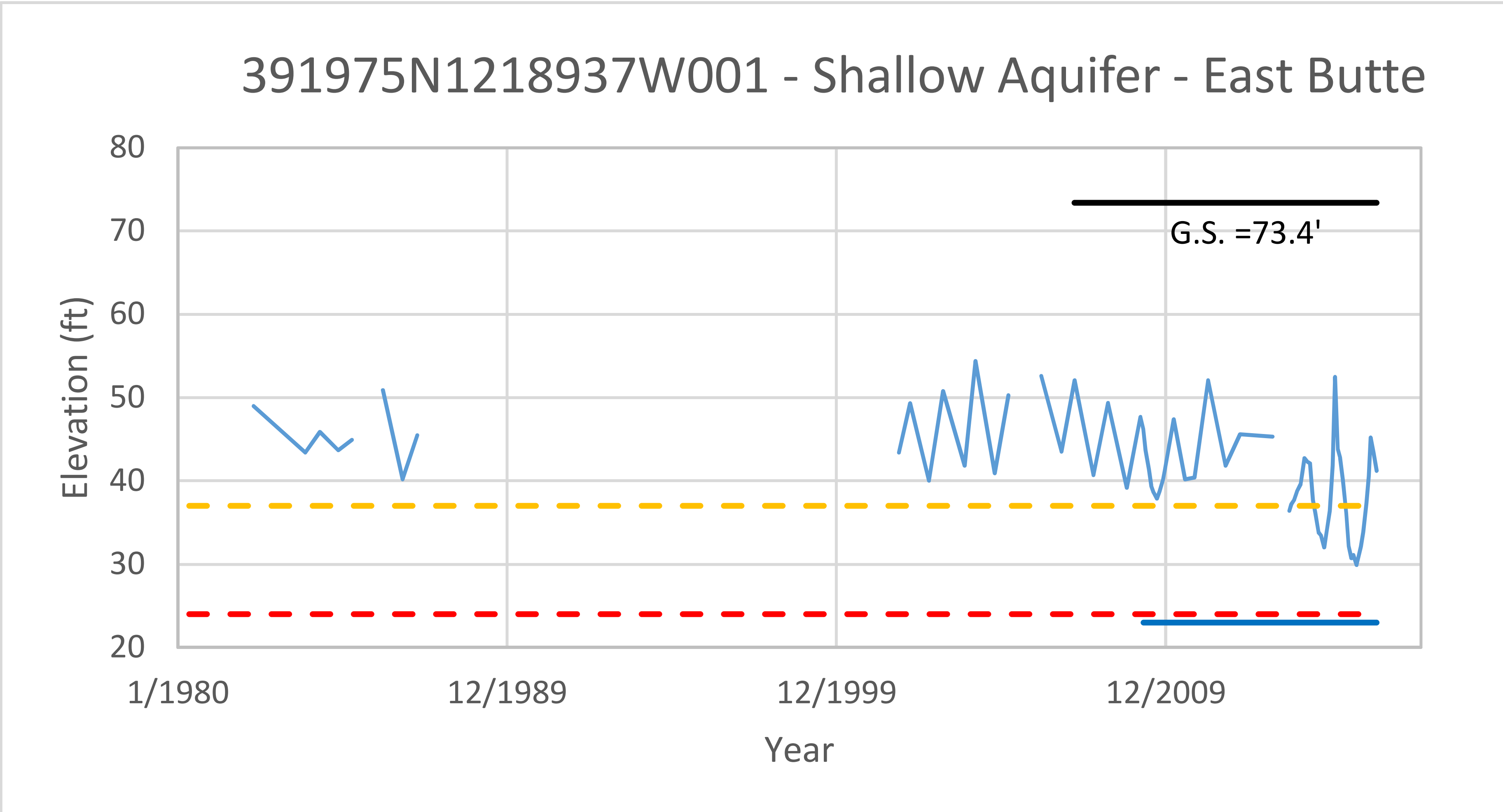
390657N1218291W001 - Unknown Well Depth - East Butte
Water Surface Elevation
Ground Surface Elevation
Approx. River Invert
Mesureable Objective
Minimum Threshold
G.S. = 39.38'
Elevation (ft)
60
50
40
30
20
10
0
1/1980
12/1989
12/1999
12/2009
Year



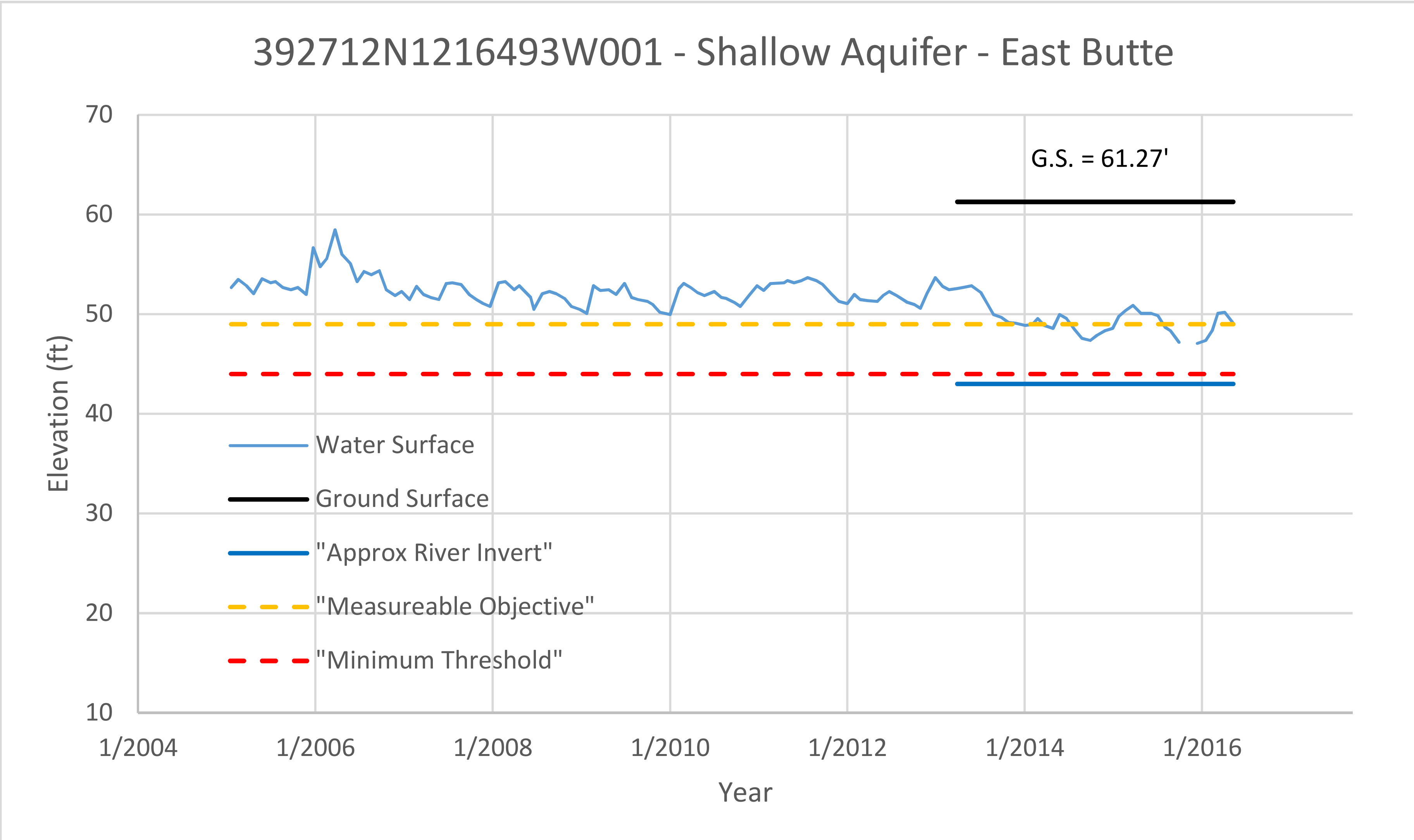
391251N1219138W001 - Shallow Aquifer
70
60
50
40
30
20
10
Elevation (ft)
WSE
Ground Surface
Approx River Invert
Measureable Objective
Minimum Threshold
G.S. = 52.4'
1/1980
12/1989
12/1999
12/2009
Year



391512N1216190W001 - Shallow Aquifer
Water Surface Elevation
Ground Surface Elevation
Measurable Objective
Approx River Invert
Minimum Threshold
G.S. = 62.08'
Elevation (ft)
70
60
50
40
30
20
10
1/1980
12/1985
12/1991
12/1997
12/2003
12/2009
12/2015
Year



391975N1218937W001 - Shallow Aquifer - East Butte
80
70
60
50
40
30
20
Elevation (ft)
G.S. =73.4'
1/1980
12/1989
12/1999
12/2009
Year


392712N1216493W001 - Shallow Aquifer - East Butte
G.S. = 61.27'
Elevation (ft)
70
60
50
40
30
20
10
1/2004
1/2006
1/2008
1/2010
1/2012
1/2014
1/2016
Year
Water Surface
Ground Surface
"Approx River Invert"
"Measureable Objective"
"Minimum Threshold"

APPENDIX N
CHRONIC LOWERING OF GROUNDWATER LEVELS
MEASUREABLE OBJECTIVES AND MINIMUM TRESHOLDS

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SHALLOW AQUIFER HYDROGRAPHS

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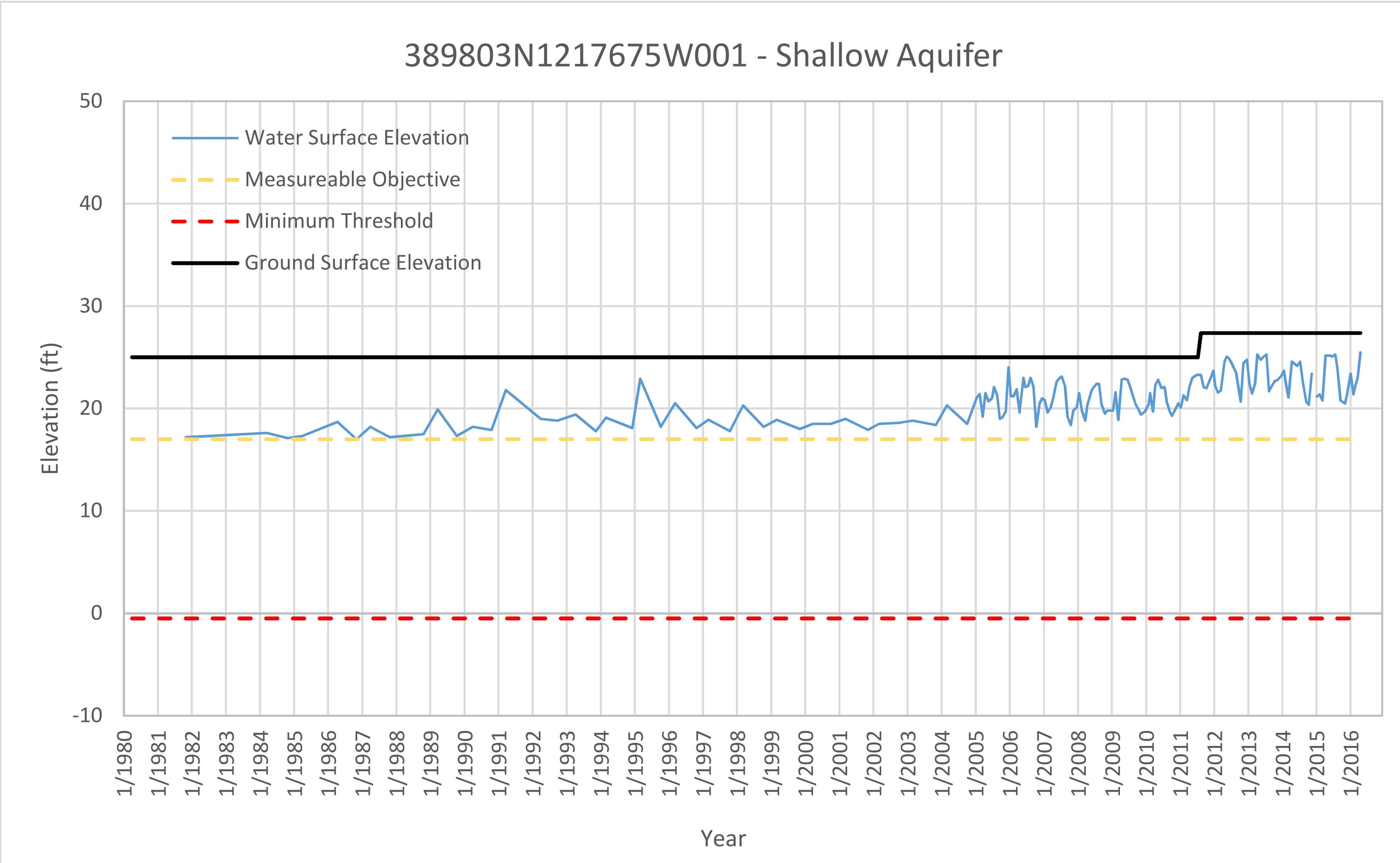
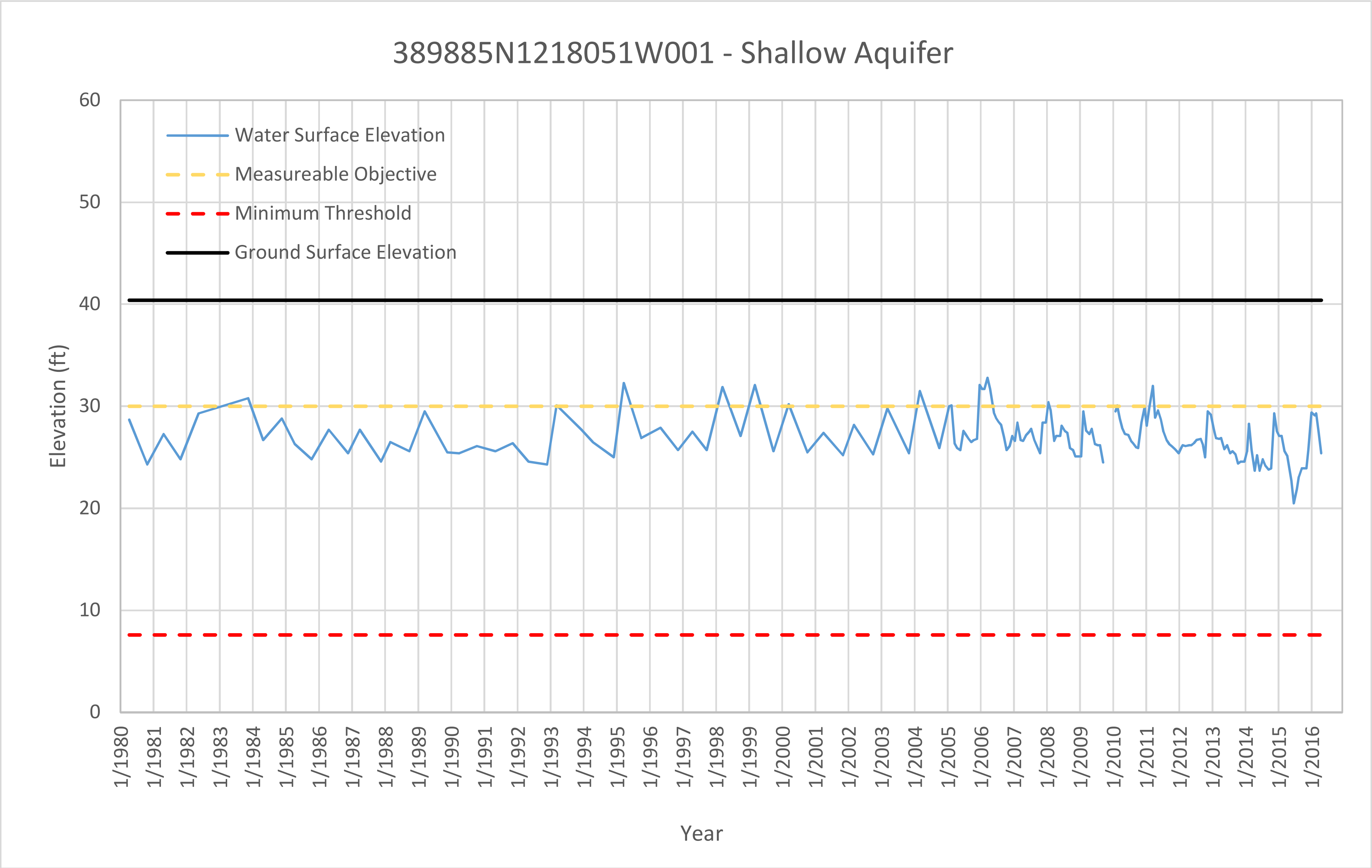
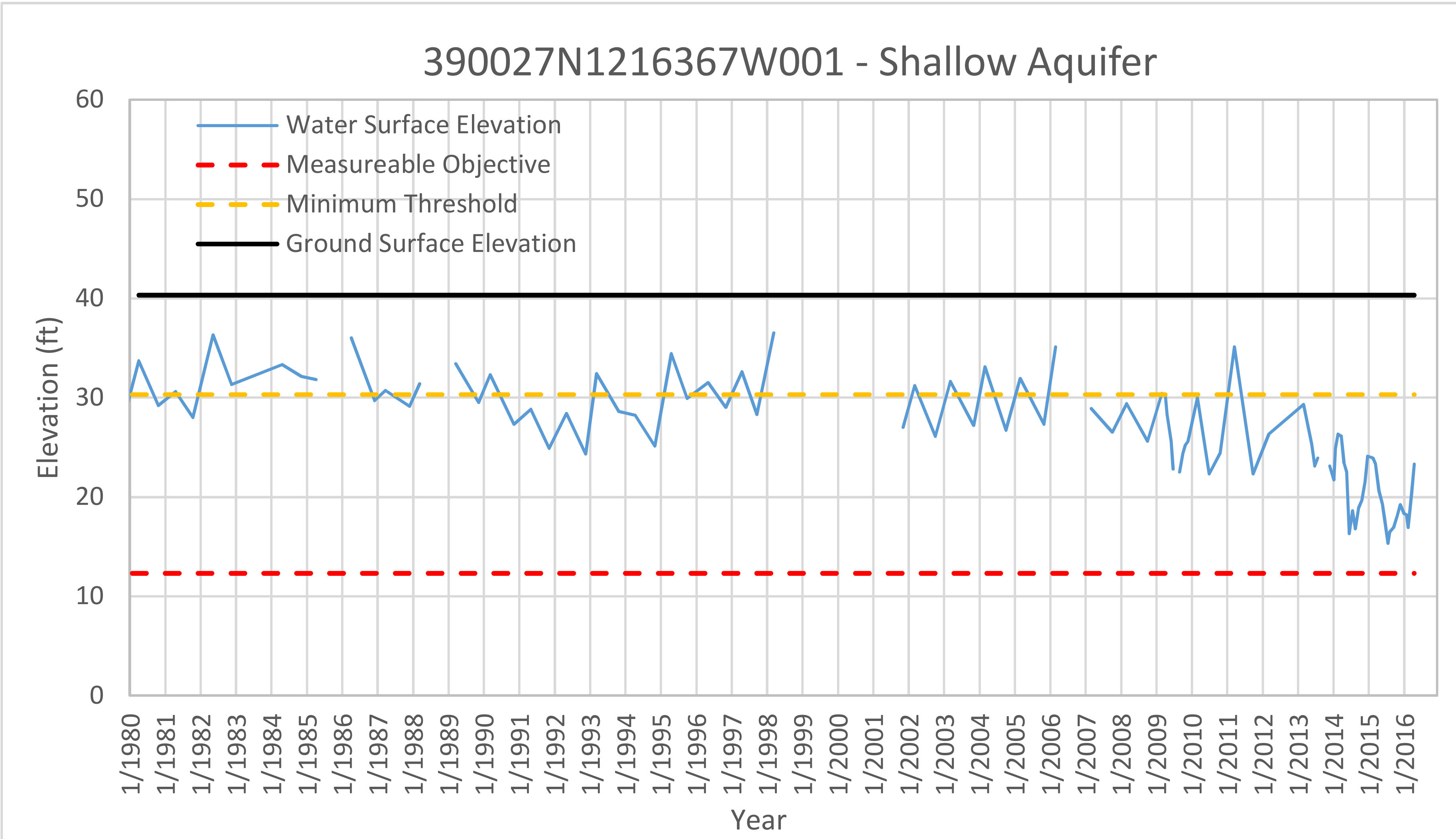
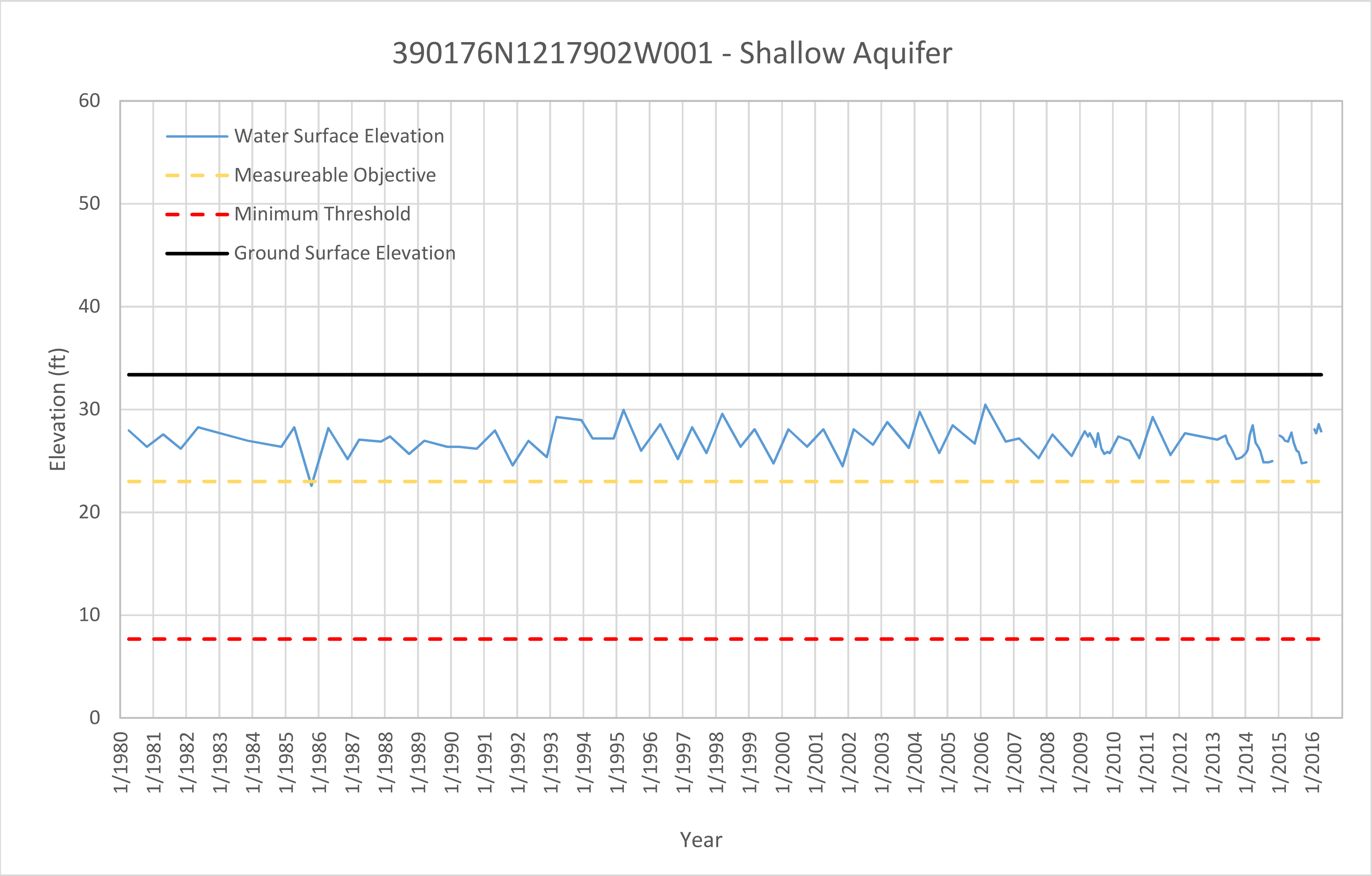


389803N1217675W001 - Shallow Aquifer
Water Surface Elevation
Measureable Objective
Minimum Threshold
Ground Surface Elevation
Elevation (ft)
50
40
30
20
10
0
-10
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year

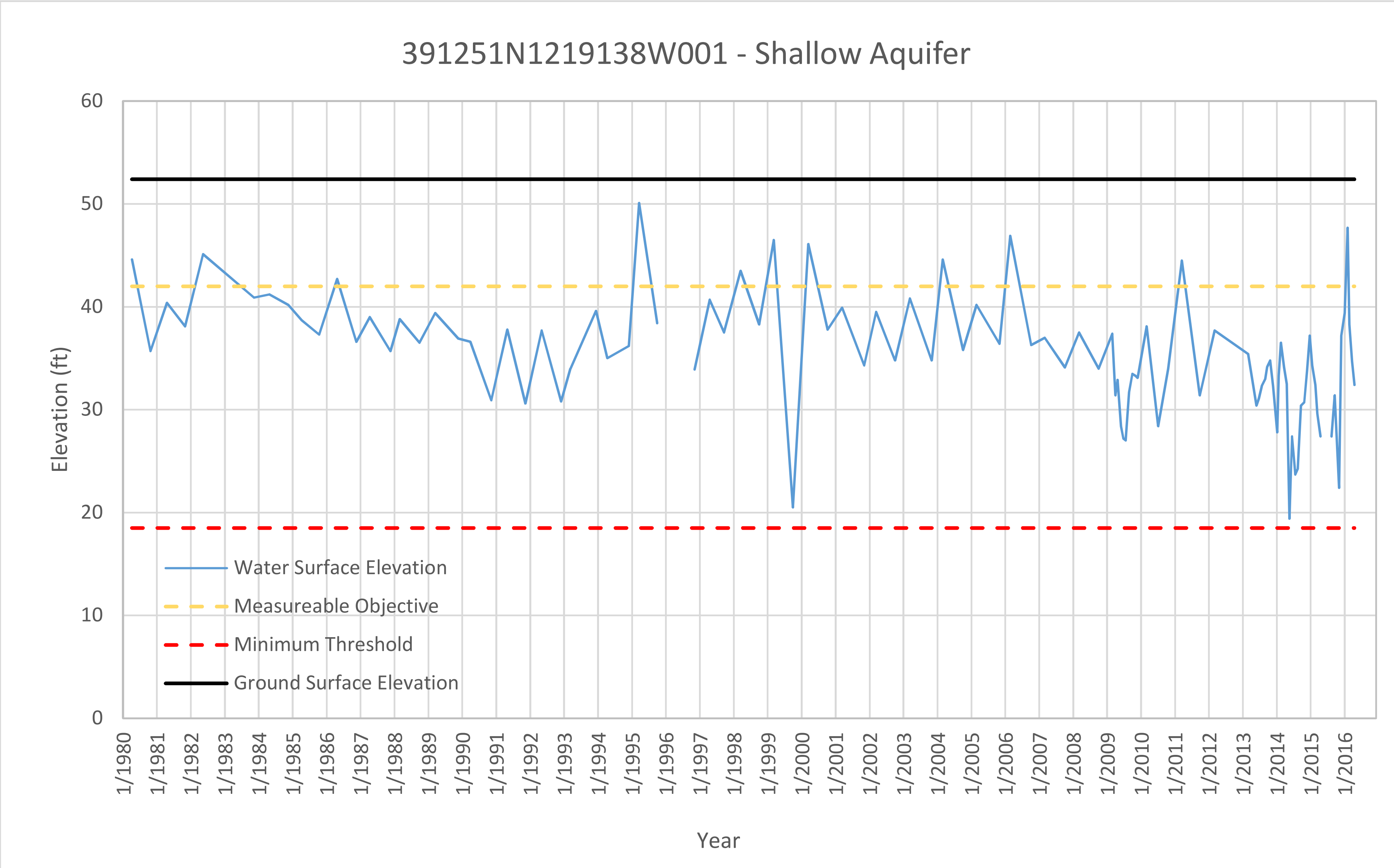

389885N1218051W001 - Shallow Aquifer
Water Surface Elevation
Measureable Objective
Minimum Threshold
Ground Surface Elevation
Elevation (ft)
60
50
40
30
20
10
0
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year



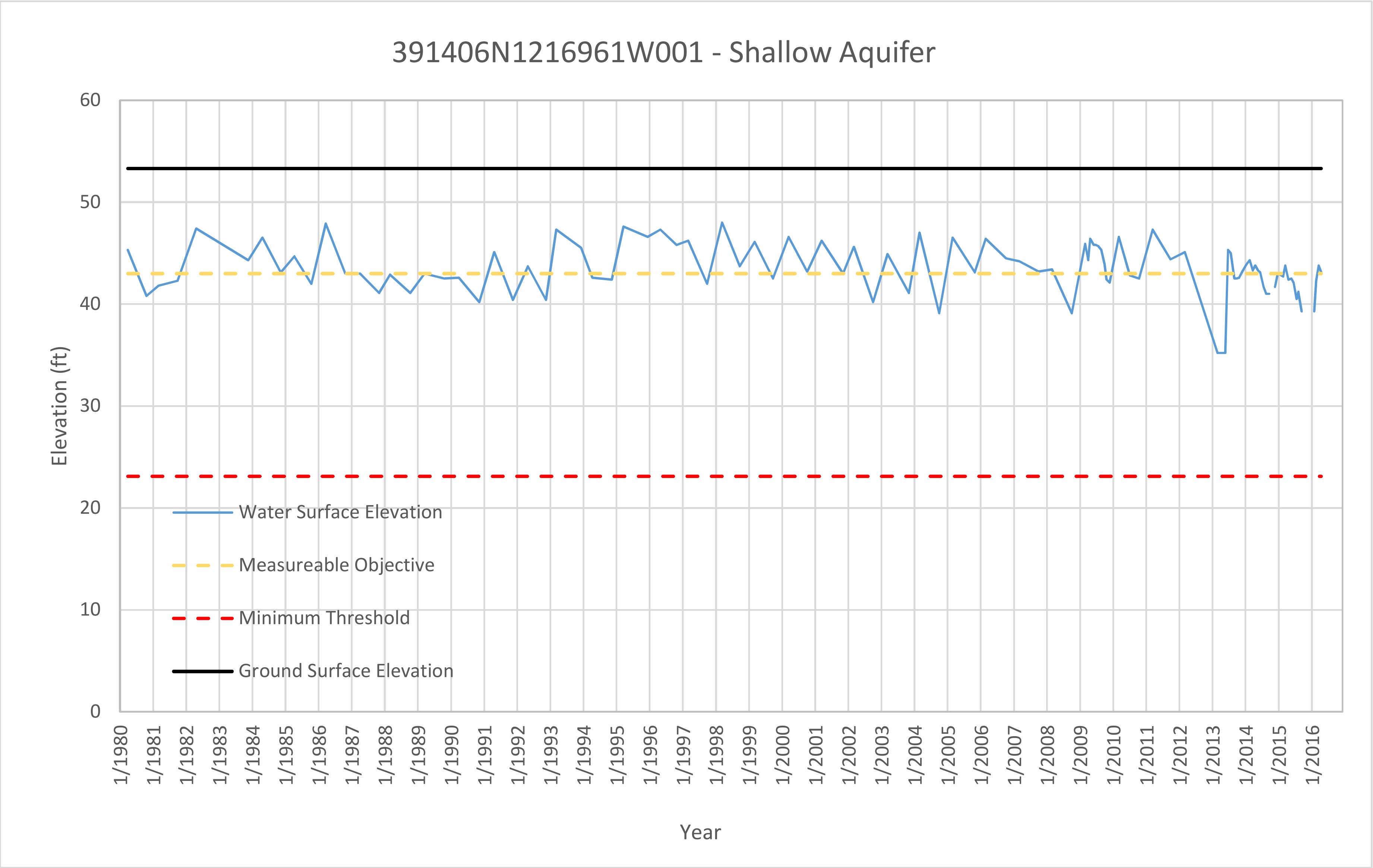
390027N1216367W001 - Shallow Aquifer
Water Surface Elevation
Measureable Objective
Minimum Threshold
Ground Surface Elevation
Elevation (ft)
60
50
40
30
20
10
0
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year



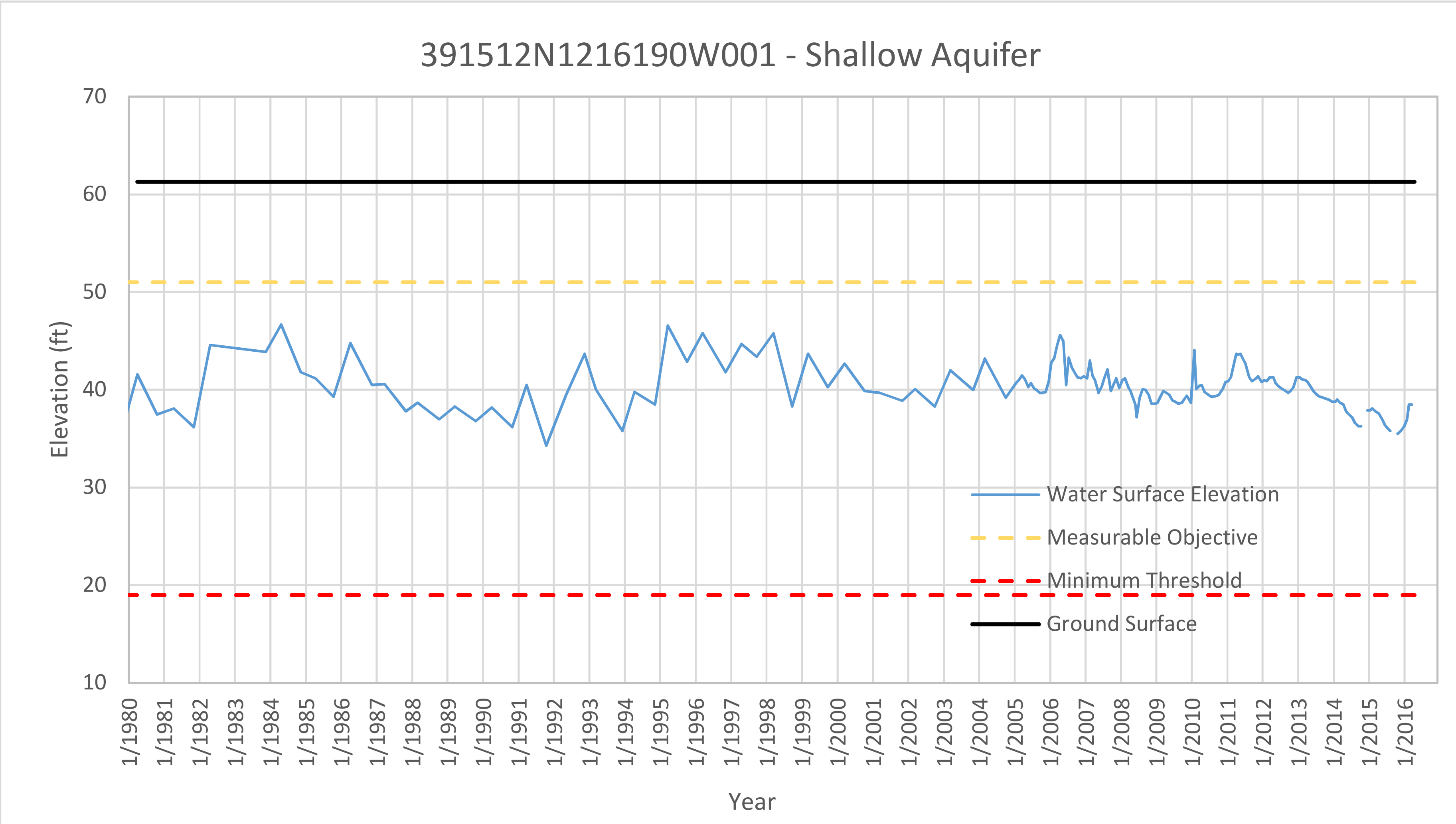
390176N1217902W001 - Shallow Aquifer
Water Surface Elevation
Measureable Objective
Minimum Threshold
Ground Surface Elevation
Elevation (ft)
60
50
40
30
20
10
0
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year



391251N1219138W001 - Shallow Aquifer
Elevation (ft)
60
50
40
30
20
10
0
Water Surface Elevation
Measureable Objective
Minimum Threshold
Ground Surface Elevation
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year



391406N1216961W001 - Shallow Aquifer
Elevation (ft)
60
50
40
30
20
10
0
Water Surface Elevation
Measureable Objective
Minimum Threshold
Ground Surface Elevation
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year


391512N1216190W001 - Shallow Aquifer
Elevation (ft)
70
60
50
40
30
20
10
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
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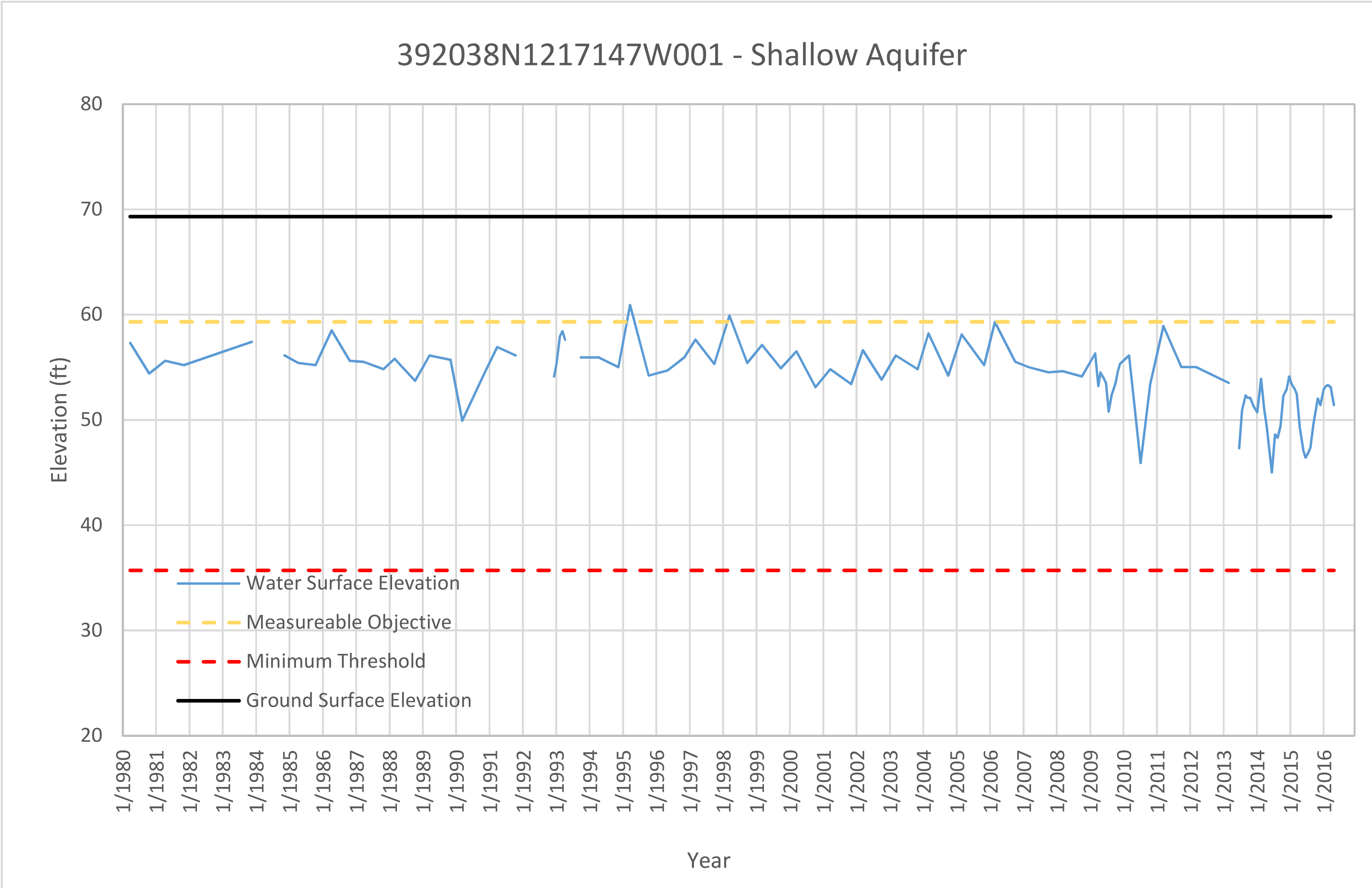
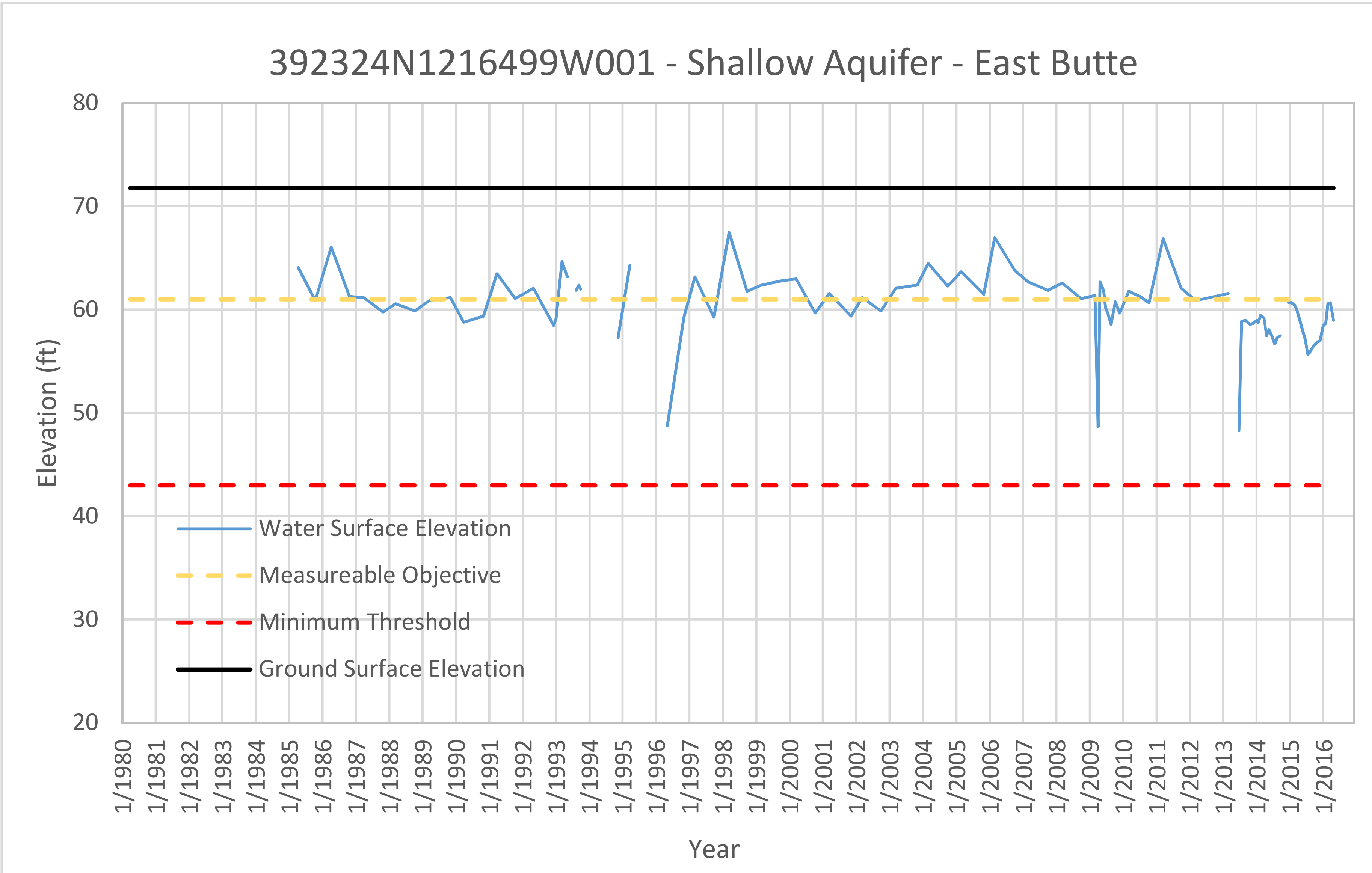
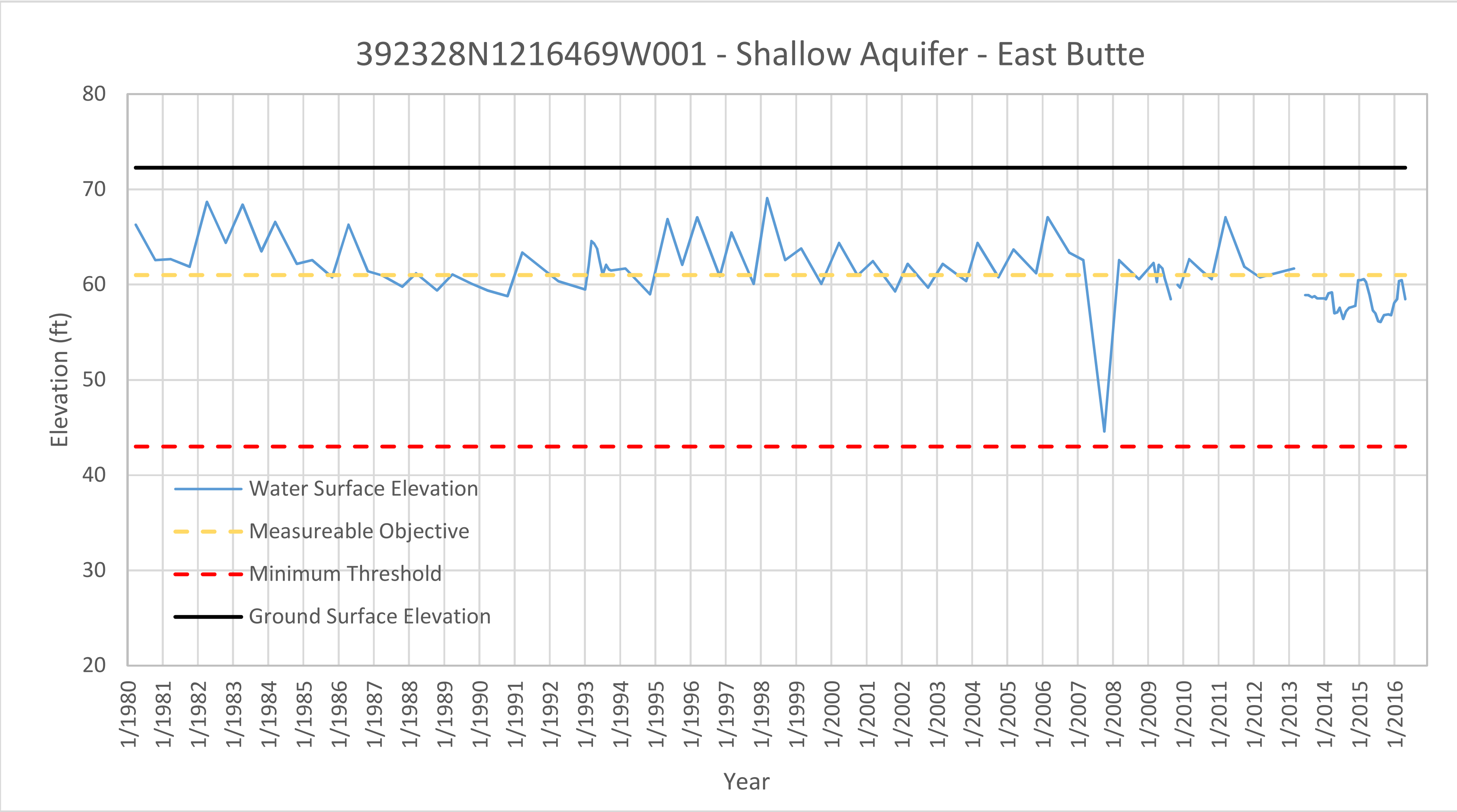
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year
Water Surface Elevation
Measurable Objective
Minimum Threshold
Ground Surface


392038N1217147W001 - Shallow Aquifer
80
70
60
50
40
30
20
Elevation (ft)
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year
Water Surface Elevation
Measureable Objective
Minimum Threshold
Ground Surface Elevation



392324N1216499W001 - Shallow Aquifer - East Butte
Elevation (ft)
80
70
60
50
40
30
20
Water Surface Elevation
Measureable Objective
Minimum Threshold
Ground Surface Elevation
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year


392328N1216469W001 - Shallow Aquifer - East Butte
80
70
60
50
40
30
20
Elevation (ft)
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year
Water Surface Elevation
Measureable Objective
Minimum Threshold
Ground Surface Elevation

INTERMEDIATE AQUIFER

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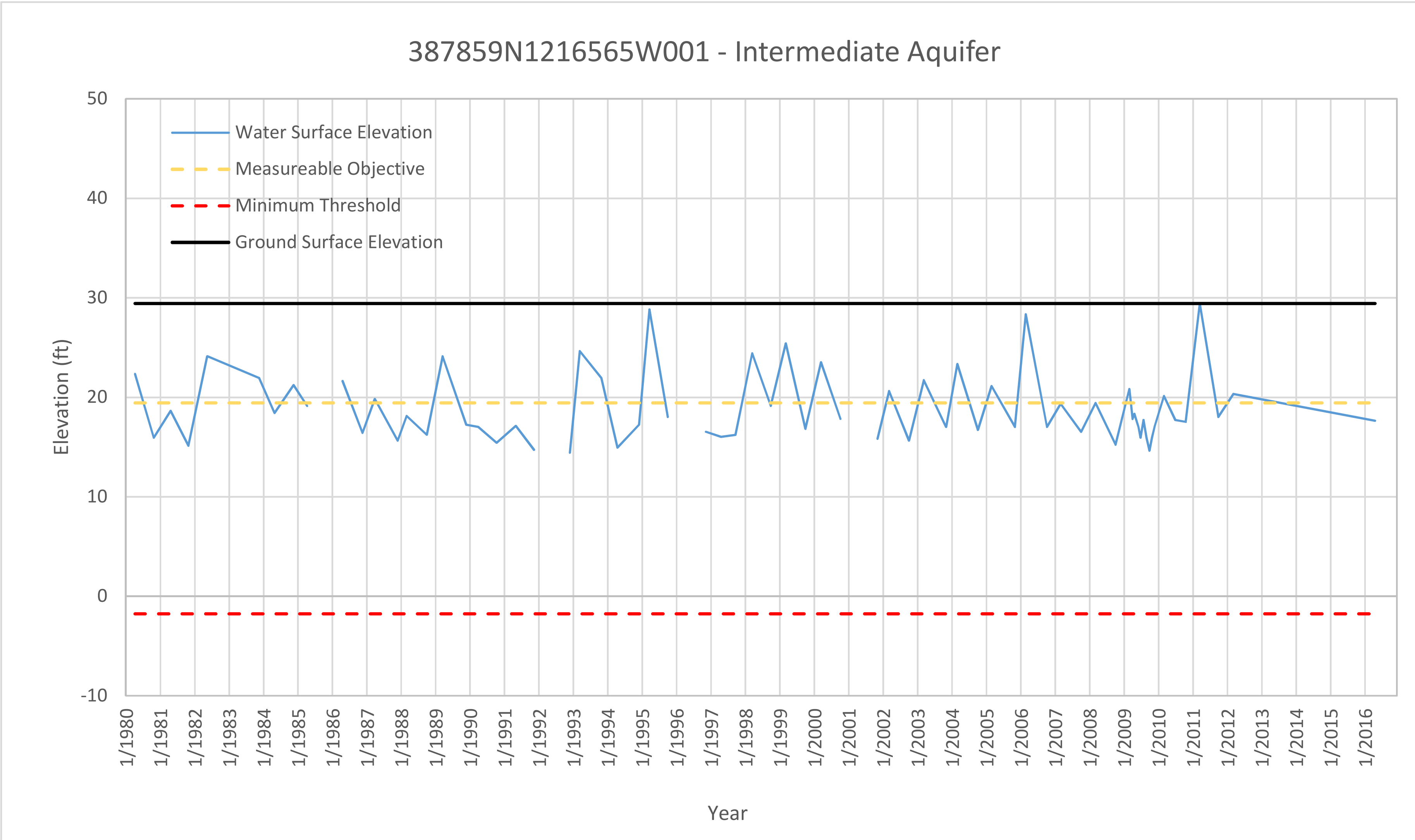
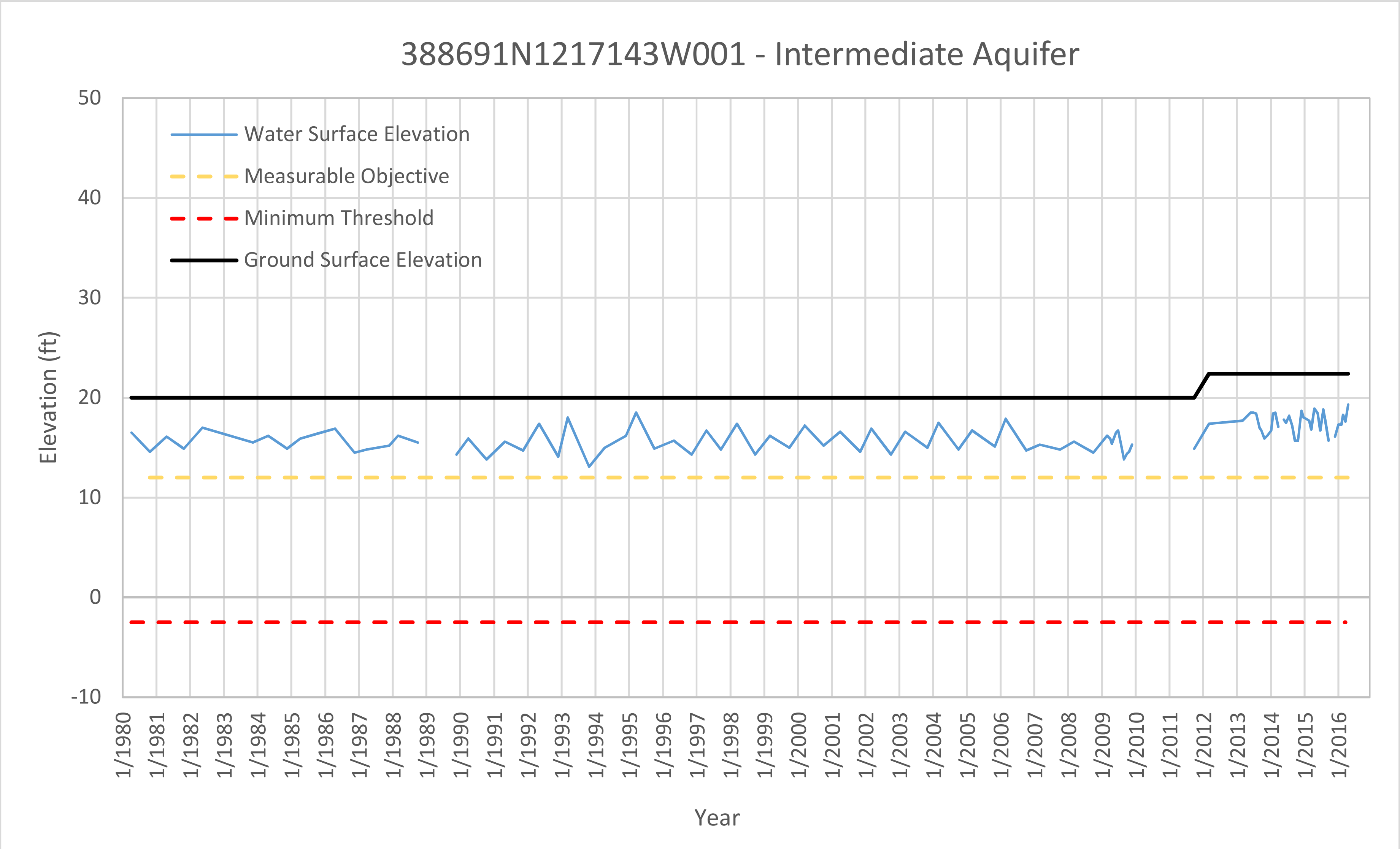
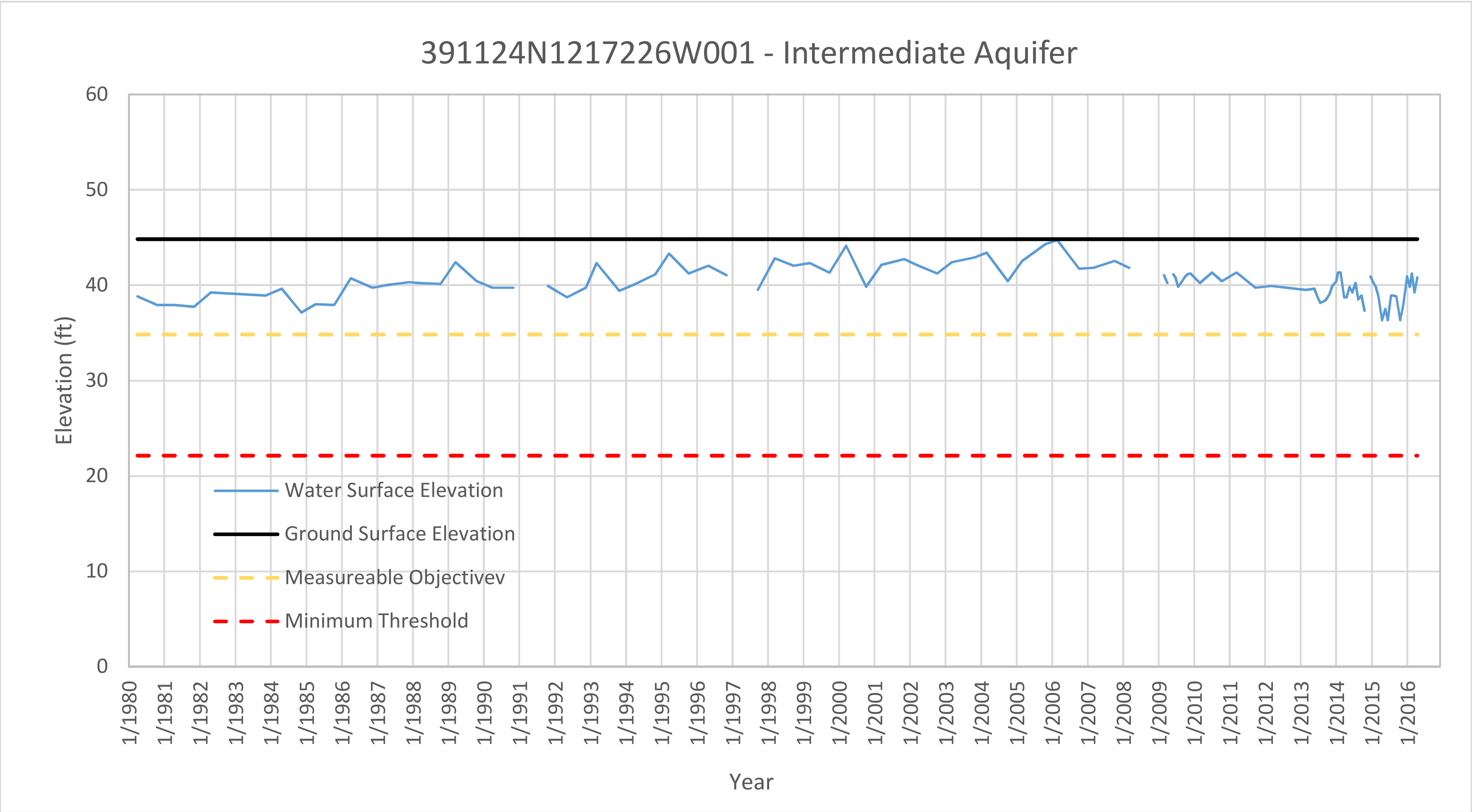
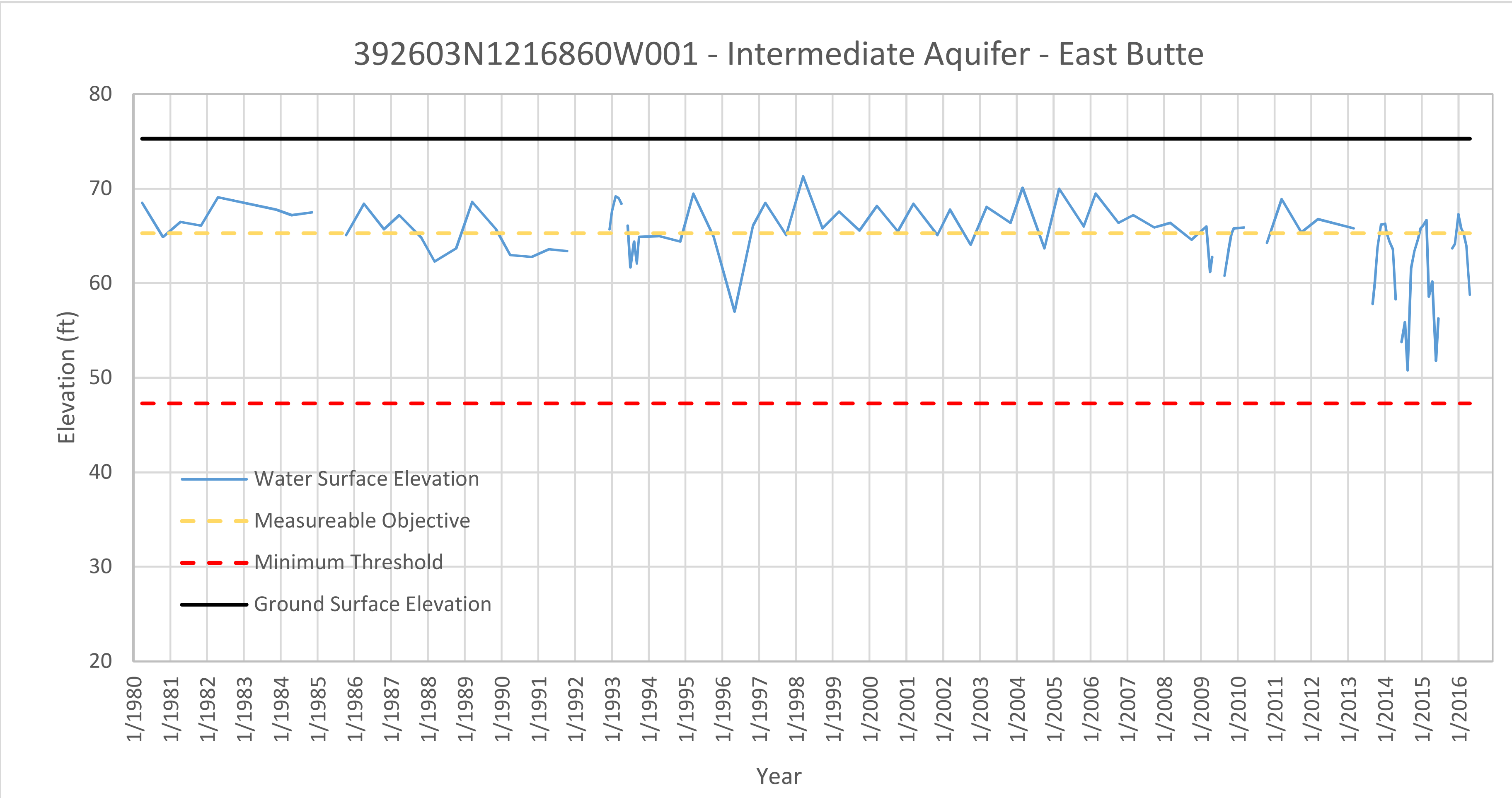


387859N1216565W001 - Intermediate Aquifer
Water Surface Elevation
Measureable Objective
Minimum Threshold
Ground Surface Elevation
Elevation (ft)
50
40
30
20
10
0
-10
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year

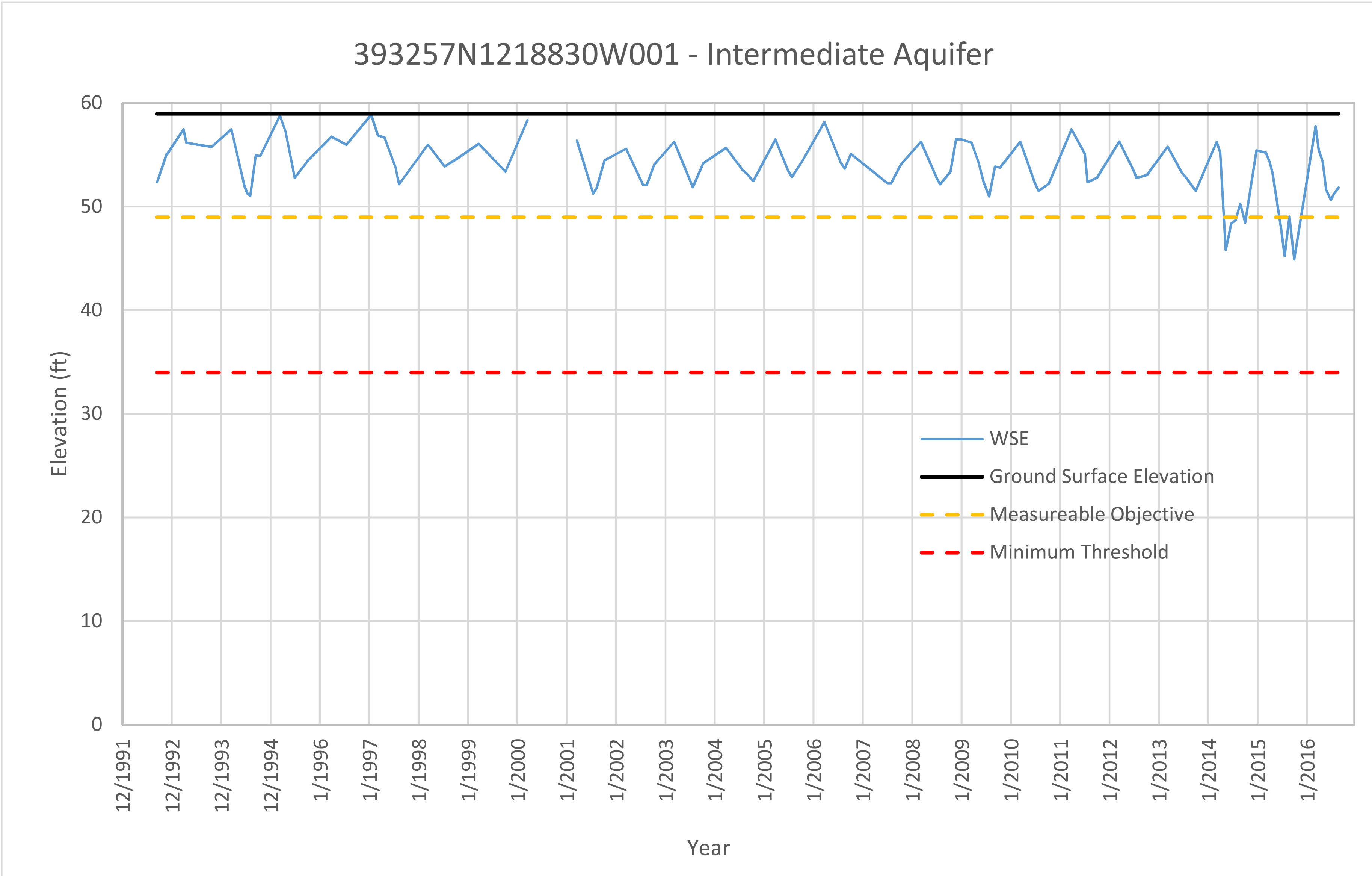

388691N1217143W001 - Intermediate Aquifer
Water Surface Elevation
Measurable Objective
Minimum Threshold
Ground Surface Elevation
Elevation (ft)
50
40
30
20
10
0
-10
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year



391124N1217226W001 - Intermediate Aquifer
Elevation (ft)
60
50
40
30
20
10
0
Water Surface Elevation
Ground Surface Elevation
Measureable Objectivev
Minimum Threshold
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year



392603N1216860W001 - Intermediate Aquifer - East Butte
80
70
60
50
40
30
20
Elevation (ft)
Water Surface Elevation
Measureable Objective
Minimum Threshold
Ground Surface Elevation
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year


393257N1218830W001 - Intermediate Aquifer
Elevation (ft)
Year
0
10
20
30
40
50
60
12/1991
12/1992
12/1993
12/1994
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
WSE
Ground Surface Elevation
Measureable Objective
Minimum Threshold

DEEP AQUIFER

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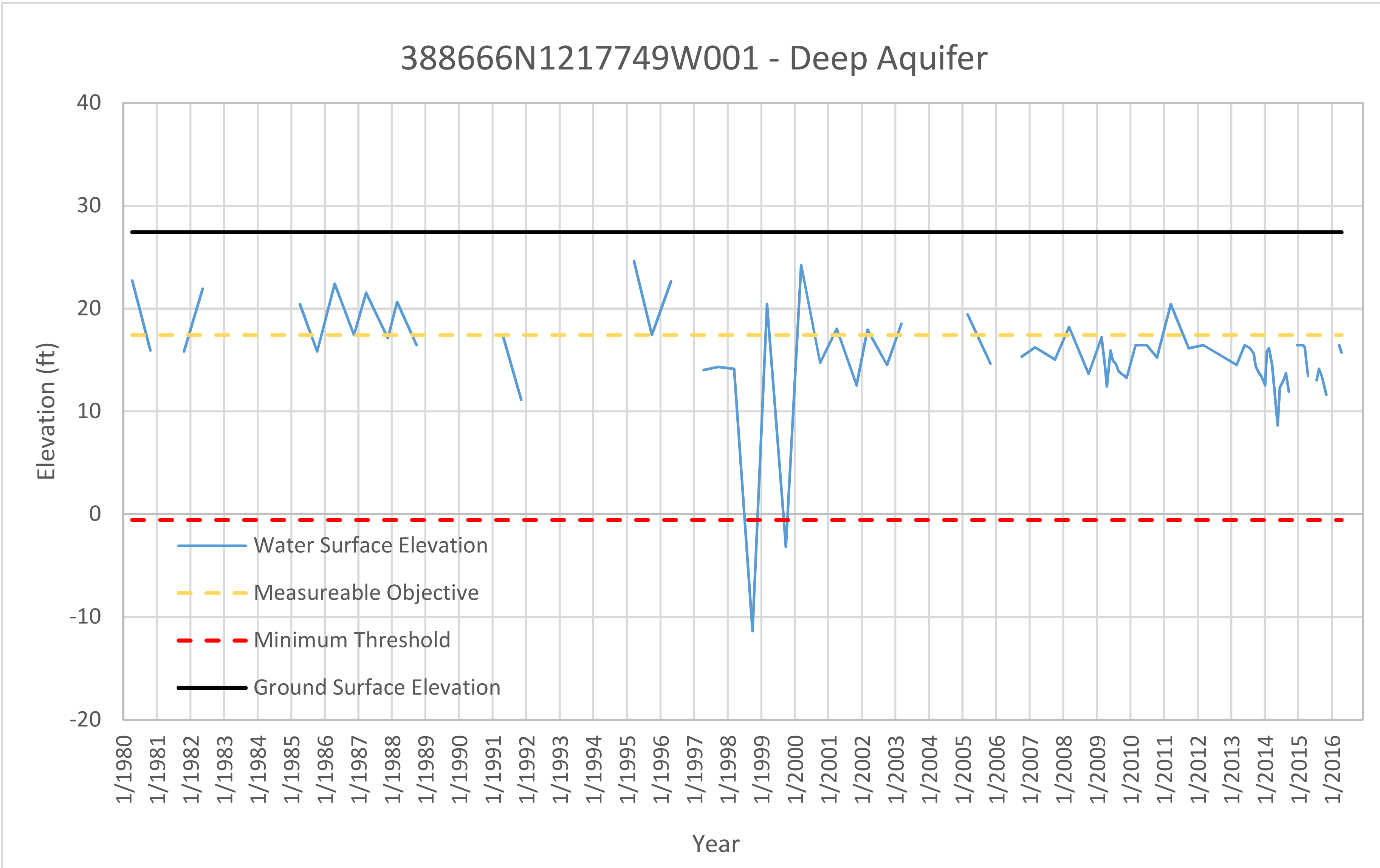
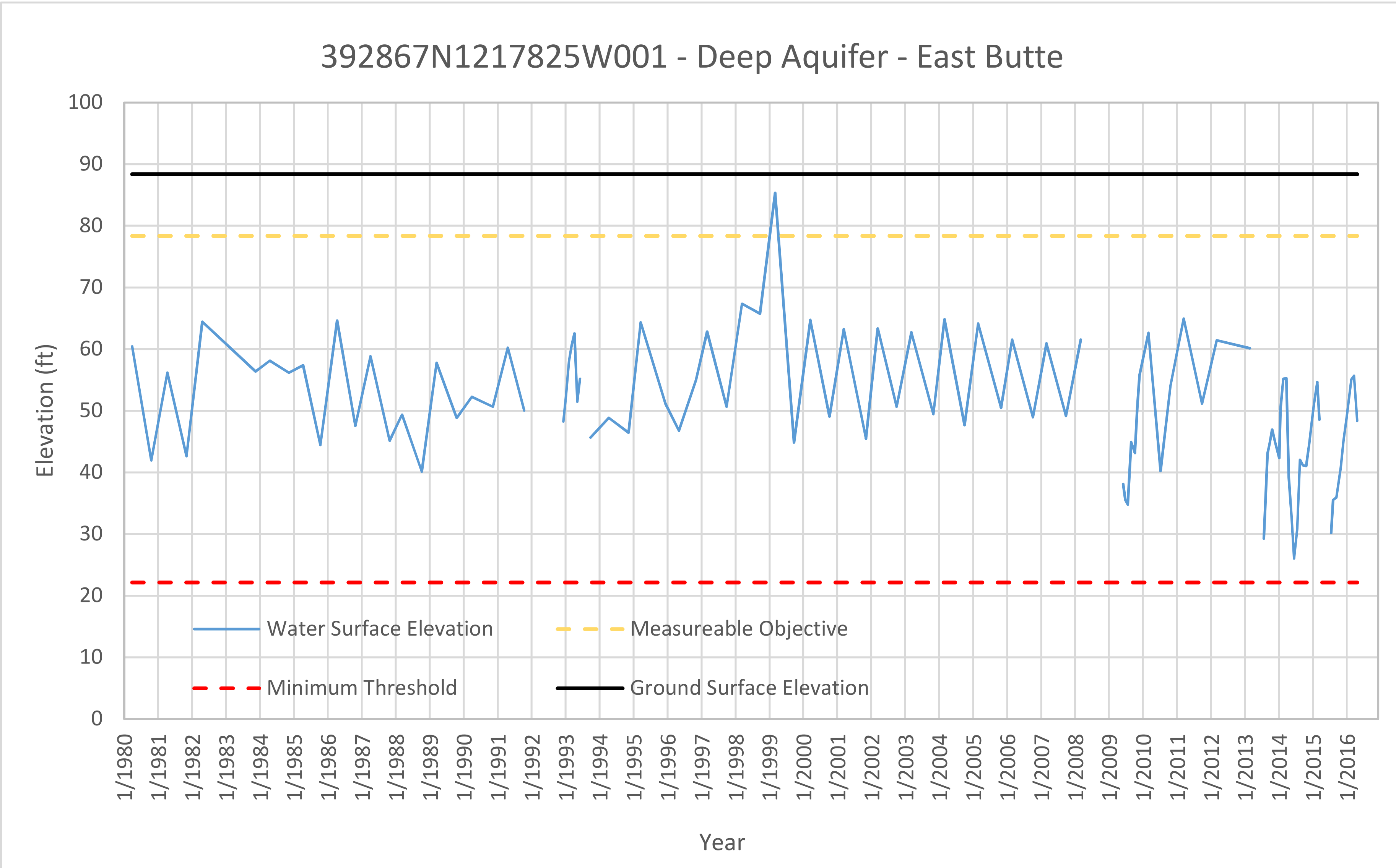

388666N1217749W001 - Deep Aquifer
Elevation (ft)
40
30
20
10
0
-10
-20
Water Surface Elevation
Measureable Objective
Minimum Threshold
Ground Surface Elevation
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year



392867N1217825W001 - Deep Aquifer - East Butte
Elevation (ft)
100
90
80
70
60
50
40
30
20
10
0
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year
Water Surface Elevation
Measureable Objective
Minimum Threshold
Ground Surface Elevation

UNKOWN AQUIFER

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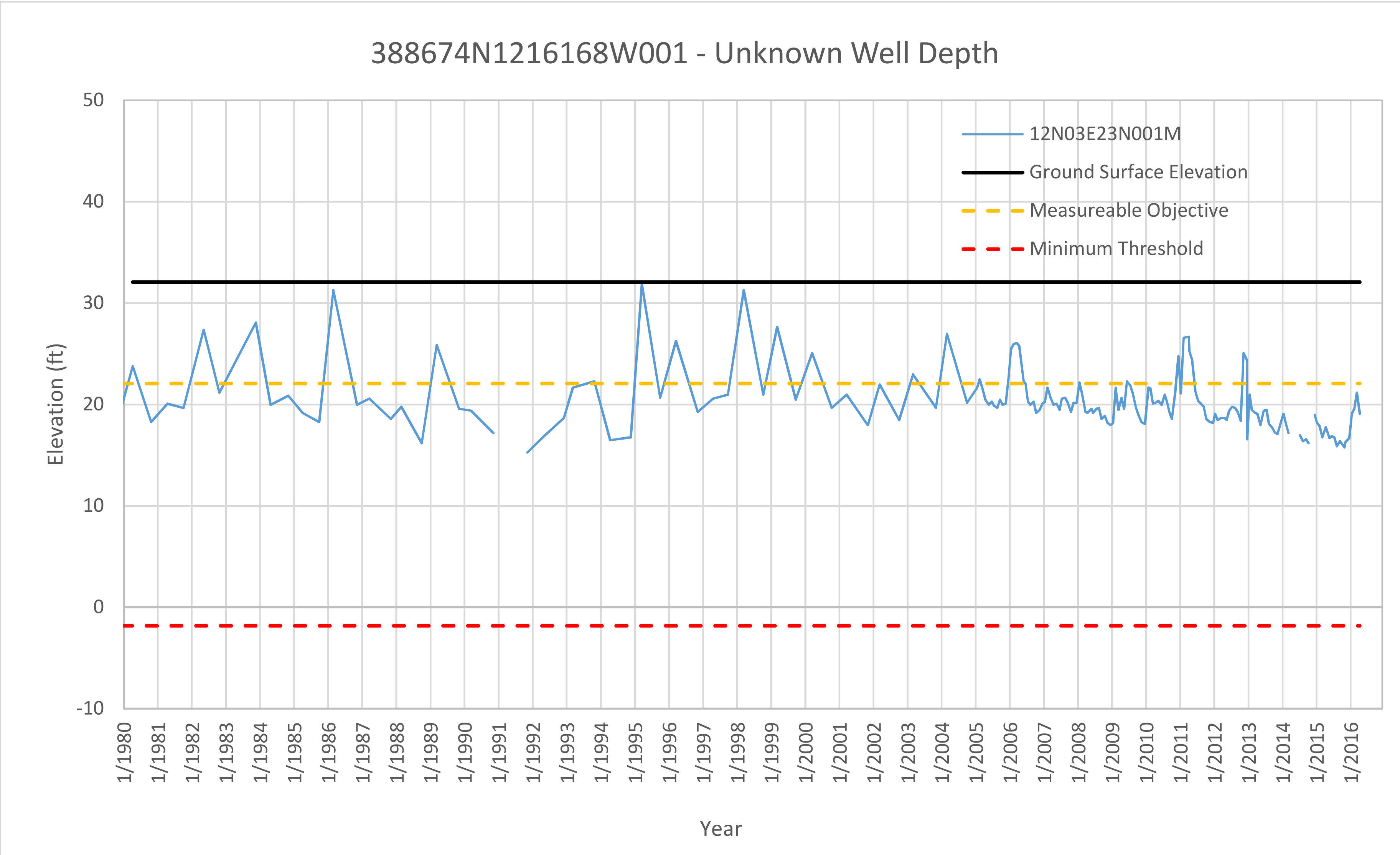
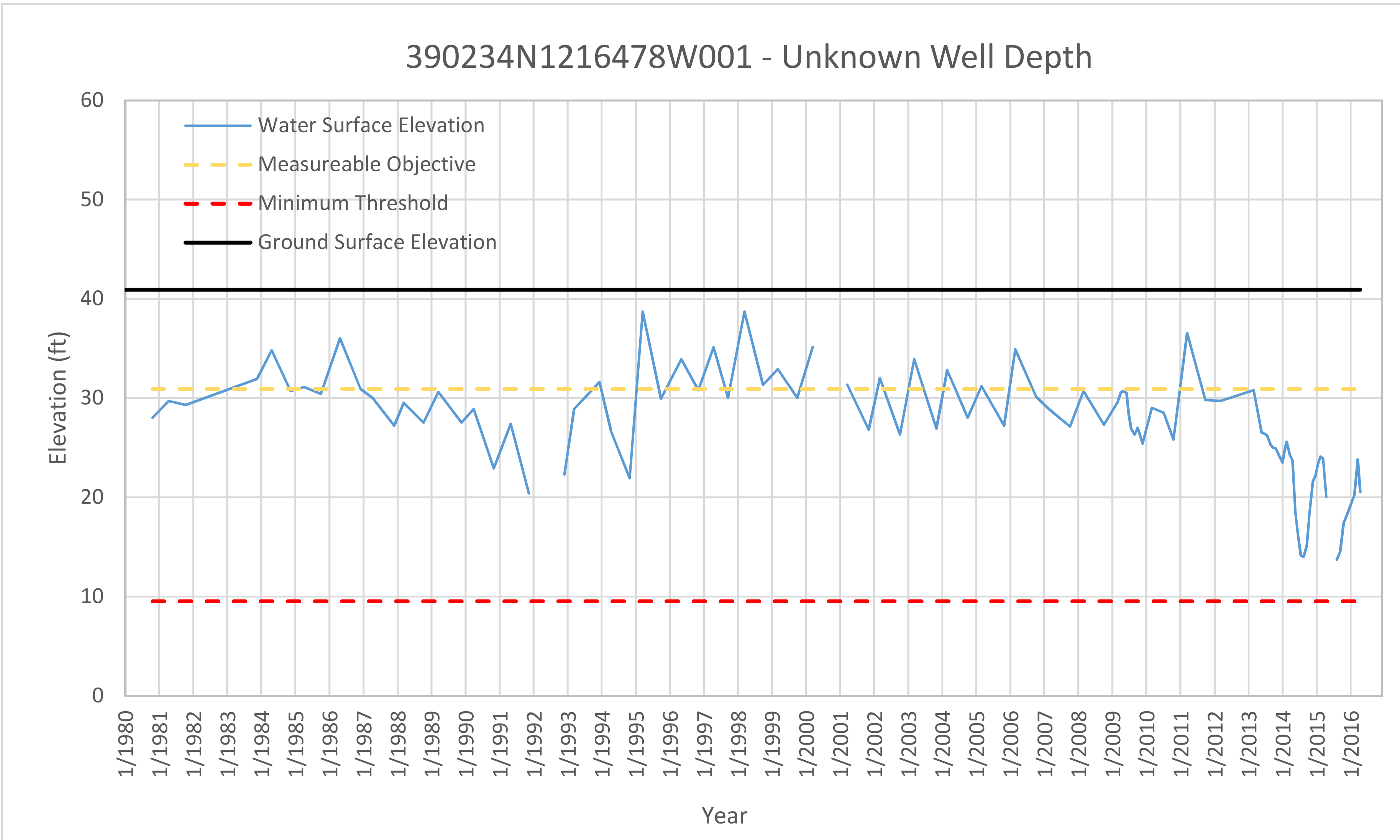
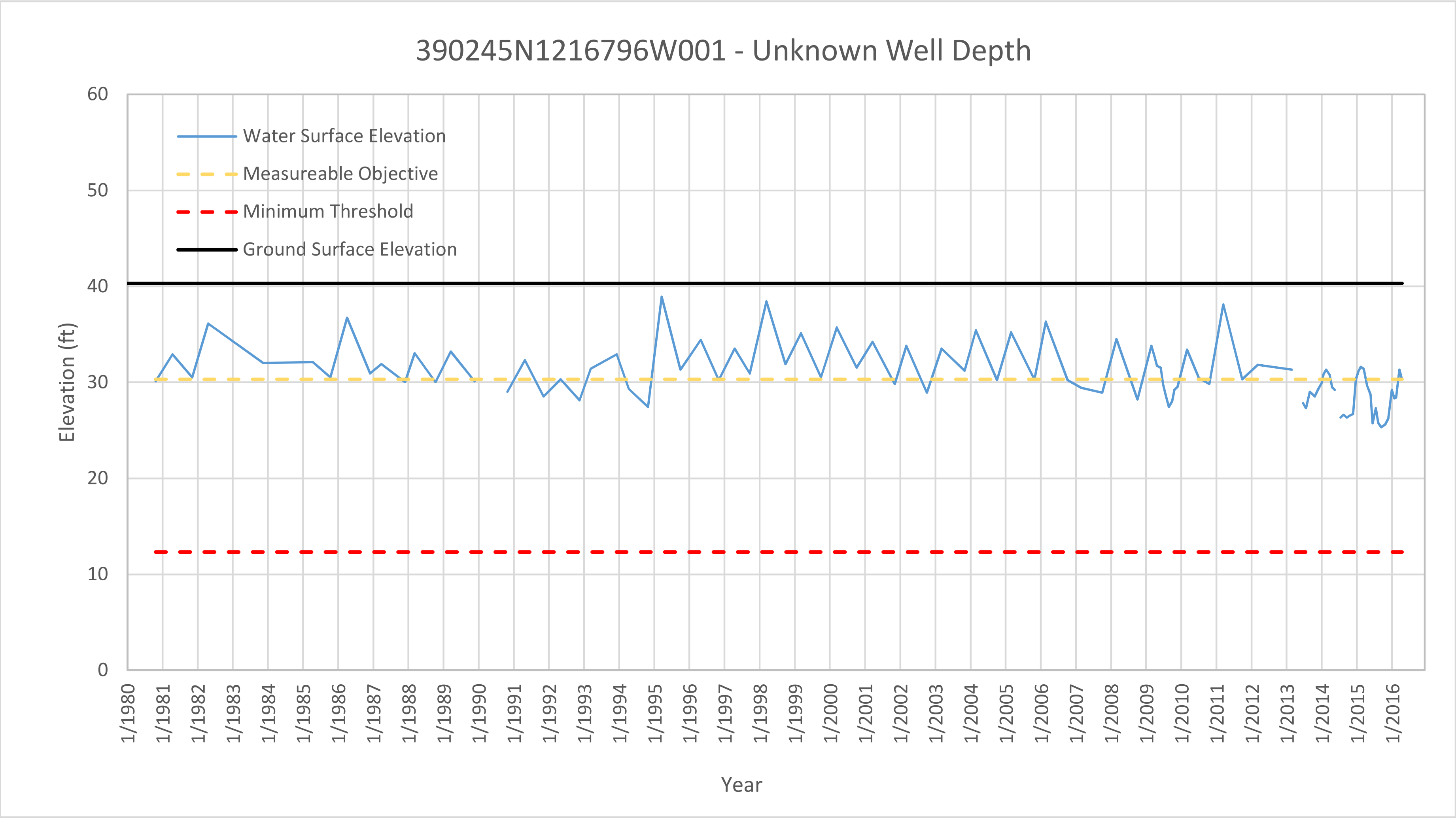


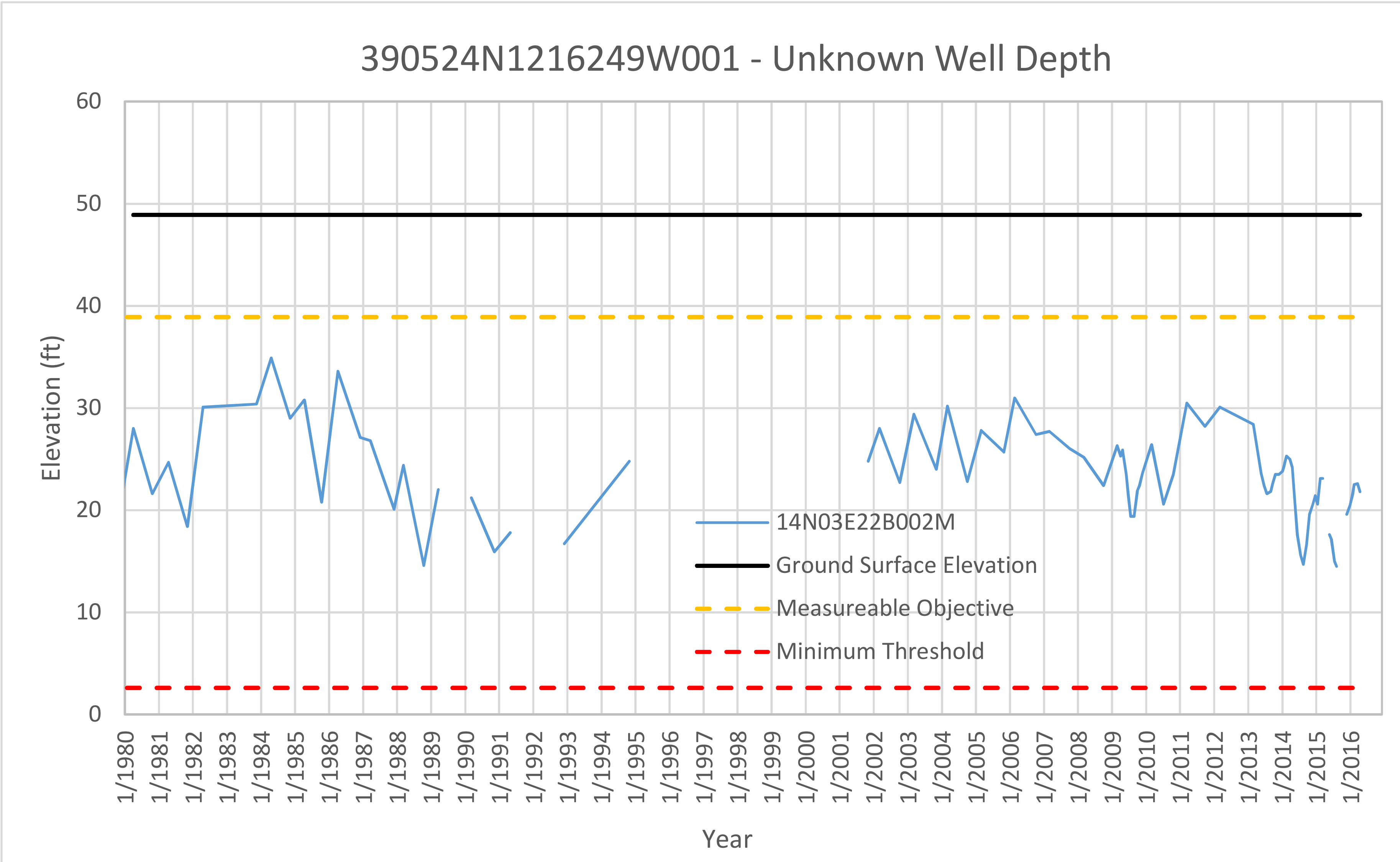
388674N1216168W001 - Unknown Well Depth
Elevation (ft)
50
40
30
20
10
0
-10
Year
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
12N03E23N001M
Ground Surface Elevation
Measureable Objective
Minimum Threshold



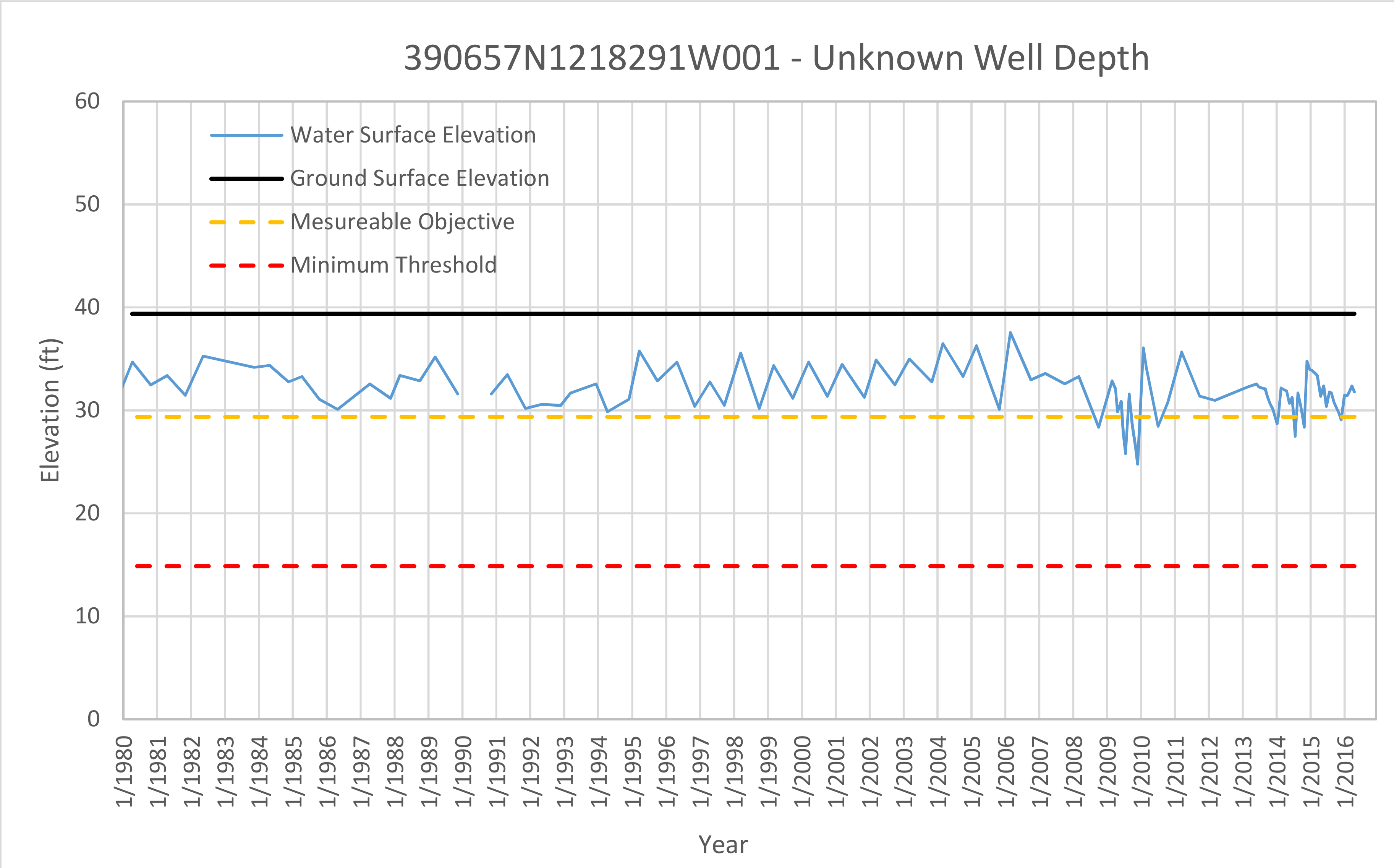
390234N1216478W001 - Unknown Well Depth
Water Surface Elevation
Measureable Objective
Minimum Threshold
Ground Surface Elevation
Elevation (ft)
0
10
20
30
40
50
60
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year



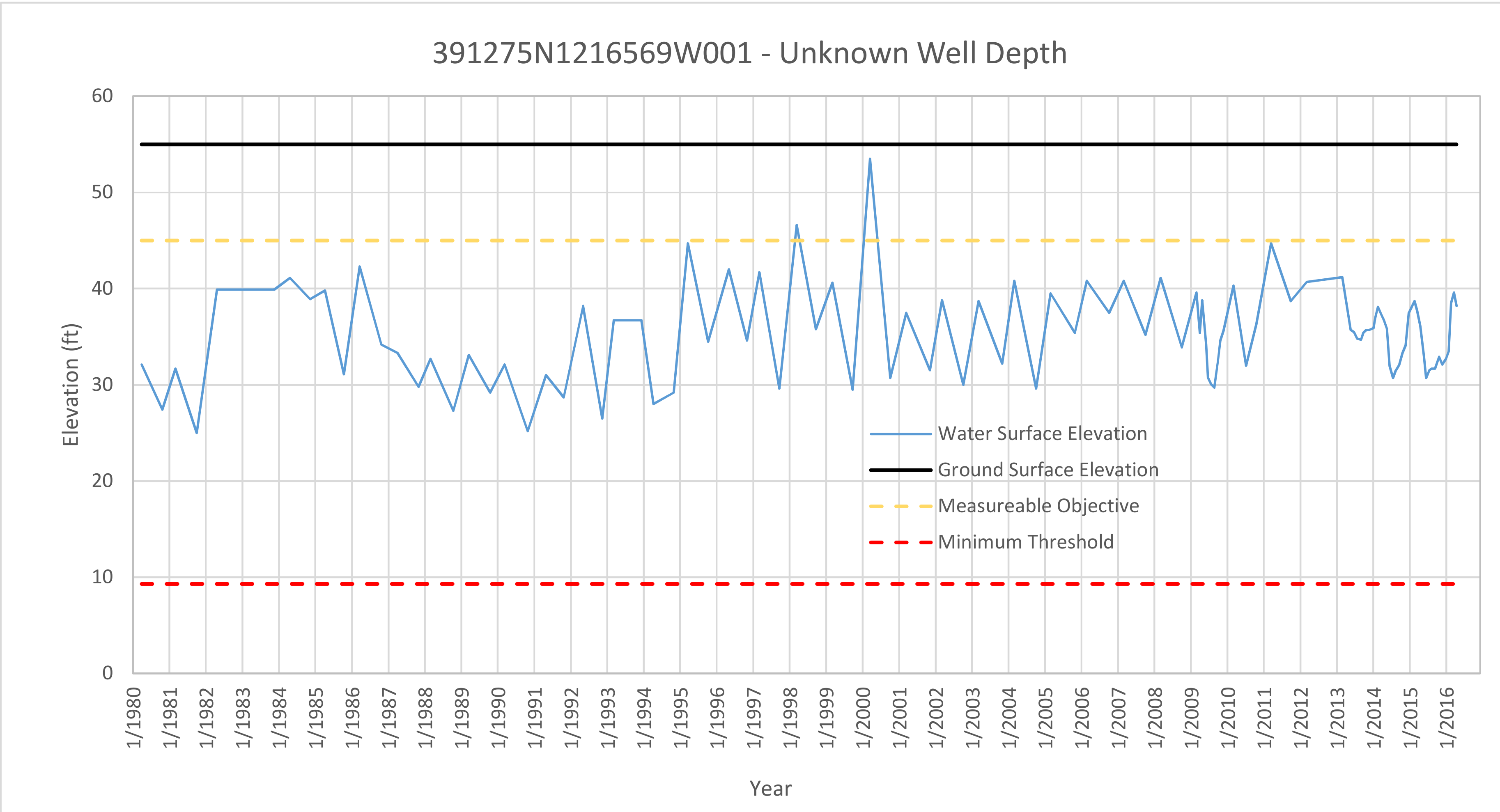
390245N1216796W001 - Unknown Well Depth
Water Surface Elevation
Measureable Objective
Minimum Threshold
Ground Surface Elevation
Elevation (ft)
60
50
40
30
20
10
0
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year



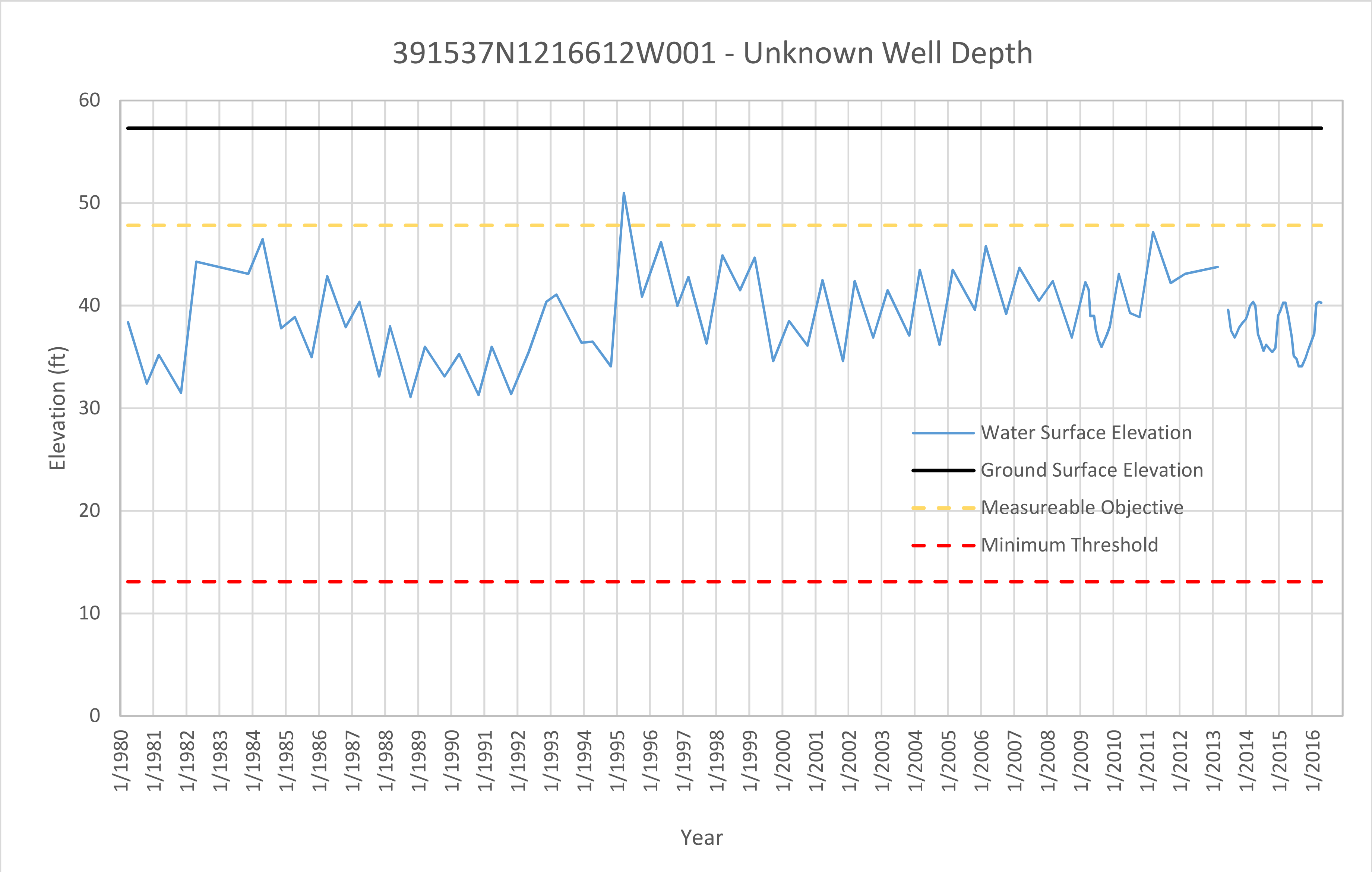
390524N1216249W001 - Unknown Well Depth
Elevation (ft)
60
50
40
30
20
10
0
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year
14N03E22B002M
Ground Surface Elevation
Measureable Objective
Minimum Threshold



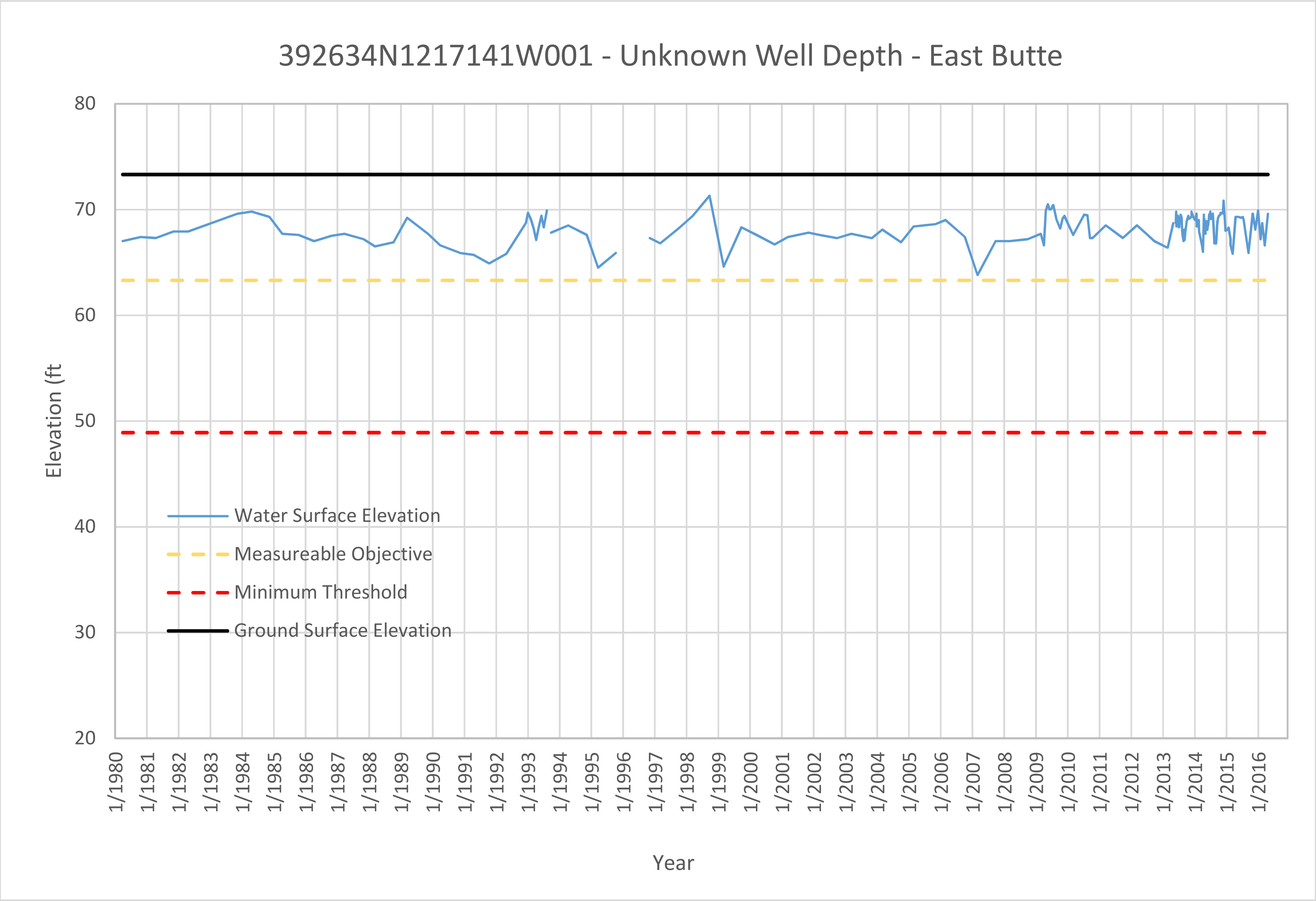
390657N1218291W001 - Unknown Well Depth
Water Surface Elevation
Ground Surface Elevation
Mesureable Objective
Minimum Threshold
Elevation (ft)
60
50
40
30
20
10
0
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year

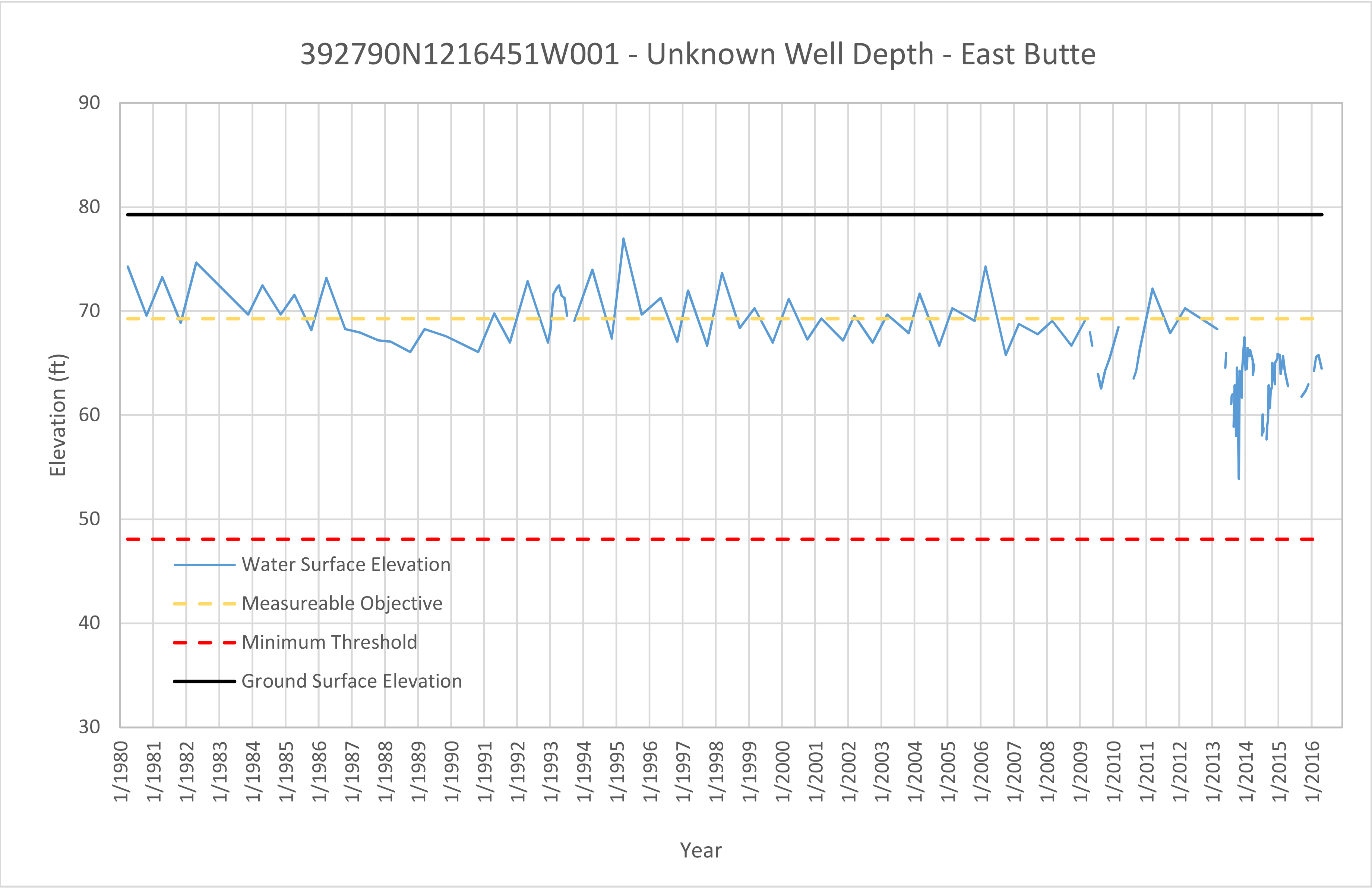


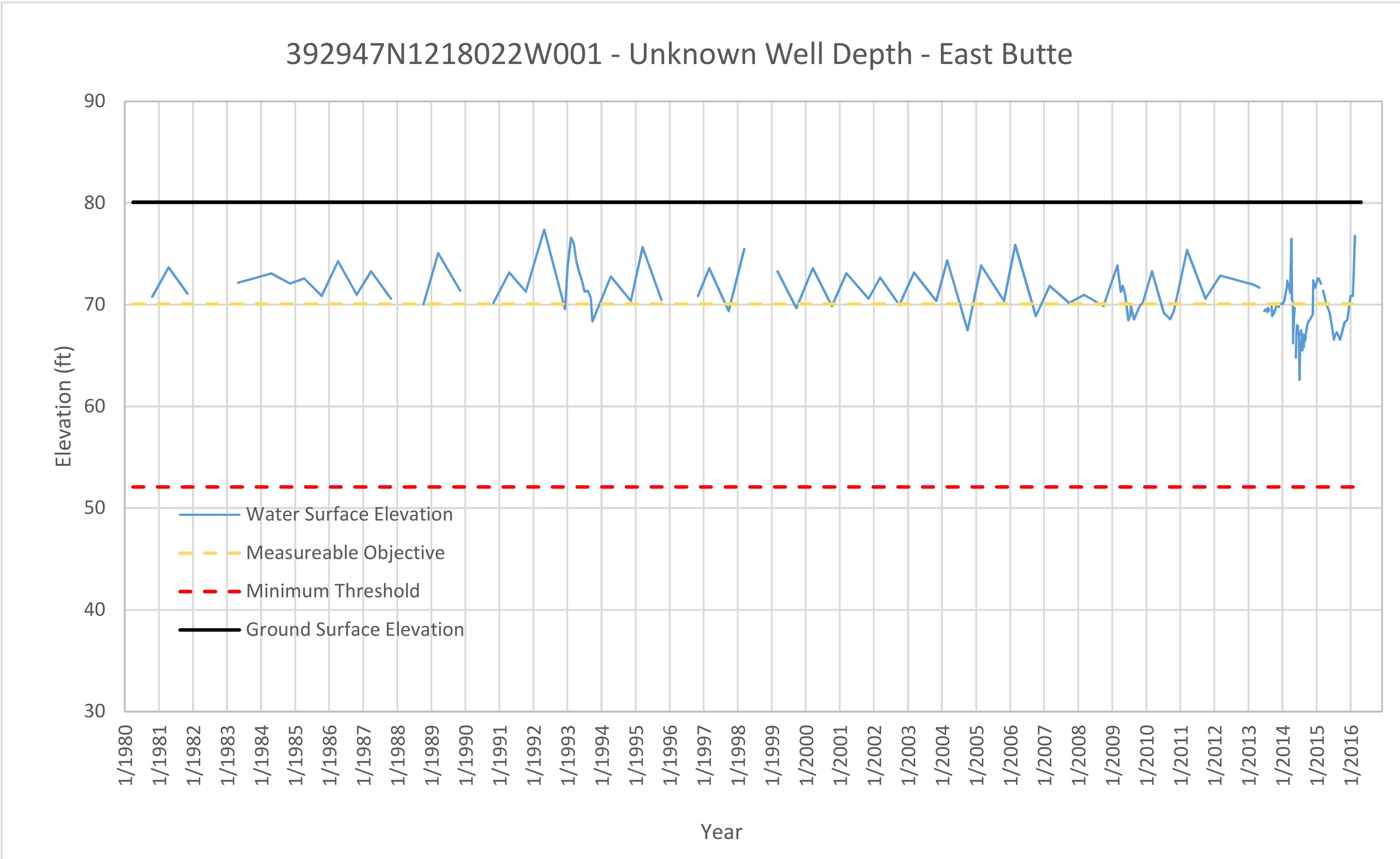
391275N1216569W001 - Unknown Well Depth
Elevation (ft)
60
50
40
30
20
10
0
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year
Water Surface Elevation
Ground Surface Elevation
Measureable Objective
Minimum Threshold



391537N1216612W001 - Unknown Well Depth
Elevation (ft)
60
50
40
30
20
10
0
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year
Water Surface Elevation
Ground Surface Elevation
Measureable Objective
Minimum Threshold


392634N1217141W001 - Unknown Well Depth - East Butte
80
70
60
50
40
30
20
Elevation (ft
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year
Water Surface Elevation
Measureable Objective
Minimum Threshold
Ground Surface Elevation


392790N1216451W001 - Unknown Well Depth - East Butte
90
80
70
60
50
40
30
Elevation (ft)
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
1/1991
1/1992
1/1993
1/1994
1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Year
Water Surface Elevation
Measureable Objective
Minimum Threshold
Ground Surface Elevation



392947N1218022W001 - Unknown Well Depth - East Butte
Elevation (ft)
Year
90
80
70
60
50
40
30
1/1980
1/1981
1/1982
1/1983
1/1984
1/1985
1/1986
1/1987
1/1988
1/1989
1/1990
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1/1992
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1/1995
1/1996
1/1997
1/1998
1/1999
1/2000
1/2001
1/2002
1/2003
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015
1/2016
Water Surface Elevation
Measureable Objective
Minimum Threshold
Ground Surface Elevation

APPENDIX O
WATER QUALITY
MEASUREABLE OBJECTIVES AND
MINIMUM TRESHOLDS

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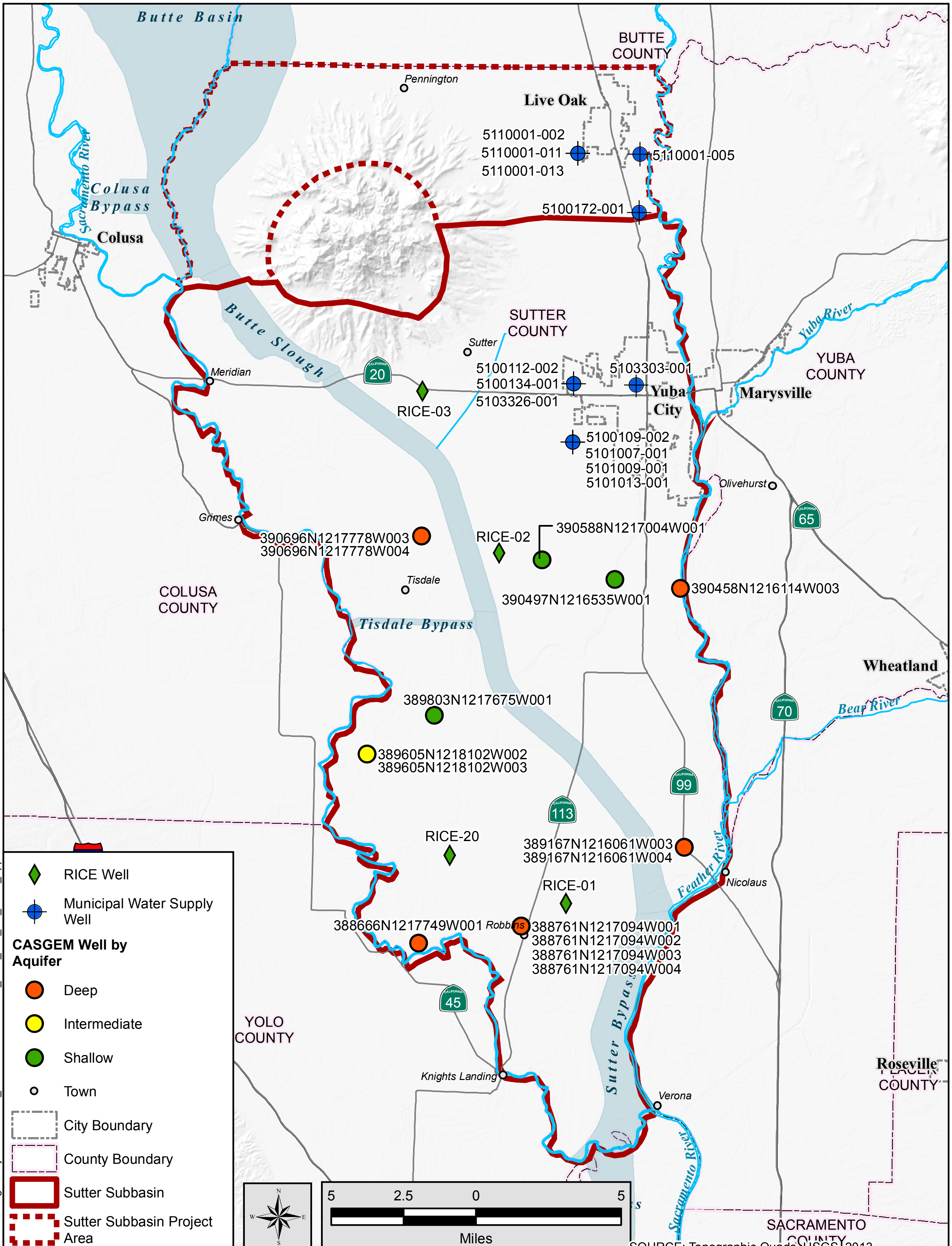


\\sac1s-fs01\gis\Projects\1610508_Sutter\SutterSubbasin\SutterSubbasin_NO3_and_SC_Wells_App.mxd SMS

15-Nov-2016

Alternative Submittal Sutter Subbasin	GEI Consultants	Groundwater Quality Wells Nitrate Trends and Specific Conductance	
Sutter County		NOVEMBER 2016	FIGURE 0-1

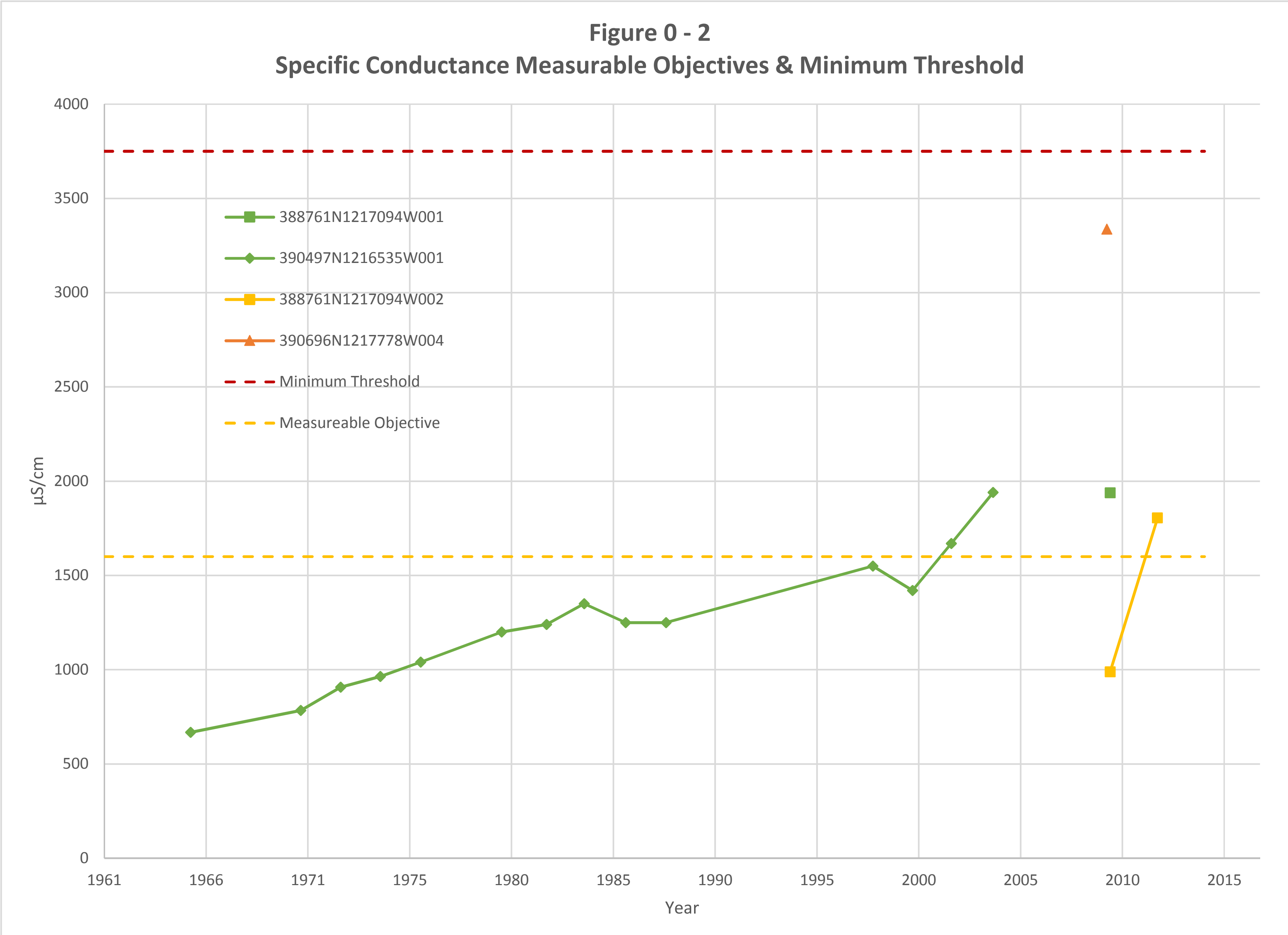


Figure 0 - 2
Specific Conductance Measurable Objectives & Minimum Threshold
388761N1217094W001
390497N1216535W001
388761N1217094W002
390696N1217778W004
Minimum Threshold
Measureable Objective
µS/cm
Year
0
500
1000
1500
2000
2500
3000
3500
4000
1961
1966
1971
1975
1980
1985
1990
1995
2000
2005
2010
2015

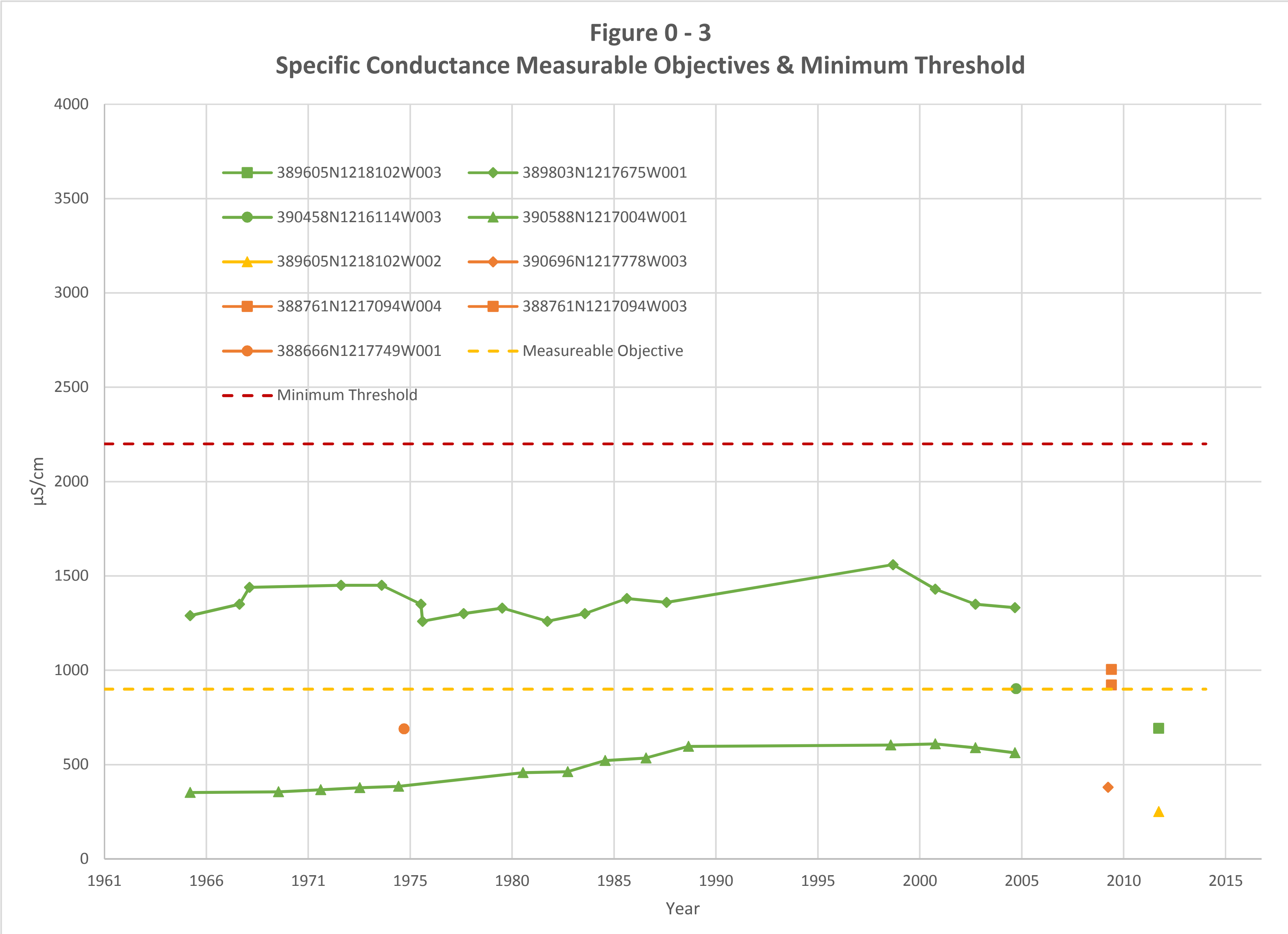


Figure 0 - 3
Specific Conductance Measurable Objectives & Minimum Threshold
µS/cm
4000
3500
3000
2500
2000
1500
1000
500
0
1961
1966
1971
1975
1980
1985
1990
1995
2000
2005
2010
2015
Year
389605N1218102W003
389803N1217675W001
390458N1216114W003
390588N1217004W001
389605N1218102W002
390696N1217778W003
388761N1217094W004
388761N1217094W003
388666N1217749W001
Measureable Objective
Minimum Threshold

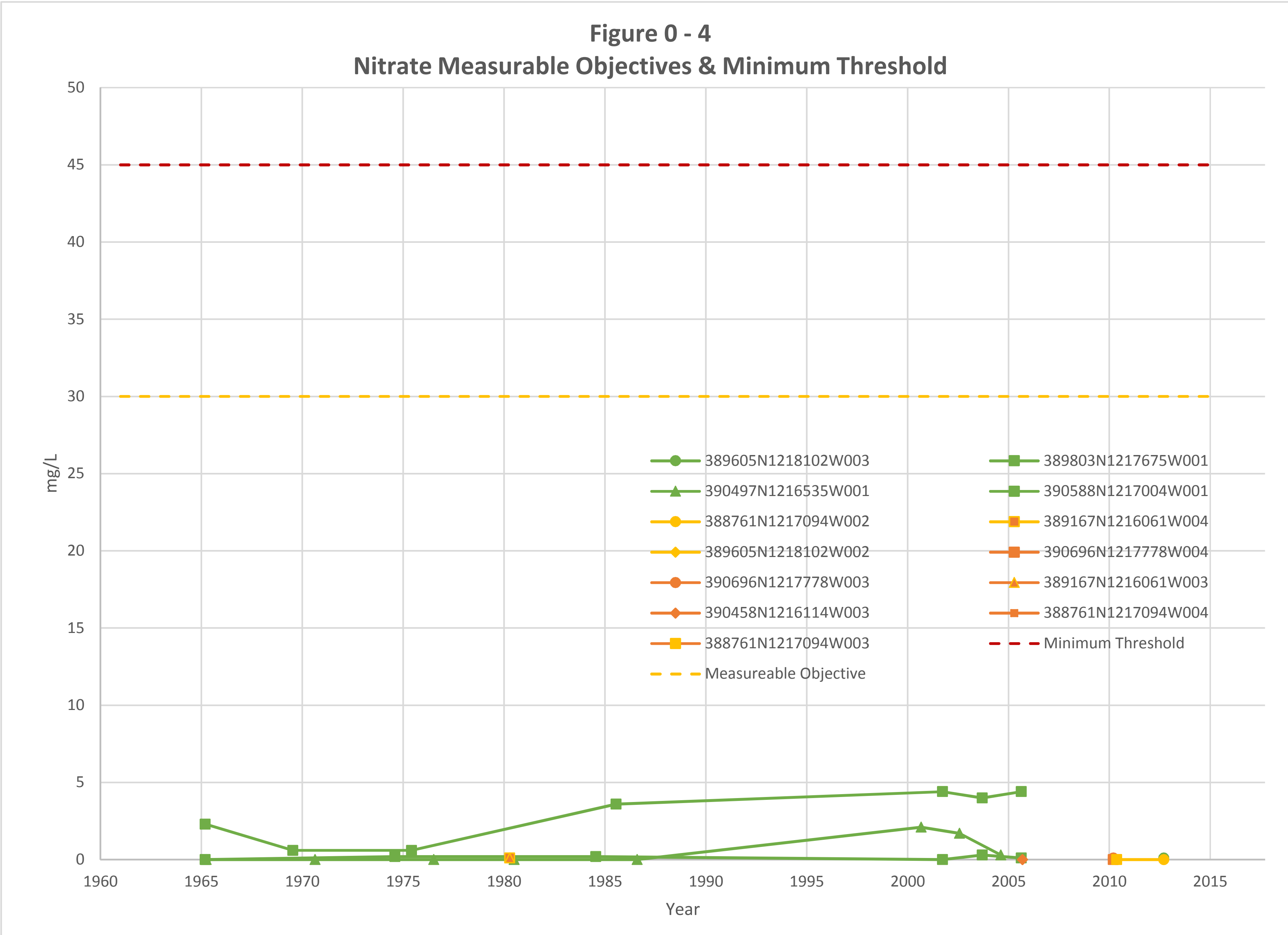


Figure 0 - 4
Nitrate Measurable Objectives & Minimum Threshold
50
45
40
35
30
25
20
15
10
5
0
mg/L
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
Year
389605N1218102W003
389803N1217675W001
390497N1216535W001
390588N1217004W001
388761N1217094W002
389167N1216061W004
389605N1218102W002
390696N1217778W004
390696N1217778W003
389167N1216061W003
390458N1216114W003
388761N1217094W004
388761N1217094W003
Minimum Threshold
Measureable Objective

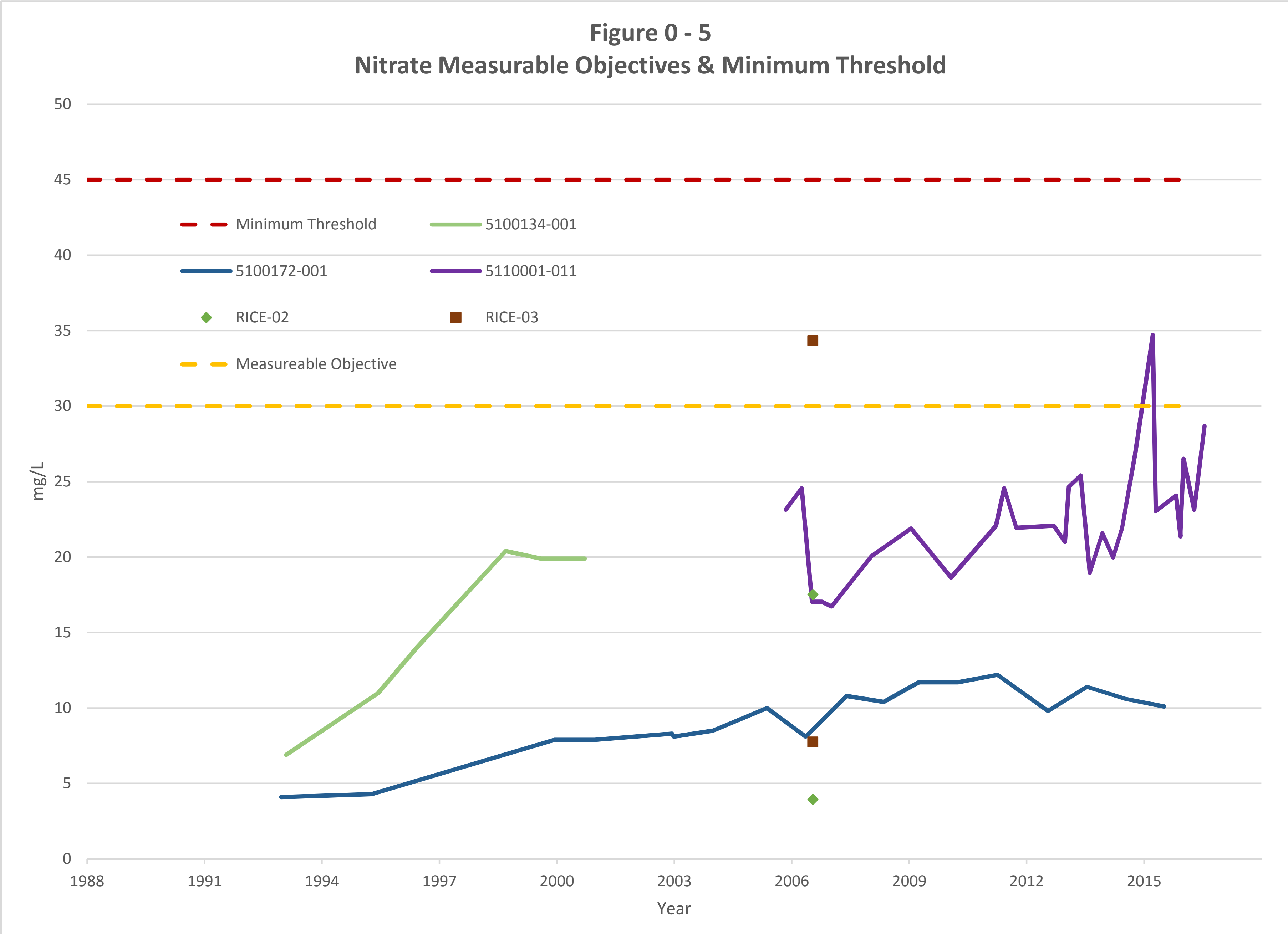


Figure 0 - 5
Nitrate Measurable Objectives & Minimum Threshold
mg/L
0
5
10
15
20
25
30
35
40
45
50
1988
1991
1994
1997
2000
2003
2006
2009
2012
2015
Year
Minimum Threshold
5100134-001
5100172-001
5110001-011
RICE-02
RICE-03
Measureable Objective

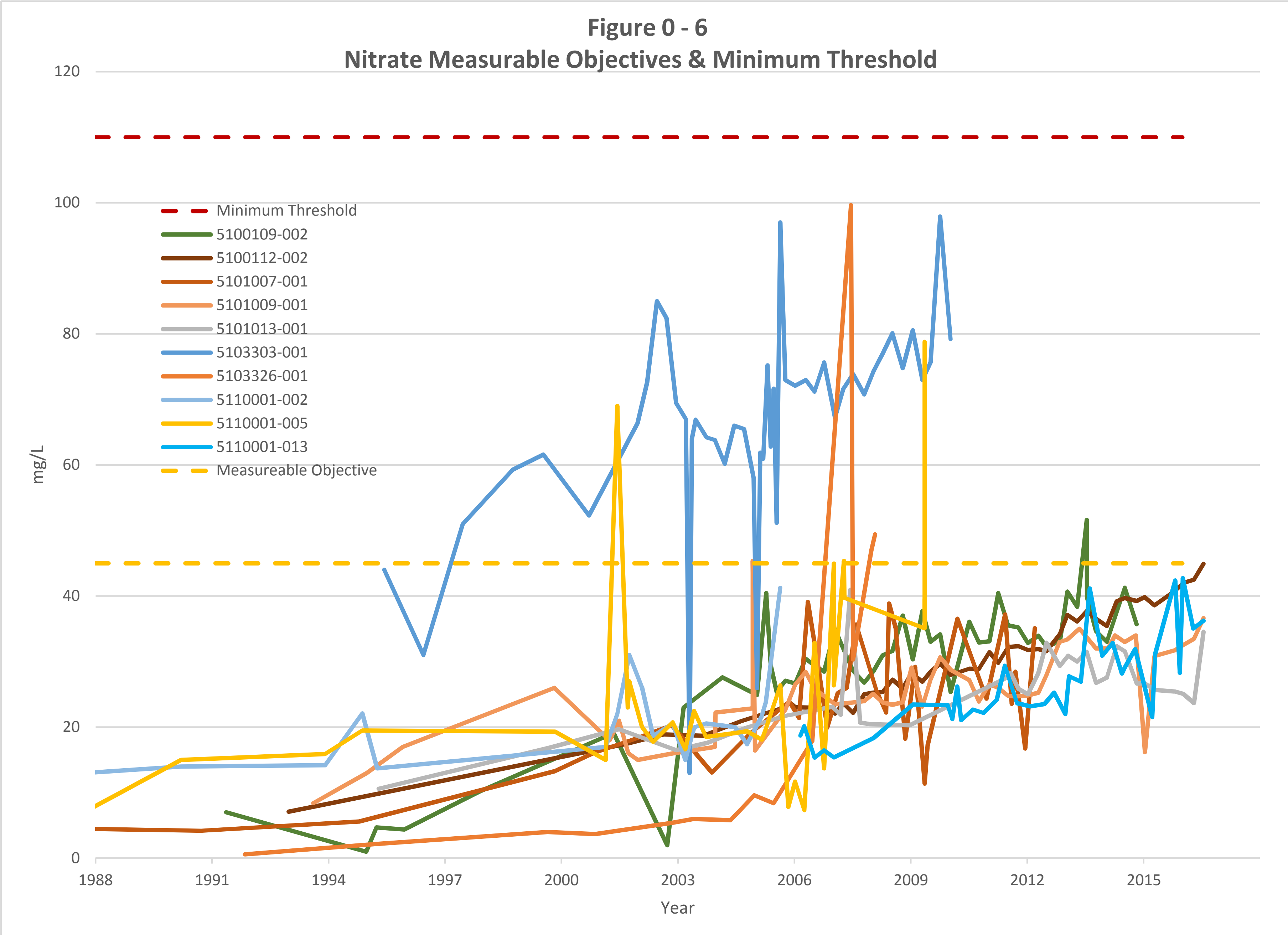


Figure 0 - 6
Nitrate Measurable Objectives & Minimum Threshold
mg/L
0
20
40
60
80
100
120
1988
1991
1994
1997
2000
2003
2006
2009
2012
2015
Year
Minimum Threshold
5100109-002
5100112-002
5101007-001
5101009-001
5101013-001
5103303-001
5103326-001
5110001-002
5110001-005
5110001-013
Measureable Objective

APPENDIX P
MONITORING NETWORK AND PROTOCOLS

Well Identification						Monitoring Frequency			
						October		April and October	
Label ID	CASGEM ID	State ID	Local ID	Lat N83	Long N83	Quality	Quality Threshold	Groundwater Level	Threshold
Shallow Aquifer									
5	388761N1217094W001	12N02E23H001M	Sutter County MW-2A	38.8761	-121.7094	EC	Yes		
12	389074N1215903W001	12N03E12C001M		38.9074	-121.5903	EC			
13	389167N1216061W001	12N03E02G004M		38.9167	-121.6061	EC			
42	389563N1215843W001		GH East MW Site	38.9563	-121.5843	EC			
44	389582N1216067W001	13N03E23K001M		38.9582	-121.6067	EC			
54	389736N1216233W001		Feather WD-3	38.9736	-121.6233	EC			
64	390087N1216722W001	13N03E06A001M	Sutter County MW-6A	39.0086	-121.6719	EC			
68	390214N1216625W001		Feather WD-4	39.0214	-121.6625	EC			
61	390027N1216367W001	13N03E04J001M	13N03E04J001M	39.0027	-121.6367	EC			Yes
26	389410N1215884W001		GH Well 18	38.941	-121.5884	EC		Yes	
43	389571N1215858W001		GH North MW Site	38.9571	-121.5858	EC		Yes	
58	389820N1215923W001		Feather WD-2	38.982	-121.5923	EC		Yes	
107	390701N1216268W001	14N03E10P003M		39.0701	-121.6268	NO3			
126	391254N1216930W001	15N02E25A001M		39.1254	-121.693	NO3			
152	391673N1217440W001	15N02E10D002M		39.1673	-121.744	NO3			
164	392394N1216509W001	16N03E17J001M	Sutter County MW-3A	39.2394	-121.6509	NO3			
136	391406N1216961W001	15N02E24B001M	15N02E24B001M	39.1406	-121.6961	NO3			Yes
160	392038N1217147W001	16N02E26Q001M	16N02E26Q001M	39.2038	-121.7147	NO3			Yes
161	392324N1216499W001	16N03E21D001M	16N03E21D001M	39.2324	-121.6499	NO3			Yes
162	392328N1216469W001	16N03E21D002M	16N03E21D002M	39.2328	-121.6469	NO3			Yes
140	391512N1216190W001	15N03E15H004M	15N03E15H004M	39.1512	-121.619	NO3		Yes	Yes
9	388813N1217525W001	12N02E21Q001M	SR-1A	38.869	-121.7525				
48	389605N1218102W003	13N01E24G004M	Flood MW-1C (shall)	38.9605	-121.8102		Yes		
71	390244N1217813W001	14N02E32D001M	SMWC MW-1A	39.0244	-121.7813				
80	390458N1216114W001	14N03E23D003M	Feather River MW-1A	39.0458	-121.6114				
84	390497N1216535W001	14N03E20H003M	14N03E20H003M	39.0497	-121.6535		Yes		
87	390588N1217004W001	14N02E13L001M	14N02E13L001M	39.0588	-121.7004		Yes		
94	390682N1216901W001	14N02E13A003M	SEWD MW-3A	39.0682	-121.6901				
102	390696N1217778W001	14N02E17C001M	Sutter County MW-1A	39.0696	-121.7778				
116	391051N1217012W001	15N02E36L001M	15N02E36L001M	39.1051	-121.7012				
121	391115N1217425W001	15N02E34D002M	15N02E34D002M	39.113	-121.7411				
122	391124N1216910W001	15N02E36A001M		39.1124	-121.691				
127	391274N1217586W001	15N02E28D002M		39.1274	-121.7586				
163	392355N1218985W001	16N01E18K001M		39.2355	-121.8985				
173	392655N1215894W001	16N03E01P002M		39.2655	-121.5894				
179	392878N1217240W001	17N02E34A001M		39.2878	-121.724				
186	392970N1216907W003	17N02E25J003M	BWD MW-1C	39.2971	-121.6907				
192	393269N1217096W001	17N02E14H001M	BMO 17N02E14H001M	39.3269	-121.7096				
193	393337N1217097W001	17N02E14A001M	BMO 17N02E14A001M	39.3337	-121.7097				
194	393383N1216575W001	17N03E08K002M	17N03E08K002M	39.3383	-121.6575				
195	393457N1218375W001	17N01E10A001M	BMO 17N01E10A001M	39.3457	-121.8375				
196	USGS 385314121401701		012N003E18H001M	38.5313	-121.4022				
197	USGS 385431121451401		012N002E09B002M	38.5431	-121.4518				
198	USGS 390416121433601		014N002E10R001M	39.0415	-121.4339				
199	USGS 390832121463601		015N002E20D001M	39.0833	-121.4639				
56	389803N1217675W001	13N02E17A001M	13N02E17A001M	38.9803	-121.7675		Yes		Yes
60	389885N1218051W001	13N01E12J002M	13N01E12J002M	38.9885	-121.8051				Yes
78	390426N1218166W001	14N01E24N001M	14N01E24N001M	39.0426	-121.8166			Yes	
158	391975N1218937W001	16N01E31H001M	16N01E31H001M	39.1975	-121.8937			Yes	
174	392712N1216493W001	16N03E04E001M	16N03E04E001M	39.2712	-121.6493			Yes	
67	390176N1217902W001	14N02E31K001M	14N02E31K001M	39.0176	-121.7902			Yes	Yes
125	391251N1219138W001	15N01W25A001M	15N01W25A001M	39.1251	-121.9138			Yes	Yes
			5100134-001[1]				Yes	Yes	
			5100172-001[1]				Yes	Yes	
			511001-011[1]				Yes	Yes	
			5100109-002[1]				Yes	Yes	
			5100112-002[1]				Yes	Yes	
			5101007-001[1]				Yes	Yes	
			5101009-001[1]				Yes	Yes	
			5101013-001[1]				Yes	Yes	
			5103303-001[1]				Yes	Yes	
			5103326-001[1]				Yes	Yes	
			5110001-002[1]				Yes	Yes	
			5110001-005[1]				Yes	Yes	
			5110001-013[1]				Yes	Yes	
			RICE-02[1]				Yes	Yes	
			RICE-03[1]				Yes	Yes	
Intermediate Aquifer									

6	388761N1217094W002	12N02E23H002M	Sutter County MW-2B	38.8761	-121.7094	EC	Yes		
16	389167N1216061W004	12N03E02G003M	12N03E02G003M	38.9167	-121.6061	EC	Yes		
22	389347N1215897W001		GH Well 19	38.9347	-121.5897	EC			
27	389452N1215992W001	13N03E26J002M	Sutter County MW-4A	38.9452	-121.5992	EC			
33	389495N1215863W001		GH Well 22	38.9495	-121.5863	EC			
34	389509N1215863W001		GH Well 4	38.9509	-121.5863	EC			
35	389510N1215913W001		GH Well 17	38.951	-121.5913	EC			
41	389560N1215860W001		GH Well 23	38.956	-121.586	EC			
57	389819N1215949W001	13N03E13D001M		38.9819	-121.5949	EC			
59	389860N1215928W001		Feather WD-1	38.986	-121.5928	EC			
65	390087N1216722W002	13N03E06A002M	Sutter County MW-6B	39.0086	-121.6719	EC			
66	390087N1216722W003	13N03E06A003M	Sutter County MW-6C	39.0086	-121.6719	EC			
69	390215N1216994W001	14N02E36F001M	14N02E36F001M	39.0215	-121.6994	EC			
4	388691N1217143W001	12N02E23K001M	12N02E23K001M	38.8691	-121.7143	EC			Yes
115	391021N1216275W001	15N03E34L001M		39.1021	-121.6275	NO3			
120	391078N1216244W001		La Grande	39.1078	-121.6244	NO3			
135	391370N1216371W001	15N03E21H002M		39.137	-121.6371	NO3			
141	391518N1218295W001	15N01E14F001M		39.1518	-121.8295	NO3			
146	391642N1216240W001	15N03E10G001M		39.1642	-121.624	NO3			
159	391990N1217257W001	16N02E35C003M	16N02E35	39.199	-121.7257	NO3			
165	392394N1216509W002	16N03E17J002M	Sutter County MW-3B	39.2394	-121.6509	NO3			
10	388813N1217525W002	12N02E21Q002M	SR-1B	38.869	-121.7525				
17	389242N1217740W001	13N02E32P001M	Well 3 (Klein)	38.9242	-121.774				
18	389281N1218056W001		Klein #2	38.9281	-121.8056				
37	389528N1217918W001		Pelger #1 - Shallow	38.9528	-121.7918				
38	389528N1217918W002		Pelger #1 - Middle	38.9528	-121.7918				
39	389528N1217918W003		Pelger #1 - Deep	38.9528	-121.7918				
40	389529N1217917W001		PMWC #1	38.9529	-121.7917				
46	389605N1218102W001	13N01E24G002M	Flood MW-1A (deep)	38.9605	-121.8102				
47	389605N1218102W002	13N01E24G003M	Flood MW-1B (int)	38.9605	-121.8102		Yes		
49	389605N1218103W001	13N01E24K001M	Well 2 (Flopet)	38.9605	-121.8103				
72	390244N1217813W002	14N02E32D002M	SMWC MW-1B	39.0244	-121.7813				
77	390398N1217181W001	14N02E26C001M	14N02E26C001M	39.0398	-121.7181				
81	390458N1216114W002	14N03E23D004M	Feather River MW-1B	39.0458	-121.6114				
86	390587N1218380W001		TID Park-Windship	39.0587	-121.838				
88	390590N1217538W001	14N02E16K001M	TBF Well 5	39.059	-121.7538				
93	390681N1216534W001	14N03E17A003M		39.0681	-121.6534				
95	390682N1216901W002	14N02E13A004M	SEWD MW-3B	39.0682	-121.6901				
99	390694N1217599W001	14N02E16D002M	TBF Well 2	39.0694	-121.7599				
101	390695N1217640W001	14N02E16D003M	TBF Well 7	39.0695	-121.764				
103	390696N1217778W002	14N02E17C002M	Sutter County MW-1B	39.0696	-121.7778				
108	390784N1218450W001		MFWC Park2	39.0784	-121.845				
109	390803N1218906W001		MFWC Park-Miller	39.0803	-121.8906				
110	390867N1217665W001	14N02E05R001M	TBF Well 1	39.0867	-121.7665				
112	390976N1216622W001	14N03E05C001M		39.0976	-121.6622				
114	391012N1218222W001		BS1-McClatchy	39.1012	-121.8222				
119	391068N1216464W001		Edwin	39.1068	-121.6464				
124	391173N1216125W001	15N03E26M001M		39.1173	-121.6125				
130	391279N1216989W001	15N02E24P001M	SEWD MW-2A	39.1279	-121.6989				
131	391279N1216989W002	15N02E24P002M	SEWD MW-2B	39.1279	-121.6989				
134	391283N1218286W001		BS2-Franklin	39.1283	-121.8286				
137	391414N1217442W001	15N02E22D001M	15N02E22D001M	39.1414	-121.7442				
138	391456N1218904W001		MFWC Prop 50	39.1456	-121.8904				
139	391489N1217259W001	15N02E14M001M	15N02E14M001M	39.1489	-121.7259				
143	391558N1218004W001	15N01E13A001M		39.1558	-121.8004				
147	391658N1217070W001	15N02E12E001M	SEWD MW-1A	39.1658	-121.707				
148	391658N1217070W002	15N02E12E002M	SEWD MW-1B	39.1658	-121.707				
155	391851N1216691W001	15N03E05D002M		39.1851	-121.6691				
157	391975N1215940W001	16N03E36M001M	YCWA-01	39.1975	-121.594				
169	392475N1216005W001	16N03E14B004M	YCWA-03	39.2475	-121.6005				
180	392883N1215952W001	17N03E35H003M	YCWA-04	39.2883	-121.5952				
185	392970N1216907W002	17N02E25J002M	BWD MW-1B	39.2971	-121.6907				
189	393108N1217811W001	17N02E19J001M	BMO 17N02E19J001M	39.3108	-121.7811				
1	387859N1216565W001	11N03E20H003M	RD 1500 Karnak	38.7859	-121.6565				Yes
123	391124N1217226W001	15N02E35D001M	15N02E35D001M	39.1124	-121.7226				Yes
171	392603N1216860W001	16N03E07D002M	16N03E07D002M	39.2603	-121.686				Yes
191	393257N1218830W001	17N01E17F001M	BMO 17N01E17F001M	39.3257	-121.883				Yes
Deep Aquifer									
7	388761N1217094W003	12N02E23H003M	Sutter County MW-2C	38.8761	-121.7094	EC	Yes		
14	389167N1216061W002	12N03E02G001M	12N03E02G001M	38.9167	-121.6061	EC			
15	389167N1216061W003	12N03E02G002M	12N03E02G002M	38.9167	-121.6061	EC	Yes		
28	389452N1215992W002	13N03E26J003M	Sutter County MW-4B	38.9452	-121.5992	EC			

29	389452N1215992W003	13N03E26J004M	Sutter County MW-4C	38.9452	-121.5992	EC			
30	389452N1215992W004	13N03E26J005M	Sutter County MW-4D	38.9452	-121.5992	EC			
8	388761N1217094W004	12N02E23H004M	Sutter County MW-2D	38.8761	-121.7094	EC	Yes	Yes	
144	391613N1216236W001		WTP Well	39.1613	-121.6236	NO3			
166	392394N1216509W003	16N03E17J003M	Sutter County MW-3C	39.2394	-121.6509	NO3			
167	392394N1216509W004	16N03E17J004M	Sutter County MW-3D	39.2394	-121.6509	NO3			
168	392394N1216509W005	16N03E17J005M	Sutter County MW-3E	39.2394	-121.6509	NO3			
178	392867N1217825W001	17N02E31A001M	17N02E31A001M	39.2867	-121.7825	NO3			Yes
11	388813N1217525W003	12N02E21Q003M	SR-1C	38.869	-121.7525				
23	389382N1218291W001		South Well	38.9382	-121.8291				
45	389596N1218314W001		North Well	38.9596	-121.8314				
51	389644N1218010W001	13N02E19D001M	Well 1 (Tucker)	38.9644	-121.801				
73	390244N1217813W003	14N02E32D003M	SMWC MW-1C	39.0244	-121.7813				
82	390458N1216114W003	14N03E23D005M	Feather River MW-1C	39.0458	-121.6114		Yes		
83	390458N1216114W004	14N03E23D006M	Feather River MW-1D	39.0458	-121.6114				
96	390682N1216901W003	14N02E13A005M	SEWD MW-3C	39.0682	-121.6901				
100	390695N1217623W001	14N02E16D001M	TBF Well 3	39.0695	-121.7623				
104	390696N1217778W003	14N02E17C003M	Sutter County MW-1C	39.0696	-121.7778		Yes		
105	390696N1217778W004	14N02E17C004M	Sutter County MW-1D	39.0696	-121.7778		Yes		
106	390700N1217725W001	14N02E08Q001M	TBF Well 4	39.07	-121.7725				
129	391278N1216984W001	15N02E24P004M	SEWD Well #2	39.1278	-121.6984				
132	391279N1216989W003	15N02E24P003M	SEWD MW-2C	39.1279	-121.6989				
149	391658N1217070W003	15N02E12E003M	SEWD MW-1C	39.1658	-121.707				
153	391707N1217006W001	15N02E12C001M	SEWD Well #1	39.1707	-121.7006				
182	392935N1217061W001	17N02E26R001M	17N02E26R001M	39.2935	-121.7061				
184	392970N1216907W001	17N02E25J001M	BWD MW-1A	39.2971	-121.6907				
187	393012N1216873W001	17N03E30E001M	17N03E30E001M	39.3012	-121.6873				
190	393169N1218004W002	17N01E24A003M	BMO 17N01E24A003M	39.3169	-121.8004				
2	388666N1217749W001	12N02E20P001M	12N02E20P001M	38.8666	-121.7749		Yes		Yes
Unknown Aquifer									
19	389300N1216056W001	13N03E35K002M		38.93	-121.6056	EC			
25	389398N1216162W001		GH Well 3	38.9398	-121.6162	EC			
31	389453N1216159W001		GH Well 2	38.9453	-121.6159	EC			
32	389454N1215870W001		GH Atwal Well	38.9454	-121.587	EC			
36	389525N1216161W001		GH Well 1	38.9525	-121.6161	EC			
52	389677N1215974W001		GH Rouse Ranch Well	38.9677	-121.5974	EC			
53	389678N1215967W001	13N03E24D001M		38.9678	-121.5967	EC			
55	389786N1216259W001	13N03E15C003M	13N03E15C003M	38.9786	-121.6259	EC			
62	390028N1216772W001	13N03E06K001M		39.0028	-121.6772	EC			
63	390067N1216012W001	13N03E02H001M		39.0067	-121.6012	EC			
70	390234N1216478W001	14N03E33C001M	14N03E33C001M	39.0234	-121.6478	EC			Yes
74	390245N1216796W001	14N03E31B001M	14N03E31B001M	39.0245	-121.6796	EC			Yes
89	390654N1216120W001	14N03E14E002M		39.0654	-121.612	NO3			
118	391057N1216114W001		WWTP Well	39.1057	-121.6114	NO3			
133	391282N1216799W001		Lyndsey	39.1282	-121.6799	NO3			
145	391638N1216252W001	15N03E10G002M		39.1638	-121.6252	NO3			
154	391710N1217359W001		SCSD Well #1	39.171	-121.7359	NO3			
85	390524N1216249W001	14N03E22B002M	14N03E22B002M	39.0524	-121.6249	NO3			Yes
128	391275N1216569W001	15N03E20R001M	15N03E20R001M	39.1275	-121.6569	NO3			Yes
142	391537N1216612W001	15N03E17B002M	15N03E17B002M	39.1537	-121.6612	NO3			Yes
183	392947N1218022W001	17N01E25J001M	17N01E25J001M	39.2947	-121.8022	NO3			Yes
20	389303N1217639W001		Tennis #1	38.9303	-121.7639				
21	389336N1218125W001		Broomiside #2	38.9336	-121.8125				
24	389389N1218161W001		MW-9	38.9389	-121.8161				
50	389606N1218011W001		Tucker #2	38.9606	-121.8011				
75	390277N1217090W001	14N02E26R001M		39.0277	-121.709				
76	390369N1218189W001		TID Park-Lonon	39.0369	-121.8189				
79	390433N1218097W001	14N01E24Q001M	14N01E24Q001M	39.0433	-121.8097				
91	390676N1217169W001	14N02E14B001M		39.0676	-121.7169				
92	390679N1217641W001		TBF Well 6	39.0679	-121.7641				
97	390684N1216886W001	14N03E18D001M		39.0684	-121.6886				
98	390691N1216695W001	14N03E08N001M		39.0691	-121.6695				
111	390914N1217685W001		TBF Well 8	39.0914	-121.7685				
113	390989N1216505W001	15N03E33N004M		39.0989	-121.6505				
117	391052N1218994W001		MFWC S Meridian	39.1052	-121.8994				
150	391667N1215622W001	15N04E07H001M	15N04E07H001M	39.1667	-121.5622				
151	391672N1218034W001	15N01E12A001M		39.1672	-121.8034				
156	391970N1216340W001	16N03E33J002M		39.197	-121.634				
170	392575N1218863W001	16N01E08C001M	16N01E08C001M	39.2575	-121.8863				
175	392762N1216556W001		Live Oak Well 5	39.2762	-121.6556				
177	392821N1218593W001	17N01E33G001M		39.2821	-121.8593				
181	392929N1216859W001	17N03E30N001M	17N03E30N001M	39.2926	-121.6861				

188	393081N1216163W001	17N03E22R001M		39.3081	-121.6163				
3	388674N1216168W001	12N03E23N001M	12N03E23N001M	38.8674	-121.6168				Yes
172	392634N1217141W001	16N02E02Q001M	16N02E02Q001M	39.2624	-121.715				Yes
176	392790N1216451W001	17N03E33P001M	17N03E33P001M	39.279	-121.6457				Yes
90	390657N1218291W001	14N01E14G001M	14N01E14G001M	39.0657	-121.8291			Yes	Yes

[1] - Monitored Every Two Years

1 Groundwater Level Monitoring Protocol

Groundwater levels shall be measured in all wells designated for groundwater level monitoring in April and October. This schedule is proposed to correlate with DWR requested monthly monitoring events and to provide complete coverage to monitor for compliance purposes. Monitoring personnel should arrange to make groundwater level measurements on the same day, but at no time should the measurements be taken after an one-week period.

1.1 Preparation for Field Work

Prior to collecting groundwater level and before going to the field, sampling personnel shall clean, and test the water level sounder.

The sampling personnel will assemble the following equipment and supplies:

- Copy of the Groundwater Level Measurements form
- Copy of the Monitoring Network Location map
- Electrical water level sounder
- Crescent wrenches for gaining access to the well
- Ballpoint pen and clipboard
- Paper towels
- Bleach
- Spray bottles
- Potable water

1.2 Monitoring Procedures

The following procedures shall be used to measure the depth-to-water at each designated monitoring well. Water levels measurements will be collected to assess the groundwater flow direction to develop trends that can lead to improved management of the groundwater resources.

1.2.1 Groundwater Level Measurements

Prior to obtaining the water level measurement at each well and between each well site, the bottom 10 feet of the electric sounder cable shall be rinsed in a solution of sodium hypochlorite (liquid bleach) and distilled water. The solution shall consist of bleach and distilled water in a one-tablespoon-to-one-quart ratio (a concentration of about 200 parts per million chlorine is desirable). The sounder shall then be rinsed thoroughly three times with distilled water and allowed to air-dry. Thorough cleaning of equipment is necessary to avoid any possibility of cross-contamination and transport of bacteria between wells.

Each well has been assigned a unique identification number and a common name. The numbers and names for each well to be monitored are contained in a table in Appendix Q. The Groundwater Level Measurement forms will be used to record all groundwater level measurements.

To obtain a depth-to-water measurement, the electric sounder cable will be lowered slowly into the well through the access port until the sounder indicates submergence by either a beeping sound or light, depending on the type of signal installed for that particular model. At this point, the sampling personnel will note the depth-to-water (to the nearest 0.01 foot) from the reference point. The depth shall be confirmed by lifting the sounder above the water surface by about 2 to 3 feet and then re-measuring the depth-to-water. If the depth remains constant, the depth-to-water shall be recorded on Forms, along with the time and date of the measurement. If the depth changes, the sampling personnel shall indicate that on the form, as well as the variable nature of the measurement and its possible cause (e.g., bouncing, recovering water levels, oil on water surface).

Should access to the well be prevented, use the codes listed on the bottom of the forms to provide a reason why the measurement could not be collected and/or the reason that the measurement may be questionable. Insert these codes into the Comments portion of the Form.

2 Quality Assurance

After field personnel have completed their work, a manager shall review groundwater level measurements for accuracy within five days of obtaining the measurements. Should a measurement appear suspicious, a confirmation reading shall be obtained.

2.1.1 Groundwater Level Measurements

After field personnel have completed their work, they shall enter the data into an electronic spreadsheet or database. The managers shall review groundwater level measurements for accuracy within five days of obtaining the measurements. Should a measurement appear suspicious, a confirmation reading shall be obtained.

2.1.2 Annual Groundwater Level Sounder Calibration

During use of a water level sounder, it is possible for the cable to become stretched or shortened because of tangles and obstructions in wells. The water level sounder shall be laid out and compared with a steel tape and the results documented annually. Alternatively, a new and factory calibrated water level sounder can be inserted into a well and groundwater level measuring devices used by other parties can be placed into the well and the measurements compared to assess if the water level sounders are producing similar measurements. Any differences in the measurements will be recorded and any measurements corrected for the difference before entering into the monitoring database. When calibration shows the measurements are greater than 0.10 feet off in 100 feet, the cable shall be replaced.

1 Groundwater Quality Monitoring Protocol

1.1. Groundwater Monitoring Parameters

Water quality samples collected from wells included in the groundwater quality monitoring program will be analyzed for the constituents listed in Table 1. Based on recommendations from the monitoring reports, the analyte list may change for the entire monitoring well network, or for select individual wells, based on concentration trends and areas of concern. Changes to the analyte list and monitoring well network will be presented in the annual reports.

Table 1 List of Constituents and Analytical Methods

Constituent	Field Analysis	Laboratory Analysis*
EC	Water Quality Meter	---
Nitrate	---	EPA Method 300.0

Key:
* Or other approved methodology
EC = electrical conductivity
--- = no analysis
EPA = US Environmental Protection Agency

1.2. Field Sampling Preparation

The following sections present the standard procedures for groundwater sampling, equipment decontamination, and waste management and disposal. Field forms for documentation of sampling activities are attached.

1.2.1. Preparation for Sampling

Prior to the initiation of groundwater sampling, the following activities will be completed:

1. Review existing information.
2. Notify laboratory and obtain sample bottles.
3. Organize equipment and materials.
4. Field instruments.

Review Existing Information

Before groundwater sampling commences, project personnel will review background information on the Project. The information may include historic sampling data, this protocol, and the health and safety plan. Review of this information will assist the sampling personnel in becoming familiar with the site, general conditions, and expected range of field data.

Notify Laboratory and Obtain Sample Bottles

Prior to the start of the groundwater quality monitoring the sampler must contact an ELAP certified laboratory and request sample bottles for nitrate. A California-certified analytical laboratory will provide the appropriate sample containers with any necessary sample preservative. Table 2 provides a list of the appropriate sample containers and preservatives for the analyte listed in Table 2. The analytical method listed in Table 2 must be provided to the laboratory.

The number of wells/sample bottles should be provided to the laboratory to obtain sufficient bottles. It is always wise to request at least one additional bottle in case one breaks or is compromised. The laboratory should also be requested to provide an ice chest along with blue ice. A chain-of-custody form should also be provided by the laboratory.

Table 2 List of Constituents and Sample Containers

Analyte	Analytical Method*	Sample Container and Preservative*
Nitrate	EPA Method 300.0	One (1) 50 mL poly bottle with HSO_4

Key:
* Or other approved methodology
EPA = Environmental Protection Agency
HSO_4 = sulfuric acid
mL = milliliter

Organize Equipment and Materials

It is the responsibility of sampling personnel to ensure that the appropriate sampling equipment, health and safety equipment, materials, and appropriate sample containers are available. Daily field records (daily reports, health and safety forms, purge logs), sample labels, and chain-of-custody records will be used to document the groundwater sampling events and track custody of the samples from collection to transfer to the analytical laboratory for analysis.

Field Instruments

A multi-parameter field meter shall either be purchased by or rented for use during water quality sampling. The meter should be capable of measuring EC, pH, and temperature.

Calibration of the water quality meter will be completed daily prior to sampling activities, and during daily sampling operations if readings are suspect. The calibration activities will be performed in a manner consistent with the manufacturer’s recommendations. Daily instrument calibration data will be recorded in the field logbook, field forms, and/or calibration logs (Attachment A).

1.3. Monitoring Well Sampling Procedures

A monitoring well without a dedicated pump can be sampled by a variety of methods. Two of the most common methods are use of a submersible pump or from the Hydrosleves™ bailer.

All wells will be visually inspected prior to purging and any conditions that might affect well or data integrity will be documented. Any water collected in the protective outer casing above the well cap will be removed prior to opening the top of the well. If this condition exists document it in the field notebook. The depth to water will be measured and recorded on the Groundwater Collection Log (Attachment A).

1.3.1. Pumps

Generally, groundwater sampling will be conducted based on the U.S. Environmental Protection Agency (EPA) guidelines described in *Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures* (EPA, 1996). Groundwater monitoring wells will be sampled using submersible pumps, dedicated or non-dedicated. Prior to collection of groundwater samples, well purging will be completed using the procedures described below.

All non-dedicated groundwater purging and sampling equipment will be decontaminated prior to use in accordance with the procedures outlined in Section 1.3.2.

Low-Flow Groundwater Sampling Procedures

Groundwater samples will be collected using dedicated pumps or non-dedicated portable submersible pumps equipped with PTFE (Teflon™) discharge tubing. The non-dedicated groundwater purging and sampling equipment will be decontaminated prior to use in accordance with the procedures outlined in Section 1.3.2. The pump will be carefully placed in each well at a depth such that the intake is located within the screened interval opposite apparent highly transmissive sediments based on well logs or geophysical surveys. Dedicated pumps will only be removed and decontaminated during pump maintenance activities.

For low-flow purging, pump flow rates will be adjusted to maximize withdrawal rates without imparting stress on the formation. The flow rate will be closely monitored during purging by dividing the volume purged by the elapsed time and recorded on the Groundwater Sample Collection Log. A graduated device will be used to determine the volume purged. The initial flow rate will be targeted to be approximately 0.5 gallons per minute or 2.5 gallons of purge water in five minutes. The volume purged will be recorded at least every five minutes.

To document the stress imparted to the aquifer, drawdown will be calculated from the water level measurements during purging, using the static depth to water as reference, and recorded on the Groundwater Sample Collection Log.

To monitor water quality parameters needed for stabilization, purge water will be directed to a flow-through device in which the water quality meter is able to measure physical parameters prior to contact with the atmosphere. Measurements of the stabilization parameters pH, electrical conductivity (EC), turbidity, dissolved oxygen (DO), and temperature will be conducted at 5-minute intervals for the first 30 minutes of purging (following entry of purge water into the flow-through device).

The minimum volume of groundwater that must be purged prior to collecting a sample will be equal to two volumes of discharge tubing. Low-flow purging will continue until three consecutive measurements of the water quality parameters temperature, pH, EC, DO, and turbidity have met the stabilization requirements provided in Table 3.

Table 3 Water Quality Parameter Requirements

Parameter	Stabilization Requirement
Temperature	± 1 degree °C
pH	± 0.1 units
EC	± 5% of span (i.e., ±0.05 for span of 0 to 1 µS per centimeter)

± = plus or minus
% = percent
µS = microSiemens
< = less than
°C = degree Celsius
EC = electrical conductivity

Water quality measurements will be taken at 5-minute intervals, starting after one pump and hose volume has been purged. Groundwater samples will be collected after a minimum of six water quality measurements have been collected and the stabilization criteria are met. Purging will continue until the stabilization criteria are met, or until the well is pumped dry.

Once the stabilization criteria have been met, groundwater samples will be collected directly from the discharge end of the hose. The flow rate may be reduced to minimize agitation of the samples. Samples will then be labeled, handled, and shipped to the laboratory as described in Section 2.6.

Purge water will be discharged to the ground surface at each sample location.

When a submersible pump is present sample containers will be filled directly from the pump discharge line. A sample shall then be poured into the field meter and the temperature, EC and pH shall be recorded in the field log book. Sample identification, handling, and shipment procedures are included in Section 2.6.3.

1.3.2. Hydrasleeves

When a Hydrasleeves bailer is used the sample shall be poured directly from the bailer into the sample bottle first. A portion of the sample shall then be poured into the field meter and the temperature, EC, and pH shall be recorded in the field log book. Sample identification, handling, and shipment procedures are included in Section 1.4.1. Hydrasleeve SOP attached at the bottom of this document.

1.3.1. Water Supply Wells Sample Collection

Groundwater samples from water supply wells will be collected after purging a minimum of three well volumes. In a similar fashion to low flow purging water quality measurements will be taken at 5-minute intervals after starting the pump. Groundwater samples will be collected after a minimum of six water quality measurements have been collected and the stabilization criteria are met. Once the stabilization criteria have been met, groundwater samples will be from either sample ports or the end of the discharge pipe directly into the laboratory prepared sample bottles. A sample shall then be poured into the field meter and the temperature, EC and pH shall be recorded in the field log book. Sample identification, handling, and shipment procedures are included in Section 1.4.1.

1.3.2. Decontamination Procedures

The purpose of decontamination and cleaning procedures during groundwater sampling is to prevent foreign contamination of the samples and cross-contamination between sampling locations. All non-dedicated equipment that has the potential to come into contact with samples will be decontaminated on site. The following sampling-specific decontamination procedures will be performed on all non-dedicated sampling equipment:

1. Wash and scrub with phosphate-free detergent (laboratory grade).
2. Rinse with tap water.
3. Double rinse with deionized or distilled water.
4. Air dry.
5. Protect from fugitive dust and vapors.

The outer surfaces of any non-dedicated pump and tubing will be decontaminated by the procedures listed above. The inner surfaces of the pump and water discharge line will be decontaminated with a soap solution, tap water, and deionized/distilled water. The bottom of the pump will be removed and scrubbed with decontamination fluids. The pump will then be immersed in a container filled with tap water and detergent. The pump will be turned on, and the detergent/water mixture will be circulated through the pump and discharge hose and back into the container for two to three minutes. The equipment will be removed from the detergent/water mixture and placed in a second container filled with tap water. The pump will be turned on, and the initial slug of detergent/water mixture remaining in the discharge tubing from the first wash cycle will be discharged into the wash water container. Tap water from the second container will then be circulated through the pump and discharge hose and back into the container for two to three minutes. The above procedure will be repeated using deionized/distilled water in a third container. The initial slug of rinsate remaining in the discharge tubing from the tap water rinse will be discharged into the tap water container. Deionized/distilled water from the third container will then be circulated through the pump and discharge hose and back into the container for two to three minutes.

1.4. Record Keeping

This section provides guidance for the content of the daily report, how corrections are made to the daily reports and other documents, as well as information to be included in the photographic log (see below).

Daily Logbook

All information pertinent to a field and/or sampling survey will be recorded on appropriate data sheets and in daily field reports. The daily field report will be completed using waterproof ink and will include the following information:

- Name and address of the field contact
- Date of entry
- Names and companies of personnel on site
- General descriptions of each day’s field activities

- Documentation of weather conditions during field activities
- Location of sampling (e.g., monitoring identification (ID) or sample port ID)
- Data points for field equipment derived during calibration procedures
- Observation of sample or collection environment
- Identification of sampling device
- Any field measurements made
- Sequence of collection of environmental samples
- Type of sample matrix (e.g., groundwater, surface water, etc.)
- Date and time of sample collection
- Field sample ID number
- Sampler's name

Each daily field report page will be signed or initialed by the person making the entries.

In addition to the information entered into the daily field report, the appropriate data sheets must be filled out as each activity is completed.

Corrections to the Daily Field Reports and Other Documents

All original data recorded in daily field reports, on sample tags, or in custody records, as well as other data sheet entries, will be written with waterproof ink. If an error is made on the document, corrections will be made simply by crossing a line through the error in such a manner that the original entry can still be read, and the correct information added as the change. All corrections will be initialed by the author and dated.

Photographs

Photographs, if taken, will be recorded in the daily field report. Information to be recorded will include the following elements:

- Electronic file name
- Time and date photograph was captured
- Photographer
- Details for the location of the photograph
- Subject of the photograph
- Significant or relevant features
- Names of any personnel included in photograph

1.4.1. Field and Laboratory Sample Custody

Field Operations

Sample custody procedures in the field will be based on EPA-recommended procedures that emphasize sample collection and sample transfer (EPA, 1994). To ensure that all pertinent information for each sample is recorded, the documentation procedures described in the following sections will be implemented during sample collection and sample transfer.

Sample Identification and Labeling

Sample identification provides a method for tracking each sample through collection, analysis, and data reduction. Sample identifications will incorporate three components: the well ID, the sampling date, and the sample matrix (i.e., WG = groundwater).

Sample labels will be permanently affixed to all sample containers (i.e., the sampler will affix labels to the bottles used in the case of water samples, or any other containers used for other matrices). Sample labels shall be completed with waterproof ink.

Each sample label will include the following information:

- Sample location (the well name or number)
- Date and time of sample collection
- Sample matrix
- Initials of sample

After collection and identification, the sample will be maintained under chain-of-custody procedures.

Sample Packaging and Shipping

All samples will be packaged carefully to avoid breakage or contamination, and will be delivered or shipped to the laboratory at proper temperature. Each sample container will be labeled and placed in an ice chest cooled with double-bagged “wet” ice. Coolers will be filled with ice at the beginning of the day, prior to sampling. Sample packaging and shipping to laboratory will follow the procedures outlined below. Samples will be couriered or shipped every day of sampling to the respective laboratory.

Chain-of-custody records (CCRs) will be signed and sealed in plastic bags and affixed to the inside of the ice chest. CCRs are described in more detail below. If the cooler has a drain, it will be taped shut. Labels indicating “This Side Up” and “Fragile” will also be affixed to the outside of the cooler.

Custody in the Field

The following chain-of-custody procedures will be complied with to guarantee sample custody documentation. A sample will be considered under proper custody if: (1) it is in actual possession of the responsible person; (2) it is in view, following physical possession; (3) it is in the possession of a responsible person and is locked or sealed to prevent tampering; or (4) it is in a secure area.

Field personnel who collect the samples are responsible for the care and custody of the samples until they are transferred to the delivery agent. A CCR will accompany all samples. When transferring the samples, the individuals relinquishing and receiving the samples will sign, date, and note the time on the CCR.

A shipment record will be completed in addition to the CCR to provide a concise summary of the samples included within each cooler. CCRs, along with the shipment record initiated in the field, will be signed, placed in a plastic bag, and taped to the inside of the shipping container used for sample transport. The project manager or a specific designee is responsible for ensuring that all shipping records are consistent and placed in the permanent job file.

Laboratory Operations

All sample receipt documentation, log-in, and storage are the responsibility of each laboratory. A designated “sample custodian” is responsible for retaining documents and for verifying sample custody records are filled out accurately. The sample custodian is also responsible for maintaining security and proper temperature in the sample storage area.

The laboratory project manager provides a second review of the log-in procedure and is ultimately responsible for its completeness and accuracy.

Sample Handling

Upon receipt of samples, shipping containers will be checked to verify that they are intact and that ice is present. There should be no broken containers, leaks, missing or obscured labels, or breakage of custody seals. No headspace is allowed in sample vials to be used for volatile analysis. This information will be recorded on a sample receipt log-in form. Resolution of any anomalies will also be recorded.

A thermometer will be used to measure the temperature blank. The sample custodian at the laboratory will record the temperature on the CCR. If the temperature is below 2 degrees Celsius (ºC), then all associated samples will be checked for ice formation in the containers. If the temperature blank is not present, the temperature will be taken by placing a thermometer adjacent to a bottle located in the center of the ice chest. For samples couriered to the laboratory, the laboratory will continue chilling the samples to the required 4ºC ± 2ºC. This is required since cooling to 4ºC ± 2ºC may not be possible in the short time between sampling and laboratory receipt. When samples are outside the temperature criteria, the laboratory will notify the project manager.

The following are specific information recorded in the Laboratory Information Management System (LIMS) and Sample Receiving Log Book:

- Date samples were received by laboratory
- Source of samples
- Laboratory sample ID
- Analytical tests required
- Number of samples in each analytical or preparatory batch
- Final disposition of the samples

Labels with the sample ID numbers are printed from the LIMS and attached to the containers to assure proper handling and distribution. A printout of the labels is attached to the log-in record. The log-in record is printed as well, serving both as a work acknowledgment and a record of receipt.

All samples received by the laboratory will be placed in the refrigerator, which is maintained at 4ºC ± 2ºC. Water samples designated for volatile organic analysis will be stored in the volatiles laboratory in the sample refrigerator. Samples, which may have high contamination levels, will be noted on the CCR and stored in a separate refrigerator, also maintained at 4ºC ± 2ºC, to prevent cross-contamination. Sample refrigerator temperatures will be monitored and recorded daily by the sample custodian on a data sheet specific to each refrigerator.

Samples that are past holding time will be kept until the project manager or Project QA/QC coordinator confirms disposal.

Laboratory Sample Identification

Each sample received by each laboratory will be given a discrete identification number that will enable the laboratories to track the samples, the dates of analysis, and the QA/QC for that sample.

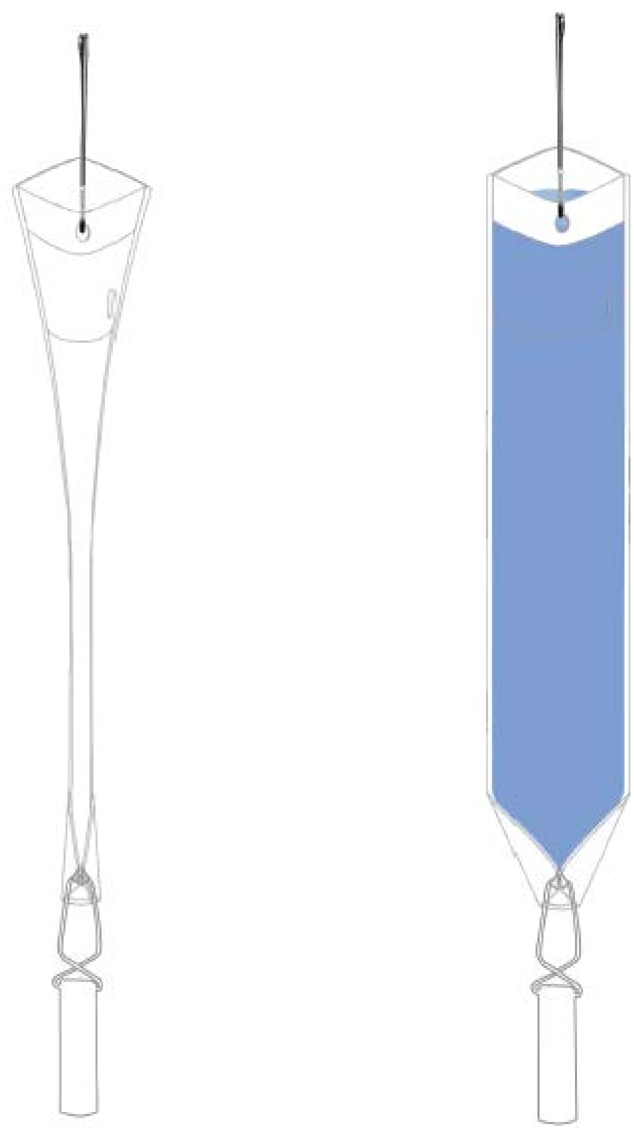
Sample Custody Records

Laboratories typically use the LIMS for internal tracking. Each analytical workstation can access the complete sample test request invoice for a given set of samples at any time. The laboratories also track the samples manually using a copy of the CCR. The original CCR will be forwarded to the project manager with the final report.

HYDRASleeve™

Simple by Design US Patent No. 6,481,300; No. 6,837,120 others pending

Standard Operating Procedure: Sampling Groundwater with a HydraSleeve



This guide should be used in addition to field manuals and instructions appropriate to the chosen sampling device (i.e., HydraSleeve, SpeedBag or Super/Skinny Sleeve and W3 HybridSleeve).

Find the appropriate field manual and instructions on the HydraSleeve website at http://www.hydrasleeve.com.

For more information about the HydraSleeve, or if you have questions, contact:
GeoInsight, P.O. Box 1266, Mesilla Park, NM 88047
800-996-2225, info@hydrasleeve.com.

Table of Contents

Introduction

The HydraSleeve is classified as a no-purge (passive) grab sampling device, meaning that it is used to collect groundwater samples directly from the screened interval of a well without having to purge the well prior to sample collection. When it is used as described in this Standard Operating Procedure (SOP), the HydraSleeve causes no drawdown in the well (until the sample is withdrawn from the water column) and only minimal disturbance of the water column, because it has a very thin cross section and it displaces very little water (<100 ml) during deployment in the well. The HydraSleeve collects a sample from within the screen only. It excludes water from any other part of the water column in the well through the use of a self-sealing check valve at the top of the sampler. It is a single-use (disposable) sampler that is not intended for reuse, so there are no decontamination requirements for the sampler itself.

The use of no-purge sampling as a means of collecting representative groundwater samples depends on the natural movement of groundwater (under ambient hydraulic head) from the formation adjacent to the well screen through the screen. Robin and Gillham (1987) demonstrated the existence of a dynamic equilibrium between the water in a formation and the water in a well screen installed in that formation, which results in formation-quality water being available in the well screen for sampling at all times. No-purge sampling devices like the HydraSleeve collect this formation-quality water as the sample, under undisturbed (non-pumping) natural flow conditions. Samples collected in this manner generally provide more conservative (i.e., higher concentration) values than samples collected using well-volume purging, and values equivalent to samples collected using low-flow purging and sampling (Parsons, 2005).

Applications of the HydraSleeve

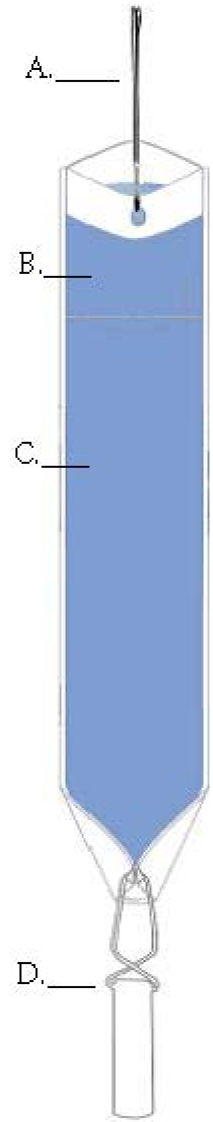
The HydraSleeve can be used to collect representative samples of groundwater for all analytes (volatile organic compounds [VOCs], semi-volatile organic compounds [SVOCs], common metals, trace metals, major cations and anions, dissolved gases, total dissolved solids, radionuclides, pesticides, PCBs, explosive compounds, and all other analytical parameters). Designs are available to collect samples from wells from 1” inside diameter and larger. The HydraSleeve can collect samples from wells of any yield, but it is especially well-suited to collecting samples from low-yield wells, where other sampling methods can’t be used reliably because their use results in dewatering of the well screen and alteration of sample chemistry (McAlary and Barker, 1987).

The HydraSleeve can collect samples from wells of any depth, and it can be used for single-event sampling or long-term groundwater monitoring programs. Because of its thin cross section and flexible construction, it can be used in narrow, constricted or damaged wells where rigid sampling devices may not fit. Using multiple HydraSleeves deployed in series along a single suspension line or tether, it is also possible to conduct in-well vertical profiling in wells in which contaminant concentrations are thought to be stratified.

As with all groundwater sampling devices, HydraSleeves should not be used to collect groundwater samples from wells in which separate (non-aqueous) phase hydrocarbons (i.e., gasoline, diesel fuel or jet fuel) are present because of the possibility of incorporating some of the separate-phase hydrocarbon into the sample.

Description of the HydraSleeve

The basic HydraSleeve (Figure 1) consists of the following components*:



- A suspension line or tether (A.), attached to the spring clip or directly to the top of the sleeve to deploy the device into and recover the device from the well. Tethers with depth indicators marked in 1-foot intervals are available from the manufacturer.
- A long, flexible, 4-mil thick lay-flat polyethylene sample sleeve (C.) sealed at the bottom (this is the sample chamber), which comes in different sizes, as discussed below with a self-sealing reed-type flexible polyethylene check valve built into the top of the sleeve (B.) to prevent water from entering or exiting the sampler except during sample acquisition.
- A reusable stainless-steel weight with clip (D.), which is attached to the bottom of the sleeve to carry it down the well to its intended depth in the water column. Bottom weights available from the manufacturer are 0.75" OD and are available in a variety of sizes. An optional top weight may be attached to the top of the HydraSleeve to carry it to depth and to compress it at the bottom of the well (not shown in Figure 1);
- A discharge tube that is used to puncture the HydraSleeve after it is recovered from the well so the sample can be decanted into sample bottles (not shown).
- Just above the self-sealing check valve at the top of the sleeve are two holes which provide attachment points for the spring clip and/or suspension line or tether. At the bottom of the sample sleeve are two holes which provide attachment points for the weight clip and weight.

*Other configurations such as top weighted assemblies, Super/SkinnySleeves, Speedbags, and W3 Hybrids are available.

Note: The sample sleeve and the discharge tube are designed for one-time use and are disposable. The spring clip, weight and weight clip may be reused after thorough cleaning. Suspension cord is generally disposed after one use although, if it is dedicated to the well, it may be reused at the discretion of the sampling personnel.

Selecting the HydraSleeve Size to Meet Site-Specific Sampling Objectives

It is important to understand that each HydraSleeve is able to collect a finite volume of sample because, after the HydraSleeve is deployed, you only get one chance to collect an undisturbed sample. Thus, the volume of sample required to meet your site-specific sampling and analytical requirements will dictate the size of HydraSleeve you need to meet these requirements.

Table 1. Dimensions and Volumes of HydraSleeve Models.

Diameter	Volume	Length	Lay-Flat Width	Filled Dia.
2-Inch HydraSleeves				
Standard 600 mls HydraSleeve	~600mls	30”	2.5”	1.4”
Standard 1-liter HydraSleeve	~1 Liter	38”	3”	1.9”
Super/SkinnySleeve 1-liter	~1 Liter	38”	2.5"	1.5”*
Super/SkinnySleeve 1.5-liter	~1.5 Liters	52”	2.5”	1.5”*
Super/SkinnySleeve 2-liter	~2 Liters	66"	2.5"	1.5"*
4-Inch HydraSleeves				
Standard 2.5 liter	~2 Liters	38”	4”	2.7”

* outside diameter on the Heavy Duty Universal Super/SkinnySleeves is 1.5" however when using with schedule 40 hardware the O.D. of the assembly will be 1.9"

It's also recommended that you size the diameter of the HydraSleeve according to the diameter of the well (i.e. use 2-inch HydraSleeves in 2-inch wells). Using smaller sleeves in larger diameter wells (i.e. 2-inch HydraSleeves in 4-inch wells) will result in a longer fill rate and will require special retrieval instructions (explained later).

The volume of sample collected by the HydraSleeve varies with the diameter and length of the HydraSleeve. Dimensions and volumes of available HydraSleeve models are detailed in Table 1.

HydraSleeves can be custom-fabricated by GeoInsight in varying diameters and lengths to meet specific volume requirements. HydraSleeves can also be deployed in series (i.e., multiple HydraSleeves attached to one tether) to collect additional sample to meet specific volume requirements, as described below.

If you have questions regarding the availability of sufficient volume of sample to satisfy laboratory requirements for analysis, it is recommended that you contact the laboratory to discuss the minimum volumes needed for each suite of analytes. Laboratories often require only 10% to 25% of the volume they specify to complete analysis for specific suites of analytes, so they can often work with much smaller sample volumes that can easily be supplied using a HydraSleeve.

HydraSleeve Deployment

Information Required Before Deploying a HydraSleeve

Before installing a HydraSleeve in any well, you will need to know the following:

- The inside diameter of the well
- The length of the well screen
- The water level in the well
- The position of the well screen in the well
- The total depth of the well

The inside diameter of the well is used to determine the appropriate HydraSleeve diameter for use in the well. The other information is used to determine the proper placement of the HydraSleeve in the well to collect a representative sample from the screen (see HydraSleeve Placement, below), and to determine the appropriate length of tether to attach to the HydraSleeve to deploy it at the appropriate position in the well.

Most of this information (with the exception of the water level) should be available from the well log; if not, it will have to be collected by some other means. The inside diameter of the well can be measured at the top of the well casing, and the total depth of the well can be measured by sounding the bottom of the well with a weighted tape. The position and length of the well screen may have to be determined using a down-hole camera if a well log is not available. The water level in the well can be measured using any commonly available water-level gauge.

HydraSleeve Placement

The HydraSleeve is designed to collect a sample directly from the well screen. It fills by pulling it up through the screen a distance equivalent to the length of the sampler when correctly sized to the well diameter. This upward motion causes the top check valve to open, which allows the device to fill. To optimize sample recovery, it is recommended that the HydraSleeve be placed in the well so that the bottom weight rests on the bottom of the well and the top of the HydraSleeve is as close to the bottom of the well screen as possible. This should allow the sampler to fill before the top of the device reaches the top of the screen as it is pulled up through the water column, and ensure that only water from the screen is collected as the sample. In short-screen wells, or wells with a short water column, it may be necessary to use a top-weight on the HydraSleeve to compress it in the bottom of the well so that, when it is recovered, it has room to fill before it reaches the top of the screen.

Example

2” ID PVC well, 50’ total depth, 10’ screen at the bottom of the well, with water level above the screen (the entire screen contains water).

Correct Placement (figure 2): Using a standard HydraSleeve for a 2” well (2.5” flat width/1.5” filled OD x 30” long, 600 ml volume), deploy the sampler so the weight (a 5 oz., 2.5” long weight with a 2” long clip) rests at the bottom of the well. The top of the sleeve is thus set at ~34” above the bottom of the well. When the sampler is recovered, it will be pulled upward approximately 30” before it is filled; therefore, it is full (and the top check valve closes) at approximately 64” (5.3 feet) above the bottom of the well, which is well before the sampler reaches the top of the screen. In this example, only water from the screen is collected as a sample.

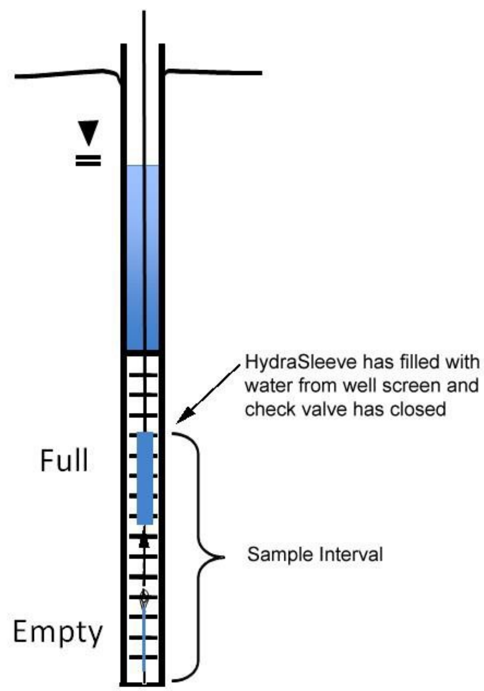


Figure 2. Correct Placement of HydraSleeve.

Incorrect Placement (figure 3): If the well screen in this example was only 5' long, and the HydraSleeve was placed as above, it would not fill before the top of the device reached the top of the well screen, so the sample would include water from above the screen, which may not have the same chemistry.

<u>The solution?</u> Deploy the HydraSleeve with a top weight, so that it is collapsed to within 6" of the bottom of the well. When the HydraSleeve is recovered, it will fill within 36" (3 feet) from the bottom of the well, or 2-feet before the sampler reaches the top of the screen, so it collects only water from the screen as the sample.

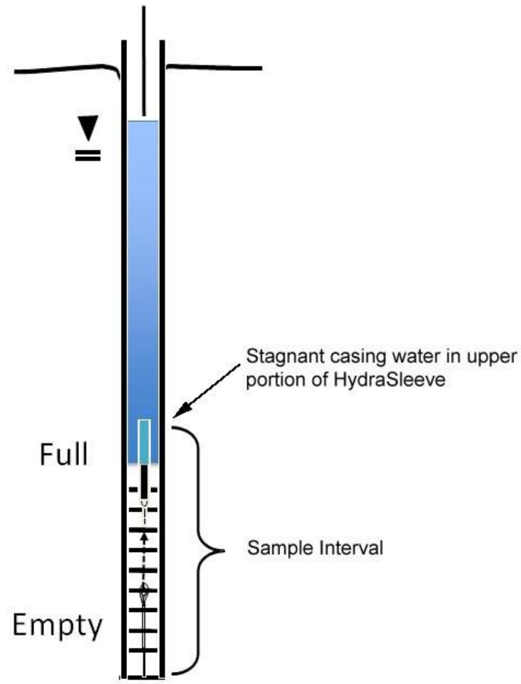


Figure 3. Incorrect placement of HydraSleeve.

This example illustrates one of many types of HydraSleeve placements. More complex placements are discussed in a later section.

NOTE: Using smaller diameter HydraSleeves (2-inch) in larger diameter wells (4-inch) causes a slower fill rate. Special retrieval methods are necessary if this is your set up (shown later in this document).

Procedures for Sampling with the HydraSleeve

Collecting a groundwater sample with a HydraSleeve is usually a simple one-person operation.

Note: Before deploying the HydraSleeve in the well, collect the depth-to-water measurement that you will use to determine the preferred position of the HydraSleeve in the well. This measurement may also be used with measurements from other wells to create a groundwater contour map. If necessary, also measure the depth to the bottom of the well to verify actual well depth to confirm your decision on placement of the HydraSleeve in the water column.

Measure the correct amount of tether needed to suspend the HydraSleeve in the well so that the weight will rest on the bottom of the well (or at your preferred position in the well). Make sure to account for the need to leave a few feet of tether at the top of the well to allow recovery of the sleeve.

Note: Always wear sterile gloves when handling and discharging the HydraSleeve.

I. Assembling the Basic HydraSleeve*

1. Remove the HydraSleeve from its packaging, unfold it, and hold it by its top.
2. Crimp the top of the HydraSleeve by folding the hard polyethylene reinforcing strips at the holes.
3. Attach the spring clip to the holes to ensure that the top will remain open until the sampler is retrieved.
4. Attach the tether to the spring clip by tying a knot in the tether.

Note: Alternatively, if spring clips are not being utilized, attach the tether to one (NOT both) of the holes at the top of the Hydrasleeve by tying a knot in the tether.

5. Fold the flaps with the two holes at the bottom of the HydraSleeve together to align the holes and slide the weight clip through the holes.
6. Attach a weight to the bottom of the weight clip to ensure that the HydraSleeve will descend to the bottom of the well.

*See Super/SkinnySleeve assembly manual and HydraSleeve Field Manual for other assembly instructions.

II. Deploying the HydraSleeve

1. Using the tether, carefully lower the HydraSleeve to the bottom of the well, or to your preferred depth in the water column

   During installation, hydrostatic pressure in the water column will keep the self-sealing check valve at the top of the HydraSleeve closed, and ensure that it retains its flat, empty profile for an indefinite period prior to recovery.

> **Note:** Make sure that it is not pulled upward at any time during its descent. If the HydraSleeve is pulled upward at a rate greater than 0.5'/second at any time prior to recovery, the top check valve will open and water will enter the HydraSleeve prematurely.

2. Secure the tether at the top of the well by placing the well cap on the top of the well casing and over the tether.

> **Note:** Alternatively, you can tie the tether to a hook on the bottom of the well cap (you will need to leave a few inches of slack in the line to avoid pulling the sampler up as the cap is removed at the next sampling event).

III. Equilibrating the Well

The equilibration time is the time it takes for conditions in the water column (primarily flow dynamics and contaminant distribution) to restabilize after vertical mixing occurs (caused by installation of a sampling device in the well).

- Situation: The HydraSleeve is deployed for the first time or for only one time in a well

  The basic HydraSleeve is very thin in cross section and displaces very little water (<100 ml) during deployment so, unlike most other sampling devices, it does not disturb the water column to the point at which long equilibration times are necessary to ensure recovery of a representative sample.

  In some cases, like when useing the SpeedBags, the HydraSleeve can be recovered immediately (with no equilibration time) or within a few hours. In regulatory jurisdictions that impose specific requirements for equilibration times prior to recovery of no-purge sampling devices, these requirements should be followed.

  NOTE: If using top weights additional equilibration time is needed to allow the top weight time to compress the HydraSleeve into the bottom of the well.

- Situation: The HydraSleeve is being deployed for recovery during a future sampling event.

  In periodic (i.e., quarterly, semi-annual, or annual) sampling programs, the sampler for the current sampling event can be recovered and a new sampler (for the next sampling event) deployed immediately thereafter, so the new sampler remains in the well until the next sampling event.

Thus, a long equilibration time is ensured and, at the next sampling event, the sampler can be recovered immediately. This means that separate mobilizations, to deploy and then to recover the sampler, are not required. HydraSleeves can be left in a well for an indefinite period of time without concern.

IV. HydraSleeve Recovery and Sample Collection

1. Hold on to the tether while removing the well cap.
2. Secure the tether at the top of the well while maintaining tension on the tether (but without pulling the tether upwards)
3. Measure the water level in the well.
4. Use one of the following 3 retrieval methods. In all 3 scenarios, when the HydraSleeve is full, the top check valve will close. You should begin to feel the weight of the HydraSleeve on the tether and it will begin to displace water. The closed check valve prevents loss of sample and entry of water from zones above the well screen as the HydraSleeve is recovered.

a. In one smooth motion, pull the tether up 30”-60" (the length of the sampler) at a rate of about 1 foot per second (or faster). The motion will open the top check valve and allow the HydraSleeve to fill (it should fill in about 1:1 ratio or the length of the HydraSleeve if the sleeve is sized to fit the well). This is analogous to coring the water column in the well from the bottom up.

b. There are times it is recommended that the HydraSleeve be oscillated in the screen zone to ensure it is full before leaving the screen area. Pull up 1-3 feet, let the sleeve assembly drop back down and repeat 3-5 times before pulling the sleeve to the surface. The collection zone will be the oscillation zone. ***When in doubt use this retrieval method.***

c. SpeedBags require check valve activation and oscillation during recovery: When retrieving the SpeedBag, pull up hard 1-2 feet to open the check valve; let the assembly drop back down to the starting point; REPEAT THIS PROCESS 4 TIMES; and then quickly recover the SpeedBag through the well sceen to the surface.

5. Continue pulling the tether upward until the HydraSleeve is at the top of the well.
6. Discard the small volume of water trapped in the Hydrasleeve above the check valve by pinching it off at the top under the stiffeners (above the check valve).

v. Sample Discharge

NOTE: Sample collection should be done immediately after the HydraSleeve has been brought to the surface to preserve sample integrity.

Be sure you have discarded the water sitting above the check valve – see step #6 above.

1. Remove the discharge tube from its sleeve.
2. Hold the HydraSleeve at the check valve
3. Puncture the HydraSleeve at least 3-4 inches below the reinforcement strips with the pointed end of the discharge tube. NOTE: For some contaminants (VOC's/sinkers) the best location for discharge is the middle to bottom of the sampler. This would be representative of the deeper portion of the well screen.
4. Discharge water from the HydraSleeve into your sample containers. Control the discharge from the HydraSleeve by either raising the bottom of the sleeve, by squeezing it like a tube of toothpaste, or both.
5. Continue filling sample containers until all are full.

Measurement of Field Indicator Parameters

Field indicator parameter measurement is generally done during well purging and sampling to confirm when parameters are stable and sampling can begin. Because no-purge sampling does not require purging, field indicator parameter measurement is not necessary for the purpose of confirming when purging is complete.

If field indicator parameter measurement is required to meet a specific non-purging regulatory requirement, it can be done by taking measurements from water within a HydraSleeve that is not used for collecting a sample to submit for laboratory analysis (i.e., a second HydraSleeve installed in conjunction with the primary sample collection HydraSleeve [see Multiple Sampler Deployment below]).

Alternate Deployment Strategies

Deployment in Wells with Limited Water Columns

For wells in which only a limited water column needs to be sampled, the HydraSleeve can be deployed with an optional top weight in addition to a bottom weight. The top weight will collapse the HydraSleeve to a very short (approximately 6” to 24”) length, depending on the length and volume of the sampler. This allows the HydraSleeve to fill in a water column only 3’ to 10’ in height (again) depending on the sampler size. Note the SuperSleeves accomplish the same thing but provide greater sample volume at a lower per sample cost.

Multiple Sampler Deployment

Multiple sampler deployment in a single well screen can accomplish two purposes:

1. It can collect additional sample volume to satisfy site or laboratory-specific sample volume requirements.
2. It can be used to collect samples from multiple intervals in the screen to allow identification of possible contaminant stratification.

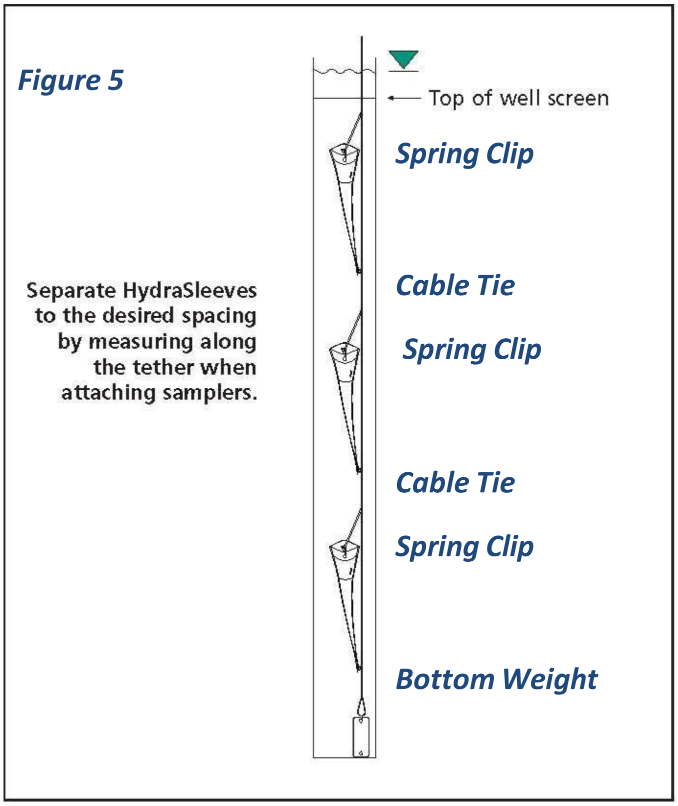


Figure 5. Multiple HydraSleeve deployment

If there is a need for only 2 samplers, they can be installed as follows. The first sampler can be attached to the tether as described above, a second attached to the bottom of the first using your desired length of tether between the two and the weight attached to the bottom of the second sampler (figure 6). This method can only be used with 2 samplers; 3 or more HydraSleeves in tandem need to be attached as described above.

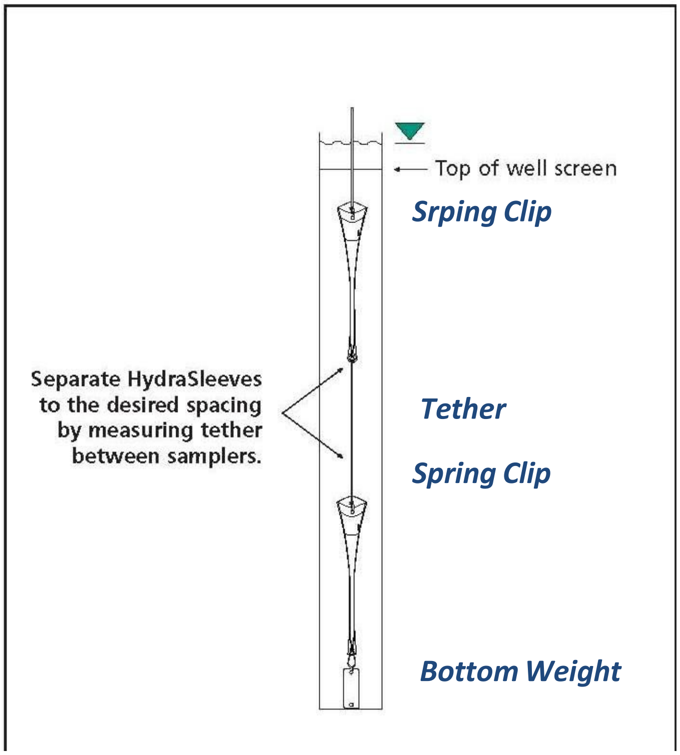


Figure 6. Alternative method for deploying multiple HydraSleeves.

In either case, when attaching multiple HydraSleeves in series, more weight will be required to hold the samplers in place in the well than would be required with a single sampler. Recovery of multiple samplers and collection of samples is done in the same manner as for single sampler deployments.

Post-Sampling Activities

The recovered HydraSleeve and the sample discharge tubing should be disposed as per the solid waste management plan for the site. To prepare for the next sampling event, a new HydraSleeve can be deployed in the well (as described previously) and left in the well until the next sampling event, at which time it can be recovered.

The weight and weight clip can be reused on this sampler after they have been thoroughly cleaned as per the site equipment decontamination plan. The tether may be dedicated to the well and reused or discarded at the discretion of sampling personnel.

References

McAlary, T. A. and J. F. Barker, 1987, Volatilization Losses of Organics During groundwater Sampling From Low-Permeability Materials, groundwater Monitoring Review, Vol. 7, No. 4, pp. 63-68

Parsons, 2005, Results Report for the Demonstration of No-Purge groundwater Sampling Devices at Former McClellan Air Force Base, California; Contract F44650-99-D-0005, Delivery Order DKO1, U.S. Army Corps of Engineers (Omaha District), U.S. Air Force Center for Environmental Excellence, and U.S. Air Force Real Property Agency

Robin, M. J. L. and R. W. Gillham, 1987, Field Evaluation of Well Purging Procedures, groundwater Monitoring Review, Vol. 7, No. 4, pp. 85-93

APPENDIX Q
MEETING NOTIFICATIONS, AGENDAS, AND ATTENDANCE RECORDS

Outreach Meetings with White Space Property Owners

- Feb. 9, 2016 – North American Subbasin
- Feb. 23, 2016 – East Butte Subbasin
- Mar. 8, 2016 – Sutter Subbasin
- Aug. 2, 2016 – North American Subbasin
- Aug 2, 2016 – East Butte Subbasin
- Aug. 3, 2016 – Sutter Subbasin – Alt. GSP discussed; those present agreed to proceed

Meetings with Stakeholders

- July 28, 2016 – Sutter Subbasin: Alt. GSP discussed
- Aug. 5, 2016 – Sutter Subbasin: Will move forward with Alt. GSP
- Aug. 31, 2016 – Sutter Subbasin
- Oct. 18, 2016 – Sutter Subbasin
- Oct. 31, 2016 – Sutter Subbasin
- Dec. 5, 2016 – Conference call to discuss progress of Alt. GSP
- Dec. 9, 2016 – Sutter Subbasin

Board of Supervisors Meetings

- Aug. 23, 2016 – Staff discussed moving forward with the preparation of the Alternative Plan
- Sept. 27, 2016 – Sutter County Water Resource Update, discussed the Alternative Plan in the Sutter Subbasin
- Dec. 20, 2016 – Board approved the Alternative Plan via Resolution, and authorized the Director of Development Services to submit the plan.

Sutter County Department of Development Services

To: Individual Well Owners, North American Subbasin

You're Invited!

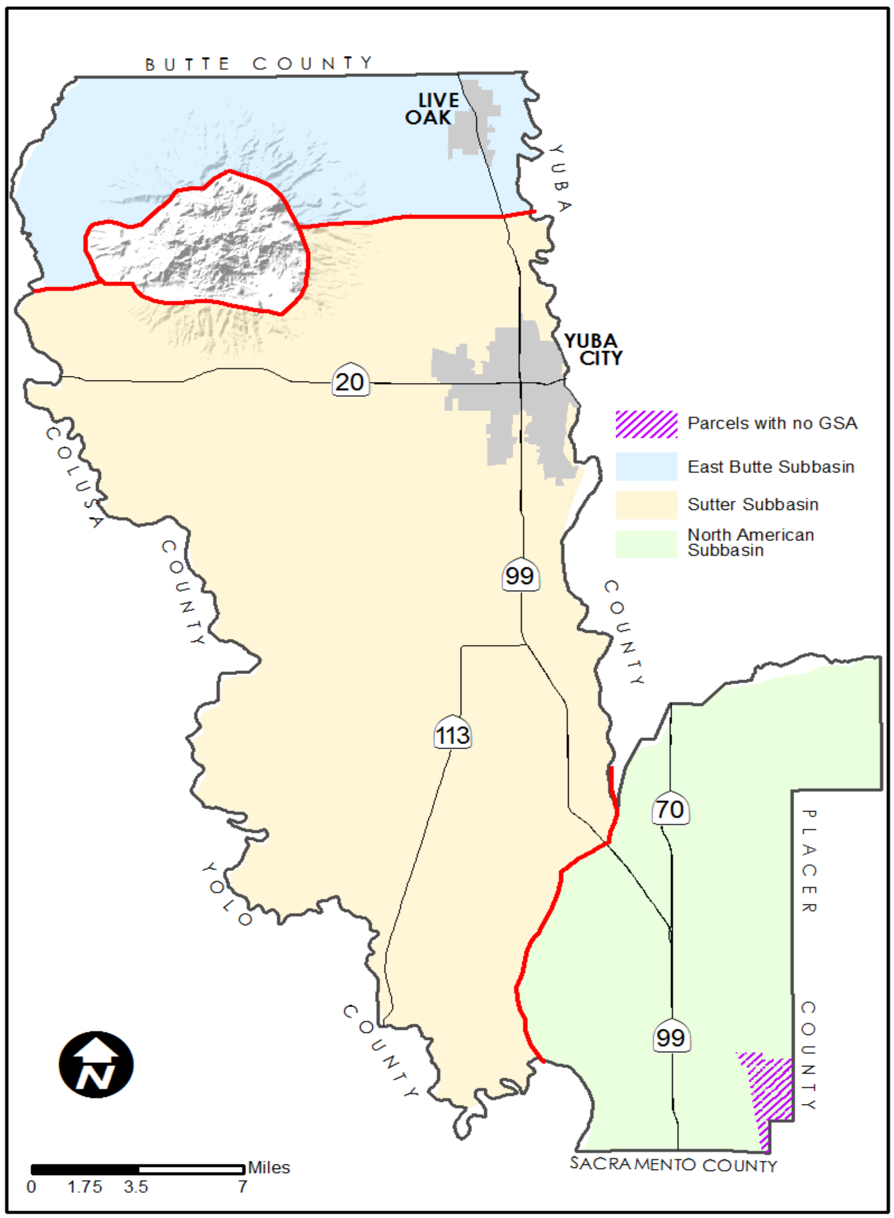
The Sutter County Department of Development Services is hosting a meeting for individual well owners within the County to provide information regarding the State's Sustainable Groundwater Management Act (SGMA), and how this act affects them. You have received this invitation because you are a property owner in an area where a Groundwater Sustainability Agency (GSA) has not been established, and we'd like to share with you next steps and options.

Please join us!

Date:
February 9, 2016

Time:
1 PM

Place:
Sutter County Veterans Hall
1425 Veterans Memorial Cir.
Yuba City, CA 95993



Questions?

Please Contact:
Guadalupe Rivera
1130 Civic Center Blvd.
Yuba City, CA 95993
Phone: 530-822-7400
Email: GRivera@co.sutter.ca.us

SGMA Outreach Meeting - North American Subbasin

Date: 2/9/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Address	Phone	Email
1.	Bob Slakey	4343 Glenridge Dr, Carmichael	916-962-0539	bslakey@comcast.net
2.	Janice Wagner	3670 Sankey Rd Pleasant Grove	916-9911350	
3.	[illegible]	6641 Pleasant Grove Rd	916-709-7885	
4.	Barbara LeVake	Sutter County		
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SGMA Outreach Meeting - North American Subbasin

Date: 2/9/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Address	Phone	Email
1.	Rick Hanson	1670 Kearney St	916-601-4662	Ehanson16@gmail.com
2.	Chris Burke	6623 LOCUST RD 95668	916 655 3350	
3.	Jim Hintz	3355 Sankey Rd.	(916) 425-9159	hintzpls@aol.com
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SGMA Outreach Meeting - North American Subbasin

Date: 2/9/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Address	Phone	Email
1.	Christine Hanson	5600 Caleb Ave Sacto	907-440-2689	afclh@uaa.alaska.edu
2.	Jimmy Wuster	8139 Pleasant Grove rd. Elverta	916-284-8206	jwuster@gmail.com
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Sutter County Department of Development Services

To: Individual Well Owners, East Butte Subbasin

You're Invited!

The Sutter County Department of Development Services is hosting a meeting for individual well owners within the County to provide information regarding the State's Sustainable Groundwater Management Act (SGMA), and how this act affects them. You have received this invitation because you are a property owner in an area where a Groundwater Sustainability Agency (GSA) has not been established, and we'd like to share with you next steps and options.

Please join us!

Date:
February 23, 2016

Time:
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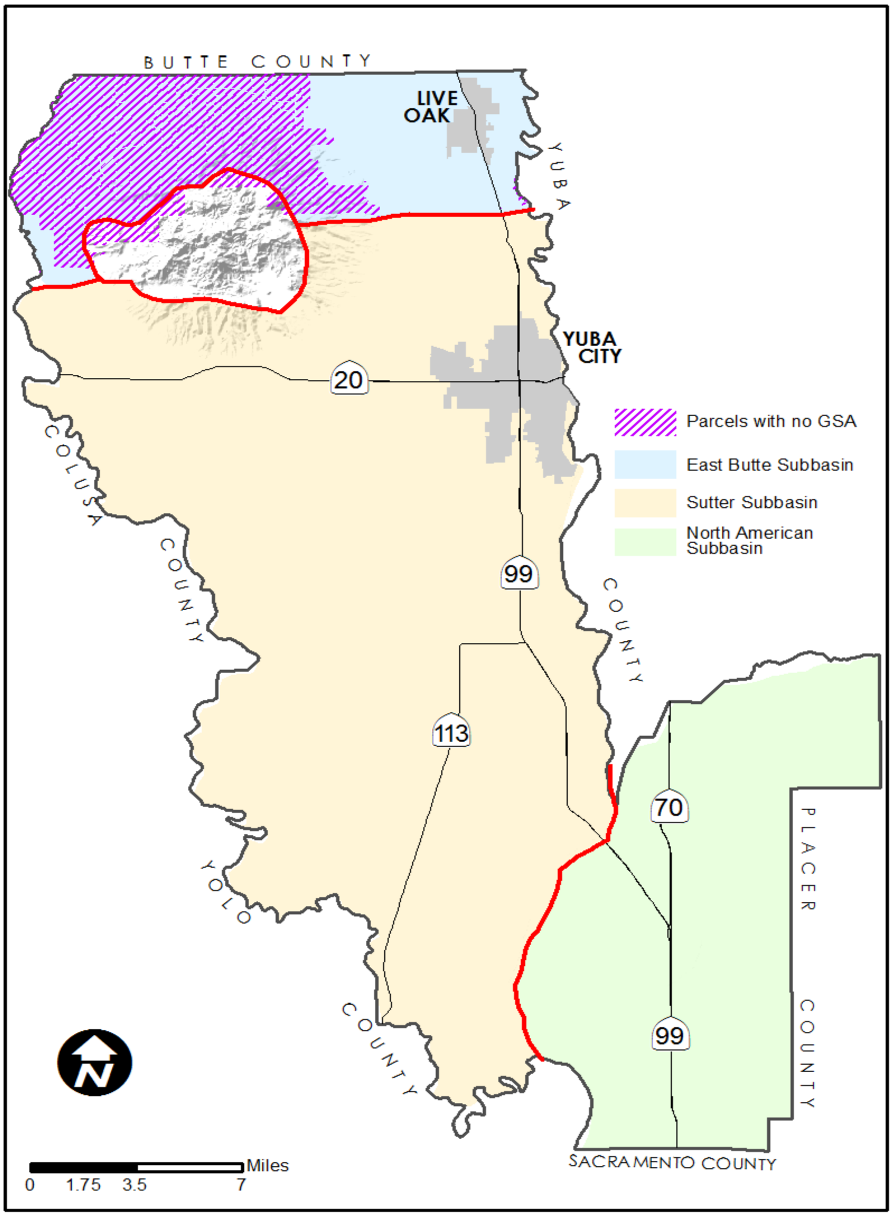
Place:
Sutter County Veterans Hall
1425 Veterans Memorial Cir.
Yuba City, CA 95993



Questions?

Please Contact:
Guadalupe Rivera
1130 Civic Center Blvd.
Yuba City, CA 95993
Phone: 530-822-7400
Email: GRivera@co.sutter.ca.us

SGMA Outreach Meeting - East Butte Subbasin

Date: 2/23/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Address	Phone	Email
1.	Sharon Cooper	(NA subd.) 7315 Pleasant Gr Rd Pleasant Gr, CA 95668	(916) 205-8300	sharonvc@pacbell.net
2.	Loren Bottorff	PO Box 1737 Placerville CA	530-306-4082	L.bottorff@comcast.net
3.	Rich Bottorff	391 Diana St. Placerville CA	5306224420	richbot@yahoo.com Sutter Sutter
4.	Gary Shaeffer	2281 Sierra Ave, Clovis CA	559-217-2440	
5.	Tyrone Shaeffer	2050 Pheasant Dr Yuba City 95993		spchman@aol.com
6.	ALAN WALKER / JOHN RIBEIRO	7450 W. BUTTE RD	530-300-6751	ALANWALKER720@ROCKETMAIL.COM
7.	~~Taisha Thiara~~ Campbell	~~PO Box 416 Live Oak CA 95953~~		~~buttevista2006@comcast~~ .net
8.	Clay Goodman	8581 Bigelow Rd Live Oak	(530) 218-3110	goodmanranch@gmail.com
9.	Lynette Filler	1095 Morse Rd. L 95953		lynette.filler@hotmail.com
10.	Malinda Bogdanoff	1185 JONES RD. YC 95991		m.bogdonoff@yahoo.com
11.	Liz Powell	9738 ~~Live Oak~~ Cornerway Live Oak CA 95953		lizpowell@ymail.com
12.	Belinda Scholl	1130 MORSE RD LIVE Oak		
13.	Sally Donati	1908 State Hwy 70, Oroville, CA 95965	ph. 846-6548	sally@donatiranch.com
14.	Dennis Cash	724 Oak St Colusa, Ca		
15.	Debbie Tarke	9441 W Butte Rd Live Oak, CA 95953		debtarke@gmail.com

SGMA Outreach Meeting - East Butte Subbasin

Date: 2/23/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Address	Phone	Email
1.	Reece Cordi	10401 Ingram Ln Live oak	530695-1785	recordi@yahoo.com
2.	Mike DeRee	12020 N. Butte Rd. Live Oak	(530)695-2585	~~dereeranch~~ dereeranch@succeed.net
3.	Lyndol Swartz	11358 N. Butte Rd Live Oak	530-695-2788	
4.	Susan Young	12035 N. Butte Rd Live Oak CA	695-8459	butte.ridge@yahoo.com
5.	Jeff Spence	12710 N. Butte Road " "	671-1008	Jeff@LaughlinSpence.com
6.	Ben Moody	8189 Griffith Ln. Sutter	(530) 755-2884	
7.	E. Fantozzi	11270 Craig Rd. L.O.	530-219-0447	
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SGMA Outreach Meeting - East Butte Subbasin

Date: 2/23/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Address	Phone	Email
1.	Richard Harp	6005 Hwy 99 Live Oak	(530) 695-1888	Richard@lomocold.com
2.	David Swartz	14310 Pass Rd L.O.	530-682-9832	swartz@cecusa.net
3.	Sam Kamilos	3968 Hillgrove Way Carmichael	916 769-9452	barbsam@calweb.com
4.	Garry Laughlin	10304 Ingram Ln	671-1008	Garry@laughlinspence.com
5.	Kristel Martin	4031 Bogue Rd YC	530-671-9092	marioon@comcast.net
6.	Pam Clifton	11070 Ingram Ln, Live Oak	218-4536	vongeldern_pam@sbcglobal.net
7.	Stephen Tarke	9441 West Butte Rd	696-0265	Tarke@Live.com
8.	Richard W. Campbell and Jasha	P.O. Box 416 Live Oak CA	671-6334	buttevista2006@comcast.net
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Sutter County Department of Development Services

To: Individual Well Owners, Sutter Subbasin

You're Invited!

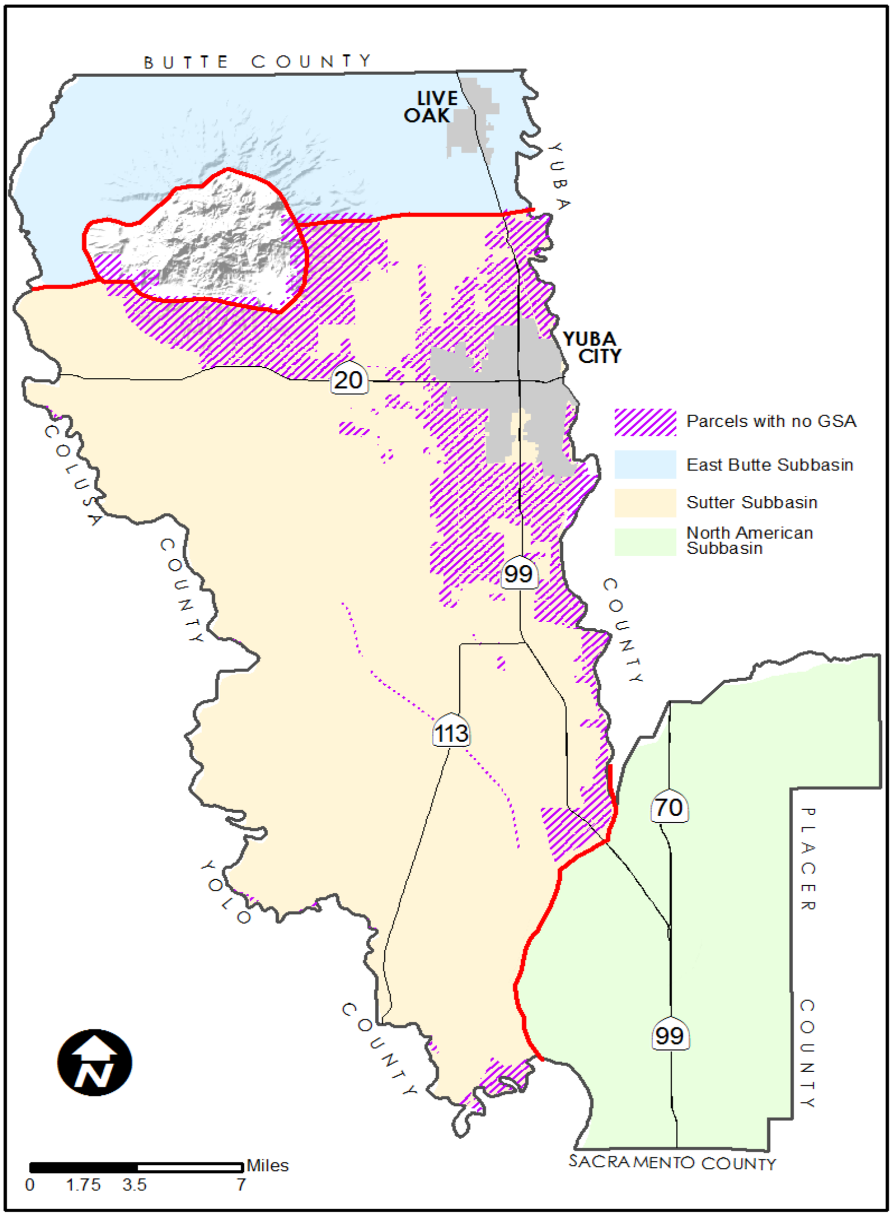
The Sutter County Department of Development Services is hosting a meeting for individual well owners within the County to provide information regarding the State's Sustainable Groundwater Management Act (SGMA), and how this act affects them. You have received this invitation because you are a property owner in an area where a Groundwater Sustainability Agency (GSA) has not been established, and we'd like to share with you next steps and options.

Please join us!

Date:
March 8, 2016

Time:
1 PM

Place:
Sutter County Veterans Hall
1425 Veterans Memorial Cir.
Yuba City, CA 95993



Questions?

Please Contact:
Guadalupe Rivera
1130 Civic Center Blvd.
Yuba City, CA 95993
Phone: 530-822-7400
Email: GRivera@co.sutter.ca.us

SGMA Outreach Meeting - Sutter Subbasin

Date: 3/8/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

530-671-1455

	Name	Address	Phone	Email
1.	Jasbir Johal	1315 Hooper Rd. Yuba City, CA		mjohal78@yahoo.com
2.	Judy Lawhorn	4443 Markley Rd YC		judylawhorn@comcast.net
3.	June Gildemeister	8829 S Butte Rd Sutter		
4.	Wayne Meyer	1173 Northridge Dr YC	530-933-9192	wmeyer42@comcast.net
5.	Philip Filter	1010 Morse Road	530 695-1310	filterfarms@yahoo.com
6.	Allan & Mary Kay Bye	3527 Franklin YC	673-2832	
7.	Margit Sands	204 Wright Ave Gridley	846-5142	sandsmp@comcast.net
8.	Jerome Burk	2092 Tierra Buena Rd. YC	673-0399	nutsinyc@comcast.net
9.	DEL HEFFLEY	483 BARRY RD Y.C.	673-2887	
10.	Andy Jansen	1250 Smith Rd	673-0734	Andy@sillerhelicopters.com
11.	CHRISTINE SCHAAD	3122 Werritt Rd Sutter	755-1274	
12.	Larry Roper	4530 Fortna Rd		LarryRRoper@gmail.com
13.	Cindy Amaral	2883 Garden Hwy	6734948	
14.	Prabhjot Dhillon	3865 rail road ave YC	916-752 9100	nash82@Live.com
15.	Kyle Amarel	2883 Garden Hwy	673-4948	

SGMA Outreach Meeting - Sutter Subbasin

Date: 3/8/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Address	Phone	Email
1.	JAMES CAMBLIN	P.O. BOX 3730 YC 95992	(530)682-9108	james@wilburpacking.com
2.	CARMEN FRYE (G&C FRYE ENTERPRISES LP.)	4291 Colusa Hwy, YUBA CITY 95993-9357		fryebaby53@yahoo.com
3.	PIARA S. JOHL	P.O. Box 95 Y.C 95992	530-682-6527	PJOHL@yahoo.com
4.	STAN CHRISTOPHERSON	1463 STEWART RD YC 95993		
5.	CURT SODERLUND	210 FIRESTONE DR ROSEVILLE 95678	916-782-8754	CURTISSODERLUND@GMAIL.COM
6.	David Karnegas	431 Stewart Rd., YC. 95993	(530)673-2353	dkarnegas@att.net
7.	Tim McIsaac	PO 1076 West Sacramento 95691	916 372 5595	Tim@[illegible].com
8.	Joe Lemenager	1765 wildflower Cir		JLemenager@baralemc.com
9.	Craig Tarke	3327 West Butte Rd.	(530) 696-8289	
10.	Cliff Beumel	5320 Garden Hwy Y.C. 95991	530-957-2512	cliff@sgtrees.com
11.	BRETT MEYER	530 GREGORY YC 95993	530 682 3699	BWMEYER@SBCGLOBAL.NET
12.	Richard McPherrin	PO Box AB YC 95992	530-671-1021	
13.	[illegible]	8540 Garden Hwy	530 682-5350	
14.	Amy Regalia-Kochummel	270 Park Ave Y.C.	530 822 3239 x 419	
15.	Amarjit Takhar	9451 Hanford st., Ventura Ca 93004	~~53~~ (805) 320-9456	

SGMA Outreach Meeting - Sutter Subbasin

Date: 3/8/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Address	Phone	Email
1.	Rollin C. Ahlers	3089 Acacia Av.	5307550554	—
2.	Leonard Henson	2689 Colusa Y.C.	6740776	—
3.	Mary Santillan	PO Bx 3276 YC	5302180019	heavy10@syix.com
4.	Steve Perry	1610 Vacu Vie Dr. YC	530-822-3239 x 427	
5.	Jeff Stephens	8540 Garden Hwy. Y.C	(530)682-5348	
6.	John Amarel	5765 S. George Washington Blvd YC	(530)682-5786	jsmsrcl@ [illegible]farms.com
7.	Jerry+Lorelei Munger	8757 S. Butte Rd Sutter	755-0526	g.munger@sbcglobal.net
8.	Don Miller	1477 Oswald Rd	530-300-6009	
9.	Roger Hauger	1621 Wynecoop RD	530-674-0769	
10.	Ajit S. Bains	813 Sanborn Rd	682-7554.	
11.	Joanne Keech	2355 Redding Ave	530-674-1424	bjs1mom@comcast.net
12.	John Taylor	182 Wilkie Ave Yuba City 95991	530-671-1505	jtaylor@Succeed[illegible]
13.	Dorothy + Bob Rake	822 Lewis Rd. Santa Rosa, CA 95404		
14.	Craig Hendy	8710 S. Butte Rd Sutter	755-1179	
15.	Randall Krehe	1021 Bogue Rd YC	6826427	

SGMA Outreach Meeting - Sutter Subbasin

Date: 3/8/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Address	Phone	Email
1.	Dan Brink	4721 Franklin Rd Yuba City CA 95993	(530) 701 1894	
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SGMA Outreach 2nd Meeting - North American Subbasin

Date: August 2, 2016 **Time:** 10:00 am **Location:** Veterans Hall, 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Phone	Email	Address
1	DAN WILLEFORD	916-655-3418	DDWILLE4D@GMAIL.&	3828 Sankey RD PLEASANT GROVE 95668
2	ELOISE WILLEFORD	"	"	"
3	Jim Sills	5302630350	Jimmy Sills@ sprintfarm.com	3415 Riego Rd 95626
4	Pam Clifton	530-218-4536	vongeldern_pam	11070 INGRAM LN.
5			@sbcglobal.net	WILDOAK CO 95953
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Sustainable Groundwater Management Act Outreach

February 9, 2016 – North American Subbasin
February 23, 2016 – East Butte Subbasin
March 8, 2016 – Sutter Subbasin

Sutter County's Subbasins

East Butte Subbasin

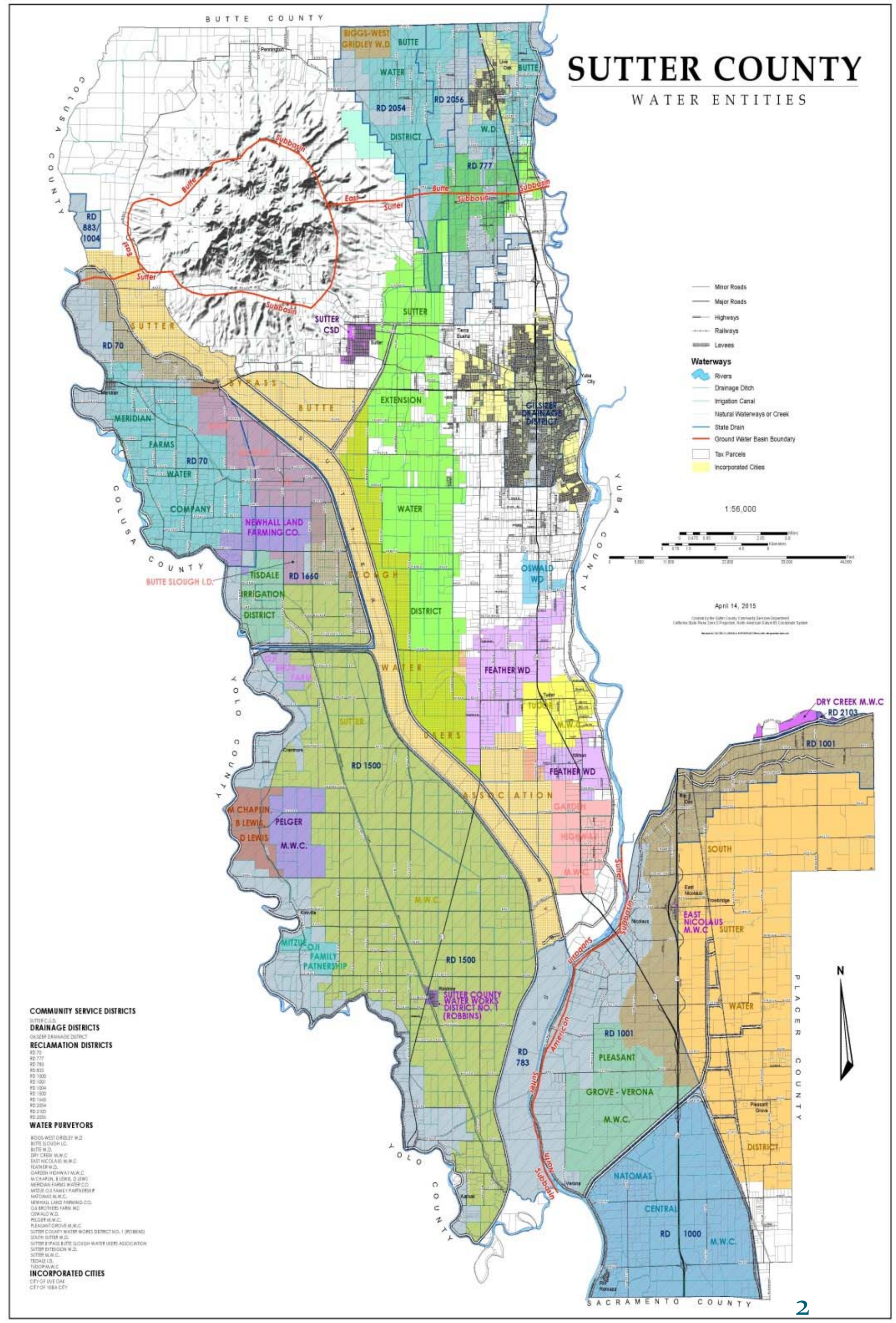
- Medium Priority
- 20% in Sutter, 80% in Butte

Sutter Subbasin

- Medium Priority
- 100% in Sutter County

North American Subbasin

- High Priority
- 25% in Sutter, 40% in Placer, 35% in Sacramento County



Sustainable Groundwater Management Act (SGMA)

A comprehensive legislation to manage groundwater in a sustainable manner.

- Provides incentives, tools, authority and guidance to manage groundwater
- Required for high and medium priority basins
- Retains local authorities with limited state intervention
- Requires formation of a Groundwater Sustainability Agencies (GSAs)
- Requires preparation of Groundwater Sustainability Plans (GSPs)

SGMA Defined

Sustainable Groundwater Management is defined as the "management and use of groundwater in a manner than can be maintained during the planning and implementation horizon without causing undesirable results."

Undesirable results include:

- Chronic lowering of groundwater levels
- Reduction of groundwater storage
- Seawater intrusion
- Degraded water quality
- Land subsidence
- Depletions of interconnected surface waters

SGMA Roles and Responsibilities

- Local management with State oversight
- Department of Water Resources (DWR)
  - Technical and financial assistance
  - Groundwater basin priorities
  - Develops regulations
  - Reviews GSPs and monitors implementation
- State Water Resources Control Board (SWRCB)
  - Intervention if locals do not act

SGMA Milestones

9/16/2014	SGMA passed by Governor Brown
1/1/2015	SGMA became effective
1/1/2016	DWR to adopt regulations to revise basin boundaries
2/18/2016	DWR released draft regulations for evaluating and implementing GSPs
6/1/2016	DWR to adopt regulations for evaluating and implementing GSPs
6/30/2017	Establish Local GSAs
1/31/2022	Develop GSPs
1/31/2042	Achieve Sustainability

Groundwater Sustainability Agency

- The GSA is the primary agency responsible for achieving groundwater sustainability.
- Who can be a GSA?
  - Any local public agency that has water supply, water management or land use responsibilities within a groundwater basin.
- Counties are presumed GSA, if no other identified
- Notification to DWR due by June 2017
  - Public hearing and comment period required
- Local Determination
  - DWR encourages local collaboration
  - Multiple Governance Options available

Basin Boundary Regulations

- Opportunity to request changes to existing basin boundaries
- Boundaries defined in Bulletin 118
- Timeline
  - August 2015 – Sacramento Webinar Public Meeting to present draft regulations
  - September 2015 – deadline for public comments
  - Oct 2015 – DWR draft final regulations
  - Dec 2015 – Adopt final regulations
  - Jan 2016 - 90 day window to submit basin boundary revision requests
  - Summer 2016 - Bulletin 118 update to CA Water Commission for approval

Stakeholder Meetings

- Subbasin stakeholder discussions
  - SGMA updates
  - Discuss governance models
  - Provide network avenue for GSA formations
- SGMA networking meetings with neighboring counties
- Preferred Governance Model: Multiple GSAs – Single GSP for each subbasin

Next Steps

- Meet with all stakeholders
- Coordinate with eligible GSAs
- Submit GSA Notifications in 2017
- Begin Developing GSPs

Sutter County Department of Development Services

To: Individual Well Owners, North American Subbasin

You're Invited!

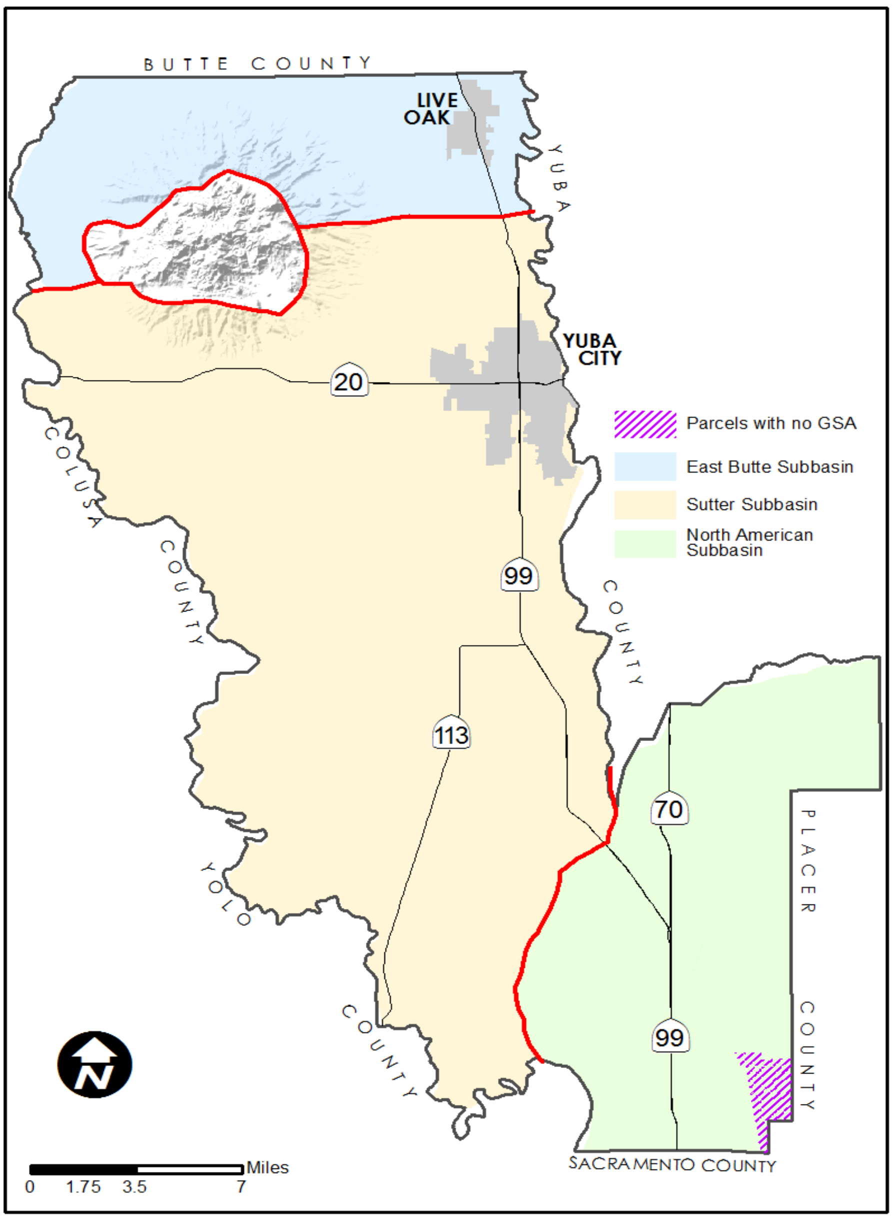
The Sutter County Department of Development Services is hosting a meeting for individual well owners within the County to provide information regarding the State's Sustainable Groundwater Management Act (SGMA), and how this act affects them. You have received this invitation because you are a property owner in an area where a Groundwater Sustainability Agency (GSA) has not been established, and we'd like to share with you next steps and options.

Please join us!

Date:
February 9, 2016

Time:
1 PM

Place:
Sutter County Veterans Hall
1425 Veterans Memorial Cir.
Yuba City, CA 95993



Questions?

Please Contact:
Guadalupe Rivera
1130 Civic Center Blvd.
Yuba City, CA 95993
Phone: 530-822-7400
Email: GRivera@co.sutter.ca.us

SGMA Outreach Meeting - North American Subbasin

Date: 2/9/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Address	Phone	Email
1.	Bob Slakey	4343 Glenridge Dr., Carmichael	916-962-0539	bslakey@comcast.net
2.	Janice Wagner	3670 Sankey Rd Pleasant Grove	916-9911350	
3.	B Chris McKeo	6641 Pleasant Grove Rd	916-709-7885	
4.	Barbara LeVake	Sutter County		
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SGMA Outreach Meeting - North American Subbasin

Date: 2/9/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Address	Phone	Email
1.	Rick Hanson	1670 Kearney St	916-601-4662	Ehanson16@gmail.com
2.	Chris Burke	6623 LOCUST RD 95668	916 655 3350	
3.	Jim Hintz	3355 Sankey Rd.	(916) 425-9159	hintzpls@aol.com
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SGMA Outreach Meeting - North American Subbasin

Date: 2/9/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Address	Phone	Email
1.	Christine Hanson	5600 Calvin Ave Sacto	907-440-2689	afclh@uaa.alaska.edu
2.	Jimmy Wnster	8139 Pleasant Grove rd. Elverta	916-284-8206	jwnster@gmail.com
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Sutter County Department of Development Services

To: Individual Well Owners, East Butte Subbasin

You're Invited!

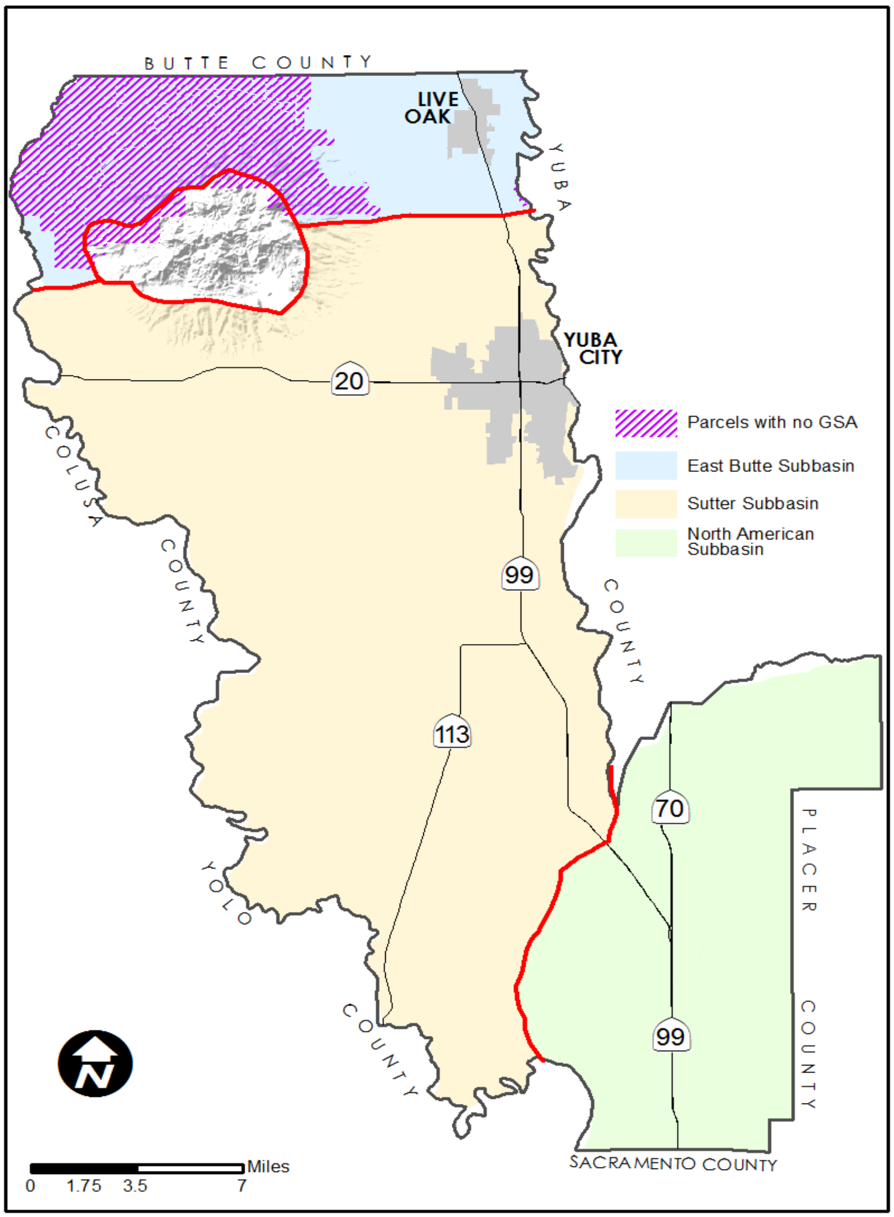
The Sutter County Department of Development Services is hosting a meeting for individual well owners within the County to provide information regarding the State's Sustainable Groundwater Management Act (SGMA), and how this act affects them. You have received this invitation because you are a property owner in an area where a Groundwater Sustainability Agency (GSA) has not been established, and we'd like to share with you next steps and options.

Please join us!

Date:
February 23, 2016

Time:
1 PM

Place:
Sutter County Veterans Hall
1425 Veterans Memorial Cir.
Yuba City, CA 95993



Questions?

Please Contact:
Guadalupe Rivera
1130 Civic Center Blvd.
Yuba City, CA 95993
Phone: 530-822-7400
Email: GRivera@co.sutter.ca.us

SGMA Outreach Meeting - East Butte Subbasin

Date: 2/23/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Address	Phone	Email
1.	Sharon Cooper	(NA subd.) 7315 Pleasant Gr Rd Pleasant Gr, CA 95668	(916) 205-8300	sharonvc@pacbell.net
2.	Loren Bottorff	PO Box 1737 Placerville CA	530-306-4082	L.bottorff@comcast.net
3.	Rich Bottorff	391 Diana St. Placerville CA	5306224420	richbot@yahoo.com (Sutter Sutter)
4.	Gary Shaeffer	2281 Sierra Ave, Clovis CA	559-217-2440	
5.	Tyrone Shaeffer	2050 Pheasant Dr Yuba City 95993		spchman@aol.com
6.	ALAN WALKER / JOHN RIBEIRO	7450 W. BUTTE RD	530-300-6751	ALANWALKER720@ROCKETMAIL.COM
7.	~~Taisha Thiara~~ Campbell	~~PO Box 416 Live Oak CA 95953~~		~~buttevista2006@comcast~~ .net
8.	Clay Goodman	8581 Bigelow Rd Live Oak	(530) 218-3110	goodmanranch@gmail.com
9.	Lynette Filler	1095 Morse Rd. L.O. 95953		lynette.filler@hotmail.com
10.	Malinda Bogdonoff	1185 JONES RD. YC 95991		m.bogdonoff@yahoo.com
11.	Liz Powell	9738 ~~Live Oak~~ Connor way Live Oak CA 95953		lizpowell@ymail.com
12.	Belinda Scholl	1130 MORSE RD LIVE Oak		
13.	Sally Donati	1908 State Hwy 70, Oroville, CA 95965	ph. 846-6548	sally@donatiranch.com
14.	Daniel Cash	724 Oak St Colusa, Ca		
15.	Debbie Tarke	9441 W Butte Rd Live Oak, CA 95953		debtarke@gmail.com

SGMA Outreach Meeting - East Butte Subbasin

Date: 2/23/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Address	Phone	Email
1.	Reece Cordi	10401 Ingram Ln Live oak	530695-1785	recordi@yahoo.com
2.	Mike DeRee	12020 N. Butte Rd. Live Oak	(530)695-2585	~~deree~~ranch dereeranch@succeed.net
3.	Lyndol Swartz	11358 N. Butte Rd Live Oak	530-695-2788	
4.	SUSAN YOUNG	12035 N. BUTTE Rd LIVE OAK CA	695-8459	butte.ridge@yahoo.com
5.	JEFF SPENCE	12710 N. BUTTE ROAD " "	671-1008	JEFF@LAUGHLINSPENCE.com
6.	Ben Moody	8189 GRIFFITH LN. SUTTER	(530) 755-2884	
7.	E. Fantozzi	11270 Craig Rd. L.O.	530-219-0447	
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SGMA Outreach Meeting - East Butte Subbasin

Date: 2/23/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Address	Phone	Email
1.	Richard Harp	6005 Hwy 99 Live Oak	(530) 695-1888	richard@lomocold.com
2.	David Swartz	14310 Pass Rd L.O.	530-682-9832	swartz@cecusa.net
3.	Sam Kamilos	3968 Hillgrove Way Carmichael	916 769-9452	barbsam@calweb.com
4.	Garry Laughlin	10304 Ingram Ln	671-1008	Garry@laughlinspence.com
5.	Kristel Martin	4031 Bogue Rd YC	530-671-9092	marioon@comcast.net
6.	Pam Clifton	11070 Ingram Ln., Live Oak	218-4536	vongelderdn_pam@sbcglobal.net
7.	Stephen Tarke	9441 West Butte Rd.	696-0265	Tarke@Live.com
8.	Richard W. Campbell (and Jasha)	P.O. Box 416 Live Oak CA	671-6334	buttevista2006@comcast.net
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Sutter County Department of Development Services

To: Individual Well Owners, Sutter Subbasin

You're Invited!

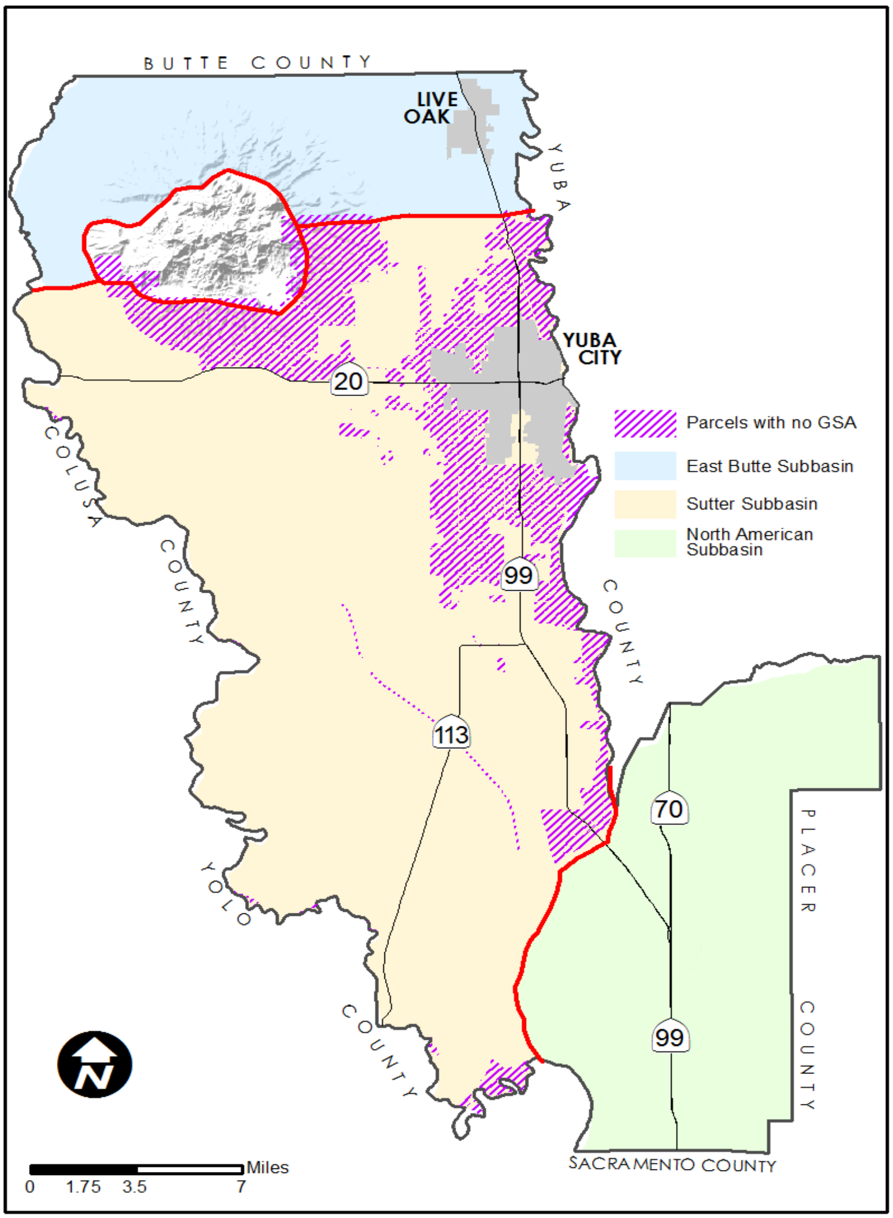
The Sutter County Department of Development Services is hosting a meeting for individual well owners within the County to provide information regarding the State's Sustainable Groundwater Management Act (SGMA), and how this act affects them. You have received this invitation because you are a property owner in an area where a Groundwater Sustainability Agency (GSA) has not been established, and we'd like to share with you next steps and options.

Please join us!

Date:
March 8, 2016

Time:
1 PM

Place:
Sutter County Veterans Hall
1425 Veterans Memorial Cir.
Yuba City, CA 95993



Questions?

Please Contact:
Guadalupe Rivera
1130 Civic Center Blvd.
Yuba City, CA 95993
Phone: 530-822-7400
Email: GRivera@co.sutter.ca.us

SGMA Outreach Meeting - Sutter Subbasin

Date: 3/8/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

530-671-1455

	Name	Address	Phone	Email
1.	Jasbir Johal	~~[illegible]~~ 1315 Hooper Rd. Yuba City, CA		mjohal78@yahoo.com
2.	Judy Lawhorn	4443 Markley Rd YC		judylawhorn@comcast.net
3.	June Gildemeister	8829 S Butte Rd Sutter		
4.	Wayne Meyer	1173 Northridge Dr YC	530-933-9192	~~[illegible]~~ wmeyer42@comcast.net
5.	Philip Filter	1010 Morse Road	530 695-1310	filterfarms@yahoo.com
6.	Allan & Mary Kay Boyer	3527 Franklin YC	673-2832	
7.	Margit Sands	204 Wright Ave Gridley	846-5142	sandsmp@comcast.net
8.	Jerome Burk	2092 Tierra Buena Rd. YC	673-0399	nutsinyc@comcast.net
9.	DEL HEFFLEY	4833 BARRY RD Y.C.	673-2887	
10.	Andy Jansen	1250 Smith Rd	673-0734	Andy@sillerHelicopters.com
11.	CHRISTINE SCHARA	3122 Werritt Rd Sutter	755-1274	
12.	Larry Roper	4530 Fortna Rd	—	LarryRRoper@gmail.com
13.	Cindy Amaral	2883 Garden Hwy	6734948	
14.	Prabhjit Dhillon	3865 Railroad Ave YC	916-752-9100	nash82@Live.com
15.	Kyle Amarel	2833 Garden Hwy	673-4948	

SGMA Outreach Meeting - Sutter Subbasin

Date: 3/8/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Address	Phone	Email
1.	JAMES CAMBLIN	P.O. BOX 3730 YC 95992	(530)682-9108	james@wilburpacking.com
2.	CARMEN FRYE (G&C FRYE ENTERPRISES LP.)	4291 Colusa Hwy, YUBA CITY 95993-9357		fryebaby53@yahoo.com
3.	PIARA S. JOHL	P.O. Box 95 Y.C 95992	530-682-6527	PJOHL@yahoo.com
4.	Stan CHRISTOPHERSON	1463 Stewart RD YC 95993		
5.	CURT SODERLUND	210 FIRESTONE DR ROSEVILLE 95678	916-782-8754	CURTISSODERLUND@GMAIL.COM
6.	David Karnegas	431 Stewart Rd., YC. 95993	(530)673-2353	dkarnegas@att.net
7.	Tim McIsaac	PO 1076 West Sacramento 95691	916 372 5595	Tim@[illegible].com
8.	Joe Lemenager	1765 wildflower Cir		JLemenager@baralemc.com
9.	Craig Tarke	3327 West Butte Rd.	(530) 696-8289	
10.	Cliff Beumel	5320 Garden Hwy Y.C. 95991	530-957-2512	cliff@sgtrees.com
11.	BRETT MEYER	530 GREGORY YC 95993	530 682 3699	BWMEYER@SBCGLOBAL.NET
12.	Richard McPherrin	PO Box AB YC 95992	530-671-1021	
13.	[illegible]	8540 Garden Hwy	530 692-5350	
14.	Amy Regalia-Korhummel	270 Park Ave Y.C.	530 822 3239 x 419	
15.	Amarjit Takhar	9451 Hanford st., Ventura Ca 93004	~~53~~ (805) 320-9456	

SGMA Outreach Meeting - Sutter Subbasin

Date: 3/8/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Address	Phone	Email
1.	Rollin C. Ahlers	3089 Acacia Av.	5307550554	—
2.	Leonard Henson	2689 Colusa Y.C.	6740776	—
3.	Mary Santillan	PO Bx 3276 YC	5302180019	heavy10@ayin.com
4.	Steve Perry	1610 Vacy Vie Dr YC	530-822-3239 ex 427	
5.	Jeff Stephens	8540 Garden Hwy Y.C.	(530) 682-5348	
6.	John Amarel	5765 S. George Washington Blvd YC	(530) 682-5786	jamarel@rossonfarms.com
7.	Jerry + Lorelei Munger	8757 S. Butte Rd Sutter	755-0526	g.munger@sbcglobal.net
8.	Don Miller	1477 Oswald Rd	530-300-6009	
9.	Roger Hauger	1621 Wyn Coop Rd	530-674-0769	
10.	Ajit S. Bains	813 Sanborn Rd	682-7554.	
11.	Joanne Keech	2355 Redding Ave	530-674-1424	bjs1mom@comcast.net
12.	John Taylor	182 Wilkie Ave Yuba City 95991	530-671-1505	jtaylor@Succeed...
13.	Dorothy + Bob Rake	822 Lewis Rd. Santa Rosa, CA 95404		
14.	Craig Hendy	8710 S. Butte Rd Sutter	755-1179	
15.	Randall Krehe	1021 Bogue Rd YC	6826427	

SGMA Outreach Meeting - Sutter Subbasin

Date: 3/8/2016
Time: 1:00 PM
Location: 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Address	Phone	Email
1.	Dan Brink	4721 Franklin Rd Yuba City CA 95993	(530) 701 1894	
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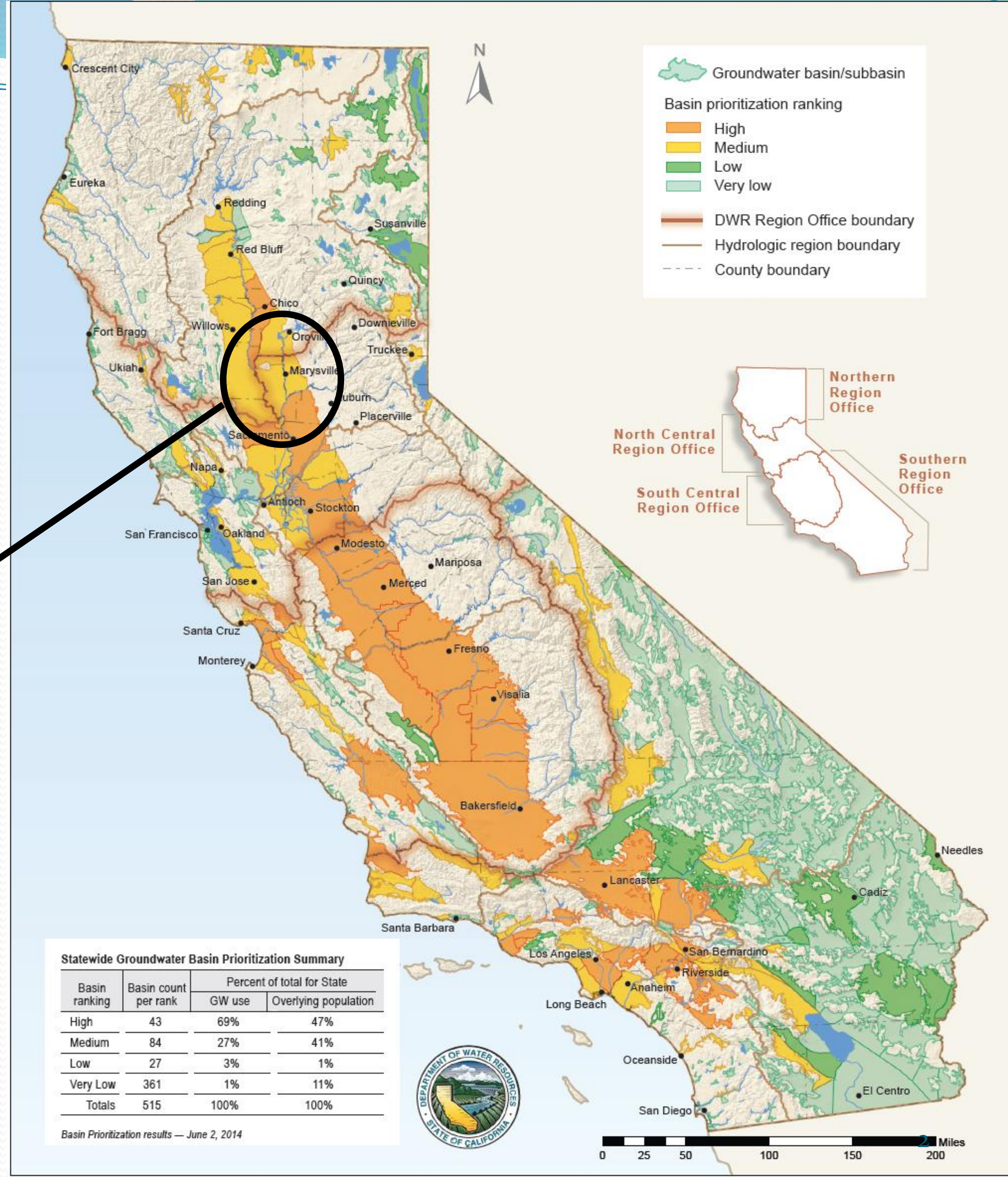
Sustainable Groundwater Management Act Outreach

August 2, 2016 – North American Subbasin

August 2, 2016 – East Butte Subbasin

August 3, 2016 – Sutter Subbasin

California Subbasins



Statewide Groundwater Basin Prioritization Summary

Basin ranking	Basin count per rank	Percent of total for State	
		GW use	Overlying population
High	43	69%	47%
Medium	84	27%	41%
Low	27	3%	1%
Very Low	361	1%	11%
Totals	515	100%	100%

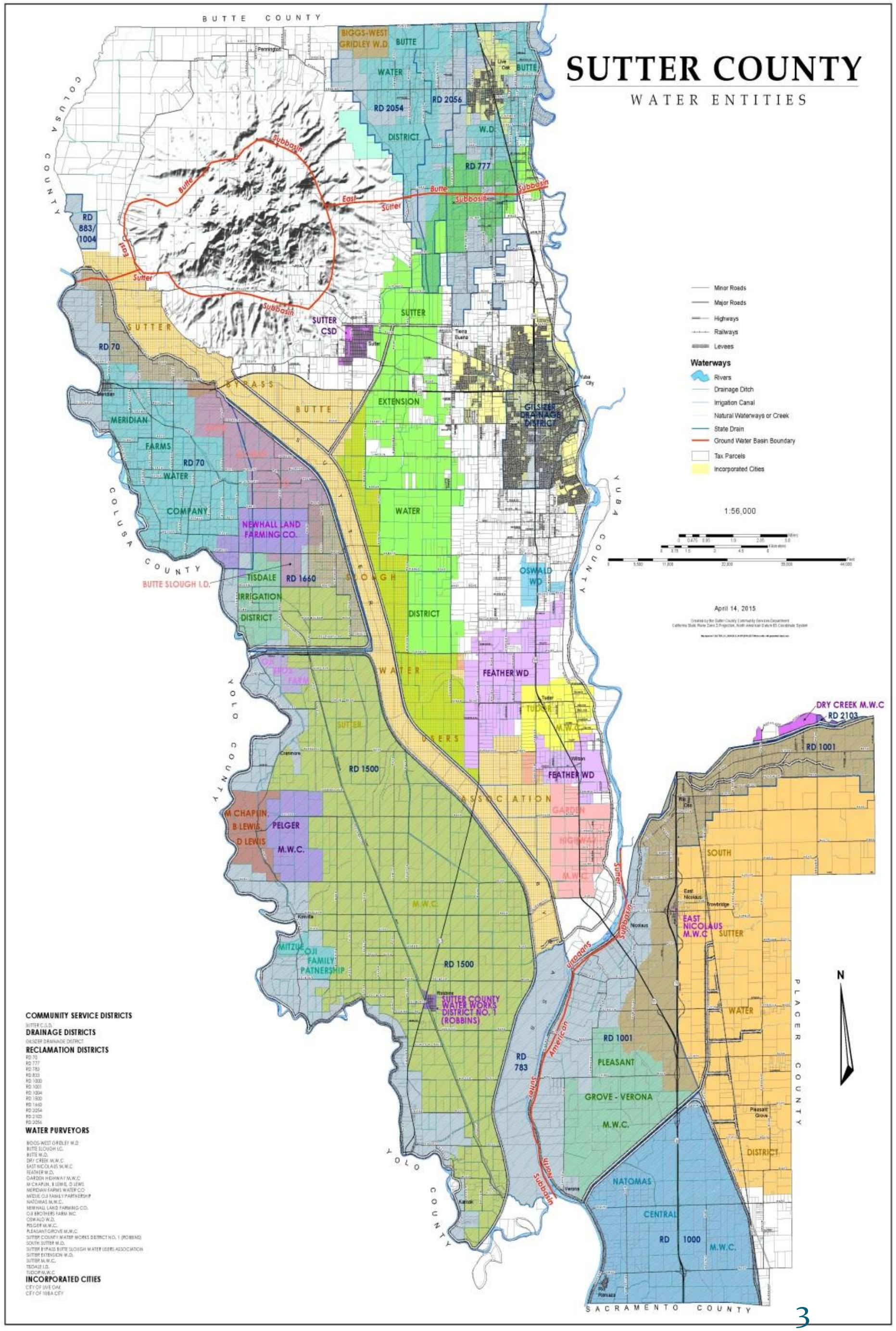
Basin Prioritization results — June 2, 2014

Sutter County's Subbasins

East Butte Subbasin
- Medium Priority
- 20% in Sutter, 80% in Butte

Sutter Subbasin
- Medium Priority
- 100% in Sutter County

North American Subbasin
- High Priority
- 25% in Sutter, 40% in Placer, 35% in Sacramento County



Sustainable Groundwater Management Act (SGMA)

A comprehensive legislation to manage groundwater in a sustainable manner.

- Provides incentives, tools, authority and guidance to manage groundwater
- Required for high and medium priority basins
- Retains local authorities with limited state intervention
- Requires formation of a Groundwater Sustainability Agencies (GSAs)
- Requires preparation of Groundwater Sustainability Plans (GSPs)

SGMA Defined

Sustainable Groundwater Management is defined as the “management and use of groundwater in a manner than can be maintained during the planning and implementation horizon without causing undesirable results.”

Undesirable results include:

- Chronic lowering of groundwater levels
- Reduction of groundwater storage
- Seawater intrusion
- Degraded water quality
- Land subsidence
- Depletions of interconnected surface waters

SGMA Roles and Responsibilities

- Local management with State oversight
- Department of Water Resources (DWR)
  - Technical and financial assistance
  - Groundwater basin priorities
  - Develops regulations
  - Reviews GSPs and monitors implementation
- State Water Resources Control Board (SWRCB)
  - Intervention if locals do not act

SGMA Milestones

9/16/2014	SGMA passed by Governor Brown
1/1/2015	SGMA became effective
1/1/2016	DWR to adopt regulations to revise basin boundaries
2/18/2016	DWR released draft regulations for evaluating and implementing GSPs
6/1/2016	DWR to adopt regulations for evaluating and implementing GSPs
6/30/2017	Establish Local GSAs
1/31/2022	Develop GSPs
1/31/2042	Achieve Sustainability

Groundwater Sustainability Agency

- The GSA is the primary agency responsible for achieving groundwater sustainability.
- Who can be a GSA?
  - Any local public agency that has water supply, water management or land use responsibilities within a groundwater basin.
- Counties are presumed GSA, if no other identified
- Notification to DWR due by June 2017
  - Public hearing and comment period required
- Local Determination
  - DWR encourages local collaboration
  - Multiple Governance Options available

Stakeholder Meetings

- Subbasin stakeholder discussions
  - SGMA updates
  - Discuss governance models
  - Provide network avenue for GSA formations
- SGMA networking meetings with neighboring counties
- Preferred Governance Model: Multiple GSAs – Single GSP for each subbasin

Next Steps

- Meet with all stakeholders
- Coordinate with eligible GSAs
- Submit GSA Notifications in 2017
- Begin Developing GSPs

Sutter County Department of Development Services

To: Individual Well Owners, North American Subbasin

You're Invited! - 2nd Meeting

The Sutter County Department of Development Services is hosting a meeting for individual well owners within the County to provide information regarding the State's Sustainable Groundwater Management Act (SGMA), and how this act affects them. You have received this invitation because you are a property owner in an area where a Groundwater Sustainability Agency (GSA) has not been established, and we'd like to share with you next steps and options.

Please join us!

Date:

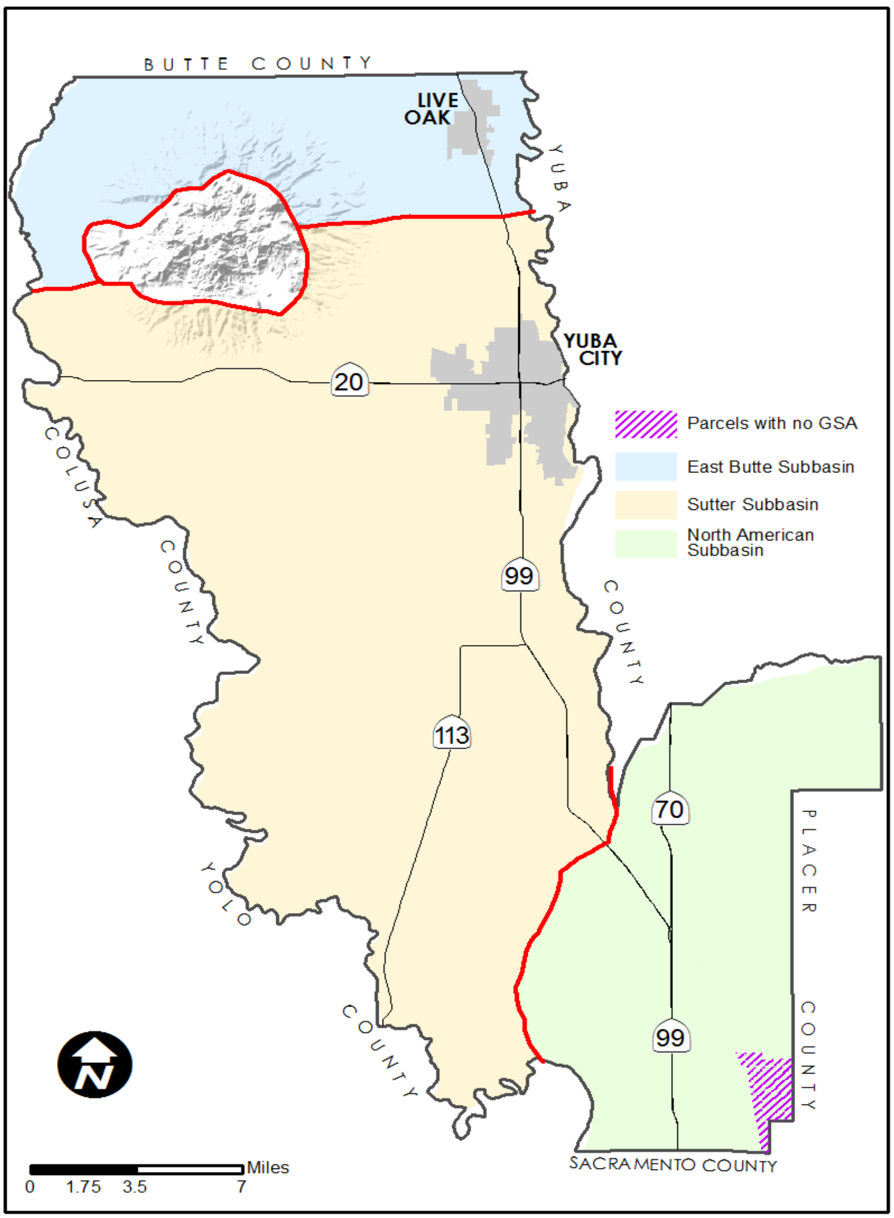
August 2, 2016

Time:

10 AM

Place:

Sutter County Veterans Hall
1425 Veterans Memorial Cir.
Yuba City, CA 95993



Questions?

Please Contact:
Guadalupe Rivera
1130 Civic Center Blvd.
Yuba City, CA 95993
Phone: 530-822-7400
Email: GRivera@co.sutter.ca.us

SGMA Outreach 2nd Meeting - North American Subbasin

Date: August 2, 2016 **Time:** 10:00 am **Location:** Veterans Hall, 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Phone	Email	Address
1	DAN WILLEFORD	916-655-3418	DDWILLE4D@GMAIL.&	3828 SANKEY RD PLEASANT GROVE 95668
2	ELOISE WILLEFORD	"	"	"
3	Jim Sills	5302630350	jimmy sills@ sprintfarm.com	3415 Riego Rd 95626
4	Pam Clinton	530-218-4536	vongeldern_pam	11070 INGRAM LN.
5			@sbcglobal.net	WIEODLCO 95953
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Sutter County Department of Development Services

To: Individual Well Owners, East Butte Subbasin

You're Invited! - 2nd Meeting

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Please join us!

Date:

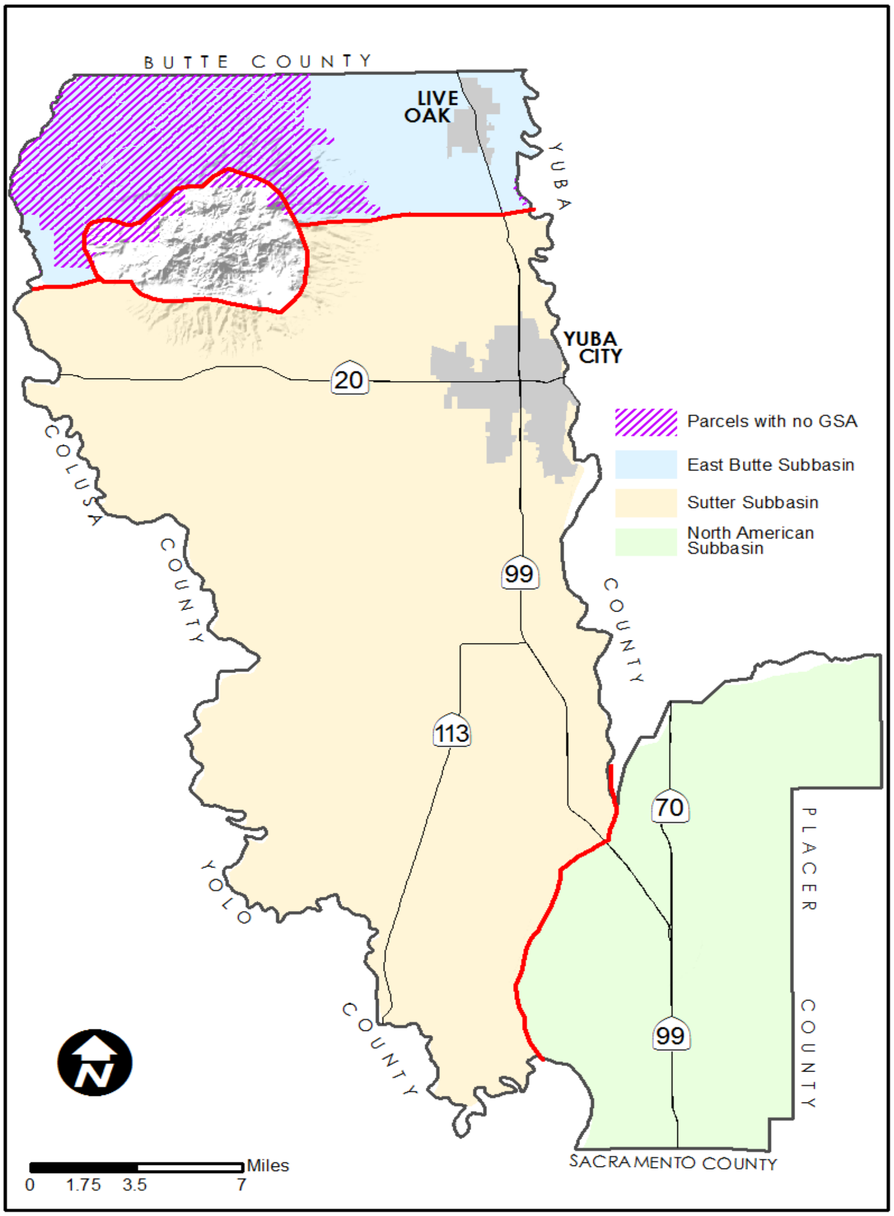
August 2, 2016

Time:

2 PM

Place:

Sutter County Veterans Hall
1425 Veterans Memorial Cir.
Yuba City, CA 95993



Questions?

Please Contact:
Guadalupe Rivera
1130 Civic Center Blvd.
Yuba City, CA 95993
Phone: 530-822-7400
Email: GRivera@co.sutter.ca.us

SGMA Outreach 2nd Meeting - East Butte Subbasin

Date: August 2, 2016 **Time:** 2:00 pm **Location:** Veterans Hall, 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Phone	Email	Address
1	Joseph Akers	530 538 3820	JAkers@Parks.CA.Gov	400 Glen Dr. Oroville 95966
2	Jeff Spence.	530-671-1008.	JeffeLaughlinSpence.Com.	1008 Live Oak Blvd Y.C.
3	Cindy Amarel	530-673-4948	Cindyandlarryl@gmail	2883 garden Hwy
4	Kyle Amarel	" "	KyleAmarel@Yahoo	" "
5	Taishe I Thiara	530 671-6334	buttevista2006@comcast.net	
6	Reece Cordi	(530)695-1785	rcordi@yahoo.com	10401 Ingram Ln LiveOak, CA 95953
7	Clay Goodman	(530) 695-2764	goodmanranch@gmail.com	8581 Bigelow Rd LiveOak
8	Peter Jelavich	530-682-9402	Pnuts1@sbcglobal.net	PO Box 1476 Yuba City CA 95992
9	Warren S Miller	530 695 1334	WarrenMiller55@Gmail.com	11200 Ingram Lane L.O. 95953
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SGMA Outreach 2nd Meeting - East Butte Subbasin

Date: August 2, 2016 **Time:** 2:00 pm **Location:** Veterans Hall, 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Phone	Email	Address
1	Tom Donald	530 846 6548	donaldrand@wccisp.com	1908 Hwy 70, Durham, 95965
2	Michael Tarke	530 693-0021	tarke92@gmail.com	3540 W. Butte Rd Sutter 95982
3	[illegible]	559-314-5890		2281 Sierra Ave, Clovis, CA 93...
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SGMA Outreach 2nd Meeting - East Butte Subbasin

Date: August 2, 2016 **Time:** 2:00 pm **Location:** Veterans Hall, 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Phone	Email	Address
1	Susan Young	530-695-8459	butte.ridge@yahoo.com	12035 N. Butte Rd Live Oak, CA 95953
2	Liz Powell	530-682-9645	lizpowell@ymail.com	7334 Remington Rd, Live Oak 95953
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Sutter County Department of Development Services

To: Individual Well Owners, Sutter Subbasin

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Please join us!

Date:

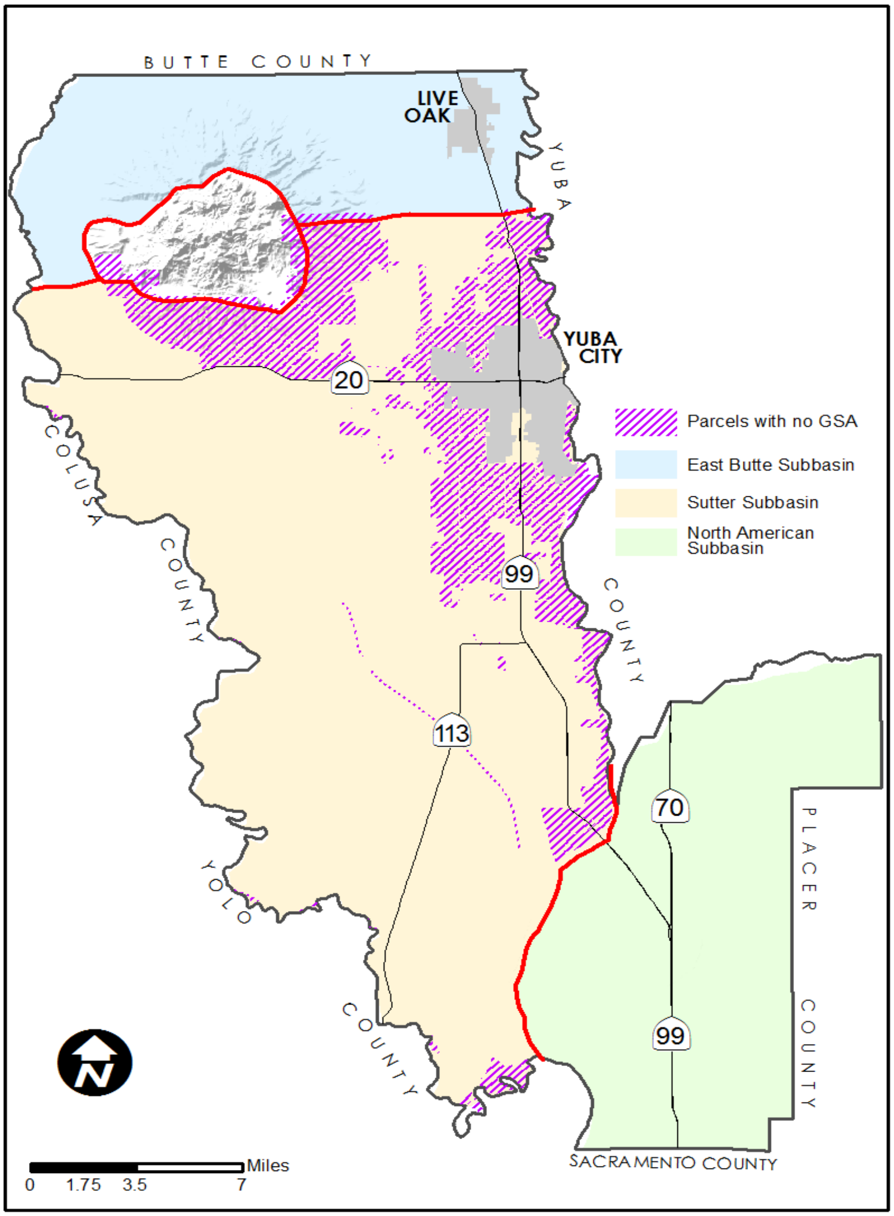
August 3, 2016

Time:

2 PM

Place:

Sutter County Veterans Hall
1425 Veterans Memorial Cir.
Yuba City, CA 95993



Questions?

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Guadalupe Rivera
1130 Civic Center Blvd.
Yuba City, CA 95993
Phone: 530-822-7400
Email: GRivera@co.sutter.ca.us

SGMA Outreach 2nd Meeting - Sutter Subbasin

Date: August 3, 2016 **Time:** 2:00 pm **Location:** Veterans Hall, 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Phone	Email	Address
1	G+C FRYE ENTERPRISES LP. Carmen Frye			4291 Colusa Hwy. Yuba City 95993-9357
2	Ned Lemenager			7461 Lemenager Rd. Sutter CA 95982
3	Loren Bottorff		L.bottorff@comcast.net	
4	Ed Davis	530.673.7968	JDDAVIS@Succeed.Net	1171 Clements Rd YC
5	Marilyn Freeman		mjfrank@aol.com	8921 So Butte Rd Sutter 95982
6	DAVid KARNEGAN	530)491-1914	dkarnegan@att.net	431 StewART Rd., YC 95991
7	Sat Dallar		Satdallar@yahoo.com	25 Sacramento Ave YC 95991
8	Vince Naso	749-7210	Vince@cdms.net	2877 Railroad, YC
9	LARA S JOHL	530-6826597	RJOHL@Yahoo.Com	P.O. Box 951 Y.C
10	David Rai	530 6820639		1415 S.George Washington Y.C.
11	Dawn Bon	530-755-1700	dawn@empirefarming.com	P.O. Box 3686 Yuba City 95992
12	Michael Baki	530-673-5938		
13	Yoshimi Yohokawa	530-673-9699		4407 Garden Hwy, Y.C. 95991
14	John Rohrbach	530.632.0692		
15	DUAYNE HEFFLEY	530-218-4843		483 BARRY RD, YC 95991
16	Valeri Severson	530-674-3881	valeri@strachanbees.com	
17	Ronald Chan	530-674-7265		506 Oldegon Rd Y.C.
18	Gerald Munger	530 755-0526		8757 So. Butte Rd Sutter
19	DORIS Niccolai	916-454-2984	none	PO Box 22414, Sacramento, 95822
20	Ron Dale	916-955-7751	rdale904@gmail.com	PO Box 132 Nicolaus CA 95659
21.	ANTHONY LANEY			1624 POOLE BLVD. YUBA CITY CA 95953

SGMA Outreach 2nd Meeting - Sutter Subbasin

Date: August 3, 2016 **Time:** 2:00 pm **Location:** Veterans Hall, 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Phone	Email	Address
1	KATHLEEN GOODNIGHT	(530) 674-5551	dkgoodnight@comcast.net	3684 FRAKES, YUBA CITY CA
2	Paula Schmidt	530 671-3329	N/A	3560 Frakes way, Y.C.
3	Brian Greathouse	530-301-5858	bgreathouse@sbcglobal.net	
4	JAMES CAMBLIN	(530) 671-4911	james@wilburpacking.com	P.O. BOX 3730 Y.C 95992
5	Joe Heier	671-1895	2351 Sanders	Live Oak
6	Milton Greathouse	673-4435		785 S. Walton Ave Y.C.
7	Ben DuBose	673-1053		4965 Markley Rd Y.C
8	Paula Tomei	673-2408	paulatomei@succeed.net	4345 Oswald Rd YC 95993
9	Pat Carroll	916-747-3731	peachy1117@aol.com	2768 Lincoln Rd YC
10	June Gildemeester	751-7504		8829 S Butte Rd Sutter
11	Pete + Margit Sands	632-5172	sandsmp@comcast.net	204 Wright Ave, Gridley 95948
12	Kathleen C. Ahlers	7550554	—	3089 Acacia AV Sutter
13	DIRK TOLDERNAART	673-0483	dirkh256@comcast.net	4109 Bogue Rd YC.
14	JACK POUKISH	682-0038	jack@sgtrees.com	5320 Garden Hwy YC
15	Michael Johl	530-671-1308		2311 Eager Rd Live Oak 95953
16	Stan Anderson	530-632-3126	stnanrsn@comcast.net	3888 Franklin Rd Yuba City 95993
17	Andy Jansen	530 701-1507	Andy@SutterHelicopter.com	631 Buchanan Ave YC 95993
18	Claudia Street	on file	on file	on file
19	Wm LeBaron		willielebaron@hotmail.com	7982 Pass Rd Sutter 95982
20	Marylin Beyer	673-2832		3567 Franklin Rd 95993

SGMA Outreach 2nd Meeting - Sutter Subbasin

Date: August 3, 2016 **Time:** 2:00 pm **Location:** Veterans Hall, 1425 Veterans Memorial Circle, Yuba City, CA 95993

	Name	Phone	Email	Address
1	Bill Minton	674 2085		272 S. George Washington Y.C.
2	Sal Cancilla	(209)993-6454	SalFms@Yahoo.com	P.O. Box 458 Herald CA 95638
3	Jerome Burk	(530) 788-8431	nutsnyc@comcast.net	2092 Tierra Buena Rd Yuba City CA 95993
4	Navneet Thiara	(530) 755-1700	navneet@empirefar ming.com	
5	Lal Chima	(530) 674-1169	lchima10yc@yahoo.com	4840 W. Onstott Live Oak
6	Bill Brace	530 674 2926	rdking1@comcast.com	
7	DEL HEFFLEY	530-632-5774	DCHEFFLEY@COMCAST.NET	483 BARRY ROAD YUBA City 95991
8	Mike Smith	530-742-6485	msmith@mhm-inc.com	P.O. Box 243 3189 Pass Rd. Sutter
9	Randall Kroe	682-6427		1021 Bogue Rd YC
10	BOB AMAREL	682-5785	bob@reasonFARMS.com	6368 SOUTH TOWNSHIP Y.C.
11	Joanne Keech	530-674-1420	bjs1Mom@Comcast.net	2355 Redding Ave Y C
12	BRIAN BERL	530-682-0036	brian@sgtrees.com	
13	Ernie Rodriguez	530-682-0118	Ernie@ButteBasin.com	P.O. Box 3275 Yuba City CA 95993
14	BRENT MEYER	530 682-3699	BLUMEYER@SBCGLOBAL.NET	11870 S. BUTTE SUTTER CA 95982
15	Justin Micheli	682-0638	justin@lanocrossing.com	P.O. Box 395 Live Oak
16	Craig Hendy	713-2766	craighendy1@aol.com	8710 S. Butte Rd Sutter
17	Michael Baki	(530) 673-5938		
18	Stanley Schmidt	674-2112		4194 RAILROAD AV. Y.C. 95991
19				
20				

AGENDA

Sutter County Stakeholder Groundwater Workshop
Sutter Subbasin

Date: Thursday, July 28, 2016

Time: 2:00 to 3:30 PM

Location: Veterans Hall, Tucker Room, located on North East corner of Building
1425 Veterans Memorial Circle, Yuba City CA 95993

Discussion Topics:

1. Introductions
2. Sustainable Groundwater Management Act Overview
3. Sutter Subbasin
   - Medium Priority Basin
   - 100% Sutter County
4. Basin Governance Options
   - Single GSA – Single GSP
   - Multiple GSAs – Single GSP
   - Multiple GSAs – Multiple GSPs
5. Basin Boundary Revision Options
6. Groundwater Sustainability Plan Regulation Development
7. Future Meetings

Notes:

SIGN-IN SHEET

SGMA Stakeholders Meeting	Meeting Time: 2:00 pm on July 28, 2016
Sutter Subbasin Stakeholders	Location: Veterans Hall, Tucker Room 1425 Veterans Memorial Circle, Yuba City, CA 95993

Name	Organization	Phone	E-Mail
Richard Shatz	GEI	916-631-4566	rshatz@geiconsultants.com
Claudia Street	YSFB	on file	
Justin Michel	YSFB	530 682-0638	mfsfb@succeed.net
David Miller	GEI	916-631-4588	dmiller@geiconsultants.com
Diana Langley	Yuba City	822-4792	dlangley@yubacity.net
Ben Moody	Yuba City	822-4783	bmoody@yubacity.net
Paul Schubert	GSWC	916-853-3600	pschubert@gswater.com
Al Sawyer	Sutter Co.	530 822 7450	
Andy Duffey	RD70/1660		aduffey@succeed.net
Lynn Phillips	SEWD	530-673-7138	lpsewd@hughes.net
Nick Ramos	SC	—	on file —
Danelle Stylos	SC	—	on file

AGENDA

Sutter County Stakeholder Groundwater Workshop
Sutter Subbasin

Date: Friday, August 5, 2016

Time: 8:30 to 9:30 am

Location: Veterans Hall, Tucker Room, located on North East corner of Building
1425 Veterans Memorial Circle, Yuba City CA 95993

Discussion Topics:

1. Introductions
2. Sustainable Groundwater Management Act Overview
   - Alternative Plan vs Groundwater Sustainability Plan
   - Coordination
     - MOA/MOU
     - JPA
   - Cost Distribution
3. Basin Governance Options
   - ~~Single GSA – Single GSP~~
   - Multiple GSAs – Single GSP
   - Multiple GSAs – Multiple GSPs
4. Sutter Subbasin
   - Medium Priority Basin
   - 100% Sutter County
5. Future Meetings

Notes:

SIGN-IN SHEET

SGMA Stakeholders Meeting	Meeting Time: 8:30 am on August 5, 2016
Sutter Subbasin Stakeholders	Location: Veterans Hall, Tucker Room 1425 Veterans Memorial Circle, Yuba City, CA 95993

Name	Organization	Phone	E-Mail
Lynn Phillips	SEWD	530-673-7135	lpsewd@hughes.net
Carl Yank	SEWD	530 713 6200	carlyank48@gmail.com
Geri Goetzinger	SCSD	530-755-1733	sutterwater@AOL.com
Max Sakato	RD1500/SMWC	916-765-0187	mssakato70@gmail.com
[illegible]	[illegible]	[illegible]	DAN Duncan
Claudia Street	YSPB	on file	
Andy Duffey	RD70/1660	530-682-2996	
Jon Munger	GMWC Sutter Bypass Assc.	330-2827	jon@montnafarms.com
Scott Tucker	RD 1500	908-8424	pelgerwater@comcast.net
Mark Orme	BWD	846-3100	morme@buttewater.net
Ben Moody	Y. C.	822-4783	bmoody@yubacity.net
Nick Ramos	Sutter County	822-7407	on file
Danelle Stylos	Sutter County	— on file	on file

Sign-In Sheet

SGMA Stakeholders Meeting	Meeting Time: 8:30 am on August 5, 2016
Sutter Subbasin Stakeholders	Location: Veterans Hall, Tucker Room 1425 Veterans Memorial Circle, Yuba City, CA 95993

Name	Organization	Phone	E-Mail
Richard Shatz	GEI	916-631-4566	rshatz@geiconsultants.com

AGENDA

Sutter County Stakeholder Groundwater Workshop
Sutter Subbasin

Date: Wednesday, August 31, 2016

Time: 1:30 to 2:30 pm

Location: Oak Room
1130 Civic Center Blvd, Yuba City CA 95993

Discussion Topics:

1. Introductions
2. Sustainable Groundwater Management Act Overview
    - Cost distribution of Sutter Subbasin GSA based on acreage
3. Sutter Subbasin
    - Medium Priority Basin
    - 100% Sutter County
4. Future Meetings

Notes:

SIGN-IN SHEET

SGMA Stakeholders Meeting	Meeting Time: 1:30 pm on August 31, 2016
Sutter Subbasin Stakeholders	Location: Veterans Hall, Tucker Room 1425 Veterans Memorial Circle, Yuba City, CA 95993

Name	Organization	Phone	E-Mail
Danelle Stylos	Sutter	822-7400	
Jon Munger	GHMWC	530-330-2827	
Scott Tucker	RD1500	908-8421	
Nick Ramos	Sutter County	-	-
Lynn Phillips	SEWD	673-7138	
Andy Duffey	RD70/1660	530-696-2569	
Guadalupe Rivera	Sutter Co.	822-7400	

SUTTER COUNTY
DEVELOPMENT SERVICES DEPARTMENT

Building Inspection
Code Enforcement

Planning
Environmental Health

Fire Services
Engineering

Road Maintenance
Water Resources

PROJECT STATUS MEETING AGENDA

PROJECT: Sutter Subbasin Alternative GSP

Meeting Date: October 18, 2016, 9:00 – 11:00 AM
Meeting Location: Tucker Room, 1425 Veterans Memorial Circle, Yuba City, CA 95993

Items to Discuss:

1. Review of Alternative Plan Submittal – Sustainability Indicators

2. Discussion - Continue to Proceed or Not

3. Schedule Meeting Time to Review and Discussion Thresholds and Management Options

1130 Civic Center Boulevard • Yuba City, CA 95993
Building Inspection • Code Enforcement • Planning • Environmental Health • Fire Services • (530) 822-7400
Engineering • Road Maintenance • Water Resources • (530) 822-7450

SUSTAINABILITY MEETING AGENDA

PROJECT: Sutter Subbasin Alternative GSP

Meeting Date: October 31, 2016, 9:00 – 11:00 AM
Meeting Location: Tucker Room, 1425 Veterans Memorial Circle, Yuba City, CA 95993

1. Purpose and Goals of Meeting
2. Brief Review of Alternative Plan Submittal Status – Update
3. Review and Prepare Locally Defined Undesirable Results
4. Review and Establish Measureable Objectives for each Sustainability Indicator
5. Review and Establish Minimum Thresholds for each Sustainability Indicator

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SUTTER COUNTY
DEVELOPMENT SERVICES DEPARTMENT

Building Inspection
Code Enforcement

Planning
Environmental Health

Fire Services
Engineering

Road Maintenance
Water Resources

BOARD MEETING: AUGUST 23, 2016
PWSS REVIEW: N/A

TO: **BOARD OF SUPERVISORS**

FROM: **GUADALUPE RIVERA, SENIOR CIVIL ENGINEER**
DANELLE STYLOS, DIRECTOR

SUBJECT: **APPROVAL OF CONTRACT ADDENDUM FOR TECHNICAL ASSISTANCE RELATED TO THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT PROGRAM FOR SUTTER COUNTY.**

Recommended Action: That the Board of Supervisors:

1. Approve an Agreement Addendum #1 for Professional Services with G.E.I. Consultants Inc. to:
   a. Organize and Create up to three Groundwater Sustainability Agencies (one per sub basin);
   b. Prepare a Groundwater Sustainability Plan (GSP); and,
   c. Assist in Implementing Groundwater Management In Accordance With The GSP.
2. Authorize the Director of Development Services, or her designee, to execute the contract addendum and all documents related to the administration of the Professional Services Agreement in accordance with the Public Contract Code.

Background: In September 2014, the Sustainable Groundwater Management Act (SGMA) was signed in order to allow local agencies to customize groundwater sustainability plans to their regional economic and environmental needs. A new governance structure, known as Groundwater Sustainability Agencies (GSA's), will be created by local agencies to assess the local groundwater basins and create Groundwater Sustainability Plans (GSP's) in order to establish long-term sustainability.

There are three groundwater sub basins within Sutter County: the East Butte Sub Basin, the Sutter Sub Basin, and the North American Sub Basin. Within each sub basin, the County, along with all other potential GSA's, are required to have created a GSA, or multiple GSA's, covering the entire sub basin by June 2017. If a portion of a basin is not managed by GSA's, the County is presumed to be the GSA for that unmanaged area. SGMA requires that by January 31, 2022, basins must be managed by either a single GSP or multiple GSP's. All GSA's within each sub basin will be working collaboratively to create a GSP for the sub basin.

Discussion: The Department hired G.E.I. Consultants Inc. (GEI) last year to provide technical services necessary to comply with SGMA and the creation of a possible GSA. GEI is similarly under contract with other Counties in the region and is well versed in the requirements of SGMA. Our contract was executed under the monitory authority of the County Purchasing Agent ($50,000) for work on creating GSAs, and is still active.

Recent guidelines from the Department of Water Resources concerning the preparation of GSPs allows for submission of an "Alternative Plan" for sub basins assumed to be meeting sustainment requirements now. The submission date for this plan is December 31, 2016. This leaves only four months for the preparation of this "Alternative Plan" in lieu of a GSP.

Due to the time sensitivity of this project and the demonstrated recent performance of GEI, the Department has determined that GEI is best qualified to continue work on the GSAs, GSP and Alternative and assist in its implementation. Staff recommends that amending the existing GEI contract is in the best interests of the County.

Prior Board Action: No known past Board actions exist.

Board Alternatives: The Board could choose not to authorize the GEI Agreement addendum. However, the quick development of an Alternative Plan and the creation of the GSA's and associated GSP is complicated and requires specialized skills which Department staff does not currently possess.

Other Department and/or Agency Involvement: The California Department of Water Resources and the State Water Resources Control Board are the lead State agencies responsible for developing regulations and reporting requirements necessary to comply with SGMA. The County is meeting and working collaboratively with local mutual water companies, water districts, drainage districts, and reclamation districts within the County, as all are potential GSA's. The County is also working with neighboring counties to ensure there are no conflicting issues with the GSP's.

Action Following Approval: The Department Director will execute a contract addendum with the GEI Consultants Inc. bringing the contract compensation to NTE $124,754.

Fiscal Impact: The additional anticipated project costs of $90,000 associated with the FY2016-17 SGMA program are included in the FY 2016-17 Recommended Budget, 1922-52180.

Standing Committee Review: Due to the time sensitivity and non-controversial and routine nature of this item, it did not appear before the Public Works/Support Services Committee.

Attachments: Contract Addendum #1
GEI Proposal

ADDENDUM #1
TO AGREEMENT FOR PROFESSIONAL SERVICES:
GROUNDEATER SUSTAINABILITY AGENCY DEVELOPMENT ASSISTANCE FY 15/16

WHEREAS, as of May 20, 2016, GEI Consultants, Inc. ("Consultant") and the County of Sutter ("County") entered into an Agreement for Professional Services: Groundwater Sustainability Agency Development Assistance FY 15/16, which is incorporated herein by this reference, and

WHEREAS, the parties are mutually desirous of amending the agreement Scope to include the attached GEI Proposal dated April 12, 2016 under Section 1 of the agreement, and Time of Performance under Section 2 of the agreement to expire on Jun 30, 2017, and

WHEREAS, the parties are mutually desirous of amending the agreement Compensation under Section 3 of the agreement to an amount not to exceed $124,754,

NOW, THEREFORE, for valuable consideration receipt of which is hereby acknowledged, Consultant and County agree that the Scope under Section 1, Time of Performance under Section 2, and Compensation under Section 3 of that certain Agreement for Professional Services: Groundwater Sustainability Agency Development Assistance FY15/16 entered into as of May 20, 2016, be amended.

Dated:___________

GEI Consultants, Inc

By______________________
Richard W. Shatz
Principal Hydrogeologist

Dated:____________

County of Sutter

By______________________
Danelle Stylos
Director of Development Services

Board of Supervisors Authorization _____

Approved as to Form

By____________________
Deputy County Counsel

April 12, 2016

GEI Consultants

Geotechnical
Environmental and
Water Resources
Engineering

Ms. Danelle Stylos
Director of Development Services Department
Sutter County
1130 Civic Center Blvd., Suite A
Yuba City, CA 95993

Re: Proposal
Groundwater Sustainability Management Assistance – FY 2017
Sutter County, California

Dear Ms. Stylos:

GEI Consultants, Inc. (GEI) is pleased to submit this proposal to continue to assist Sutter County (County) with implementation of the 2014 Sustainable Groundwater Management Act (Act). The Act requires local public agencies to: 1) organize and create a Groundwater Sustainability Agency(s) (GSAs); 2) prepare a Groundwater Sustainability Plan (GSP); and; 3) implement groundwater management in accordance with the GSP. The County overlies the Sutter Groundwater Subbasin, partially overlies both the North American and East Butte subbasins and has land use authority within each of the subbasins. As such it may be leading or participating in up to three different GSAs, one in each of the three subbasins. This proposal is to assist the County with the development of GSA(s) or other management approaches in each subbasin and complete any required applications to the California Department of Water Resources (DWR) by June 30, 2017.

Based upon the type of management organization selected by the County and others in the subbasins, the County will then need to lead or be involved in the second phase of implementation of the Act, preparation of GSPs. GSPs are to be developed over a five-year period starting in July 2017 and be completed by January 31, 2022. The draft regulations indicate that the GSPs are an extensive review of historic, current, and projected future groundwater conditions. The comment period for the draft regulations has just closed and there are some indications that the requirements may become tiered to allow those basins that are currently sustainable to reduce their efforts. Final regulations are due to be released by June 1, 2016. Once released the level of effort to prepare and the level of detail to be contained in the GSP will be better known; however, what is known is the Act indicates that grant funding will be available to help fund development of GSPs. To be prepared for this opportunity, this proposal also contains services to assemble existing information to prepare rough draft GSPs with the purpose to identify data gaps and with that knowledge be able to identify the scope and budget to apply for grant funds. Winning grant applications are those that can clearly define the need, the benefit, an approach, and a reasonable cost.

GEI Consultants, Inc.
10860 Gold Center Drive, Suite 350, Rancho Cordova, California 95670
916.631.4500 fax: 916.631.4501

Scope of Services

Our scope of services has been divided into six tasks to discuss the work to be accomplished.

Task 1: Groundwater Management Support

The 2014 Sustainable Groundwater Management Act (SGMA) is in its infancy and is evolving. The purpose of this task to provide the County access to our senior hydrogeologists, engineers, and planners to help guide and support the County through development of GSA(s) or other groundwater management alternatives. We will be available to:

- Communicate with the County on a monthly basis to plan and organize efforts to meet deliverables
- Update the County on new SGMA requirements
- Assist the County in planning efforts and approaches to engage stakeholders
- Attend GSA meetings upon the request of the County
- Develop presentations and information sheets

Assumptions: Four hours of senior level personnel time per month will be available.

Deliverable: None.

Task 2: GSA Application(s)

The 2014 Sustainable Groundwater Management Act (SGMA) requires the formation of GSAs in high- and medium-priority groundwater basins and subbasins (basins) by June 30, 2017. The purpose of this task is to provide the County with support services to apply to DWR to become a designated GSA in up to three groundwater subbasins.

Within 30 days of deciding to become or form a GSA, the local agency or combination of local agencies shall inform DWR of its decision and its intent to undertake sustainable groundwater management. The notification shall include the following information, as applicable:

1. A map of the service area boundaries, the boundaries of the basin or portion of the basin the agency intends to manage pursuant to this part, and the other agencies managing or proposing to manage groundwater within the basin.
2. A copy of the resolution forming the new agency.
3. A copy of any new bylaws, ordinances, or new authorities adopted by the local agency.
4. A list of interested parties, developed pursuant to Section 10723.2, and an explanation of how their interests will be considered in the development and operation of the GSA and the development and implementation of the agency's sustainability plan.

GEI will assist the County by establishing a project schedule, tracking of the progress, creating maps, compiling of the sections, and submittal of all documents electronically to DWR.

Assumptions: The County will lead and provide Items 2 through 4 above for inclusion into each GSA submittal (assumes three GSAs).

Deliverable: Complete GSA(s) notifications.

Task 3: Compile Relevant Information

Sutter County and many water districts within the three subbasins have existing studies or information that could be used to create or support the development of GSPs as required by the draft GSP regulation. The purpose of this task to identify and collect available information to reduce overall costs by using existing data. GEI will provide staff to the County to identify groundwater and surface water data and reports and create a repository for the information. We anticipate our staff will temporarily be based in your office to allow us to visit with other County departments.

We have also anticipated and allocated time to contact, receive, and compile other local agencies documents into the repository.

The work will also include acquisition of the relevant plans (Urban Water Master Plans, General Plans, Agricultural Water Management Plans, etc.) to assess potential development projects that could increase the demand on groundwater and surface water.

Assumptions: The County will provide for introductions to staff and other participating agencies where information may be available.

Deliverable: Compiled relevant data and reports, organized as publicly available or proprietary.

Task 4: Draft GSP(s)

After the repository of information is populated, GEI will create a GSP outline and populate it with information contained in available published reports (cut and paste type actions). Some sections may be populated with information provided by DWR. The outcome of the draft GSP will be to illustrate those sections where there is sufficient data, and those sections without information (data gaps).

We assume the County will then release the draft document and have a discussion with its stakeholders on whether any additional information may be available to complete those sections. The goals are to have community-wide acceptance of the work that needs to be performed and potential projects that could be grant funded to fill data gaps.

Assumptions: An alternative GSP will be developed for the North American Groundwater Subbasin and will be due by January 1, 2017. Cost for participating in that GSP is included. Draft GSPs will be developed for the other two subbasins.

Deliverable: Draft GSPs (two) and information to support development of an alternative GSP for the North American Groundwater Basin (prepared by others).

Task 5: Grant Applications

The Act indicates that grant funding will be made available to help fund GSP development. DWR has control of about $100 million in funding to assist in the enactment of the Act. DWR released an initial round of grant funding ($10 million) for Counties with Stressed Groundwater Basins and awarded $6.7 million to applicants. It is possible DWR may release a second round of funding for the remaining $3.7 million. It is also possible during this fiscal year DWR could release other grant opportunities to fund GSP development. Other agencies have additional funding that could be used to implement potential projects to implement the GSP.

GEI will track grant opportunities and notify the County of potential opportunities to seek funding for GSP development. We will assess the grant requirements, identify those data gaps that could be funded, and bring to the County recommendations whether to proceed or to wait. GEI will also be available to assist the County to prepare the grant application(s) and file the applications with DWR or other agencies.

Assumptions: Up to three grant applications, one per subbasin, will be prepared and submitted this fiscal year.

Deliverable: Potential funding opportunities. Complete grant application.

Project Schedule

The proposed work will be accomplished within Fiscal Year 2016-2017. The time of completion of any task will be based upon Act requirements and the County's needs.

Cost Estimate

GEI proposes to complete the project on a time-and-materials basis at a cost not to exceed $90,000. Table 1 provides estimated costs for each task. Our standard fee schedule is also attached.

Please contact Richard Shatz at (916) 631-4566, if you have any questions pertaining to this proposal.

Regards,

Richard W. Shatz, C.HG. 84
Principal Hydrogeologist

Mark S. Williamson, P.E. C35671
Vice President

Table 1
Groundwater Sustainability Management Assistance - FY 2017
Sutter County, California

Description	Labor Cost	Expenses	Subcontractors	SUBTOTAL
Task 1 - Groundwater Management Support	$18,288	$0	$0	$18,288
Task 2 - GSA Applications	$10,931	$0	$0	$10,931
Task 3 - Compile Relevant Information	$11,060	$400	$0	$11,460
Task 4 - Draft GSPs	$18,222	$0	$0	$18,222
Task 5 - Grant Applications	$30,930	$0	$0	$30,930
			Total	**$89,831**

Task 1 - Groundwater Management Support

Groundwater Sustainability Management Assistance - FY 2017
Sutter County, California

Labor	Rate	Units	Hours		Fee
Senior Principal	320	Hrs.	0	$	-
Senior Consultant - Grade 8	259	Hrs.	0	$	-
Senior Consultant - Grade 7	231	Hrs.	0	$	-
Senior Professional - Grade 7	231	Hrs.	-68	$	15,708
Senior Professional - Grade 6	196	Hrs.	0	$	-
Senior Professional - Grade 5	171	Hrs.	0	$	-
Project Professional - Grade 4	145	Hrs.	0	$	-
Project Professional - Grade 3	129	Hrs.	20	$	2,580
Staff Professional - Grade 2	117	Hrs.	0	$	-
Staff Professional - Grade 1	107	Hrs.	0	$	-
Sr. CADD Drafter and Designer	129	Hrs.	0	$	-
CADD Drafter/Designer and Senior Technician	117	Hrs.	0	$	-
Technicial, Word Processor, Administrative Staff	96	Hrs.	0	$	-
Office Aid	75	Hrs.	0	$	-
			Direct Labor:	$	18,288

Expenses		Rate	Units	Quantity		Fee
Mileage	$	0.56	mile		$	-
Reproduction	$	-	L/S		$	-
Shipping	$	-	L/S		$	-
Laboratory Testing	$	-	L/S		$	-
Equipment Rental	$	-	Wk		$	-
Consumables	$	-	week		$	-
Lodging	$	130.00	day		$	-
Per Diem	$	65.00	day		$	-
Permit Fees	$	-	L/S		$	-
			Expenses:		$	-

Subcontractors		Rate	Units	Quantity		Fee
-	$	-	L/S		$	-
-	$	-	L/S		$	-
-	$	-	L/S		$	-
			Subcontractors:		$	-

SUB-TASKS	Senior Princ.	Williams Grade 8	D. Miller Grade 7	Shatz Grade 7	Grade 6	Ryan Grade 5	Grade 4	Melissa Grade 3	Grade 2	Grade 1	Sr. CADD/GIS	CADD	Word Proc.	Office Aid
Communication				48										
Planning Effort				20										
Presentaiton suport								20						
TOTAL	0	0	0	68	0	0	0	20	0	0	0	0	0	0

Task Subtotal:
$ 18,288

Task 2 - GSA Applications

Groundwater Sustainability Management Assistance - FY 2017
Sutter County, California

Labor	Rate	Units	Hours		Fee
Senior Principal	320	Hrs.	0	$	-
Senior Consultant - Grade 8	259	Hrs.	0	$	-
Senior Consultant - Grade 7	231	Hrs.	3	$	693
Senior Professional - Grade 7	231	Hrs.	3	$	693
Senior Professional - Grade 6	196	Hrs.	0	$	-
Senior Professional - Grade 5	171	Hrs.	0	$	-
Project Professional - Grade 4	145	Hrs.	8	$	1,160
Project Professional - Grade 3	129	Hrs.	35	$	4,515
Staff Professional - Grade 2	117	Hrs.	0	$	-
Staff Professional - Grade 1	107	Hrs.	0	$	-
Sr. CADD Drafter and Designer	129	Hrs.	30	$	3,870
CADD Drafter/Designer and Senior Techniciar	117	Hrs.	0	$	-
Technicial, Word Processor, Administrative St	96	Hrs.	0	$	-
Office Aid	75	Hrs.	0	$	-
			Direct Labor:	$	10,931

Expenses		Rate	Units	Quantity		Fee
Mileage	$	0.56	mile		$	-
Reproduction	$	-	L/S		$	-
Shipping	$	-	L/S		$	-
Laboratory Testing	$	-	L/S		$	-
Equipment Rental	$	-	Wk		$	-
Consumables	$	-	week		$	-
Lodging	$	130.00	day		$	-
Per Diem	$	65.00	day		$	-
Permit Fees	$	-	L/S		$	-
			Expenses:		$	-

Subcontractors		Rate	Units	Quantity		Fee
-		-	L/S			
-	$	-	L/S		$	-
-	$	-	L/S		$	-
			Subcontractors:		$	-

SUB-TASKS	Senior Princ.	Williamsc Grade 8	D. Miller Grade 7	Shatz Grade 7	Grade 6	Ryan Grade 5	David Grade 4	Melissa Grade 3	Grade 2	Grade 1	Sr. CADD/GIS	CADD	Word Proc.	Office Aid
Maps (3)				3			8				30			
Schedule								4						
Tracking								4						
Compilation								24						
Upload			3					3						
TOTAL	0	0	3	3	0	0	8	35	0	0	30	0	0	0

Task Subtotal:
$ **10,931**

Task 3 - Compile Relevant Information

Groundwater Sustainability Management Assistance - FY 2017
Sutter County, California

Labor	Rate	Units	Hours	Fee
Senior Principal	320	Hrs.	0	$ -
Senior Consultant - Grade 8	259	Hrs.	2	$ 518
Senior Consultant - Grade 7	231	Hrs.	2	$ 462
Senior Professional - Grade 7	231	Hrs.	4	$ 924
Senior Professional - Grade 6	196	Hrs.	0	$ -
Senior Professional - Grade 5	171	Hrs.	0	$ -
Project Professional - Grade 4	145	Hrs.	0	$ -
Project Professional - Grade 3	129	Hrs.	68	$ 8,772
Staff Professional - Grade 2	117	Hrs.	0	$ -
Staff Professional - Grade 1	107	Hrs.	0	$ -
Sr. CADD Drafter and Designer	129	Hrs.	0	$ -
CADD Drafter/Designer and Senior Technician	117	Hrs.	0	$ -
Technicial, Word Processor, Administrative Sta	96	Hrs.	4	$ 384
Office Aid	75	Hrs.	0	$ -
			Direct Labor:	$ 11,060

Expenses	Rate	Units	Quantity	Fee
Mileage	$ 0.555	mile	720	$ 400
Reproduction	$ -	L/S		$ -
Shipping	$ -	L/S		$ -
Laboratory Testing	$ -	L/S		$ -
Equipment Rental	$ -	week		$ -
Consumables	$ -	day		$ -
Lodging	$ -	L/S		$ -
Field meters	$ -	L/S		$ -
Hydrosieves	$ -	L/S		$ -
		Expenses:		$ 400

Subcontractors	Rate	Units	Quantity	Fee
-	$ -	L/S		$ -
-	$ -	L/S		$ -
-	$ -	L/S		$ -
		Subcontractors:		$ -

SUB-TASKS	Senior Princ.	Wilaimsı Grade 8	D. Miller Grade 7	Shatz Grade 7	Grade 6	Ryan Grade 5	Grade 4	Melissa Grade 3	Grade 2	Grade 1	Sr. CADD/GIS	CADD	Word Proc.	Office Aid
Search and compile County files								24						
Other Water Agencies information			2	2				24						
Precipitation Stations								2						
Gaging stations								2						
Subsidence stations								2						
Other plans								6						
Bibliography review		2		2				8					4	
TOTAL	0	2	2	4	0	0	0	68	0	0	0	0	4	0

Task Subtotal:
$ 11,460

Task 4 - Draft GSPs

Groundwater Sustainability Management Assistance - FY 2017
Sutter County, California

Labor	Rate	Units	Hours	Fee
Senior Principal	320	Hrs.	0	$ -
Senior Consultant - Grade 8	259	Hrs.	0	$ -
Senior Consultant - Grade 7	231	Hrs.	10	$ 2,310
Senior Professional - Grade 7	231	Hrs.	24	$ 5,544
Senior Professional - Grade 6	196	Hrs.	0	$ -
Senior Professional - Grade 5	171	Hrs.	0	$ -
Project Professional - Grade 4	145	Hrs.	0	$ -
Project Professional - Grade 3	129	Hrs.	64	$ 8,256
Staff Professional - Grade 2	117	Hrs.	0	$ -
Staff Professional - Grade 1	107	Hrs.	0	$ -
Sr. CADD Drafter and Designer	129	Hrs.	0	$ -
CADD Drafter/Designer and Senior Technician	117	Hrs.	0	$ -
Technicial, Word Processor, Administrative Sta	96	Hrs.	22	$ 2,112
Office Aid	75	Hrs.	0	$ -
			Direct Labor:	$ 18,222

Expenses	Rate	Units	Quantity	Fee
Mileage	$ 0.555	mile		$ -
Reproduction	$ -	L/S		$ -
Shipping	$ -	L/S		$ -
Laboratory Testing	$ -	L/S		$ -
Equipment Rental	$ -	day		$ -
Consumables	$ -	week		$ -
Lodging	$ -	day		$ -
Per Diem	$ -	day		$ -
Permit Fees	$ -	L/S		$ -
		Expenses:		$ -

Subcontractors	Rate	Units	Quantity	Fee
-	$ -	L/S		$ -
-	$ -	L/S		$ -
-	$ -	L/S		$ -
		Subcontractors:		$ -

SUB-TASKS	Senior Princ.	Williams Grade 8	D. Miller Grade 7	Shatz Grade 7	Grade 6	Ryan Grade 5	Grade 4	Melissa Grade 3	Grade 2	Grade 1	Sr. CADD/GIS	CADD	Word Proc.	Office Aid
Outline GSP			2	2				8					4	
Populate with information (3 GSPs)				4				48						
Review draft GSPs (3)			8	18									18	
Revisions to GSPs (3)								8						
TOTAL	0	0	10	24	0	0	0	64	0	0	0	0	22	0

Task Subtotal:
$ 18,222

Task 5 - Grant Applications

Groundwater Sustainability Management Assistance - FY 2017
Sutter County, California

Labor	Rate	Units	Hours	Fee
Senior Principal	320	Hrs.	0	$ -
Senior Consultant - Grade 8	259	Hrs.	0	$ -
Senior Consultant - Grade 7	231	Hrs.	40	$ 9,240
Senior Professional - Grade 7	231	Hrs.	8	$ 1,848
Senior Professional - Grade 6	196	Hrs.	0	$ -
Senior Professional - Grade 5	171	Hrs.	0	$ -
Project Professional - Grade 4	145	Hrs.	120	$ 17,400
Project Professional - Grade 3	129	Hrs.	0	$ -
Staff Professional - Grade 2	117	Hrs.	0	$ -
Staff Professional - Grade 1	107	Hrs.	0	$ -
Sr. CADD Drafter and Designer	129	Hrs.	10	$ 1,290
CADD Drafter/Designer and Sernior Techniciar	117	Hrs.	0	$ -
Technicial, Word Processor, Administrative Sta	96	Hrs.	12	$ 1,152
Office Aid	75	Hrs.	0	$ -
			Direct Labor:	$ 30,930

Expenses	Rate	Units	Quantity	Fee
Mileage	$ 0.555	mile		$ -
Reproduction	$ -	L/S		$ -
Shipping	$ -	L/S		$ -
Laboratory Testing	$ -	L/S		$ -
Equipment Rental	$ -	day		$ -
Consumables	$ -	week		$ -
Lodging	$ -	day		$ -
Per Diem	$ -	day		$ -
Permit Fees	$ -	L/S		$ -
		Expenses:		$ -

Subcontractors	Rate	Units	Quantity	Fee
-	$ -	L/S		$ -
-	$ -	L/S		$ -
-	$ -	L/S		$ -
		Subcontractors:		$ -

SUB-TASKS	Senior Princ.	Williamsı Grade 8	D. Miller Grade 7	Shatz Grade 7	Grade 6	Ryan Grade 5	Grade 4	Melissa Grade 3	Grade 2	Grade 1	Sr. CADD/GIS	CADD	Word Proc.	Office Aid
Grant Applications (3)			40	8			120				10		12	
TOTAL	0	0	40	8	0	0	120	0	0	0	10	0	12	0

Task Subtotal:
$ 30,930

SUTTER COUNTY
DEVELOPMENT SERVICES DEPARTMENT

Building Inspection
Code Enforcement
Planning
Environmental Health
Fire Services
Engineering
Road Maintenance
Water Resources

BOARD MEETING: SEPTEMBER 27, 2016
PWSS REVIEW: N/A

TO: BOARD OF SUPERVISORS

FROM: GUADALUPE RIVERA, SENIOR CIVIL ENGINEER
DANELLE STYLOS, DIRECTOR DS

SUBJECT: WATER RESOURCES UPDATE TO THE BOARD

Recommended Action: None.

Background and Discussion: The Water Resources Division of the Department will provide an overview and status update of current Water Resources projects and issues. Staff will provide an update on the following topics:

- Sustainable Groundwater Management Act (SGMA)
- Drainage Studies
- Floodplain Management
- Stormwater Management (NPDES MS4 Compliance)

Attachments: Water Resources Overview and Status Update, FY16/17

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Water Resources Overview and Status Update, FY16-17

1.0 Sustainable Groundwater Management Act (SGMA)

On September 16, 2014, Governor Jerry Brown signed into law a three-bill legislative packet known as the Sustainable Groundwater Management Act (SGMA). SGMA requires that a responsible Groundwater Sustainability Agency (GSA) be established by June 2017 for all high and medium priority basins. The law also requires that Groundwater Sustainability Plans (GSPs) be developed by 2020 for basins identified as being in a critical condition of overdraft, or 2022 for all other medium and high priority subbasins. The goal is to achieve sustainability by 2040/2042 (depending on each basin's critical condition of overdraft status).

Sutter County has three sub basins: East Butte, Sutter, and North American. In 2015 and 2016, Sutter County hosted stakeholder meetings with potential GSA's (water entities) within each sub basin to coordinate efforts for who is participating as a GSA. As of September 1, 2016, 7 out of 44 potential GSA's within the County have submitted paperwork to become a GSA.

The Sutter Sub Basin group discovered they are eligible to prepare an Alternate Plan for the basin as opposed to the GSP process (additional cost and time to develop GSP), as it met the sustainability criteria. The Sutter Sub Basin group agreed to continue using the County's groundwater consultant to prepare the Alternate GSP, which is to be submitted to the State by January 1, 2017. For the East Butte and North American Sub Basins, the County will be working towards having multiple GSA's with one GSP in each sub basin.

The County has also hosted "town hall meetings" for the individual well owners (10+ acres) not served by a water company, reclamation district, or water district. These property owners are considered to be in a "white space area", and agree to have Sutter County become the GSA for the white space areas in order to keep control at the local level, rather than having State intervention.

2.0 Drainage Studies

2.1 West Yuba City Area Master Drainage Study

In 2008, West Yost Associates completed the West Yuba City Area Master Drainage Study which identified the effects of future development within Yuba City's Sphere of Influence on the Live Oak Canal. In 2010, the updated Study evaluated a **fifth alternative** drainage improvement plan for the West Yuba City Area that would provide 100-year level of flood protection and support future development at less cost. The study evaluates the cost of improvements per acre in comparison to the existing Zones of Benefit as well as capital improvements and operation and maintenance costs. Upcoming efforts include determining how to implement the study and presenting the study to the Board for adoption. Impact fee adjustments are anticipated and will be coordinated with the County's overall impact fees adjustment sometime next year.

2.2 Yuba City Basin Drainage Study

The Yuba City Basin Drainage Study (to be completed May 2107 by West Yost Assoc.) will address the internal drainage issues in this basin. The Study will complete the documentation and modeling of the four water sheds that drain to the O'Banion pump station (Gilsizer, Live Oak Canal, Lower Snake River and Little Blue Creek). Potential improvements and their respective maintenance requirements will be determined along with funding mechanisms for capital improvements and operations/maintenance in these unregulated areas. Gilsizer Drainage District is a partner for this study. Recommendations will be presented for Board consideration.

3.0 Floodplain Management

3.1 SB 5

Senate Bill (SB) 5 was enacted in 2007 which requires 200-year flood protection for urban and urbanizing areas in the Sacramento-San Joaquin Valley by 2025. Counties and Cities are required to update their General Plans (GP) by July 1, 2015 and zoning ordinances by July 1, 2016 in accordance with the 2012 Central Valley Flood Protection Plan. Technical studies are required to support the GP update. Development Service's Planning Division has awarded a contract to ESA to develop the General Plan and Ordinance updates based on current studies for the Meridian, Robbins, Sutter and Yuba City drainage basins. To ensure the County's floodplain management efforts also remain in compliance, the County Flood Plain Administrator adopted current "best available study data" maps specifying flood depths for these basins. Notification letters were sent to all affected parcel owners in July of this year.

3.2 Small Communities Flood Risk Reduction Program

This program was created as part of the 2012 Central Valley Flood Protection Plan (CVFPP) as a Local/State cost shared small community assistance program to reduce the risk of flooding. $50 million of Prop 1E funds will be available in two Program phases with $18 million budgeted for awards to study the feasibility of flood risk reduction projects. The remaining funds will be available for design and construction of selected feasible projects.

Several groups approached the County to participate in the Small Community's Grant Program. The County does not have specific responsibility for flood control structures but must be the recipient of Program grants, it has executed agreements (May 2016) with SBFCA, RD 1001, RD 1500, and RD 1660/70 to manage the grants. These Districts and Agency will define their risk reduction projects, make applications for the grants, contribute the local share (50% max), hire feasibility consultants, and request grant reimbursements. The County will act as a pass through agent, with the applicants assuming all liability and risk. Final grant guidelines have been issued and applications are due to the State by early November 2016 with grant awards anticipated in Spring 2017.

3.3 Agriculture Floodplain Ordinance Task Force

The NFIP (National Flood Insurance Program), Biggert Waters 2012 and subsequent legislation to 'stay' its implementation have heightened concerns that current FEMA administration of the NFIP will have devastating consequences for the agricultural economy in floodplains. The farming community and local flood agencies have articulated their concerns in regional planning efforts and have created an informal coalition to advance improvements. In addition, DWR (Department of Water Resources) recently approved a grant to the Sacramento Valley flood management interests to pursue changes to the NFIP that could be approved within FEMA's (Flood Emergency Management Agency) administrative authority, meaning legislative changes would not be needed. While the grant identifies specific changes that will be explored, the intent is to be flexible enough to adapt to changes that have broad support from property owners, land use agencies, local and state Farm Bureaus and flood management, and environmental NGO's (Non-governmental offices). The scope of the effort covers three options: 1) use of relief cuts to lower base flood elevations, 2) Use of FEMA's existing Zone D, and 3) develop a wet flood proofing ordinance for agricultural structures (this task would include drafting recommendations for changes to FEMA's flood-proofing requirements to accommodate the unique aspects of structures that support agriculture in the Sacramento Valley. Sutter County is represented in this coalition and the group will present its information to DWR and the Central Valley Flood Control Board later this year.

4.0 NPDES Phase II MS4 Permit

The National Pollutant Discharge Elimination System (NPDES) Phase II Multiple Separate Storm Sewer System (MS4) permit was adopted by the State Water Resources Control Board and became effective July 1, 2013. Sutter County and Yuba City were co-permittees under the previous 2003 permit, however the new permit lists Sutter County as a separate permittee. Sutter County applied for a waiver during the Spring of 2013, which was officially denied by the Water Board on July 16, 2014. To comply with the permit requirements, staff filed a Notice of Intent application and obtained General Permit coverage in August 2014.

The new NPDES Phase II MS4 permit is structured into nine (9) elements with staggered due dates over the first five years of the permit with the intent of the permit being fully implemented by June 2018. A consultant services contract for $78,000 with Larry Walker Associates (LWA) is currently underway to assist in complying with permit regulations.

Sutter County's MS4 permit boundaries are currently being reviewed by the Regional Water Quality Control Board to include the community of Sutter and the urbanizing areas outside Yuba City limits within the Sphere of Influence. An additional request to waive the county's smaller communities (Rio Oso, Trowbridge, East Nicolaus, Nicolaus, Robbins and Meridian) will be submitted to the State by the end of this month, due to their MS4s not being owned or operated by the County. A number of permit required actions are dependent on establishing our MS4 permit boundaries.

Sutter County Water Resource Update

September 27, 2016

Water Resource Project Update

- Groundwater Management
- Drainage Studies
- Floodplain Management
- Stormwater Management

Sutter County's Subbasins

East Butte Subbasin

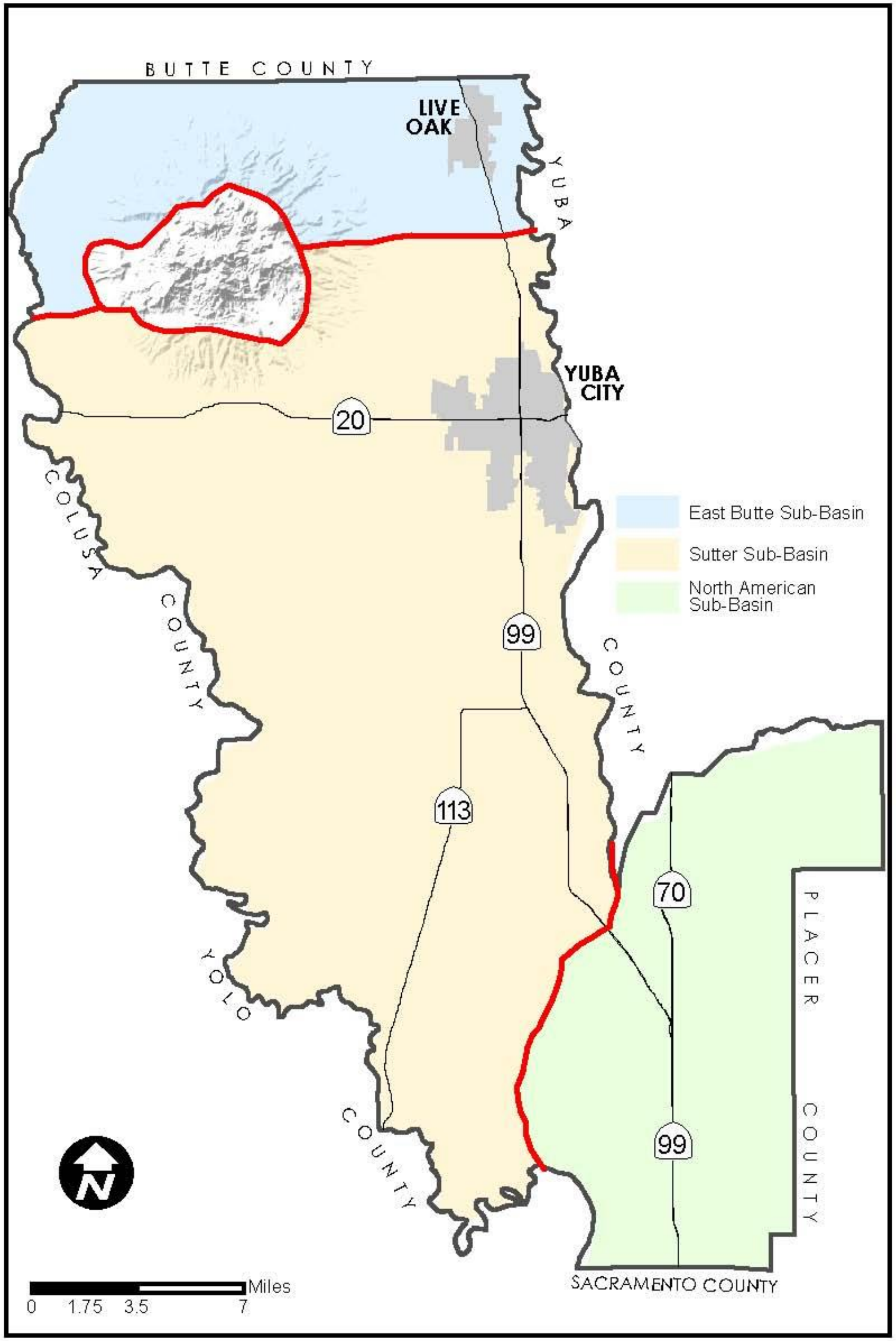
- Alternative Plan (?)

Sutter Subbasin

- Alternative Plan (1-1-2017)

North American Subbasin

- (GSP 2022)



Drainage Studies

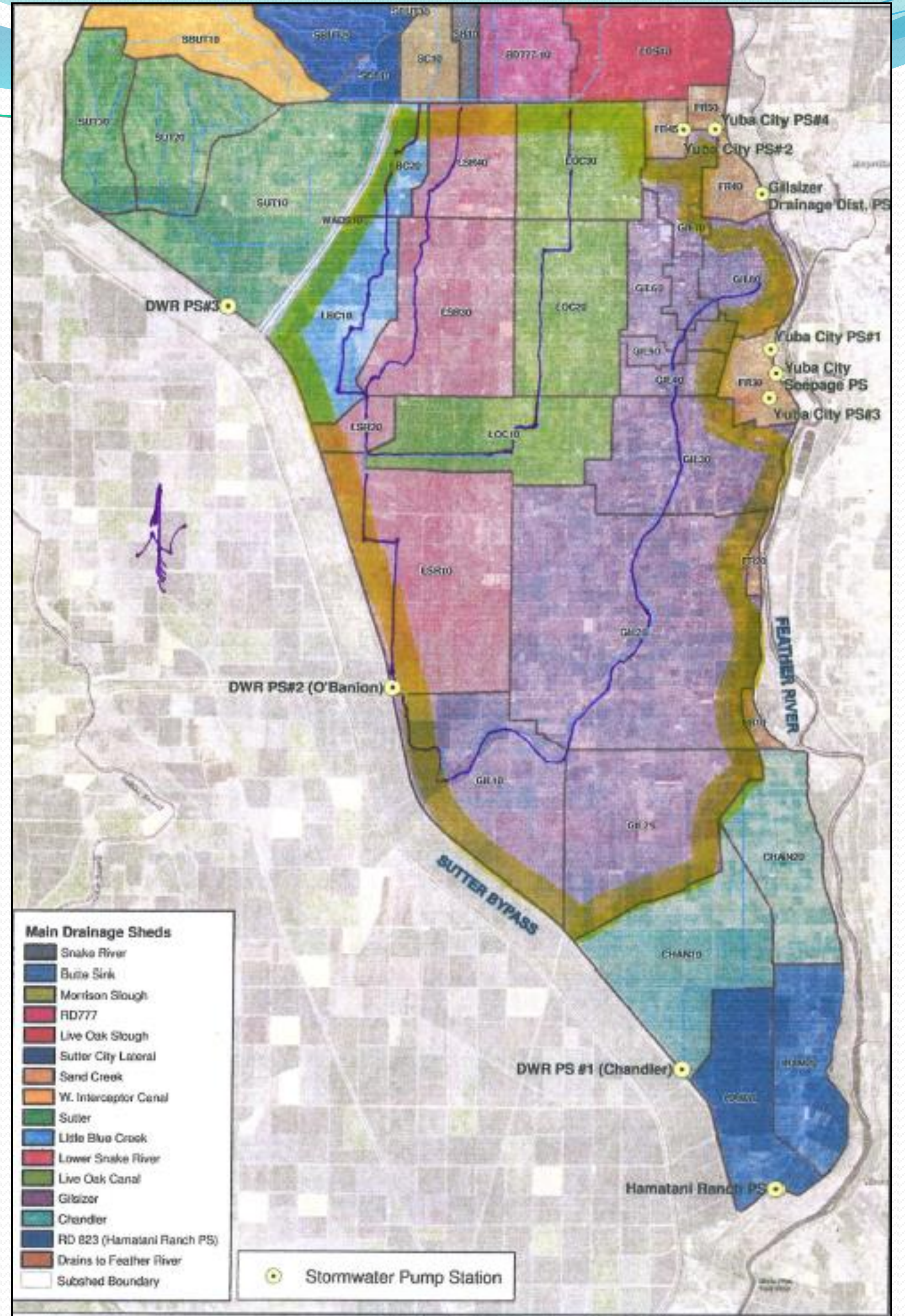
1. West Yuba City Area Master Drainage Study
2. Yuba City Basin Drainage Study

West Yuba City Area Master Drainage Study

- 2008 - West Yost Associates
- Drainage plan – 4 Improvement Alternatives - drain West Yuba City Sphere of Influence
- 2011 – updated - 5th alternative 40% Cost Reduction Capital Improvements and O & M Cost
- AB1600 Nexus Update Study for Impact Fee

Yuba City Basin Drainage Study

- Consolidate basin model and determine flooding
- Gilsizer Drainage District is a cost-share partner
- May 2017
  - Storm and irrigation drainage improvements
  - Funding mechanisms (capital imp. & O&M)



Floodplain Management

1. Senate Bill 5
2. Small Communities Flood Risk Reduction Program
3. Agricultural Floodplain Ordinance Task Force

Senate Bill (SB) 5

- July 2016 SB 5 in effect
- General Plan – SB 5
  - 200-year flood protection (2025) – urban/urbanizing areas- Sacramento-San Joaquin Valley
    - Yuba City area
    - Live Oak/Sutter Pointe excluded <10,000 residents 10 years
  - County – 100 year flood plain use best available information

Small Communities Flood Risk Reduction Program

- 2012 Central Valley Flood Protection Plan: Reduce Risk
- Two Phases ($50M Prop 1E funds):
  - $18M available for feasibility studies
  - $32M available for design and construction
- County eligible for Program grants
  - Agreements with SBFCA, RD1001, RD1500, and RD1660/70 to manage the grants
  - County – 'pass through agent'
  - Nov 2016 – 1st phase grant applications due

Agriculture Floodplain Ordinance Task Force

- Informal coalition - flood agencies, local AG, NGO's to assess:
- AG structures
- NFIP changes for AG structures
- Use of levee relief cuts; Zone D designation; and wet flood proof for agricultural structures
- Coalition group information to Central Valley Flood Control Board later this year

Stormwater Management

NPDES Phase II MS4 Permit

NPDES Phase II MS4 Permit Sutter County's History

NPDES - National Pollutant Discharge Elimination System
MS4 - Municipal Separate Storm Sewer System

- 2003 – permit effective
  - Yuba City and Sutter County co-permittees
- July 2013 - New permit effective
  - Sutter County, Yuba City and Live Oak
- July 2014 - Exemption waiver denied
- December 2014 – Requested small community waiver
- January 2015 – New proposed MS4 boundary map/ Discussions - Regulators ongoing
- October 2016 – Submitting additional waiver for County's small communities

BOARD MEETING: DECEMBER 20, 2016
PWSS REVIEW: DECEMBER 8, 2016

TO: **BOARD OF SUPERVISORS**

FROM: **GUADALUPE RIVERA, SENIOR CIVIL ENGINEER**
DANELLE STYLOS, DIRECTOR

SUBJECT: **APPROVAL OF CONTRACT ADDENDUM #2 AND RELATED BUDGET AMENDMENT FOR TECHNICAL ASSISTANCE RELATED TO THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT PROGRAM FOR SUTTER COUNTY, AND ADOPTION OF A RESOLUTION APPROVING THE ALTERNATIVE PLAN (4/5 vote required)**

Recommended Action: That the Board of Supervisors:

1. Approve an Agreement Addendum #2 for Professional Services with G.E.I. Consultants Inc. to:
   a. Delete "Task 4: Draft GSP(s)" from Agreement Addendum #1;
   b. Add "Task 4: Alternative Plan" from Agreement Addendum #2;
   c. Increase the Not-To-Exceed (NTE) amount from $124,754.00 to $293,555.00; and

2. Approve a Budget Amendment within the Water Resources budget (1-922) in the amount of $168,801.00 for the completion of the Alternative Plan (4/5 vote required); and

3. Authorize the Director of Development Services, or her designee, to execute the contract addendum and all documents related to the administration of the Professional Services Agreement in accordance with the Public Contract Code; and

4. Adopt a Resolution to approve the Alternative Plan and authorize the Director of Development Services, or her designee, to submit the Alternative Plan for the Sutter Subbasin to the State Department of Water Resources.

Background: In September 2014, the Sustainable Groundwater Management Act (SGMA) was signed in order to allow local agencies to customize groundwater sustainability plans to their regional economic and environmental needs. A new governance structure, known as Groundwater Sustainability Agencies (GSA's), will be created by local agencies to assess the local groundwater basins and create Groundwater Sustainability Plans (GSP's) in order to establish long-term sustainability.

There are three groundwater sub basins within Sutter County: the East Butte Subbasin, the Sutter Subbasin, and the North American Subbasin. Within each subbasin, the County, along with all other potential GSA's, are required to have created a GSA, or multiple GSA's, covering the entire sub basin by June 2017. If a portion of a basin is not managed by GSA's, the County is presumed to be the GSA for that unmanaged area. SGMA requires that by January 31, 2022, basins must be managed by either a single GSP or multiple GSP's. All GSA's within each sub basin will be working collaboratively to create a GSP for the sub basin.

Discussion: The Department hired G.E.I. Consultants Inc. (GEI) last year to provide technical services necessary to comply with SGMA and the creation of possible GSA's for each subbasin within the County. GEI is similarly under contract with other Counties in the region and is well versed in the requirements of SGMA.

Guidelines from the Department of Water Resources concerning the preparation of GSPs allows for submission of an "Alternative Plan" for subbasins assumed to be meeting sustainment requirements. The submission date for this Alternative Plan is January 1, 2017.

Sutter County staff has been meeting with the various stakeholders in each subbasin to discuss the SGMA process and those who choose to be a GSA in each subbasin. The Sutter Subbasin is eligible to apply for an Alternative Plan. GEI developed the cost proposal to prepare an Alternative Plan and the stakeholders (water entities and "white space area" property owners) agreed to fund their proportionate share of the Alternative Plan. This is the initial portion of the Alternative Plan submittal and additional funding mechanisms will need to be put in place for future work to be accomplished. The County will be seeking reimbursements from the various entities that make up the Sutter Subbasin, including reclamation districts, water districts, and property owners of parcels 10 acres and greater, for their share of cost to create the Alternative Plan.

Addendum #2 will amend the contract to add all the tasks necessary to complete and submit the Alternative Plan, in addition to the creation of the GSA's for the three subbasins.

The Alternative Plan is available for review at the Board Clerk's office and the Development Services counter.

Prior Board Action: On August 23, 2016, the Board approved Agreement Addendum #1, and increased the not-to-exceed agreement amount from $34,754 to $124,754.00.

Board Alternatives: The Board could choose not to authorize the GEI Agreement addendum. However, the quick development of an Alternative Plan and the creation of the GSA's and associated GSP is complicated and requires specialized skills which Department staff does not currently possess.

Other Department and/or Agency Involvement: The California Department of Water Resources and the State Water Resources Control Board are the lead State agencies responsible for developing regulations and reporting requirements necessary to comply with SGMA. The County is meeting and working collaboratively with local mutual water companies, water districts, drainage districts, and reclamation districts within the County, as all are potential GSA's. The County is also working with neighboring counties to ensure there are no conflicting issues with the GSP's.

Action Following Approval: The Department Director will execute a second contract addendum with GEI Consultants Inc., bringing the contract compensation to NTE $293,555. The Department will also submit the completed Alternative Plan to the State Department of Water Resources by the January 1, 2017, deadline.

Fiscal Impact: The attached budget amendment will increase the Water Resources Professional Services expenditure line item (1922-00-52180) by $168,801 to cover the increase contract NTE amount. Additionally it will proportionally increase revenues (1922-00-47518) for the reimbursement from outside entities.

Standing Committee Review: At the Public Works/Support Services Committee meeting of December 8, 2016, this item was reviewed and recommended for approval and placement on the agenda for the Board of Supervisors as an appearance item.

Attachments: Contract Addendum #2
Resolution
Budget Amendment