taken as absolute numbers to be compared against field measurements. Rather, the results of a calibrated groundwater model should be viewed as reasonable approximations of groundwater levels subject to the error ranges of history matching during calibration and also subject to the model assumptions, model set-up, and input data deficiencies.

However, it should be noted that a well-calibrated model could be used effectively in a comparative analysis mode to evaluate the relative impacts of different alternative scenarios.

SPECIFIC LIMITATIONS OF THE MODEL FOR THE STONY CREEK FAN CONJUNCTIVE WATER MANAGEMENT PROGRAM

The specific limitations of the model for the Stony Creek Fan Conjunctive Water Management program cannot be determined a priori because they depend on (a) the model selection; (b) the conceptual model for the Stony Creek Fan; (c) the input data quality, level of accuracy, and deficiency; (c) necessary model assumptions; (d) necessary simplifications of physical system; (e) the specific performance of the calibration (history matching) for the Stony Creek Fan model application and the level of calibration, etc.

As part of the model development and documentation process the specific limitations of the Stony Creek Fan model will be evaluated and reported to help the Project Sponsors understand the modeling process as well as the model results and findings. It should also be noted that some potential uses of the model other than the specific purposes for which the model is developed, may require modifications of the Stony Creek Fan model application. However, those potential uses of the model may or may not be desirable or deemed appropriate by the Program Sponsors or stakeholders, regardless of the technical feasibility.

CONCLUSIONS

The conceptual model for SCFIGSM, described above, will serve as the foundation for the development and calibration of the numerical simulation model for Stony Creek Fan model area. The conceptual model will also guide the determination of the level of detail of model input/output data and calibration targets. It should be noted that clarification and refinements of the SCFIGSM conceptual model may be necessary during the model development and calibration process as a better understanding of the physical system is developed through more detailed data collection and analysis.

PROJECT SUMMARY

November 2, 2017

ORLAND-ARTOIS WATER DISTRICT GROUNDWATER RECHARGE INVESTIGATION USING 215 CONTRACT WATER

SPRING 2017 TEST

Orland-Artois Water District (OAWD) has been interested in groundwater recharge and the conjunctive use of surface and groundwater for some time. In 2002, along with the Glenn-Colusa Irrigation District and the Orland Unit Water Users Association, the Stony Creek Fan Partnership was formed to investigate the recharge capabilities of the Stony Creek Fan in Glenn County. Several dedicated monitoring wells were constructed to test the recharge of surface water in different areas of the Stony Creek Fan. Later the partnership constructed several deep wells into the Tuscan Aquifer and performed an aquifer performance test. Today most of the monitoring wells are still in use collecting data for DWR including the VanTol site in OAWD. The VanTol site is located on the Westside of County Road M about 3/4s of a mile North of Road 30. All of the monitoring wells are still there including 3 80’ to 90’ wells and 1 triple completion well to 420’.

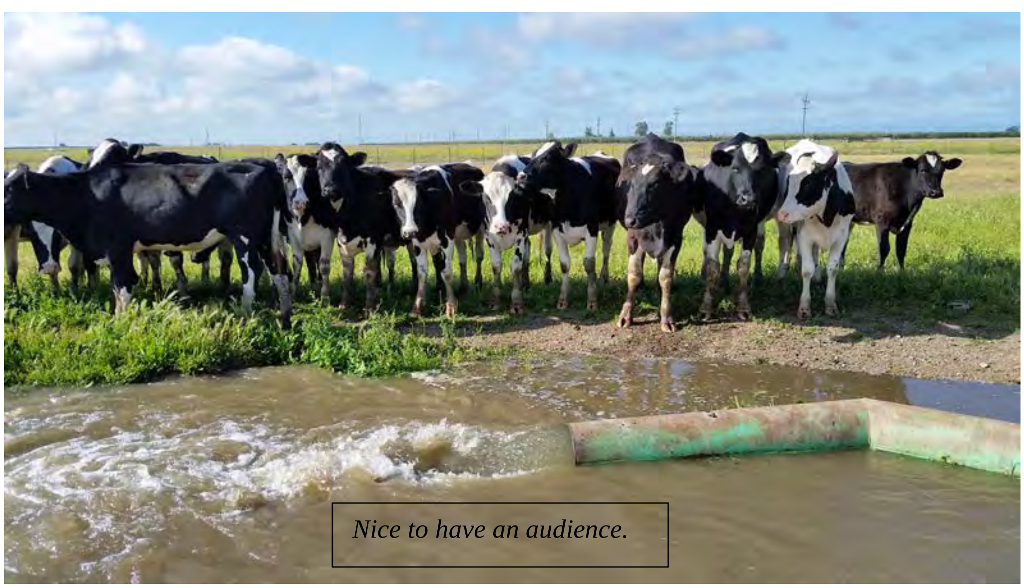
In recent years there has been a move towards permanent crops on district as well as non-district lands. These crops are almonds, walnuts, pistachios, and olives which are irrigated with drip and micro-sprinkler systems. The non-district lands are using ground water and many of the district lands are also using groundwater because of the ease of filtering. The expanded use of groundwater, the recent drought years, and the replacement of rice and field crops that utilized flood irrigation with surface water have all contributed to the decline of the local aquifers. More acres are in production and even in fields using surface water the efficient irrigation systems do not allow for recharge. Even with the recent wet year, aquifer levels are considerably lower than they were in 2002. DWR has identified a depression west of Artois that is a concern to water users in that area. In 2002 the Stony Creek Fan Project revealed that the recharged water was moving to the Southeast. Today DWR and the County of Glenn are thinking that the Artois depression is drawing water from East to West towards the depression.

In 2017 OAWD acquired a Section 215 Temporary Water Contract from Reclamation. The 215 water has a lower cost than other water but is available only during times when there are high flows in the rivers and streams. The OAWD Directors felt that a recharge test using 215 Water in the old VanTol Stoney Creek Fan site would give us some new data on the recharge capabilities in the area and be cost effective. If we can recharge water in the gravels at and around the VanTol site and it moves west towards the Artois depression it would be significant. We could recharge much more water in the gravels than the heavy ground in the area of the depression. There are some areas around the depression which may be valuable for recharge but the VanTol site is already set up for a recharge test and the wells there are about 30 feet lower than in 2002.

OAWD staff started flooding the Southeast section of the VanTol property on April 20th and turned off the water on May 2nd. 102 acre-feet of water was used and the site was monitored and the wells measured. We have continued measuring the wells to date. The results show a slight rise in the wells at the end of flooding and when compared to other wells we measure in the area, the VanTol wells started dropping 2-3 weeks later. We felt this was a positive outcome for the test and hope to continue in the coming winter and spring. In the coming months the District will be working with a Chico State grad student who will be running the recharge site as part of his thesis. It will be an expanded test using a test basin and utilizing nearby drains to test their effect on recharge. We are also hoping to show the direction of flow of recharged water.

Emil Cavagnolo

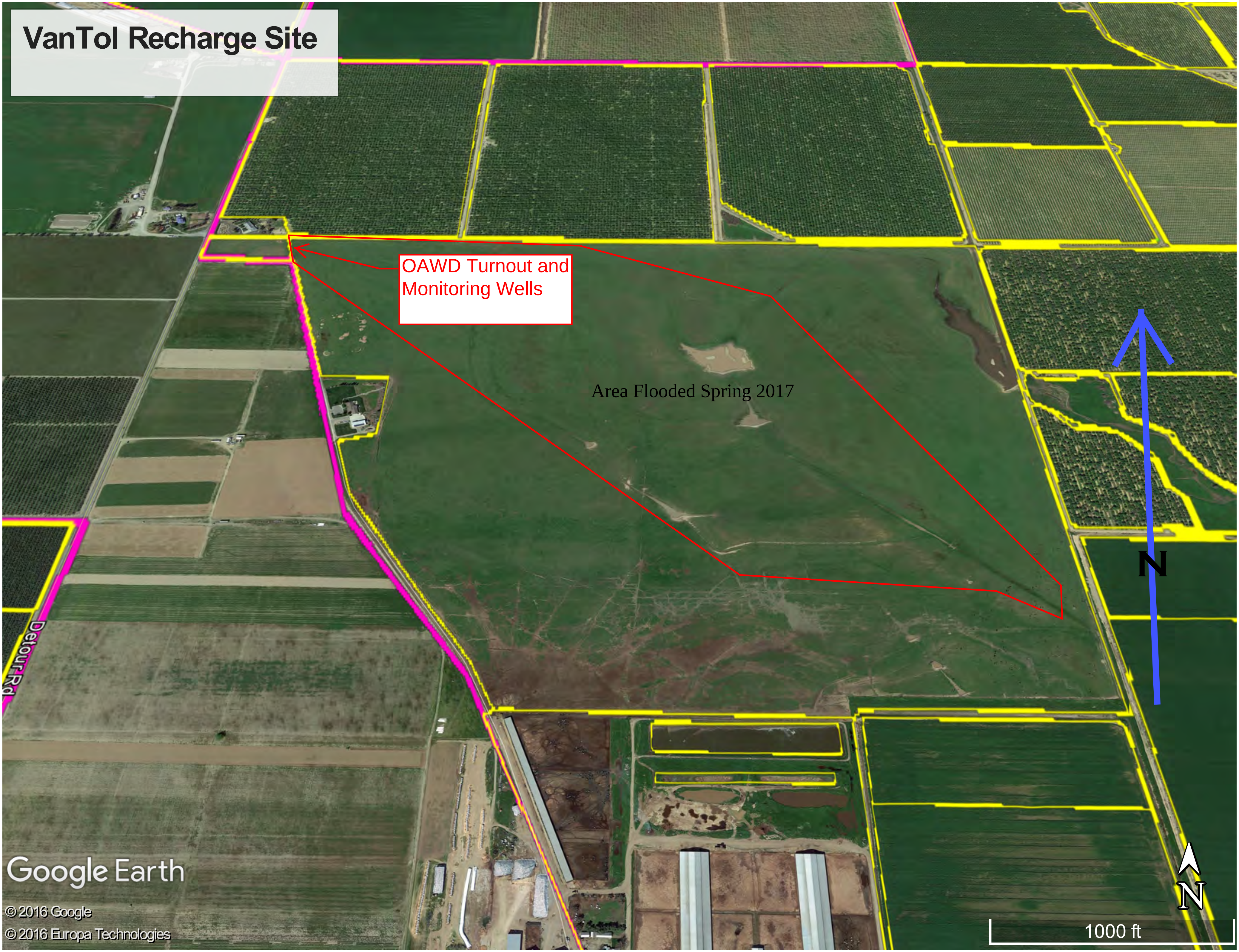
Orland-Artois Water District General Manager



Nice to have an audience.

ORLAND-ARTOIS WATER DISTRICT 2017 SPRING RECHARGE TEST

	A	B	C	D	E	F	G	H	I	J	K	L
1	DATE	TIME	VanTol Deep 21N03W23D01	VanTol Mid 21N03W23D02	VanTol Shallow 21N03W23D03	VT-01 21N03W23D05	VT-02 21N03W23D04	VT-03 21N03W23C01	TURNOUT B-26 TOTALIZER	CFS APPLIED	ACRE-FEET TOTAL	NOTES
2	04/20/17	2:00 PM	55.1	53.8	57.7	57.3	54' DRY	52.2	4322.2	2.5	0	Start Test
3	04/21/17	9:15 AM	55.5	53.1	57.2	57.3	54	52.2	4327.49	2.5	5.29	
4	04/21/17	3:00 PM	55.95	53.6	57.6	57.7	54	52.6	4328.77	2.6	6.57	
5	04/23/17	4:10 PM	55.4	52.95	56.9	56.96	54	51.93	4339.12	3	16.92	Water was at .02 miles East of
6	04/24/17	9:40 AM	55.4	53	57	57.1	54	52	4343.47	3	21.27	
7	04/24/17	3:00 PM	55.3	53	57	57.1	54	52	4344.82	3	22.62	
8	04/25/17	8:50 AM	55.7	53.35	57.4	57.5	54	52.4	4349.37	3.1	27.17	
9	04/26/17	9:10 AM	55.3	53	56.9	57	54	52	4355.47	3	33.27	Water was at .02 miles East of
10	04/27/17	9:10 AM	55.2	52.9	56.9	57	54	51.9	4361.46	3	39.26	
11	04/28/17	10:00 AM	55.2	52.9	56.8	57	54	51.9	4367.66	3	45.46	
12	05/01/17	9:50 AM	55.6	53.2	57.1	57.2	54	52.1	4385.95	3	63.75	
13	05/02/17	9:30 AM	55	52.8	56.7	56.8	54	51.7	4391.65	3	69.45	Water was at .02 miles East of
14	05/03/17	3:30 PM	55	52.8	56.6	56.7	54	51.7	4399.49	3	77.29	
15	05/04/17	5:00 PM							4405.63	0	83.43	Shut off
16	05/08/17	3:25 PM							4405.63	2.5	83.43	Re-Start
17	05/09/17	8:35 AM	54.9	53.1	56.4	56.5	54	51.4	4409.56	2.5	87.36	
18	05/11/17	10:15 AM							4419.84	2.5	97.64	
19	05/02/17	9:00 AM	54.8	52.9	56.4	56.5	54	51.4	4424.98	0	102.78	End Test/continue well measurments.
20	05/15/17	2:00 PM	54.7	53	56.2	56.3	54	51.2	4424.98	0	102.78	
21	05/23/17	7:15 AM	54.8	53.4	55.8	56	54	50.8	4424.98	0	102.78	
22	06/01/17	1:50 PM	56.4	54.4	56.8	56.9	54	51.8	4424.98	0	102.78	
23	06/14/17	9:30 AM	55.5	54.8	56.8	56.9	54	51.7	4426.02	3.5	103.82	Landowner Irrigating
24	06/27/17	10:00 AM	57.3	59.1	57.2	57.3	54	52.1	4440.91	0	118.71	
25	07/10/17	2:30 PM	57.5	60	57.3	57.3	54	52	4448.65	2.5	126.45	Landowner Irrigating
26	07/17/17	8:35 AM	57.2	58.8	57.6	57.7	54	52.4	4451.73	0	129.53	Landowner Irrigating
27	08/14/17	1:45 PM	58.9	61.2	58.7	58.7	54	53.4	4473.7	0	151.5	Landowner Irrigating
28	10/02/17	1:30 PM	58.8	58.7	59.7	59.7	54	54.4	4497.73	0	175.53	Landowner Irrigating
29	11/01/17	2:45 PM	58.9	58.4	60	60.1	54	54.7	4515.54	0	193.34	Landowner Irrigating
30	11/20/17	9:30 AM	58.9	57.9	60.2	60.3	54	55	4515.53	0	193.33	
31	12/12/17	1:52 PM	58.9	57.9	60.2	60.3	54	55.05	4515.53	0	193.33	


VanTol Recharge Site
OAWD Turnout and Monitoring Wells
Area Flooded Spring 2017
N
Detour Rd
Google Earth
© 2016 Google
© 2016 Europa Technologies
1000 ft
N

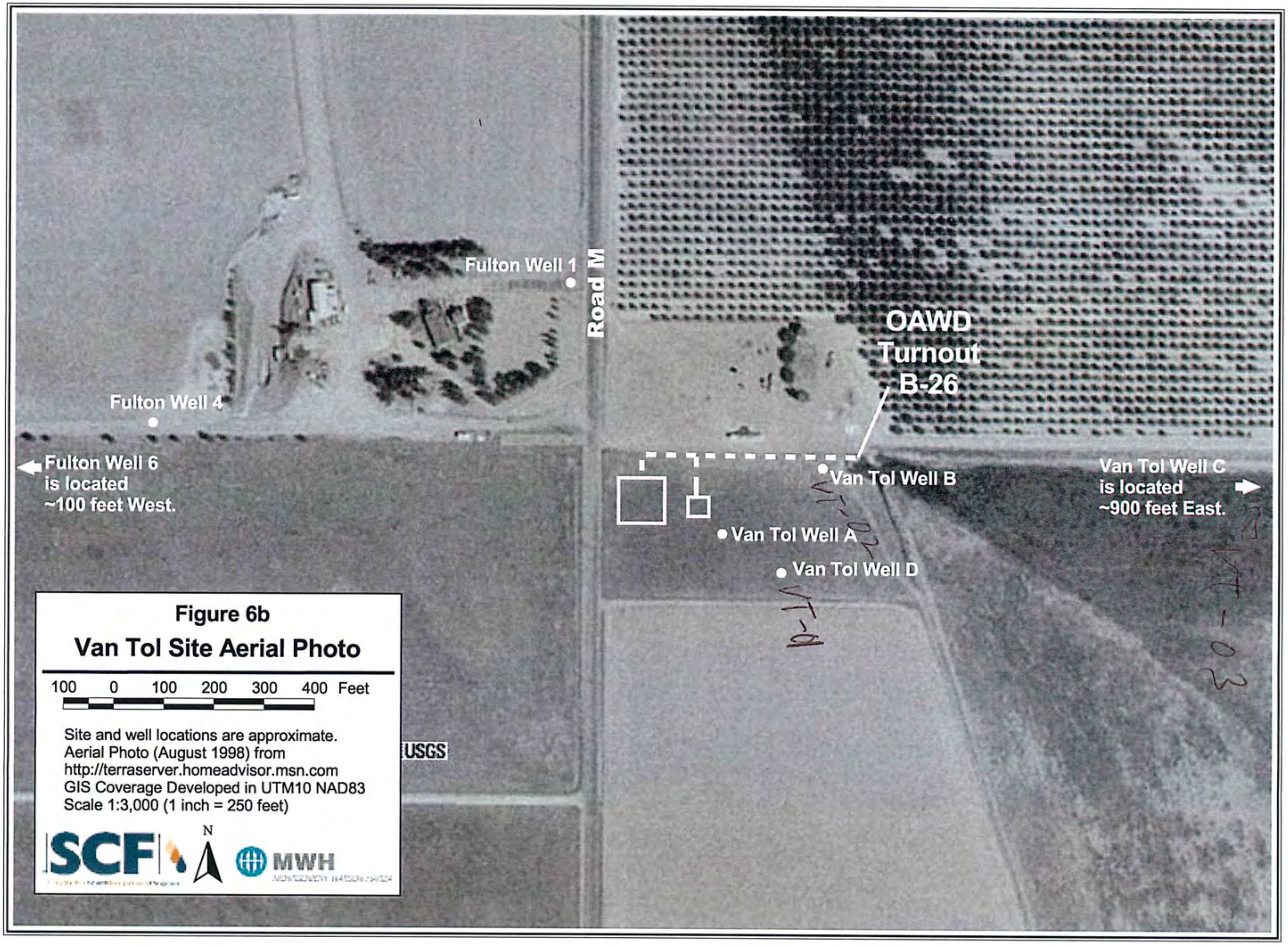
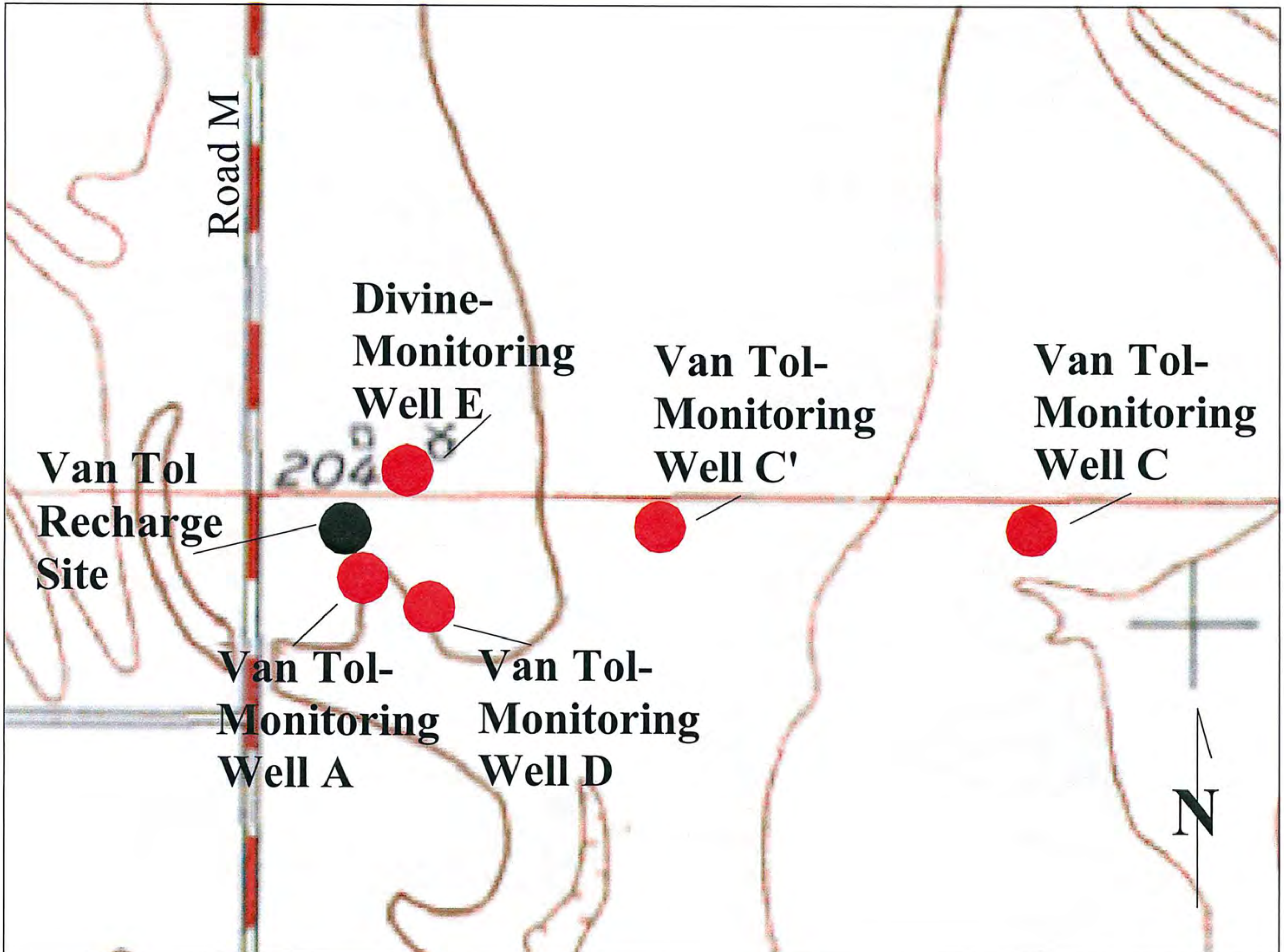


Figure 6b

Van Tol Site Aerial Photo

Site and well locations are approximate.
Aerial Photo (August 1998) from
http://terraserver.homeadvisor.msn.com
GIS Coverage Developed in UTM10 NAD83
Scale 1:3,000 (1 inch = 250 feet)

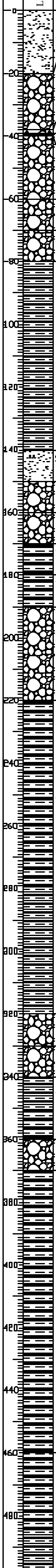

Road M
Divine-Monitoring Well E
204
Van Tol-Monitoring Well C'
Van Tol-Monitoring Well C
Van Tol Recharge Site
Van Tol-Monitoring Well A
Van Tol-Monitoring Well D
N

STATE OF CALIFORNIA - RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
NORTHERN DISTRICT

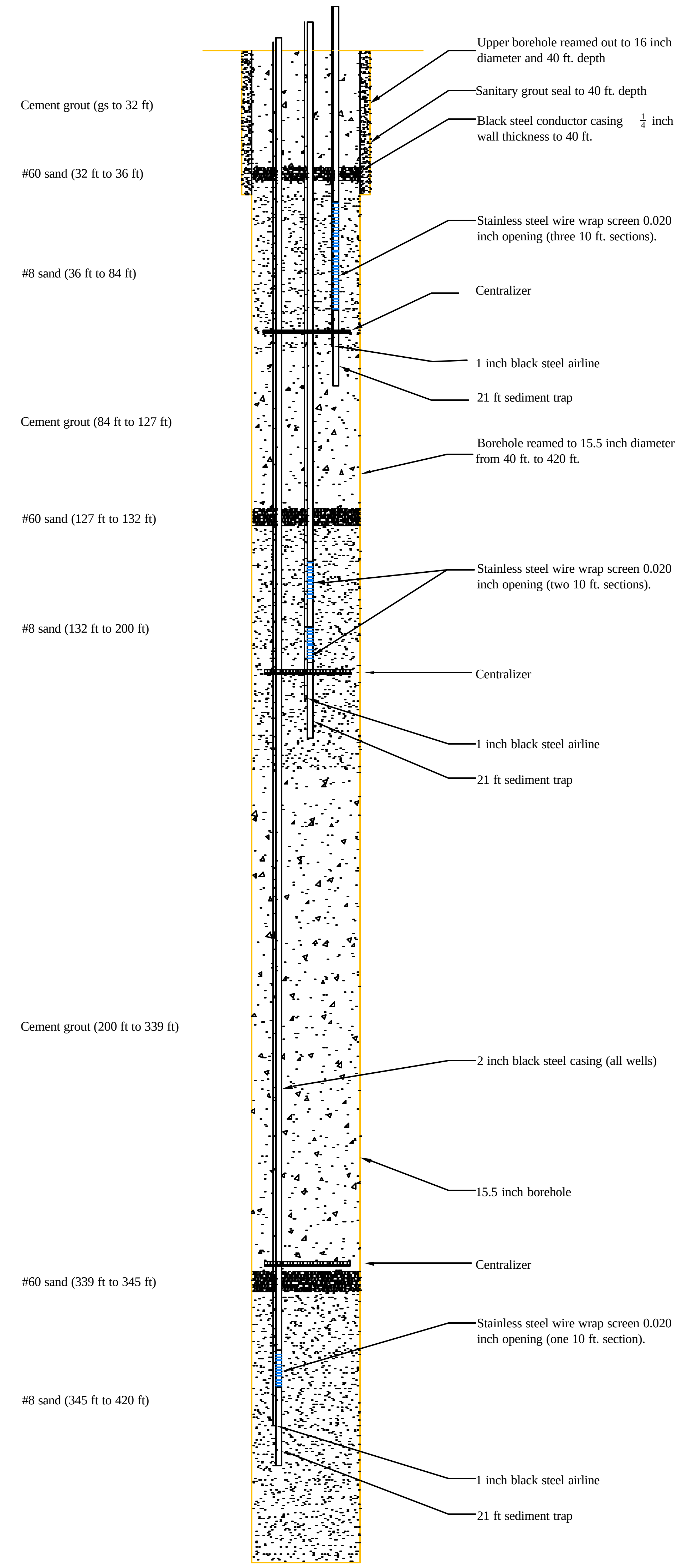
STATE WELL NUMBERS: 21N03W23D01M-Deep Zone
21N03W23D02M-Middle Zone
21N03W23D03M-Shallow Zone

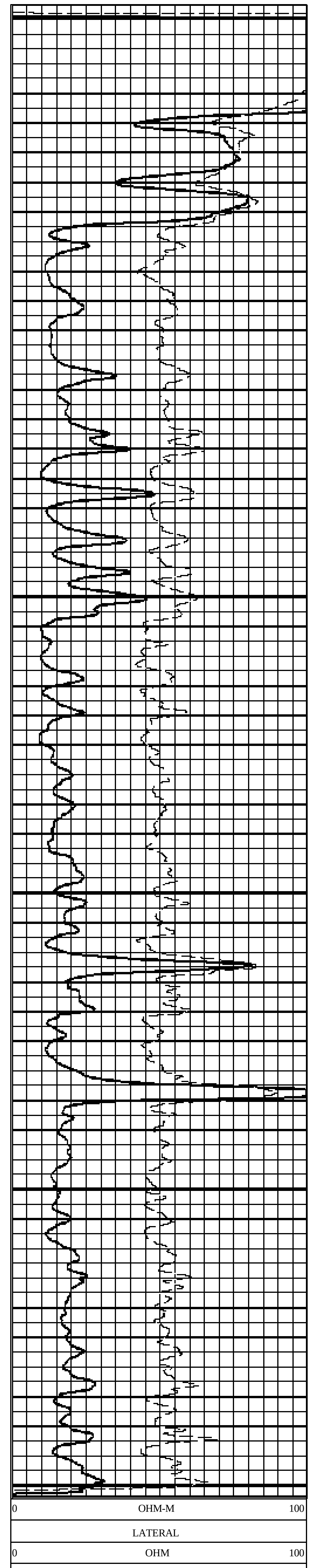
PROJECT	Stony Creek Recharge Pilot Project	HOLE NUMBER	Well A - Van Tol Site	NUMBER OF COMPLETIONS	3	CONTRACTOR	Spectrum Exploration, Inc.
FEATURE	Triple Completion Monitoring Well	TOTAL DEPTH	420 ft	TYPE OF HOLE	Direct Rotary	DRILL FOREMAN	Randy Criner
LOCATION	Glenn County, County Rd 27 and County Rd M	DATE STARTED	3/20/02	TYPE OF RIG	Ingersoll Rand	INSPECTED BY	Kelly Staton
UTM COORDINATES	UTM 10 NAD 83 570561, 4391143	DATE COMPLETED	3/29/02	COMMENTS	Test hole drilled to 500 ft.; well completed to 393 ft.		

DEPTH (ft.) | LITHOLOGY | DESCRIPTION



- Poorly graded medium sand, sub-angular to sub- rounded
- Poorly graded gravel with fine to med. sand of metam. origin, sub-angular to sub-rounded clasts
- Gravel and sand
- Clay
- Gravel with fine to coarse-grained sand
- Gravel and fine to coarse-grained sand
- Gravel with minor amount of clay and sand
- Lt. brown to tan clay with gravel and sand
- Sand with gravel and clay
- Gravel and medium to coarse sand
- Gravel and tan to brown clay
- Tan/brown clay with gravel
- Tan/brown clay with gravel and med. sand
- Gravel with tan to brown clay
- Tan to brown clay with minor amounts of gravel
- Gravel with Tan/ brown clay, slightly grey
- Gravel with Tan/ brown clay
- Tan to brown clay with minor amounts of gravel
- Gravel w/ minor amounts of clay & sand
- Clay with minor amounts of gravel
- Clay with minor amounts of sand and gravel



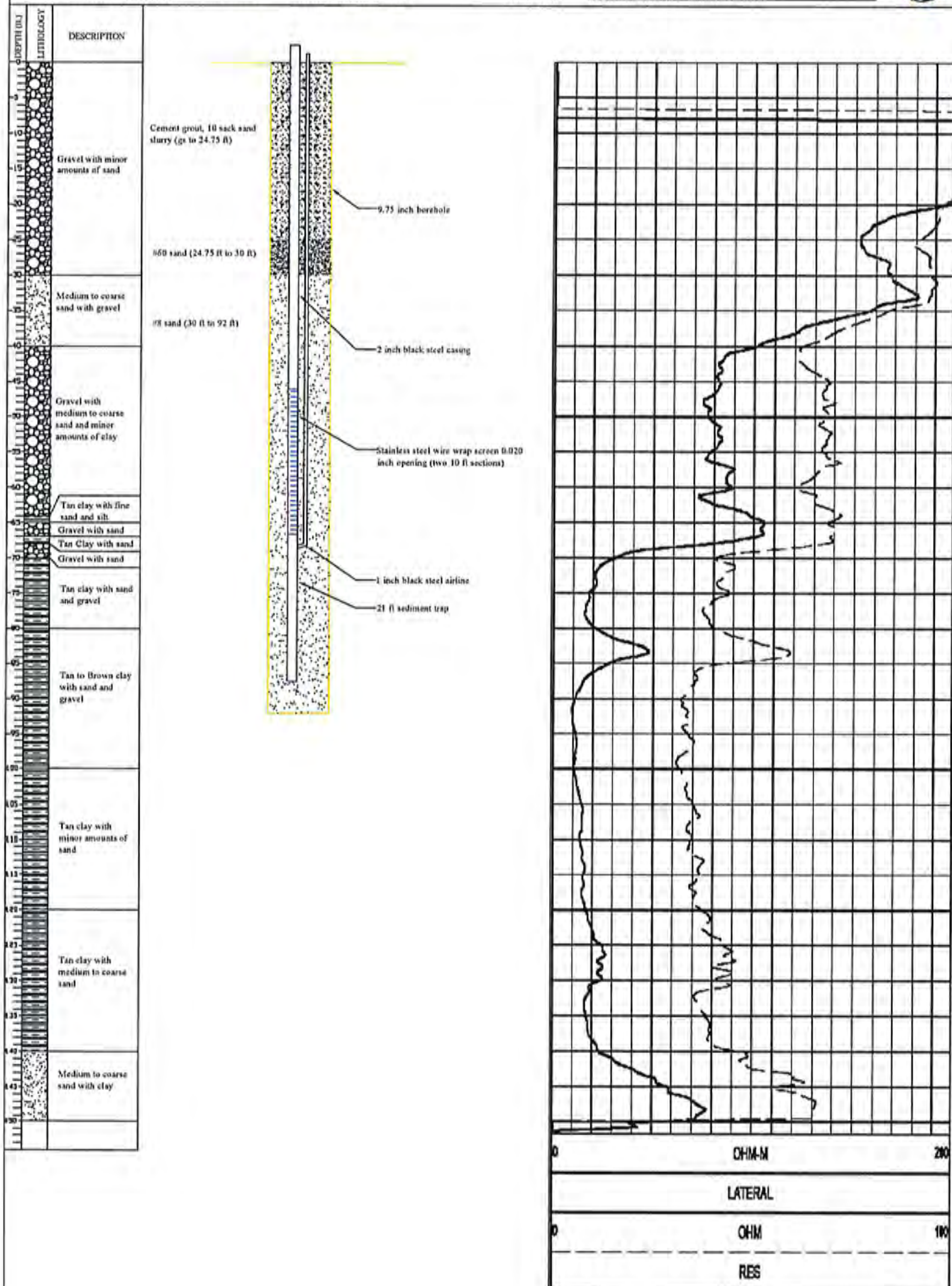


VT-01

STATE OF CALIFORNIA - RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
NORTHERN DISTRICT

STATE WELL NUMBER: 21N03W23D05M

PROJECT	Stony Creek Recharge Pilot Project	HOLE NUMBER	Well D - Van Tol Site	NUMBER OF COMPLETIONS	1	CONTRACTOR	Spectrum Exploration, Inc.
FEATURE	Single Completion Monitoring Well	TOTAL DEPTH	92 ft	TYPE OF HOLE	Direct Rotary	DRILL FOREMAN	Dan Lynch
LOCATION	Glenn County, County Rd 27 and County Rd M	DATE STARTED	3/18/02	TYPE OF RIG	Gardner-Denver	INSPECTED BY	Seth Lawrence
UTM COORDINATES	UTM 10 NAD 83 570597, 4391120	DATE COMPLETED	3/21/02	COMMENTS	Test hole drilled to 150 ft; well completed to 87 ft		



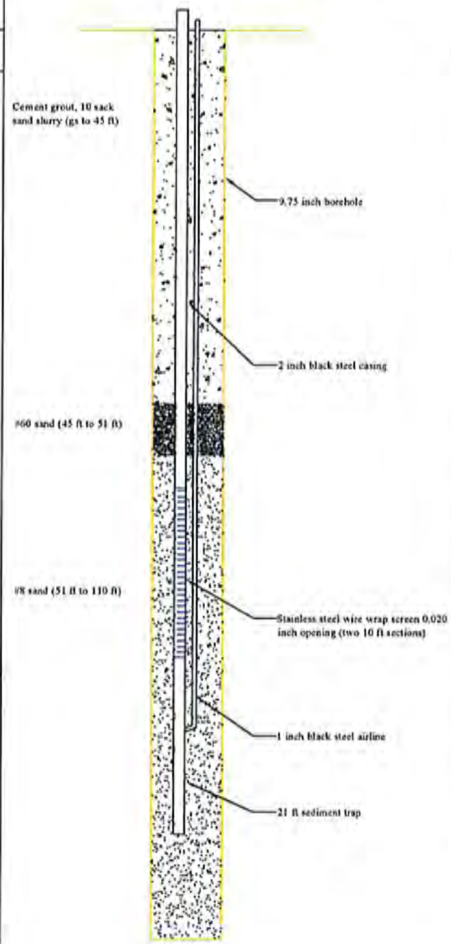
VT-03

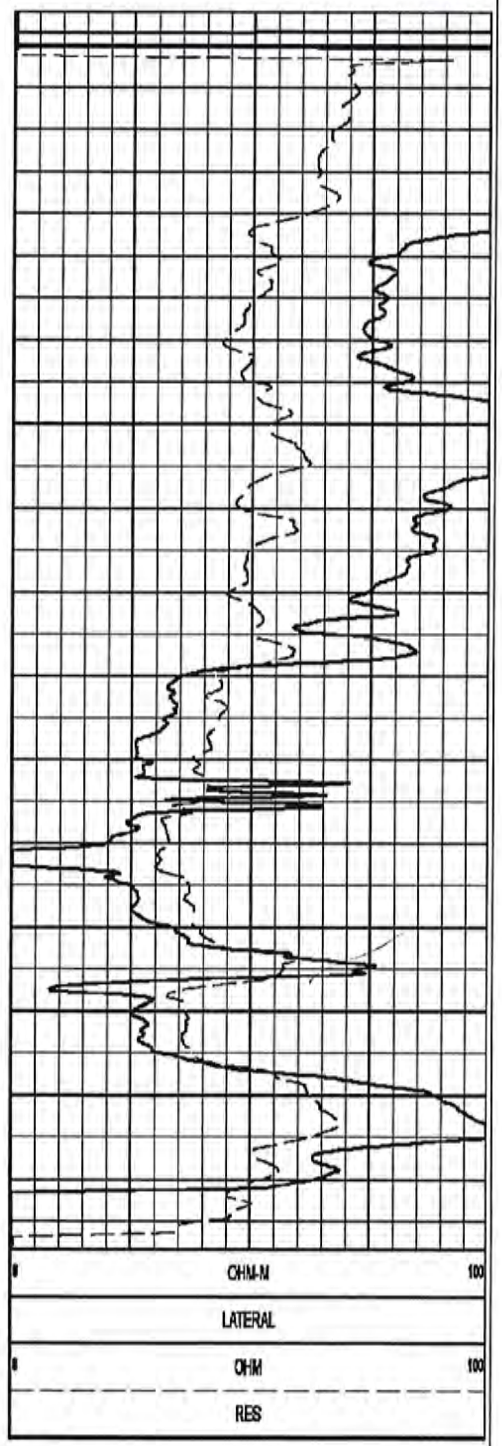
STATE OF CALIFORNIA - RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
NORTHERN DISTRICT

STATE WELL NUMBER: 21N03W23C01M

PROJECT	Stony Creek Recharge Pilot Project	HOLE NUMBER	Well C - Van Tol Site	NUMBER OF COMPLETIONS	1	CONTRACTOR	Spectrum Exploration, Inc.
FEATURE	Single Completion Monitoring Well	TOTAL DEPTH	110 ft	TYPE OF HOLE	Direct Rotary	DRILL FOREMAN	Dan Lynch
LOCATION	Glenn County, County Rd 27 and County Rd M	DATE STARTED	3/25/02	TYPE OF RIG	Gardner-Denver	INSPECTED BY	Seth Lawrence
UTM COORDINATES	UTM 10 NAD 83 571213, 4391198	DATE COMPLETED	3/27/02	COMMENTS	Test hole drilled to 150 ft.; well completed to 97 ft.		

DEPTH (ft.)	LITHOLOGY	DESCRIPTION
0–5		Silty loam
5–80		Gravels with sand
80–110		Grey/ brown clay
110–115		Coarse black sand
115–125		Brown clay
125–145		Well graded sand with fine gravel
145–150		Interbedded clay and sand stringers



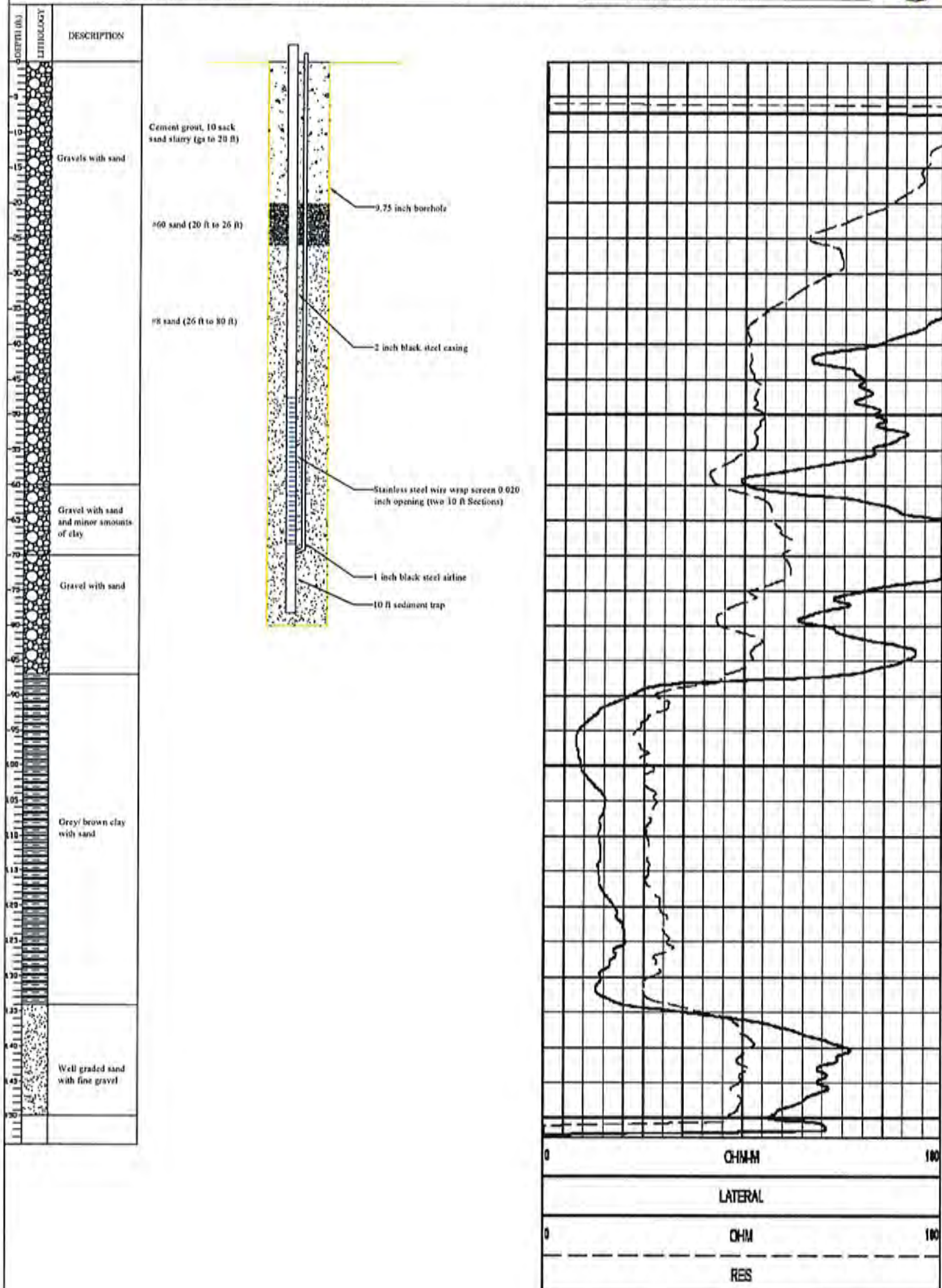


VT-02

STATE OF CALIFORNIA - RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
NORTHERN DISTRICT

STATE WELL NUMBER: 21N03W23D004M

PROJECT	Stony Creek Recharge Pilot Project	HOLE NUMBER	Well B - Van Tol Site	NUMBER OF COMPLETIONS	1	CONTRACTOR	Spectrum Exploration, Inc.
FEATURE	Single Completion Monitoring Well	TOTAL DEPTH	80 ft	TYPE OF HOLE	Direct Rotary	DRILL FOREMAN	Dan Lynch
LOCATION	Glenn County, County Rd 27 and County Rd M	DATE STARTED	3/21/02	TYPE OF RIG	Gardner-Denver	INSPECTED BY	Seth Lawrence
UTM COORDINATES	UTM 10 NAD 83 570672, 4391183	DATE COMPLETED	3/22/02	COMMENTS	Test hole drilled to 150 ft; well completed to 78 ft.		



Stony Creek Pilot Recharge Monitoring Well Data (as of 5/15/02)

Well	Screened Interval	Completed Well Depth	UTM Zone 10-NAD 83		Water Quality-Prelim Testing			Groundwater Level		
			Easting	Northing	pH	EC (microSiemens)	Temp. C	Ref. Pt. To Water Surface (ft.)	Ref. Pt. to Ground Surface (ft.)	Ground Surface to Water Surface (ft.)
Van Tol Well A-1 (deep)	362' to 372'	420'	570561	4391143	8.1	351	21.4	12.60	1.13	11.47
Van Tol Well A-2 (mid)	142' to 152'; 160' to 170'		570561	4391143	7.9	561	19.8	35.73	1.67	34.06
Van Tol Well A-3 (shallow)	42' to 72'		570561	4391143	8.1	587	18.7	38.63	2.17	36.46
Van Tol Well B (C')	48' to 68'	80'	570622	4391183	8.1	572	18.6	39.73	2.60	37.13
Van Tol Well C	55' to 75'	96'	571213	4391198	7.9	607	18.2	35.30	2.02	33.28
Van Tol Well D	46' to 66'	92'	570597	4391120	8	570	18.5	19.90	2.35	17.55
Fulton Reclamation MW-1	20' to 49'	49	570468	4391295	*	*	*	39.70	1.95	37.75
Fulton Reclamation MW-4	30' to 50'	50'	570215	4391198	*	*	*	41.23	1.88	39.35
Fulton Reclamation MW-6	none; open casing	58'	570069	4391185	*	*	*	39.93	1.56	38.37
Jasper Well A-1 (deep)	442' to 452'	490'	575379	4394921	7.9	337	21	32.20	1.50	30.70
Jasper Well A-2 (mid)	122' to 132'		575379	4394921	7.7	512	19.9	23.73	1.98	21.75
Jasper Well A-3 (shallow)	44' to 55'		575379	4394921	7.7	571	20.2	21.13	2.40	18.73
Jasper Well B	36' to 56'		575381	4394861	7.7	531	20.1	22.23	1.92	20.31
Jasper Well C (A')	30' to 35'		575378	4394918	7.7	443	19.8	19.38	2.20	17.18
Olivarez Well A-1 (deep)	390' to 400'	430'	567946	4397861	8	338	20.8	74.33	1.27	73.06
Olivarez Well A-2 (mid)	270' to 290'		567946	4397861	7.9	447	20.6	64.83	1.75	63.08
Olivarez Well A-3 (shallow)	30' to 50'		567946	4397861	7.9	416	N/A	20.57	2.30	18.27
Olivarez Well B	32' to 52'	75'	567946	4397818	7.8	451	20.1	21.03	2.30	18.73
Olivarez Ag Well	102'-104'; 128'-134'; 142-145'	200'	567838	4397766	N/A	N/A	N/A	33.70	1.30	32.40

*Data is to be faxed by Fulton Reclamation

WRIME Water Resources & Information Management Engineering, Inc. tel. 916.564.2236 fax 916.564.1639 1451 River Park Drive Suite 142, Sacramento, CA, 95815 http://www.wrime.com • info@wrime.com

TECHNICAL MEMORANDUM

DRAFT

Stony Creek Fan Conjunctive Water Management Program
SCFIGSM Hydrogeology and Model Stratigraphy

To:	Eric Hong, DWR	**CC:**	Sue King Rick Massa Van Tenney Toccoy Dudley Derrick Louie Ron Milligan Roger Putty Grant Davids
From:	Saquib Najmus Mike Cornelius	**Date:**	January 20, 2003
Subject:	**Stony Creek Fan Integrated Groundwater and Surface Water Model (SCFIGSM) Hydrogeology and Model Stratigraphy**		
Project Reference:	Contract No.: 4600000734 Task Order: WRIME-Glenn-0901-001		

D R A F T

PURPOSE

The purpose of this memorandum is to document the methodology used to develop the stratigraphy data for the Stony Creek Fan Integrated Groundwater and Surface Water Model (SCFIGSM). The SCFIGSM will be used in the Stony Creek Fan Conjunctive Water Management Program (Program) to evaluate the impacts of water management scenarios on groundwater aquifer underlying the Stony Creek Fan.

The SCFIGSM is being developed in coordination with the California Department of Water Resources (DWR) and the three Project Sponsors – the Orland Artois Water District (OAWD), the Orland Unit Water User Association (OUWUA) and Glenn Colusa Irrigation District (GCID).

DWR Northern District has recently mapped the hydrogeology of the northern Sacramento Valley in great detail; this effort has resulted in the redefinition of the hydrogeologic setting of Sacramento Valley north of the Sutter Buttes. Until recently, it was believed that the northern Sacramento Valley alluvial aquifer system consisted primarily of a thick layer of interbedded sands and clays. The recent aquifer mapping by the DWR Northern District provides more detailed information about the different aquifer layers that are present in the northern Sacramento Valley. The SCFIGSM model incorporated the recent information about the northern Sacramento Valley aquifer.

The primary goals of this Technical Memorandum are to:

- Identify and summarize the available sources of geologic and hydrogeologic data in the SCFIGSM area.
- Establish the hydrogeologic setting and describe how it is used to develop the conceptual model stratigraphy.
- Discuss the SCFIGSM finite element grid.
- Document the development of the SCFIGSM stratigraphy data.

STUDY AREA

Stony Creek Fan Conjunctive Water Management Program Study Area

The Stony Creek Fan, as shown in Figure 1.1, is a highly permeable geologic formation that extends southeast from the Black Butte Reservoir in the Glenn County. The study area for this project includes the Stony Creek Fan and the areas surrounding the Fan that may be included in the SCFIGSM (including the Counties of Tehama, Glenn, and Colusa).

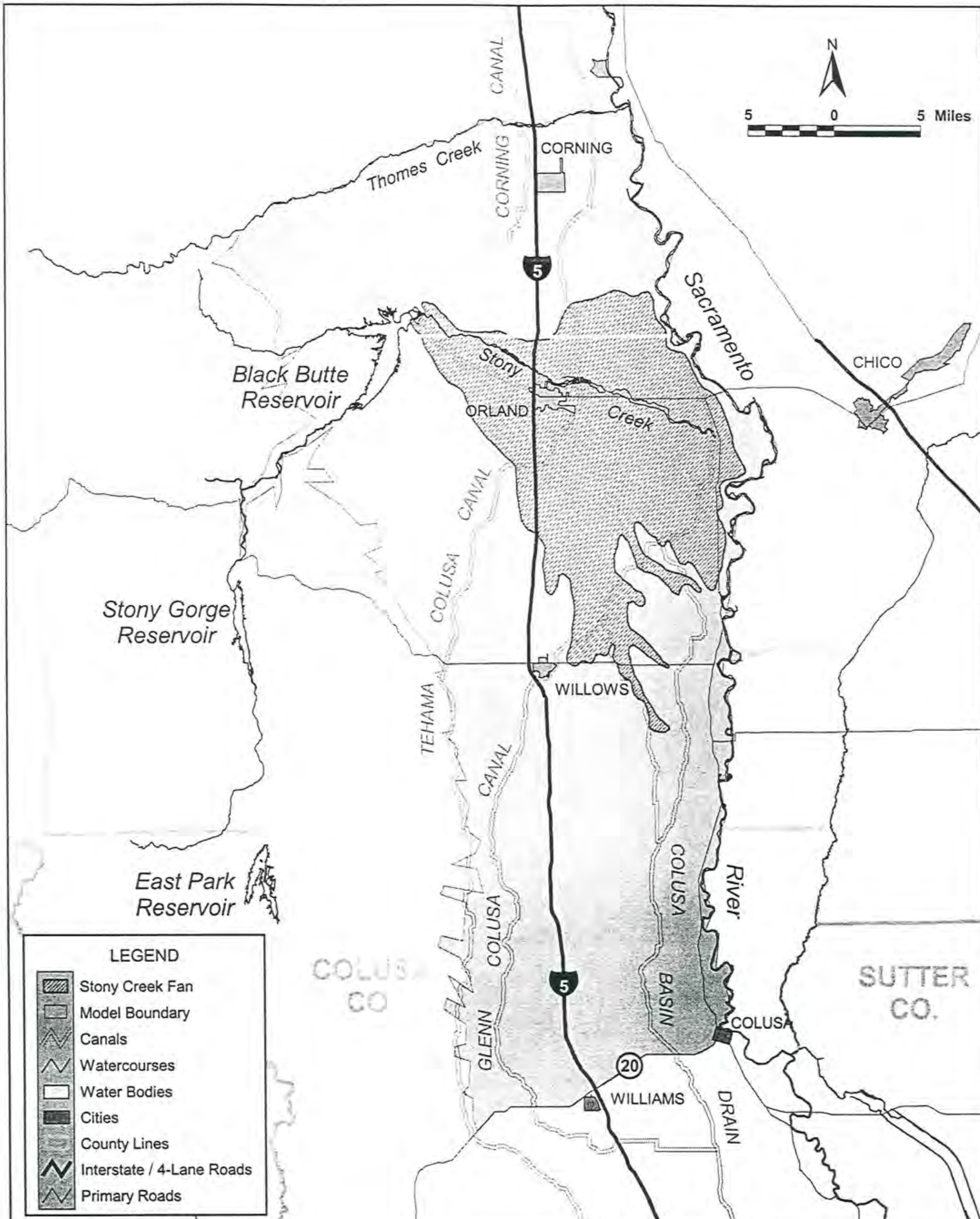
The general study area, shown in Figure 1.1, extends about 30 miles from west to east and about 70 miles from north to south. The study area includes three reservoirs (the East Park Reservoir, the Stony Gorge Reservoir, and the Black Butte Lake), three major streams (the Thomes Creek, the Stony Creek, and the Sacramento River), five major water distribution canals (the Tehama-Colusa Canal, the Glenn-Colusa Canal, the Colusa Basin Drain, the Orland North Canal, and the Orland South Canal), and several small creeks.

The SCFIGSM model area (model area) is smaller than the general study area because it follows the hydrogeologic boundaries and features of the underlying groundwater aquifer. The model area is bounded on the north by Thomes Creek and on the south by Highway 20. The model area extends east from the geologic contact with the Coast Ranges Foothills to the Sacramento River.

TECHNICAL MEMORANDUM OUTLINE

The SCFIGSM Hydrogeology and Model Stratigraphy Technical Memorandum is organized into the following sections:

- **Section 1: Introduction** identifies the purpose and outline of this technical memorandum.
- **Section 2: Collection and Review of Available Data** lists the available geologic and hydrogeologic data used in this analysis.
- **Section 3: Geologic and Hydrogeologic Setting of Model Area** summarizes the available data.
- **Section 4: Conceptual Model Stratigraphy for SCFIGSM** presents the conceptual model stratigraphy for the SCFIGSM.
- **Section 5: SCFIGSM Model Grid** describes the development of the SCFIGSM grid.



RIME Water Resources & Information Management Engineering, Inc.

STONY CREEK FAN CONJUNCTIVE WATER MANAGEMENT PROGRAM

JANUARY 2003

Model Study Area

DRAFT

FIGURE 1.1

- **Section 6: SCFIGSM Stratigraphy Data** describes the methodology used to develop the SCFIGSM stratigraphy data.
- **Section 7: Summary** presents the summary of this analysis.

SECTION 2 COLLECTION AND REVIEW OF AVAILABLE DATA

This section describes the available geologic and hydrogeologic data that were collected and reviewed during the development of the stratigraphy data for the SCFIGSM.

The available data and information for the Program was summarized in two previous project reports:

- Integrated Groundwater and Surface Water Model (IGSM) Data Collection and Assessment Report for the Stony Creek Fan Conjunctive Water Management Program, (WRIME, Inc., August 2002), and
- Existing Data Report, Technical Memorandum 1, Stony Creek Fan Conjunctive Water Management Program (MWH/Davids Engineering, December 2002).

Other sources of information utilized to develop the SCFIGSM stratigraphy data are described below.

PUBLISHED STUDIES AND REPORTS

The geology and hydrogeology of the Sacramento Valley has been investigated since the 1920s. The following list of reports provided regional information on the geology, hydrogeology, aquifer characteristics, and storage capacity of the aquifer system in the study area.

- Evaluation of Groundwater Resources; Sacramento Valley, Bulletin 118-6, DWR, 1978.
- Groundwater Levels in the Sacramento Valley Groundwater Basin, DWR, 1997.
- Geologic Features and Groundwater Storage Capacity of the Sacramento Valley, California, U.S. Geological Survey Paper 1497, 1961.
- Water Quality and Supply on Cortina Rancheria, Colusa County, California, USGS Water Resources Investigation 89-4004, 1989.
- Glenn-Colusa Irrigation District; Reconnaissance Evaluation of Groundwater Resources, CH2M HILL, 1978.
- Geochemistry of Groundwater in the Sacramento Valley California, Laurence C. Hull, USGS Professional Paper 1401-B, 1984.
- Base and Thickness of Post-Eocene Continental Deposits in the Sacramento Valley, California, R.W. Page in cooperation with DWR, USGS Water Resources Investigation 45-73, 1974.

- Progress Report of Groundwater Development Studies, North Sacramento Valley, DWR, 1976

RECENT/UNPUBLISHED STUDIES AND REPORTS

Some of the most recent work completed by DWR is not published yet. Two of these efforts are:

- Sacramento River Basin–Wide Water Management Plan Groundwater Hydrology Technical Memorandum, DWR Northern District, Bulletin 118-7 (Draft, unpublished, January 2000).
- California's Groundwater, Bulletin 118, Update 2002.

Sacramento River Basin–Wide Water Management Plan Groundwater Hydrology Technical Memorandum, DWR Northern District, Bulletin 118-7

The Sacramento River Basin–Wide Water Management Plan presents the results of a groundwater resource assessment for selected areas within the Sacramento Valley and Redding groundwater basins. This report emphasized areas associated with the Sacramento River Settlement Contractors, who are participating in Reclamation's development of a Basin-Wide Water Management Plan (BWMP).

As part of this project, the DWR Northern District is currently in the process of completing comprehensive geologic mapping of the Stony Creek Fan. Several geologic cross sections were developed based on analysis and interpretation of recent and E-logs, and oil and gas logs. These geologic cross-sections are not yet published but were provided as preliminary data to the project study team solely for the purpose of use in the model development.

California's Groundwater, Bulletin 118, Update 2002

Bulletin 118–Update 2002 identifies and describes the two groundwater basins, Corning and Colusa, in the study area. Bulletin 118 briefly describes the hydrogeologic conditions of the underlying aquifers, which were taken into consideration during the development of the conceptual model hydrogeology for the SCFIGSM. This information is currently available at the Bulletin 118 website, listed below:

(http://www.waterplan.water.ca.gov/groundwater/updatemain.htm).

OTHER DATA SOURCES

Well log and construction data, and water level data are both available from DWR. This information was used to supplement the available geologic and hydrogeologic data used in developing the stratigraphic data for the SCFIGSM. Each of these data sources is briefly described below.

Well Log and Construction Data

Monitoring and production well logs for the Counties of Glenn, Tehama, and Colusa are available as hardcopy data at the DWR Northern District office in Red Bluff. About 400–500 driller's logs available at the Northern District office were reviewed and screened for geographic coverage and level of detail reported in the well log. About 154 driller's logs distributed throughout the proposed model area were selected for use in the model data development. These well log data were analyzed, interpreted, and used to supplement the existing geologic cross-section data to develop the model stratigraphy.

Historic Groundwater Levels

Historic groundwater level data for 191 wells (18N–22N) in the Glenn County, 40 wells (15N–18N) in the Colusa County, and 203 wells (23N–25N) in the Tehama County were downloaded from DWR Web site (http://www.wdl.ca.gov). A preliminary assessment of the groundwater level data shows that there are adequate data for developing the initial condition of the SCFIGSM as well as for model calibration.

SECTION 3 GEOLOGIC AND HYDROGEOLOGIC SETTING OF MODEL AREA

The geologic and hydrogeologic setting for the model area is presented in this section to document the available information and provide the background information needed to develop the conceptual model stratigraphy (presented in Section 4), model grid (presented in Section 5), and the SCFIGSM stratigraphy data (presented in Section 6).

This section focuses on the geologic and hydrogeologic conditions of the model area; it includes discussion of the following:

- Geologic History
- Geomorphic Features
- Geologic Setting
- Hydrogeologic Setting

GEOLOGIC HISTORY

This section presents the geologic history of the model area as it relates to the deposition of marine deposits and continental deposits. In general, the older marine deposits contain saline water and underlie the younger continental deposits which contain fresh water. The freshwater bearing continental deposits are the geologic units of interest in the Stony Creek Conjunctive Water Management Program. The geologic units and a brief description of their characteristics are presented on Table 3-1.

During the Cretaceous Period to early Miocene Epoch, the present Sacramento Valley trough was inundated by an inland sea, which deposited thousands of feet of marine sediments upon the pre-Cretaceous granitic basement rocks. After withdrawal of the marine waters occurred in the Miocene Epoch, there was a period of erosion during which time there was deposition of continental deposits.

Table 3.1
Stony Creek Fan IGSM
Geologic Units in Study Area

System and Series		Geologic Unit	Lithologic Character	Maximum Thickness[1] (ft)	Water-bearing Character
QUATERNARY	Holocene	Alluvium Qa	Unconsolidated unweathered gravel, sand, silt, and clay[1].	80	Deposits are moderately to highly permeable with high permeability gravelly zones yielding large quantities to shallow wells[2]. Although deposits along Stony, Chico, and Thomes Creeks are important recharge areas[2], extensive water bearing capacity is restricted by thickness and areal extent[1].
QUATERNARY	Holocene	Basin Deposits Qb	Unconsolidated[3] fine-grained silts and clays, locally interbedded with stream and channel deposits along the Sacramento River[1].	150	Deposits are typically saturated nearly to the ground surface[2]. The low to moderate permeability results in yields of small quantity and poor groundwater quality to domestic wells[1,2].
QUATERNARY	Pleistocene	Modesto Formation Qm	Poorly sorted[5] unconsolidated weathered and unweathered gravel, sand, silt, and clay[3].	200	Moderately to highly permeable[1].
QUATERNARY	Pleistocene	Riverbank Deposits Qr	Poorly sorted[5] unconsolidated to semi-consolidated[3] pebble and small cobble gravels interleused with reddish clay, sand, and silt[1].	200	Water-bearing capability is limited by thickness. These poorly to highly permeable deposits supply moderate groundwater amounts to domestic and shallow irigation wells. Deeper irrigation wells may be supplied if the wells contain multiple perforation zones[1].
TERTIARY AND QUATERNARY	Pliocene and Pleistocene	Tehama Formation Tte	Fluviatile moderately consolidated pale green, gray, and tan sandstone and siltstone enclosing lenses of sand and gravel; silt and gravel; and cemented conglomerate derived from the Coast Ranges[1,3].	2,000	Local high permeability zones within this characteristically low to moderate permeability unit, widespread distribution, and deep thickness cause this formation to be the principle water bearing unit in the area. Deep well yields are typically moderate, but are highly variable[2].
TERTIARY	Pliocene	Tuscan Formation Tt	This series of volcanic flows, consolidated tuff breccia, tuffaceous sandstone, and volcanic ash derived from the Cascade Range interfingers with the Tehama Formation as it westerly grades into volcanic sands, gravels, and clays[1,2]. The formation is divided by layers of thin tuff or ash units into four lithologically similar units A-D[1].	1,500	Within this formation, moderately to highly permeable volcanic sediments are hyraulically confined by layers of tuff breccias and clays[2]. Units A and B are the primary water-bearing zones and are composed of volcanic conglomerate, sandstone, and siltstone layers interbedded with lahars. Stragraphically higher, the massive lahar deposits of unit C confine groundwater in the permeable beds of units A and B[1].
TERTIARY	Pliocene	Nomlaki Tuff Member	Tuff breccias and white tuffs of dacitic composition. This member of the Tehama and Tuscan Formations serves as an important stratagraphical marker bed in northern Sacramento Valley[5].	60[5]	Poorly permeable.
TERTIARY	Miocene	Neroly Formation Tn	Marine to non-marine tuffaceous andesitic sandstone interbedded with tuffaceous shales and tuff layers. Contains local conglomerate lenses[3].	500	This formation of variable permeability contains interstitial fresh water under confined conditions[4], however, deposits of the Neroly Formation are typically located below the base of fresh water.
TERTIARY	Miocene	Lovejoy Basalt Tl	Black, dense, hard microcystalline basalt[3].	65	Largely non-water bearing.
TERTIARY	Miocene and Oligocene	Upper Princeton Valley Fill Tupg	Non-marine sandstone containing mudstone, conglomerate, and sandstone conglomerate interbeds[3].	1,400	Largely non-water bearing or contains saline water.
TERTIARY	Eocene	Lower Princeton Submarine Valley Fill Tlpg	Marine conglomerate and sandstone interbedded with silty shale[3].	2,400	Largely non-water bearing or contains saline water.
CRETACEOUS		Great Valley Sequence JKgvs	Marine siltstone, shale, sandstone, and conglomerate[3].	15,000	Largely non-water bearing or contains saline water[2].
PRE-CRETACEOUS		Basement Complex pTb	Metamorphic and igneous rocks.	n/a	May contain groundwater, mainly saline, in fractures and joints.

Notes:

[1] Department of Water Resources web page (www.wq.water.ca.gov).
[2] Department of Water Resources, Bulletin 118-6, 1978.
[3] Department of Water Resources, Bulletin 118-7 (Draft, not published).
[4] Department of Water Resources, Sacramento River Basin-Wide Water Management Plan-Draft, 2000.
[5] Department of Water Resources, Groundwater Levels in the Sacramento Valley Groundwater Basin, Glenn County, 1997.

In the Pliocene Epoch, the northern Coast Range uplift was initiated which is associated with this mountain-building episode, the Sacramento Valley began to assume its current form. Coast Range uplift and related erosion of the uplifted block resulted in deposition of the Tehama Formation onto the heavily eroded, subsiding Sacramento Valley floor. In late Pliocene time, volcanic activity on the southern Cascade Range caused the widespread deposition of the Nomlaki tuff across the northern Sacramento Valley. This extensive ash layer is found near basal deposits of the Tehama and Tuscan Formations. Continuous volcanism in the southern Cascade Range produced consecutive mudflows of basaltic and andesitic composition. These igneous deposits were reworked coincident with volcanic activity resulting in the Tuscan Formation on the east side of the Sacramento Valley.

During the Pliocene Epoch, deposition of the Tehama and Tuscan Formations occurred simultaneously. These thick, widespread deposits overwhelmed the previous topography, creating a relatively flat plain that was repeatedly dissected by meandering and braided streams.

Fluviatile sedimentation of the Tehama Formation was continuous on the west side of the Sacramento Valley throughout the Pliocene and possibly into the Pleistocene. During the middle part of the Pleistocene, mountain-building activity brought the Coast Ranges to their current structure and shape. The Tehama Formation deposits, along with older deposits, were involved in this folding and faulting event, and formed low hills and dissected uplands. Intense erosion concurrent and following this orogenic activity reworked the Tehama Formation and redeposited the sediments near the center of the Valley. Much of these sediments were carried away by the Sacramento River.

Quaternary sedimentation is represented in the deposition of broad alluvial fans and flood plains. In the vicinity of the Stony Creek Fan, the newly eroded surface of the Tehama Formation was covered with poorly sorted gravel deposits of the Pleistocene Modesto and Riverbank Formations. Gravels of these terrace deposits were partially supplied by glaciers in the Coast Ranges and Klamath Mountains and partially by continued erosion of the Coast

Ranges. The northwest Sacramento Valley cycle of valley deposition resulting from continuous erosion in the Coast Ranges and low foothills continues to present day.

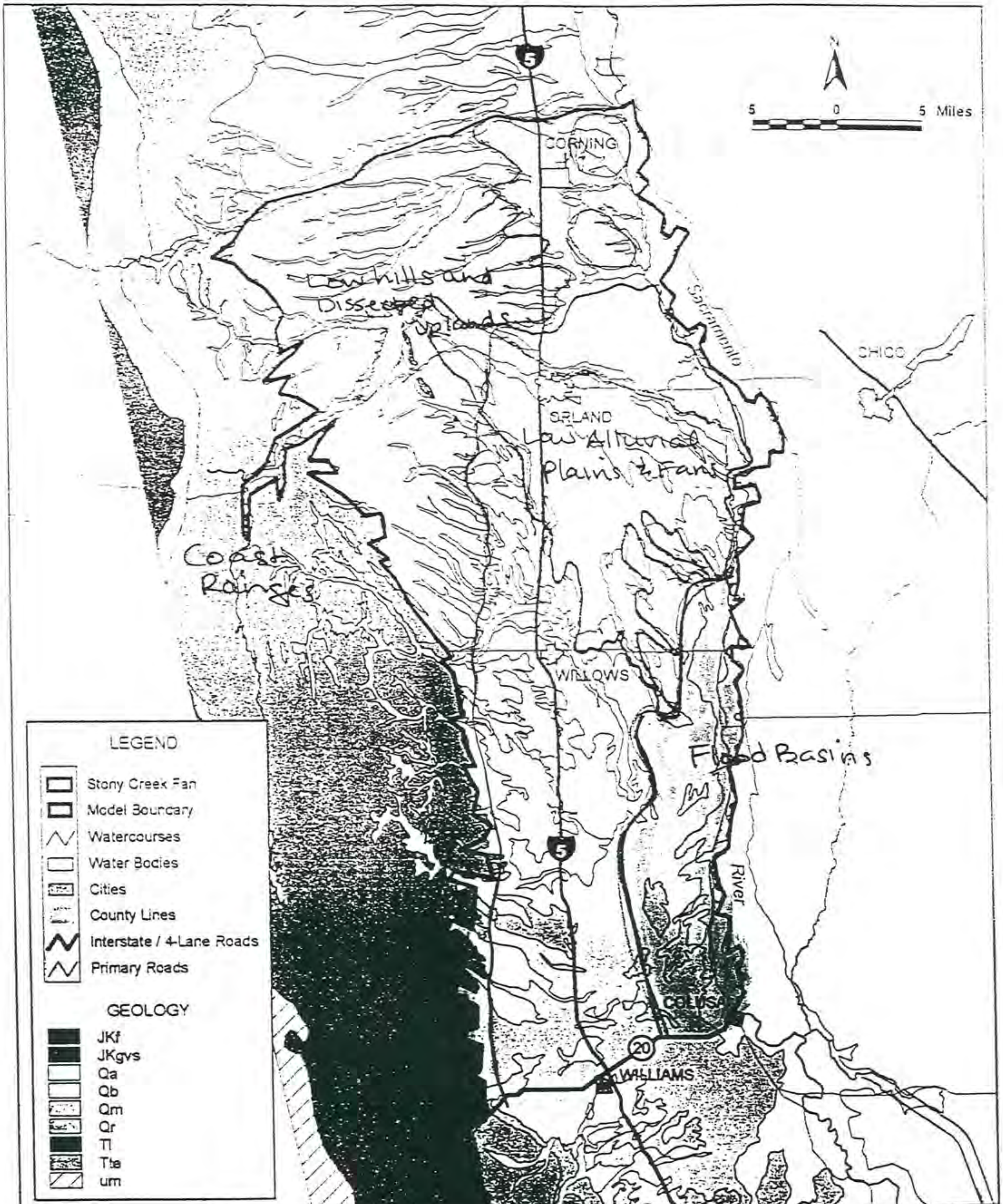
GEOMORPHIC FEATURES

Geomorphic features of the study area include the Coast Ranges, low hills and dissected uplands, alluvial fans, and flood plains (Figure 3.1). The Sacramento River and Stony Creek have significant hydrological influence on the study area.

The Coast Ranges represent the western border of the study area and extend south from the Klamath Mountains to the Cuyama River near San Luis Obispo. These north-south trending mountain ranges are predominantly composed of sedimentary deposits with minor volcanic intrusions. The sedimentary fault blocks within the ranges are complexly folded. In general, the Coast Ranges reach no higher than 6,560 feet above mean sea level.

The low hills and dissected uplands are located between the Coast Ranges and the alluvial fans of the valley. An abrupt increase in slope marks the transition between the alluvial fans and the uplands. These hills are topographic expressions of subsurface folding and faulting of the Tehama Formation and older underlying sediments.

As streams draining the Coast Ranges leave the low hills and dissected uplands, they flow out into the relatively flat valley floor. This change in slope causes them to deposit their bedload, forming broad alluvial fans. Alluvial fan deposits are an intricate system of buried channels formed by a dynamic fluviatile depositional environment. An example of an alluvial fan is the Stony Creek Fan (Figure 1.1), the focus of the current hydrogeologic investigation. This fan is the largest and most complex alluvial fan in the northwest portion of the Sacramento Valley and was deposited by Stony Creek. The apex of the Stony Creek Fan is approximately five miles northwest of the town of Orland, where Stony Creek flows out of the low hills. The Stony Creek Fan extends east to the Sacramento River flood plain, and south to the Colusa basin deposits near the town of Willows. The surface of the fan is not smooth, but rather cut by many abandoned channels. Smaller and less impressive fans



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JANUARY 2003

~~Geologic Map~~
GEOMORPHIC FEATURES MAP
DRAFT

FIGURE 3.1

have been deposited by intermittent streams south of the Stony Creek Fan. In general, these deposits are much finer grained than the deposits of the Stony Creek Fan.

In flat, low-lying basins between the alluvial fans and the Sacramento River, distal alluvial fan sediments merge with the fine-grained flood plain and basin deposits. During flooding events along the Sacramento River, water spills over the natural river levee and accumulates in these basins. The trapped water creates temporary lakes, and the quiescent environment allows for deposition of fine-grained suspended material. The Colusa Basin is an example of this phenomenon, and extends 60 miles south of the Stony Creek Fan.

The Sacramento River and Stony Creek are responsible for depositing a large quantity of coarse material in the northwest Sacramento Valley over thousands of years. These deposits constitute the alluvial aquifer in the study area. The Sacramento River and Stony Creek are important sources of surface water to the study area.

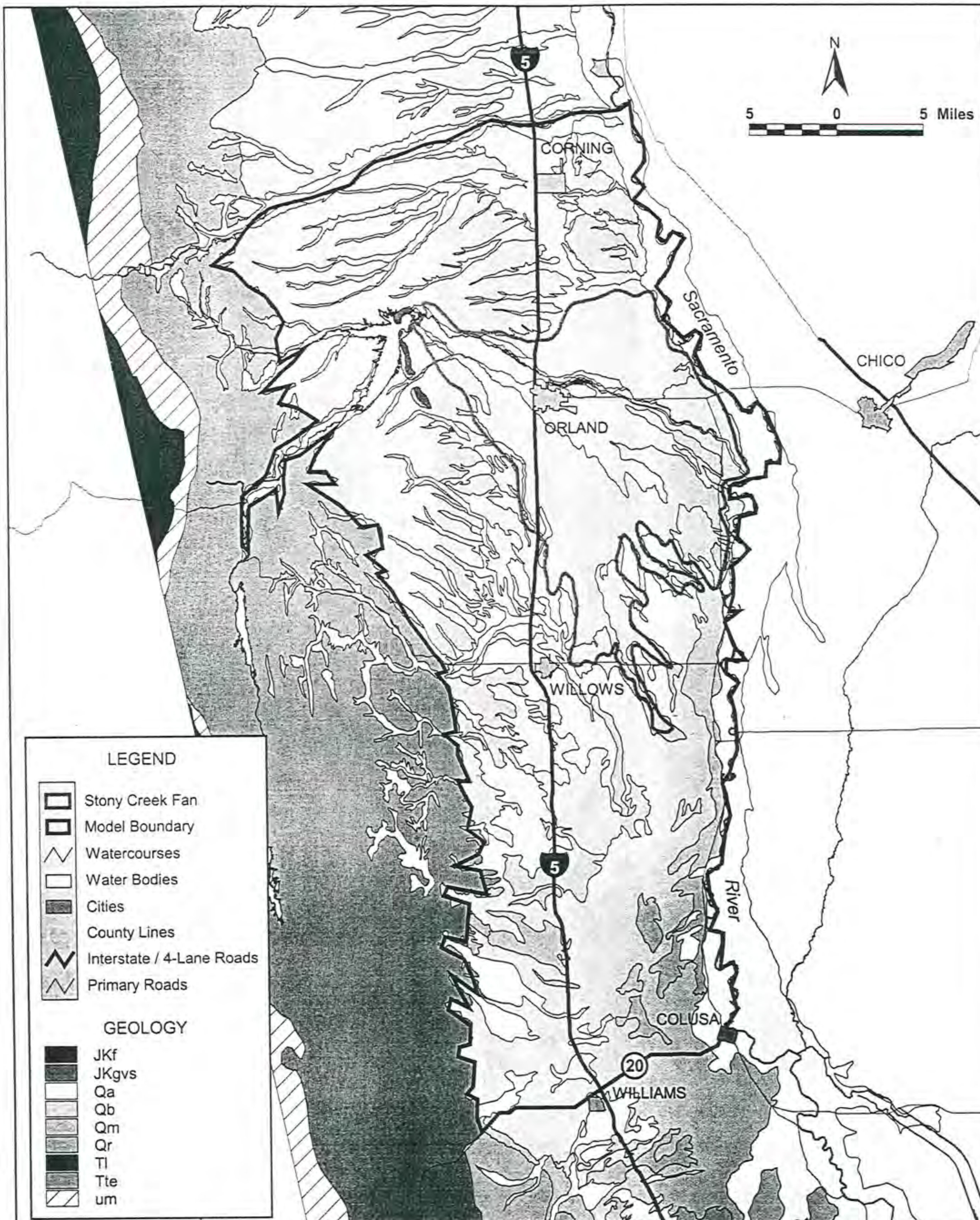
GEOLOGIC SETTING

Structure

The Sacramento Valley is an asymmetrical northward-trending syncline partially filled with sedimentary deposits. Several faulting, folding, and uplift events tilted the Sierra Nevada block relative to the Coast Ranges forming this structural basin. Latter orogenic events are expressed in folding and faulting of Pre-Middle Pleistocene basal deposits. Faults related to this activity include the Paskenta, Willows, Corning, and Black Butte Faults.

Geologic Units

This summary of the geologic units in the study area focuses on the Pliocene and younger sediments of the alluvial groundwater aquifer. These sediments include the Pliocene Tuscan Formation; Pliocene and Pleistocene Tehama Formation; Pleistocene Modesto and Riverbank Formations; and the Holocene alluvial, basin, and flood plain deposits (Figure 3.2 and Table 3.1). Little detail is given to the underlying older marine sediments.



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Geologic Map

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FIGURE 3.2

Pre-Pliocene Marine Deposits

Marine sediments in the study area include the Miocene Neroly Formation, the Miocene and Oligocene Upper Princeton Gorge Formation, the Eocene Lower Princeton Gorge Formation, and the Cretaceous Great Valley Sequence. These deposits define the subsurface freshwater aquifer boundary. In general, these largely non–water bearing deposits occur below the base of fresh water; thus they may contain small amounts of saline water. The Neroly Formation is composed of marine to nonmarine tuffaceous andesitic sandstone interbedded with tuffaceous shales and tuff layers with local conglomerate lenses. This formation generally contains saline water; however, it may contain small amounts of freshwater. The nonmarine deposits of the Upper Princeton Gorge Formation consist predominantly of sandstone containing mudstone, conglomerate, and conglomerate sandstone interbeds. Although these are continental deposits, they occur below the base of freshwater and contain saline groundwater; thus, the Upper Princeton Gorge sediments are grouped with the marine deposits. The Lower Princeton Gorge Formation is characterized by marine sandstone and conglomerate with silty shale interbeds. Sedimentary marine clastic rocks constituting the Great Valley Sequence include siltstone, shale, sandstone, and conglomerate.

Pliocene Tuscan Formation

Tuscan deposits are characterized by their Cascade Range origin and volcanic signature. This extensive series of basaltic and andesitic volcanic flows, consolidated tuff breccia, tuffaceous sandstone, and volcanic ash is primarily located on the northeastern portion of the Sacramento Valley. The Tuscan Formation underlies much of the Valley floor and extends from the Cascades to the west side of the Valley where it grades into volcanic sands, gravels, clays, and interfingers with the Tehama Formation. Thin tuff or ash units separate the Tuscan Formation into four distinct, yet lithologically similar Units A, B, C, and D (D being the youngest). Of these units, only A, B, and C are found in the study area. Unit C is composed of massive lahar (mudflow) deposits with volcanic sandstone and conglomerate interbeds. Tuscan Formation Unit C is referred to as the Upper Tuscan Formation. Both Units A and B are largely composed of layered, interbedded lahars, siltstone, and volcanic sandstone and conglomerate. Tuscan Formation Units A and B are referred to as the Lower

Tuscan Formation. Unit A is distinguished from Unit B by the presence of metamorphic rock fragments in siltstone layers.

Pliocene-to-Pleistocene Tehama Formation

Deposits of the Tehama Formation are characterized by their fluviatile nature and origin from the Klamath Mountains and Coast Ranges. This assemblage of moderately compacted sandstone and siltstone with local coarse lenses is located in the northwest portion of the Sacramento Valley. These yellowish to greenish grey deposits are separated from the underlying Eocene Epoch and Cretaceous Period marine sediments by an unconformity. The Tehama Formation was deposited under floodplain conditions by rivers and streams flowing from nearby mountains in a subsiding, low relief valley. Several properties of the Tehama Formation indicate a western and northwestern origin. Mineral composition and rock type of Tehama deposits are identical to those in the Coast Ranges and Klamath Mountains. Additionally, the grain size of Tehama Formation sediments decreases to the south and east, suggesting a western and northwestern origin.

Pliocene Nomlaki Member

This deposit is recognized as a member of both the Tehama and Tuscan Formations indicating simultaneous deposition. The Nomlaki Member is composed of coarse tuff breccias and white tuffs of dacitic composition and has an eastern source. This widespread deposit serves as an important stratigraphical marker in the northern part of Sacramento Valley.

Pleistocene Deposits

Terrace deposits of the Pleistocene Modesto and Riverbank Formations are composed of poorly sorted clay, silt, sand, and gravel, and form a thin veneer at the ground surface. The Riverbank Formation is distinguished from the Modesto deposits by interbedded clay layers. In the Stony Creek Fan area, these terraces are well-defined, but they are absent or poorly defined along other minor streams in the study area.

Holocene Deposits

Quaternary alluvium, the most recent deposit, is found along major rivers and is composed of unconsolidated unweathered clay, silt, sand, and gravel. Fine-grained flood plain deposits include silt with minor amounts of sand. The basin deposits are composed of fine-grained sediments and are found in flood basins and near streams. The coarse-grained sediments of the alluvial fan include sand and gravel.

Geologic Relationships

This section identifies the relationship between the geologic units in the model area. There are two specific areas of interest because of their potential affect on the groundwater in the aquifer system.

- Alluvial sediments of the Stony Creek Fan and the underlying Tehama Formation
- Tehama Formation and the Tuscan Formation

Each of these is described below.

Stony Creek Fan Area

The Stony Creek Fan deposits include Pleistocene and Holocene upper, unconfined aquifer deposits. As Stony Creek meandered across the fan, channels were created, abandoned, then buried, creating a complex system of coarse- and fine-grained sediments. The variable nature of this fluviatile, depositional environment causes difficulty in defining groundwater aquifers within the fan.

The Stony Creek alluvial fan sediments form a thin veneer over the Tehama Formation. During the Pleistocene, the surface of the Tehama Formation was intensely eroded, then backfilled with both coarse- and fine-grained deposits of the Stony Creek Fan. The resulting uneven contact between the geologic units makes it difficult to determine the contact between the Stony Creek Fan deposits and the underlying Tehama Formation. In addition, the similar lithology, variable grain size, and the channelized nature of both deposits result in questionable boundary lines.

Tuscan and Tehama Formations Relationship

Typical Tuscan deposits are coarser than those of the Tehama Formation. Simultaneous deposition of these extensive formations onto a broad valley surface resulted in the interfingering of Tuscan and Tehama sediments near the center of the valley. In general, the grain size of the Tehama Formation becomes finer to the east, and the Tuscan Formation grades into volcanic gravels, sands, and clays where the deposits overlap. The nature of groundwater interaction where these formations merge is uncertain.

HYDROGEOLOGIC SETTING

The aquifer system of the Stony Creek Fan Area includes a freshwater aquifer overlying a saline aquifer. The freshwater alluvial aquifer system in the study area is composed of late Tertiary to Quaternary continental deposits. The aquifer system includes an upper unconfined alluvial aquifer consisting of Quaternary deposits overlying a confined aquifer system composed of Quaternary and Tertiary continental deposits of fluvial and volcanic origin. The saline aquifer system composed primarily of Tertiary and older marine deposits.

Freshwater Aquifer System

The freshwater aquifer system is composed of an unconfined aquifer overlying a confined aquifer as described below.

Unconfined Aquifer

The upper unconfined aquifer consists of Quaternary deposits, including Holocene alluvium, flood plain, alluvial fan, and basin deposits, and the Pleistocene Riverbank and Modesto Formations. The unconfined aquifer system is important to local groundwater users, but the potential for significant groundwater storage is limited due to insufficient thickness.

Holocene Deposits

The unconsolidated, highly permeable Quaternary alluvium deposits are important recharge areas. These deposits are generally located along major rivers and facilitate groundwater recharge from rivers. Highly permeable alluvial fan deposits, specifically of the Stony Creek

Fan, are also important recharge areas. The moderately permeable basin deposits and floodplain deposits are less important recharge areas.

Pleistocene Deposits

In addition to the Holocene deposits, the highly permeable terrace deposits of the Pleistocene Modesto and Riverbank Formations are significant recharge areas. However, low permeability clay beds of the Riverbank Formation limit the water-bearing capabilities of this deposit.

Confined Aquifer

The confined aquifer is composed of Tertiary Deposits, including the Pliocene and Pleistocene Tehama Formation and the Pliocene Tuscan Formation. These widespread and thick formations are important in aquifer storage and well water supply.

Tehama Formation

The Tehama Formation is the primary water source of the study area. Groundwater in this formation occurs under semi-confined and confined conditions. The widespread distribution and high thickness allow this formation to supply water to most of the wells in the study area. Moderately compacted, thickly bedded sandstone and siltstone layers derived from the Coast Ranges result in characteristically low to moderate permeability. However, thinner lenses of sand and gravel result in local, high permeability zones.

Potential for groundwater recharge and storage is limited by the geographic irregularity of these permeable lenses. Well yields are typically moderate for deeper wells. However, well yields vary from high to low due to variable permeability zones. Generally, wells located near the Stony Creek Fan have higher yields than those located to the south. The Tehama Formation has a higher concentration of more permeable coarse material in the vicinity of the alluvial fan deposits. Variations in well yields indicate the north to south decrease in grain size.

Tuscan Formation

The Tuscan Formation serves as the primary source of groundwater on the east side of the Sacramento River. In the study area, these deposits occur at depths inaccessible to most domestic and irrigation wells. Of the four Tuscan Units, only A, B, and C are found in the study area.

Within this formation, moderately to highly permeable volcanic sediments are hydraulically confined by layers of tuff breccias and clays. The low permeability lahar deposits of Unit C serve as confining beds for the underlying older Tuscan Units A and B. Although Unit C contains permeable volcanic sandstone and conglomerate interbeds, this unit is characterized by an overall low yield of water to wells. Units A and B are much more coarse-grained than the overlying Unit C, causing them to be the primary water-bearing zones of eastern Sacramento Valley.

Saline Aquifer System

The saline aquifer system lies beneath the fresh water aquifer. The base of the fresh water aquifer is defined by the contact between continental deposits and pre-Pliocene marine deposits. The marine deposits present in the study area subsurface include the Miocene Neroly Formation, the Miocene and Oligocene Upper Princeton Gorge Formation, the Eocene Lower Princeton Gorge Formation, and the Cretaceous Great Valley Sequence.

SECTION 4 CONCEPTUAL MODEL STRATIGRAPHY FOR SCFIGSM

This section presents the conceptual model stratigraphy for the SCFIGSM. The conceptual model stratigraphy was presented to the Stony Creek Fan Technical Team at the August 8, 2002, Technical Team Meeting. The conceptual model stratigraphy was developed based on the hydrogeologic properties of the geologic units described in Section 3. A schematic of the four-layer conceptual SCFIGSM stratigraphy is presented in Figure 4.1, and summarized on Table 4.1.

SCFIGSM LAYER 1

The conceptual model for SCFIGSM Layer 1 includes Pleistocene and Holocene deposits consisting of Holocene alluvium, alluvial fan, flood plain, and basin deposits, and the Pleistocene Modesto and Riverbank Formations. The highly permeable sands and gravels of Pleistocene Modesto and Riverbank Formations are only present on the Stony Creek Fan. Where Layer 1 is present throughout the model area it is exposed at the ground surface, and represents the unconfined groundwater system. Wells perforated in this layer are likely used for domestic and some agricultural water supplies.

The highly permeable sands and gravels are 50 to 80 feet thick within the Stony Creek Fan. They are not present outside the Stony Creek Fan. On the Fan, some of the highly permeable deposits are underlain by up to 50 feet of finer-grained alluvial or basin deposits. Outside the Fan, alluvial and basin deposits can reach a total thickness of 200 feet. The conceptual model stratigraphy was developed to reflect the significant difference in the characteristics of the Fan material and the other alluvial deposits present within the model area.

Inside the Fan Area

Inside the Stony Creek Fan Area, SCFIGSM Layer 1 represents the 50 to 80 foot thick highly permeable sand and gravel deposits. Any alluvial or basin deposits that may be present beneath the sands and gravels are included in Layer 2.

Figure 4.1
Stony Creek Fan IGSM
Conceptual Model Stratigraphy

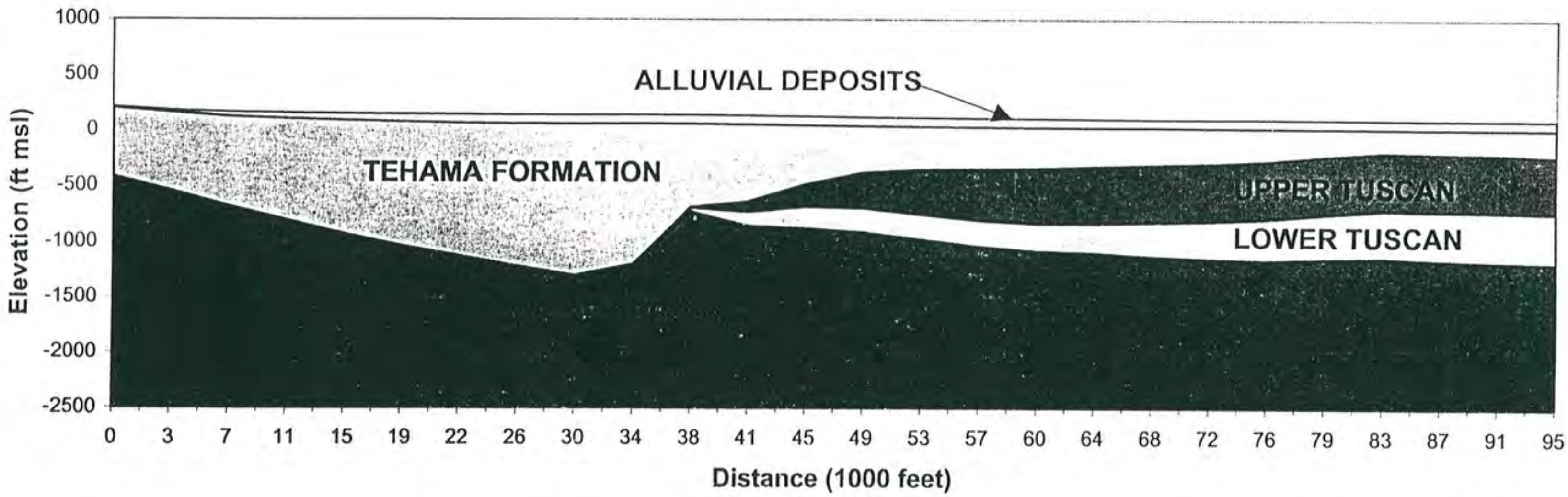


Table 4.1
SCFIGSM Stratigraphy
Definition of Layers

Location within Model	Fan Material	Alluviam, Basin and Flood Plain Deposits	Tehama Formation	Upper Tuscan Formation	Lower Tuscan Formation
	Predominantly gravel and sand with minor amounts of silt and clay.	Characterized by fine-grained silts and clays.	Moderately compacted sandstone and siltstone enclosing lenses of sand and gravel; silt and gravel; and cemented conglomerate.	Characterized by massive lahar deposits.	Composed of volcanic conglomerate, sandstone, and siltstone layers interbedded with lahars.
Inside Fan Area					
Layer 1	■1 ●1	●1			
Layer 2		■2	■2 ●2		
Layer 3				■3 ●3	
Layer 4					■4 ●4
Outside Fan Area					
Layer 1	Not Present	up to 80 feet ■1 ●1			
Layer 2		greater than 80 feet ■2	■2 ●2		
Layer 3				■3 ●3	
Layer 4					■4 ●4

■ Designates the composition of each layer in the current model using Layer 1 = 50-80 feet thick where Layer 1 is defined by the hydrogeologic properties of the material.

● Designates the composition of each layer in the alternate model which would follow the geologic cross sections exactly and classifly Layer 1 as all Quaternary alluvial deposits.

Outside the Fan Area

Outside the Stony Creek Fan Area, SCFIGSM Layer 1 represents the upper 80-foot thickness of the basin and alluvial deposits. Any remaining basin or alluvial deposits are considered part of SCFIGSM Layer 2.

SCFIGSM LAYER 2

The conceptual model for SCFIGSM Layer 2 consists primarily of the Tehama Formation (described in Section 3). The widespread distribution and thickness allow this formation to supply water to many of the agricultural wells in the study area. The Tehama Formation is present throughout the model area ranging in thickness from about 200 feet to over 2,000 feet. Model Layer 2 thickens from west to east about halfway across the model area. Model Layer 2 thins rapidly where Model Layer 3 is present (Table 4.1). As mentioned above, for modeling purposes, Layer 2 does include some basin and alluvial deposits.

Model Layer 2 generally represents groundwater systems ranging from semi-confined to confined conditions. Confinement generally increases with depth, but the actual level of confinement may vary locally due to other conditions, such as continuously perforated wells connecting different aquifer layers. Model Layer 2 is exposed at the ground surface in the northwestern portion of the model area.

SCFIGSM LAYER 3

The conceptual model for SCFIGSM Layer 3 consists of the Upper Tuscan Formation (described in Section 3). Model Layer 3 is present throughout the eastern portion of the model area (Figure 4.1). It consists of fine-grained lahar deposits, so groundwater within Layer 3 represents confined aquifer conditions. Because of its low permeability, few wells in the model area rely on Layer 3 for groundwater supply.

SCFIGSM LAYER 4

The conceptual model for SCGIGSM Layer 4 consists of the Lower Tuscan (described in Section 3). Model Layer 4 is present throughout the eastern portion of the model area (Figure 4.1). In contrast to Layer 3, it is composed of more permeable volcanic conglomerate, sandstone, and siltstone layers interbedded with lahars. It is overlain by the Upper Tuscan Formation (Layer 3), which acts as a confining layer; as a result, groundwater within Layer 4 represents confined aquifer conditions. At this time, few production wells in the model area reach Layer 4, so it currently has little groundwater production and water level data.

BASE OF THE AQUIFER SYSTEM

The base of the aquifer system is considered to be the base of the freshwater-bearing deposits (Figure 4.1). The base of the aquifer system is represented by the base of Model Layer 2 (base of the Tehama Formation) in the western half of the model area,. The base of the aquifer system is represented by the base of Model Layer 4 (base of the Lower Tuscan Formation) in the eastern half of the model area,.

The base of freshwater is mapped in the model area on the basis of available electronic log data. In some locations the base of freshwater is identified to exist within the lower portions of the Tehama Formation or Tuscan Formation (Figure 4.1). The base of freshwater is not considered as a boundary between model layers because it is not a fixed location (such as the base of a formation). Also, it is unlikely to significantly interact with the water supply projects because it is located at the bottom of the aquifer system.

The purpose of this section is to document the methodology used to develop the SCFIGSM grid. A two-dimensional finite element grid network was developed to model the groundwater flow in the Stony Creek Fan Area. The entire model area consists of about 1,060 square miles. The SCFIGSM model grid (shown in Figure 5.1) was divided into 2,148 elements and 1,853 model nodes. The average size of single element is about one-half square mile (316 acres). Notable features of the model grid are:

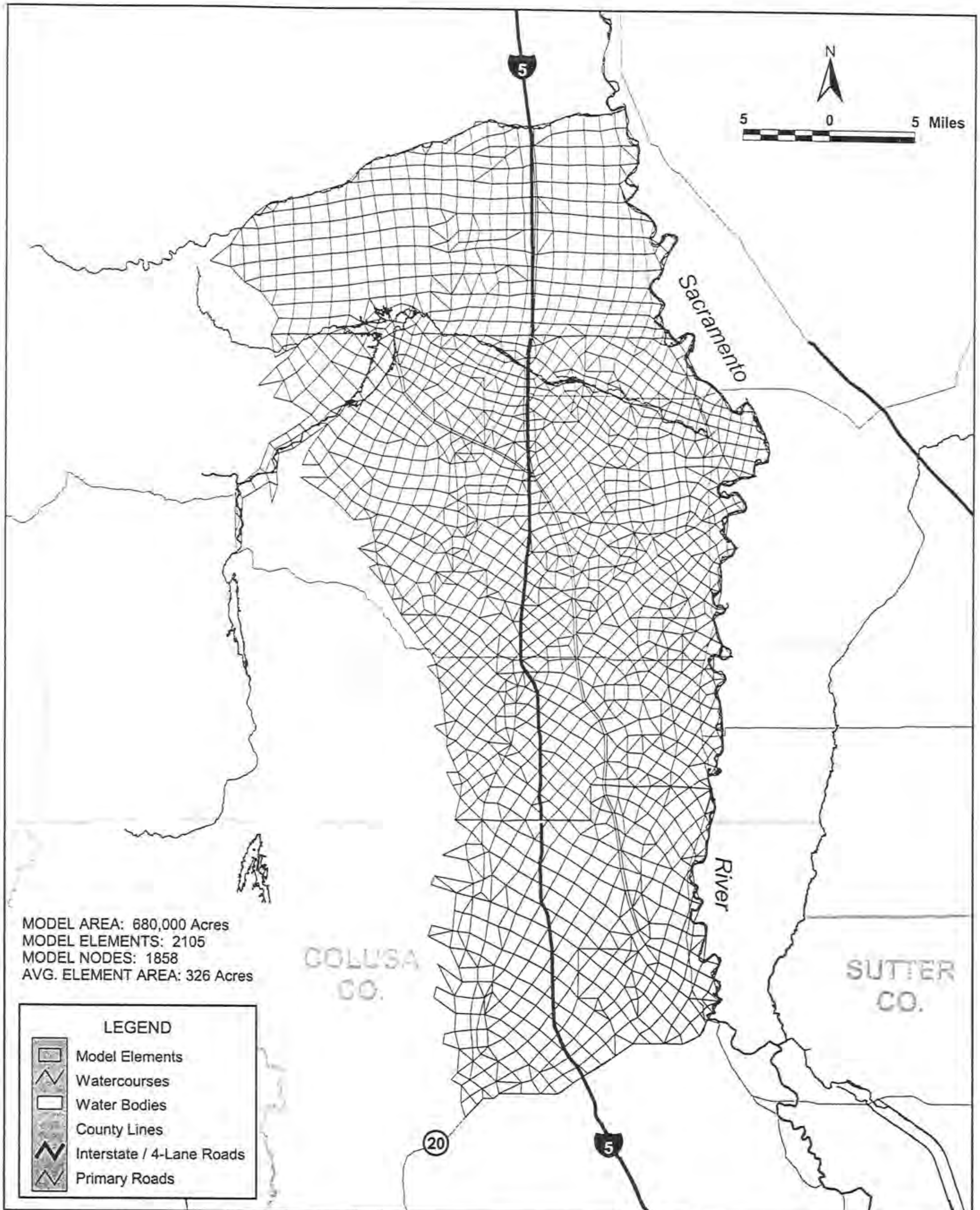
- Model boundary matches the hydrologic and hydrogeologic boundaries of the Stony Creek Fan Area;
- Grid orientation follows the regional groundwater streamlines;
- Elements are smaller in the vicinity of steep groundwater gradients; and
- Thin strips of elements are used to incorporate the discontinuities in the groundwater levels across major geologic faults and barriers.

The model grid is defined by Universal Transverse Mercator (UTM) coordinates at each model node and be the list of connecting nodes for each model element. The x-y coordinates for each model node were obtained from Geographic Information System (GIS) coverage of the model area in UTM Zone 10.5. The list of connecting nodes for each element was developed after numbering the model nodes and model elements. Two independent sets of sequential numbers were used for nodes and elements. These node and element numbers are used in specifying model input data.

The SCFIGSM grid was develop to reflect local conditions including:

- Geologic and Hydrogeologic Considerations,
- Hydrologic Considerations, and
- Potential Water Management Project Areas.

Each of these considerations is described below.



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Model Grid

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FIGURE 5.1

GEOLOGIC AND HYDROGEOLOGIC CONSIDERATIONS

The geologic and hydrogeologic information presented in Section 3 was considered during the SCFIGSM model grid development. These include:

- Geologic Contacts,
- Faults, and
- Groundwater Flow Direction.

Geologic Contacts

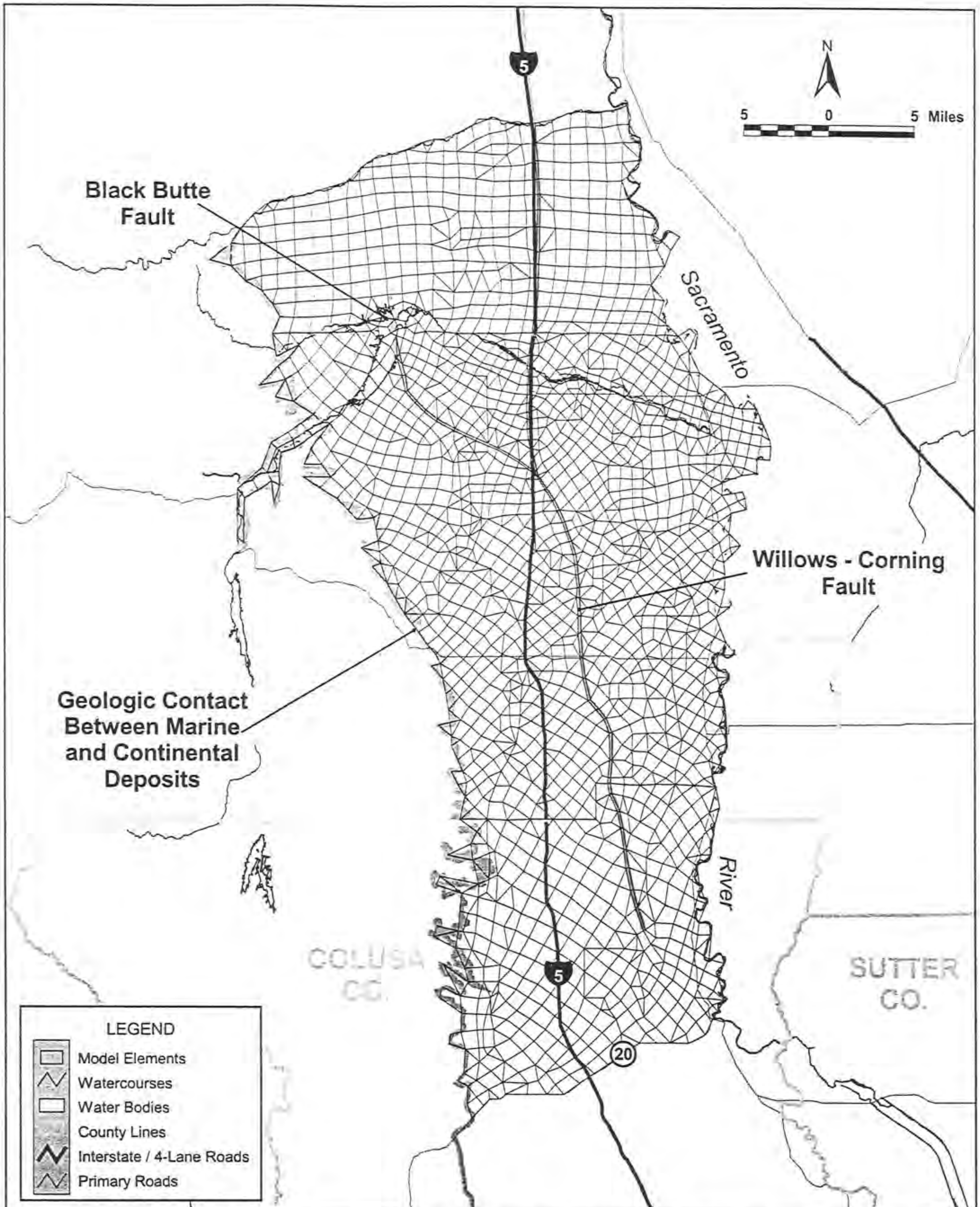
The western boundary of the SCFIGSM grid was defined as the contact between the marine basement rocks of the Coast Range and the continental and alluvial deposits of the Central Valley. The geologic contact between the marine deposits and the continental alluvial deposits is shown in Figure 5.2.

Faults

The SCFIGSM model grid was developed to reflect those faults that either may affect the flow of groundwater, or result in an abrupt change in the aquifer thickness. The SCFIGSM model grid reflects existence of faults by a narrow band of elements along the trace of the fault. After several discussions with DWR, the two faults incorporated into the model grid include the Black Butte Fault and the Willows-Corning Fault. The locations of these faults are shown in Figure 5.2.

Groundwater Flow Direction

The long-term regional groundwater flow directions were considered in the SCFIGSM grid development. Near the Stony Creek Fan, the regional groundwater flow direction is from the fan's apex to the distal portions of the fan generally in the northwest to southeast direction. North and South of the Stony Creek Fan groundwater generally flows from the upland areas in the west towards the Sacramento River near the center of the Valley.



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Geologic and Hydrogeologic Considerations

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FIGURE 5.2

HYDROLOGIC CONSIDERATIONS

The surface water flow system is modeled by using 1-dimensional line elements along the stream courses. These line elements are defined by stream nodes that are coincident with the aquifer nodes. An independent numbering system is used to number the stream nodes. There are 266 stream nodes representing the surface water flow system in the SCFIGSM. This includes rivers, creeks, and lakes as well as major unlined water delivery canals and drains. Figure 5.3 shows the locations of the hydrologic features simulated in the SCFIGSM model area, such as:

- Rivers and Creeks,
- Lakes, and
- Canals and Drains.

Rivers and Creeks

There are three rivers and creeks simulated in the SCFIGSM: Thomes Creek, Sacramento River, and Stony Creek.

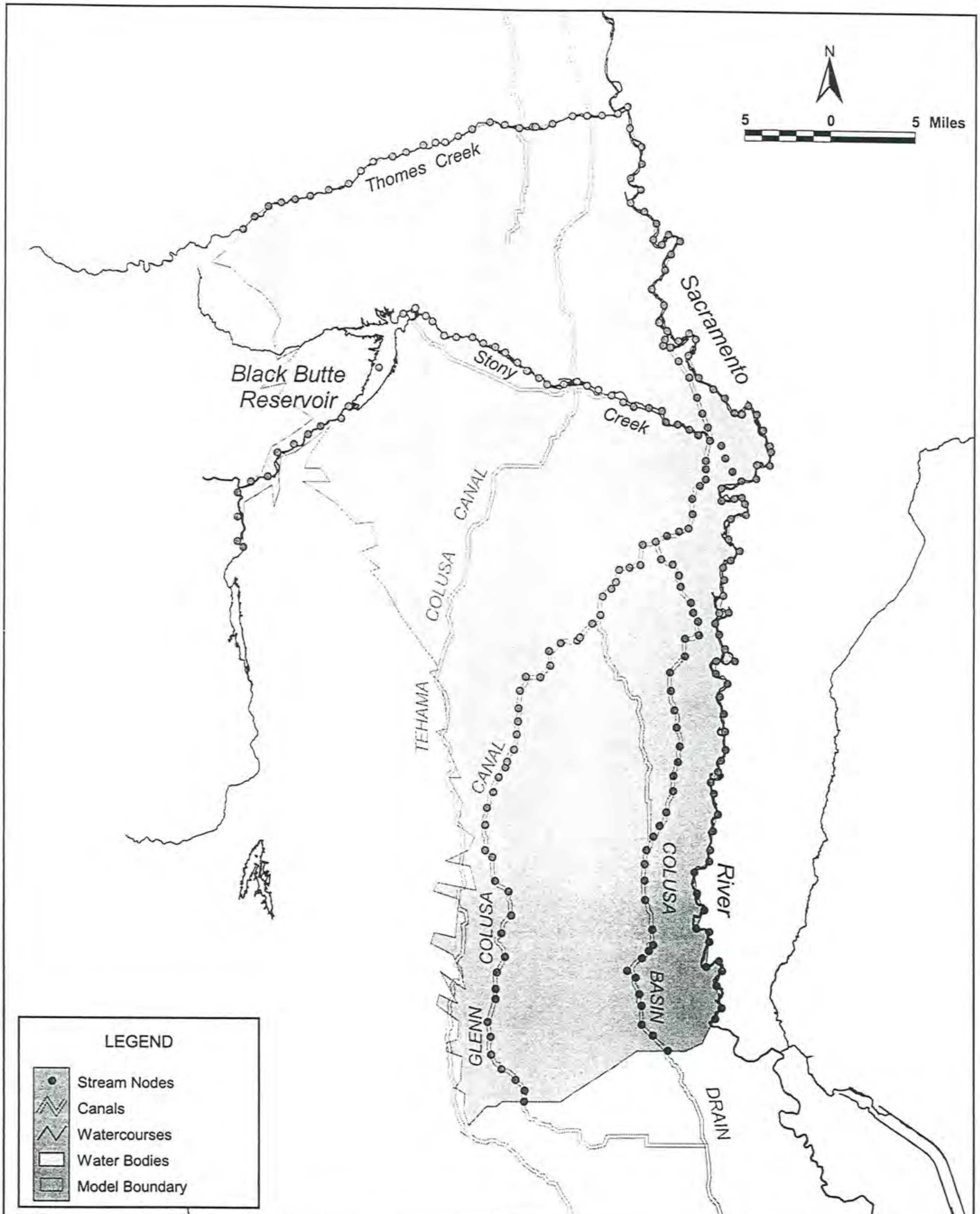
- **Thomes Creek** coincides with the northern boundary of the SCFIGSM, and is simulated along the stream nodes shown in Figure 5.3.
- **The Sacramento River** coincides with the eastern boundary of the SCFIGSM, and is simulated along the stream nodes shown in Figure 5.3.
- **Stony Creek** is located within the SCFIGSM model area. It is simulated both above and below Black Butte Reservoir along the stream nodes shown in Figure 5.3.

Lakes

Black Butte Lake is located entirely within the SCFIGSM model area. The model grid was developed to represent the maximum inundation area of Black Butte Lake. The extent of the Black Butte Lake is shown in Figure 5.3.

Canals and Drains

There are six major canals and drains within the SCFIGSM area. Each of these canals and drains was considered individually to determine if it should be simulated in the model. They are listed below:



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Location of Hydrologic Features

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FIGURE 5.3

- The southern extent of the **Corning Canal** extends approximately 5 miles south of Thomes Creek into the model area. At this time the Corning Canal is not simulated in the SCFIGSM.
- The **Orland North and South Canals** are piped, so there is limited interaction with the groundwater basin. They are not simulated in the SCFIGSM.
- The **Tehama Colusa Canal** is lined through the model area, so it is not simulated in the SCFIGSM.
- The **Glenn-Colusa Irrigation District Main Canal** is unlined. It is simulated in the SCFIGSM along the stream nodes shown on Figure 5.3.
- The **Colusa Basin Drain** is unlined. It is simulated in the SCFIGSM along the stream nodes shown on Figure 5.3.

POTENTIAL WATER MANAGEMENT PROJECT AREAS

Water and land use management in the model area is represented in the SCFIGSM by subdividing the model area into 17 management areas called subregions. The criteria for the subregion delineation is described below and presented in Table 5.1. The location of the SCFIGSM model subregions is shown on Figure 5.4.

Stony Creek Feasibility Study Subunits

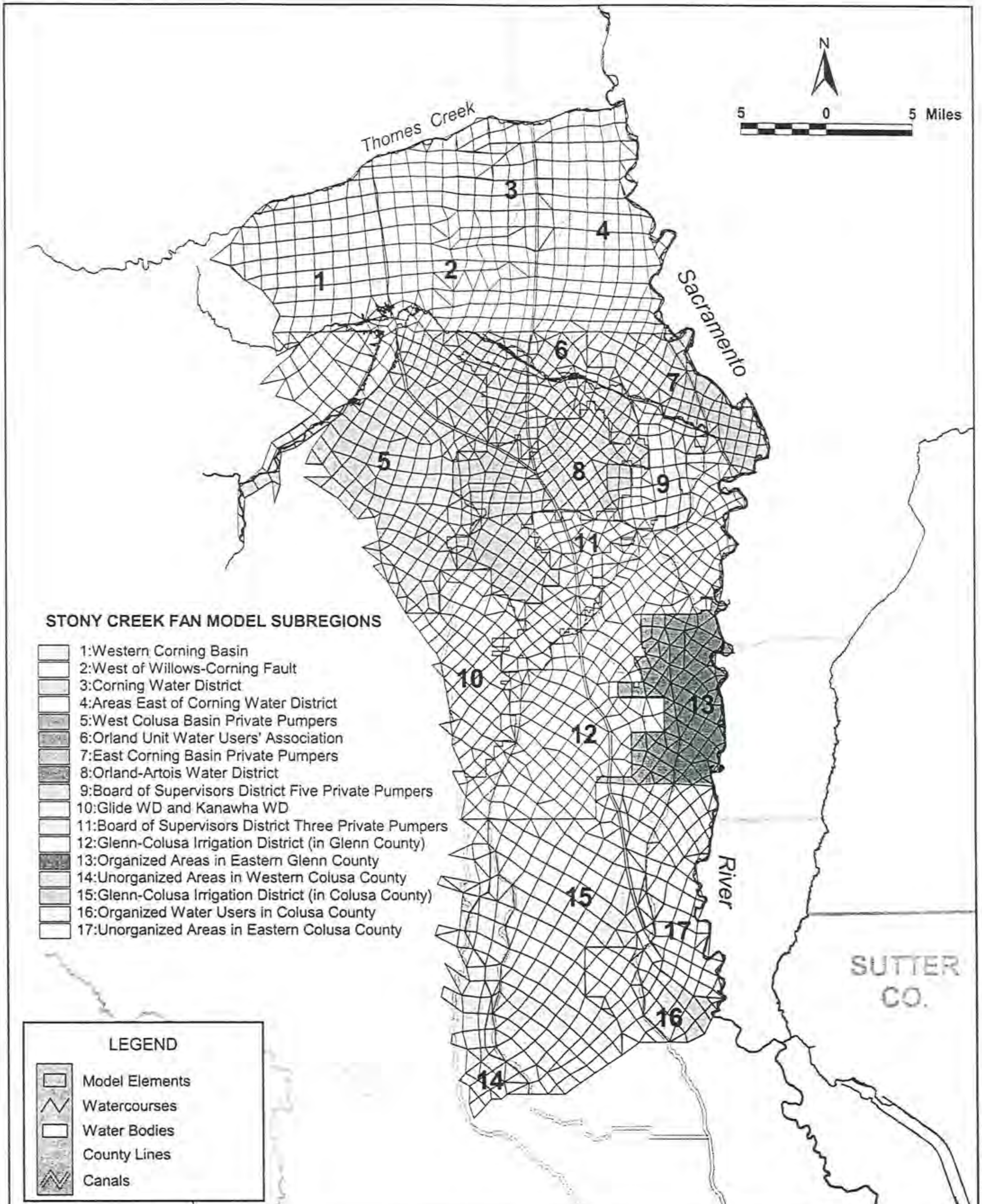
Model subregions were developed to provide geographic coverage similar to the water balance subunits used in the Stony Creek Fan Feasibility Study. This criterion was utilized to define six subregions on or adjacent to the Stony Creek Fan as presented in Table 5.1 and shown in Figure 5.4. SCFIGSM Subregions 6, 7, 8, 9, 11, and 12 were defined based on this criterion.

Glenn County Basin Management Objectives Basin Management Sub-Areas

Additional model subregions were developed to provide geographic coverage similar to the basin management subareas used in the Glenn County Basin Management Objectives. This criterion was utilized to define four subregions within the model area in Glenn County as presented in Table 5.1 and shown in Figure 5.4. SCFIGSM Subregions 1 (portion in Glenn County), 5, 10, and 13 were defined based on this criterion.

Table 5.1
Stony Creek Fan Conjunctive Use Project
SCF IGSM Model Subregions

Stony Creek Fan Conjunctive Use Project		*Primary Criteria*	*Optional Criteria*	
Subregion Number	**Model Subregion Name**	**Stony Creek Fan Feasibility Study Water Balance Subunits**	**Glenn County BMO Basin Management Sub-Area**	**Comments**
1	Western Corning Basin	NA	1 (West Corning Basin Private Pumpers)	Includes unorganized areas in western Tehama County.
2	West of Willows Corning Fault	NA	NA	Includes the area between the northern extension of the Black Butte Fault and the Willows-Corning Fault.
3	Corning Water District	NA	NA	
4	Areas east of Corning Water District	NA	NA	
5	West Colusa Basin Private Pumpers	NA	3 (West Colusa Basin Private Pumpers)	
6	Orland Unit Water Users' Association	1 (Orland Unit Water Users' Association)		
7	East Corning Basin Private Pumpers	5 (East Corning Basin Private Pumpers)		
8	Orland-Artois Water District	2 (Orland-Artois Water District) and 4(Unorganized Pumpers embedded in OAWD)		
9	Board of Supervisors District Five Private Pumpers	6 (Board of Supervisors District Five Private Pumpers)		
10	Glide WD and Kanawha WD	NA	6 (Glide WD) and 7 (Kanawha WD) (and small portion of Sub-Area 11 west of GCID)	
11	Board of Supervisors District Three Private Pumpers	7 (Board of Supervisors District Three Private Pumpers)		
12	Glenn-Colusa Irrigation District (in Glenn County)	3 (Glenn-Colusa Irrigation District)		
13	Organized Areas in Eastern Glenn County	NA	12 (Provident ID), 13 (Willow Creek MWC), 14 (Princeton-Codora- Glenn ID)	Includes portion of Willow Creek MWC in Glenn County.
14	Unorganized Areas in western Colusa County	NA	NA	
15	Glenn Colusa Irrigation District (in Colusa County)	NA	NA	Includes portion of GCID in Colusa County north of Highway 20.
16	Organized Water Users in Colusa County	NA	NA	Includes Maxwell ID, Colusa Drain Water Users' Association
17	Unorganized Areas in Eastern Colusa County	NA	NA	



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Model Subregions

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FIGURE 5.4

Tehama County

Four subregions were defined in Tehama County based on the hydrogeologic conditions and water supply source (access to surface water). Subregions 1 (portion in Tehama County), 2, 3, and 4 were defined based on this criterion.

Colusa County

Four subregions were defined in Colusa County, primarily based on the water supply source (access to surface water). Subregions 14, 15, 16, and 17 were defined based on this criterion.

The purpose of this section is to document the data and methodology used to develop the stratigraphy data for the SCFIGSM. The stratigraphy data is assigned to each model node in the model area (total of 1853 model nodes) for each layer included in the model.

The methodology to develop the SCFIGSM stratigraphy data involved a three-step process described below:

- **Step 1. Develop Preliminary Stratigraphy Data:** The purpose of this step is to collect and analyze the available stratigraphy data for the model area and develop a preliminary set of stratigraphy data for the SCFIGSM.
- **Step 2. Refine Stratigraphy Data:** The purpose of this step is to refine the SCFIGSM stratigraphy data set developed in Step 1 to check for accuracy and reasonableness of the data.
- **Step 3. Quality Control of Stratigraphy Data:** The purpose of this step is to complete the quality control process of SCFIGSM stratigraphy data and develop the figures and tables necessary to allow efficient presentation and review of the stratigraphy data.

STEP 1: PRELIMINARY STRATIGRAPHY BASED ON CROSS-SECTION DATA

The goal of Step 1 is to convert the available cross-section data (randomly spaced stratigraphy data) to each of the SCFIGSM model nodes. The six sub steps listed below were required to develop the preliminary SCFIGSM stratigraphy data file.

- **Step 1A. Collect Cross-Section Data Available From DWR**
- **Step 1B. Digitize Cross-Sections to Establish Control Points**
- **Step 1C. Aggregate Control Point Data to SCFIGSM Layers**
- **Step 1D. Distribute Stratigraphy Layer Data to SCFIGSM Area**
- **Step 1E. Distribute Stratigraphy Data to SCFIGSM Nodes**
- **Step 1F. Develop Model Layer Thickness by Model Nodes**

Each of these sub steps is described below.

STEP 1A. COLLECT CROSS-SECTION DATA AVAILABLE FROM DWR

Based upon the review of available geologic and hydrogeologic data described in Section 2 of this technical memorandum, it was determined that the best source of data available to develop the stratigraphy data for the SCFIGSM was the recent set of cross-sections developed by the DWR Northern District. The Northern District office completed two sets of cross-sections, one for the northern Sacramento Valley, and a second set for the Stony Creek Fan Area. Each of these sets of cross-sections is described below.

Sacramento Valley

The Northern District developed six cross-sections based on electric logs for the northern Sacramento Valley. The northern Sacramento Valley generally includes the portion of the Central Valley north of the Sutter Buttes and extending north to Redding. This includes portions of Colusa, Butte, Glenn, Tehama, and Shasta Counties.

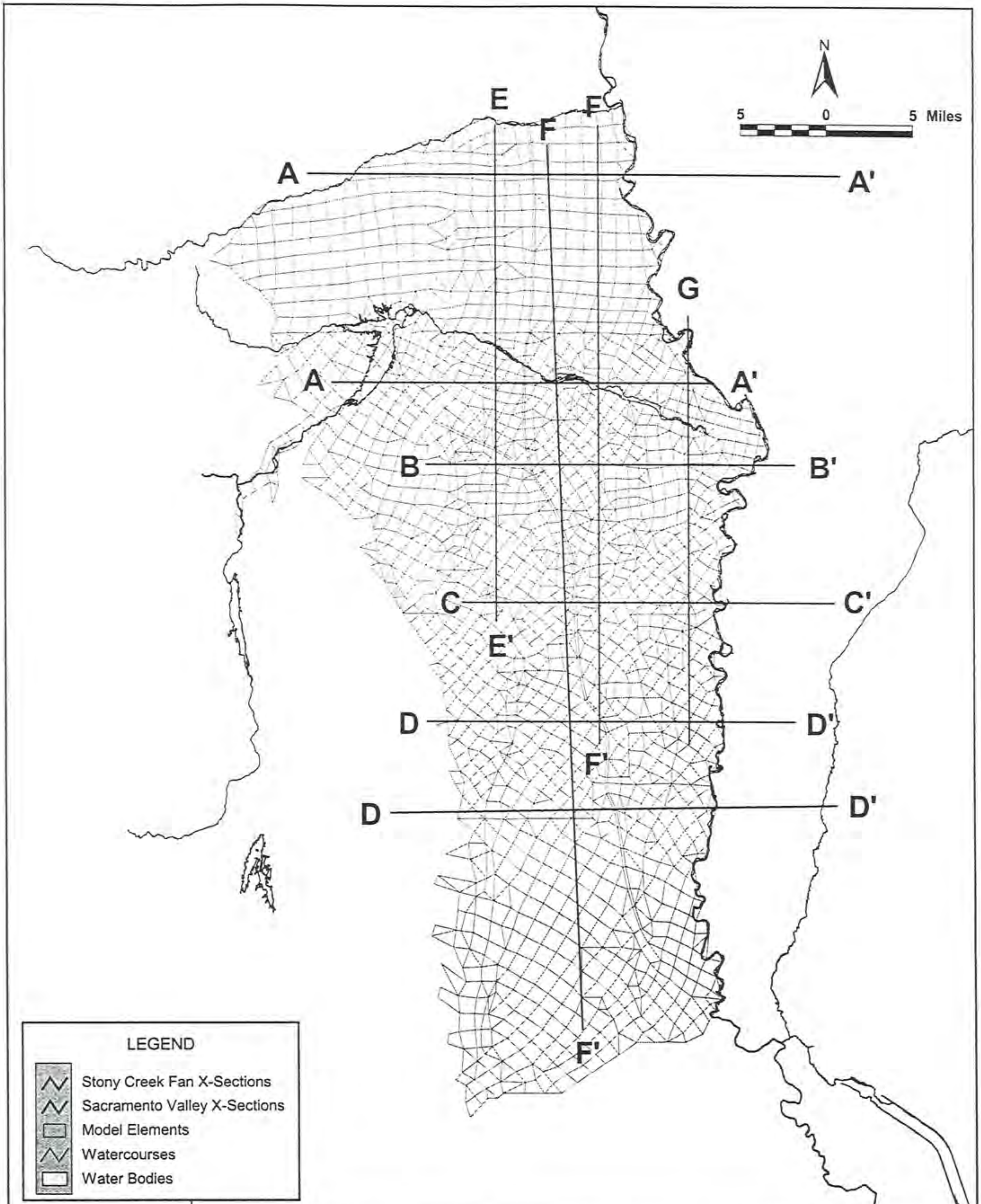
Stony Creek Fan

More recently, the Northern District developed seven cross-sections based on electronic logs for the Stony Creek Fan Area. These were developed as part of the Department's ongoing investigation of the Stony Creek Fan Area. These sections were the primary source of stratigraphy data used to develop the model layering in the SCFIGSM.

The three cross-sections from the Sacramento Valley cross-sections were used to extend the Stony Creek Fan cross-section data to the entire SCFIGSM model area for those areas that extend beyond the Stony Creek Fan. The Northern District provided electronic files for each of the cross-sections included in their analysis. Figure 6.1 shows the sections used in this analysis.

STEP 1B. DIGITIZE CROSS-SECTIONS TO ESTABLISH CONTROL POINTS

Once the selected DWR cross-sections within the SCFIGSM model area were identified, all geologic layers were digitized using Surfer 8.0 (Surfer). The digitization required carefully tracing each contact and fault as well as digitizing the minimum and maximum x and y



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DWR Geologic Cross Sections Used in Stratigraphic Analysis

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FIGURE 6.1

values from the axes of each cross section. This process established control points (points of known location and stratigraphic thickness), which would be used to develop the stratigraphic data.

STEP 1C. AGGREGATE CONTROL POINT DATA TO SCFIGSM LAYERS

This step converts the control points of the individual cross-sections developed in Step 1B to the model layers to be used in the SCFIGSM.

Approximately 500 control points were identified to represent the base for each model layer from the digitized cross-sections. This process was completed for the:

- Elevation of the Base of Model Layer 1,
- Elevation of the Base of Model Layer 2 (base aquifer system in the western portion of the SCFIGSM),
- Elevation of the Base of Model Layer 3, and
- Elevation of the Base of Model Layer 4 (base aquifer system in the eastern portion of the SCFIGSM).

The ground surface elevation was developed from digital elevation model (DEM) data developed by the USGS.

STEP 1D. DISTRIBUTE STRATIGRAPHY LAYER DATA TO SCFIGSM AREA

The purpose of this step is to distribute the model layer elevation control point data developed in Step 1C to the SCFIGSM nodes. The irregularly spaced control points for each model layer were distributed to a finely spaced regular grid. This was completed with Surfer using a 250 by 250 mesh grid that covered the SCFIGSM area.

STEP 1E. DISTRIBUTE STRATIGRAPHY DATA TO SCFIGSM NODES

The purpose of this step is to assign the model layer elevation data from fine mesh grid (Step 1D) to SCFIGSM model nodes. This was completed using the bilinear interpolation provided in Surfer. Note the SCFIGSM grid is generally coarser than the fine mesh grid.

STEP 1F. DEVELOP MODEL LAYER THICKNESS BY MODEL NODES

The purpose of this step was to convert the model layer elevation data to model layer thickness (for input into the SCFIGSM stratigraphy data file). This was completed by determining the difference between model layers at each node. The thickness of Model Layer 1 was calculated as the difference between the ground surface and the elevation of the base of Layer 1.

The completion of Step 1 provided a preliminary stratigraphy data file for the SCFIGSM area. Any Further refinements to the stratigraphy data in Step 2 would be completed using the SCFIGSM stratigraphy model data.

STEP 2. STRATIGRAPHY DATA REFINEMENT

The purpose of Step 2 is to review and refine the SCFIGSM stratigraphy data file to confirm there was no loss of stratigraphy data integrity due to the data processing completed in Step 1. The stratigraphy refinement was completed through the following steps:

- **Step 2A. Check Model Stratigraphy Data Accuracy**
- **Step 2B. Check Model Stratigraphy Data Reasonableness**
- **Step 2C. Check Level of Detail of Model Stratigraphy Data**
- **Step 2D. Refine Model Stratigraphy Data**

Each of these steps is described below.

Step 2a. Check Model Stratigraphy Data Accuracy

The purpose of this step is to check the accuracy of the model stratigraphy data by comparing it to known and widely accepted stratigraphy data, including knowledge of faults, formation transitions, and accepted ranges and thickness. One of the primary checks for model data accuracy was to compare the model stratigraphy data to the original DWR cross-sections. Figures 6.2a–g compare the cross-section data. This included:

Figure 6.2 a
Stony Creek Fan IGSM
Comparison of SCFIGSM Stratigraphy with DWR Cross Section Data
SCF Section A

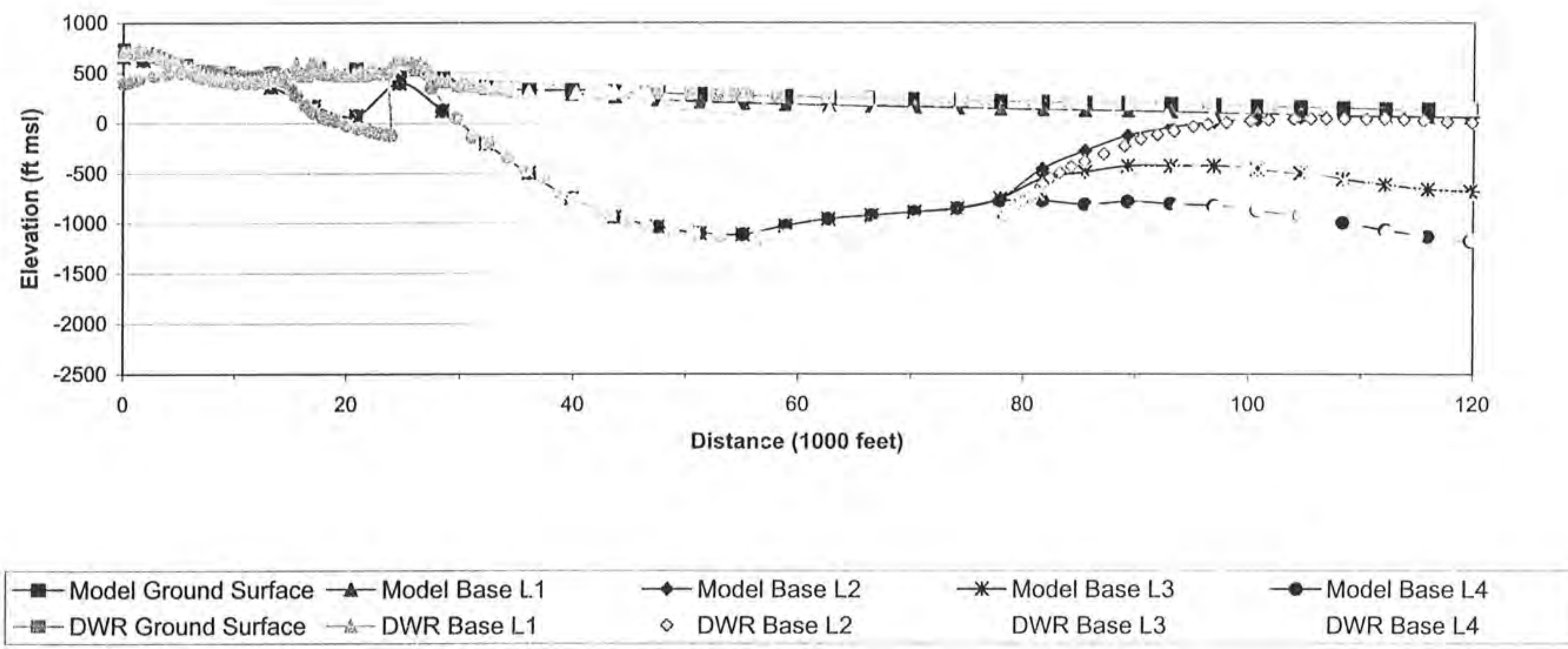


Figure 6.2 b
Stony Creek Fan IGSM
Comparison of SCFIGSM Stratigraphy with DWR Cross Section Data
SCF Section B

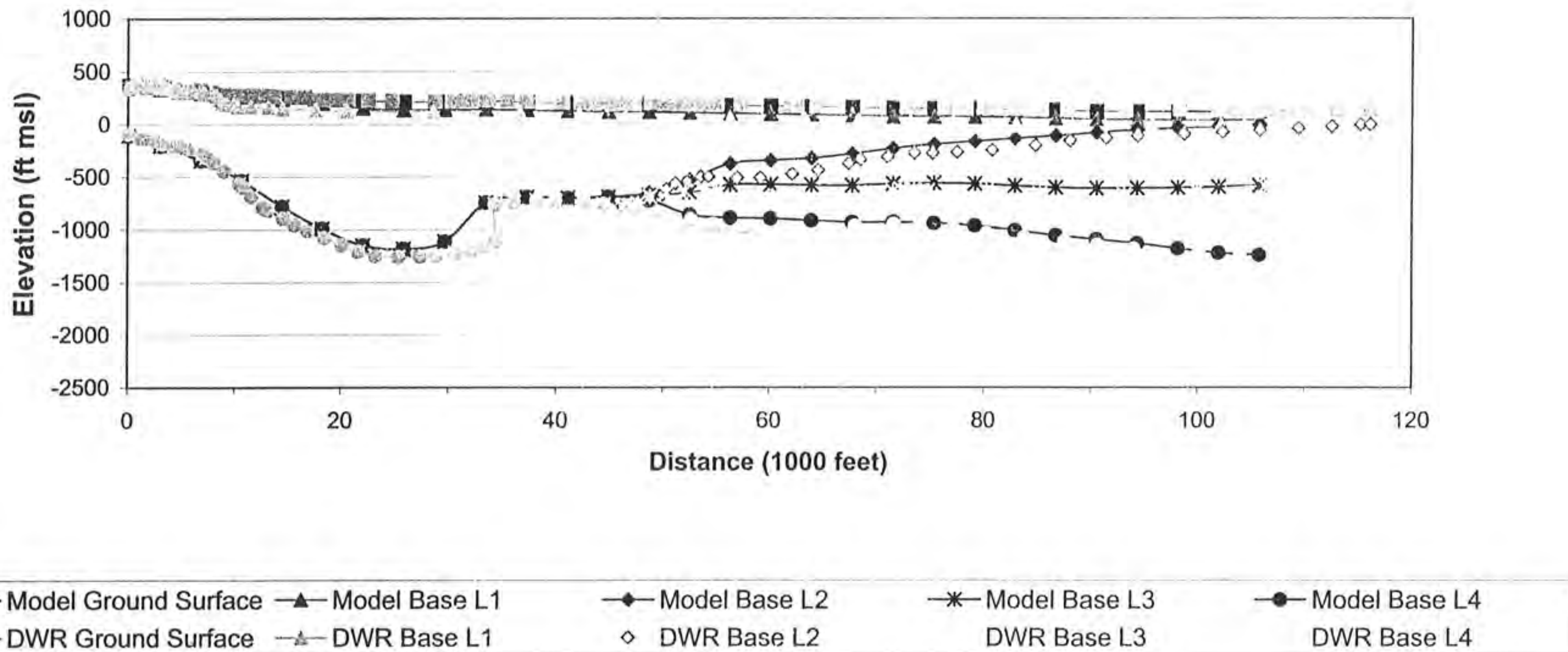


Figure 6.2 c
Stony Creek Fan IGSM
Comparison of SCFIGSM Stratigraphy with DWR Cross Section Data
SCF Section C

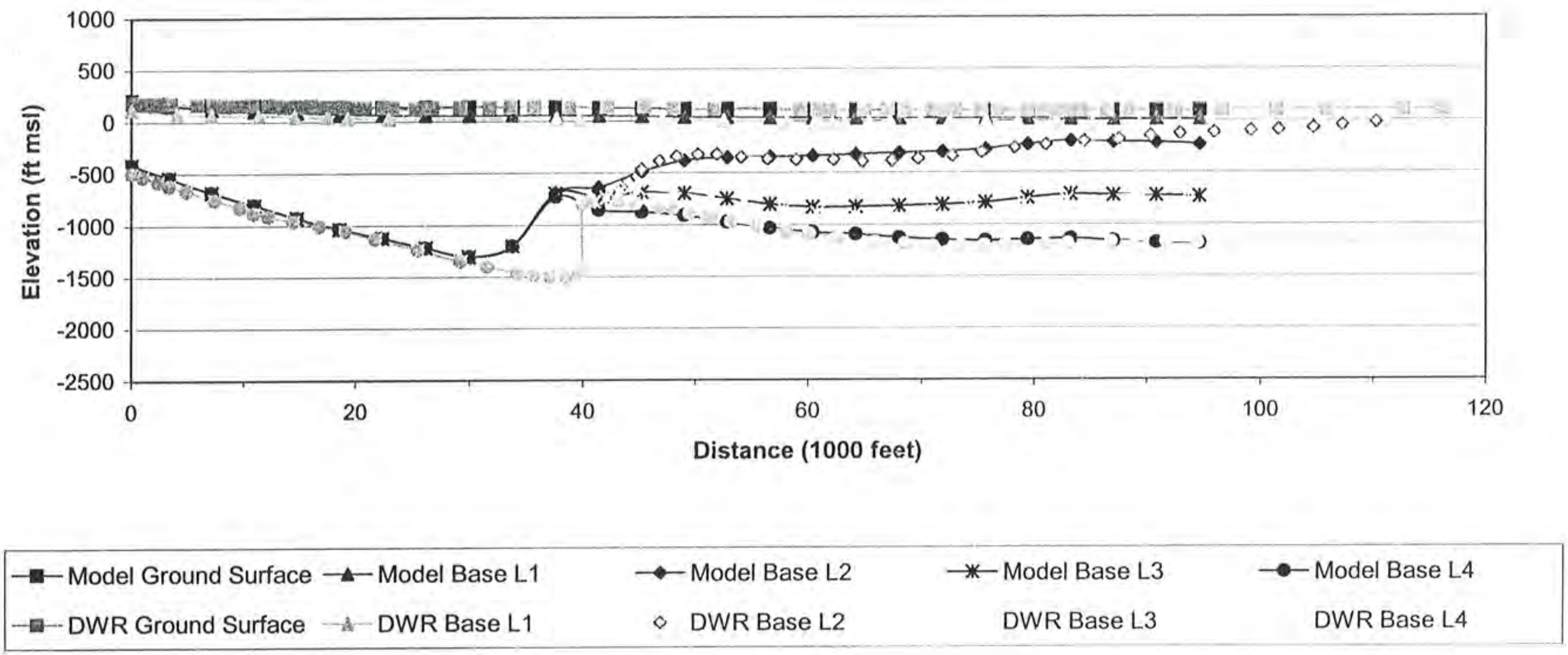


Figure 6.2 d
Stony Creek Fan IGSM
Comparison of SCFIGSM Stratigraphy with DWR Cross Section Data
SCF Section D

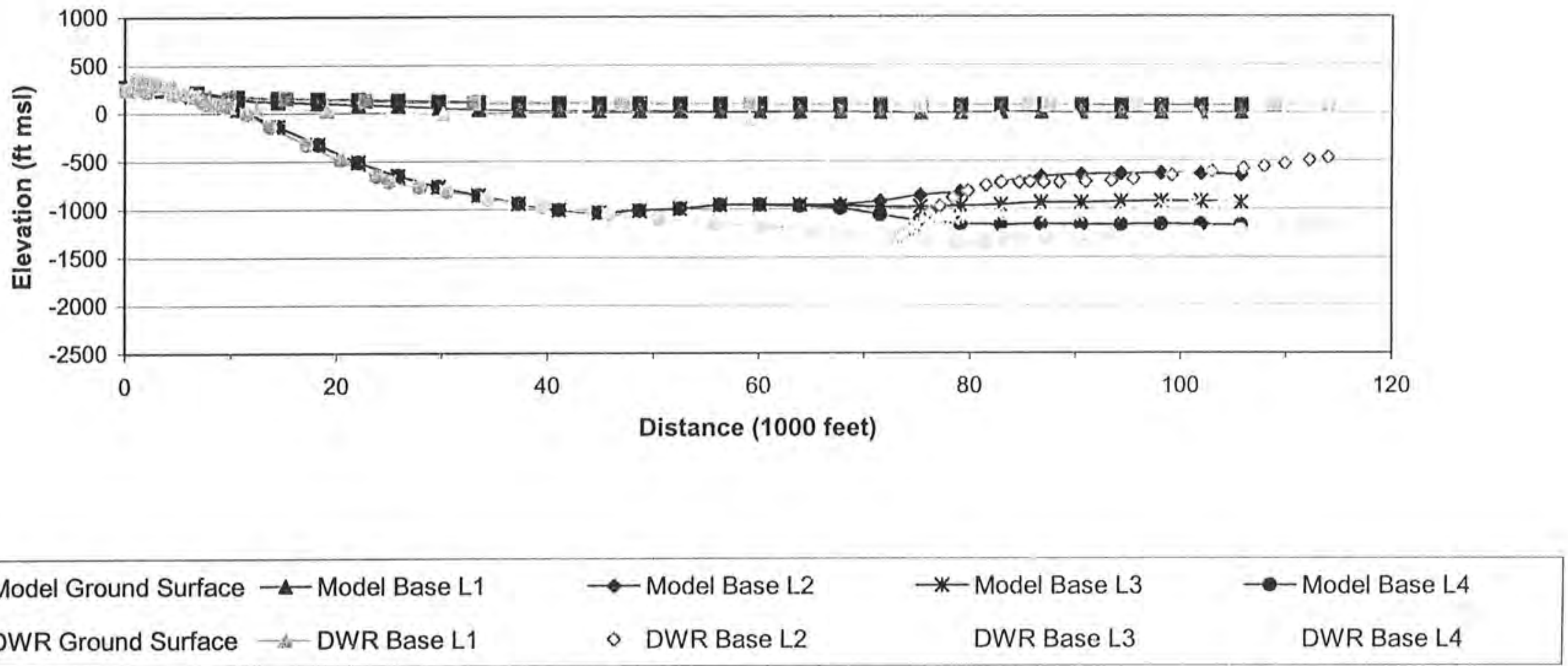


Figure 6.2 e
Stony Creek Fan IGSM
Comparison of SCFIGSM Stratigraphy with DWR Cross Section Data
SCF Section E

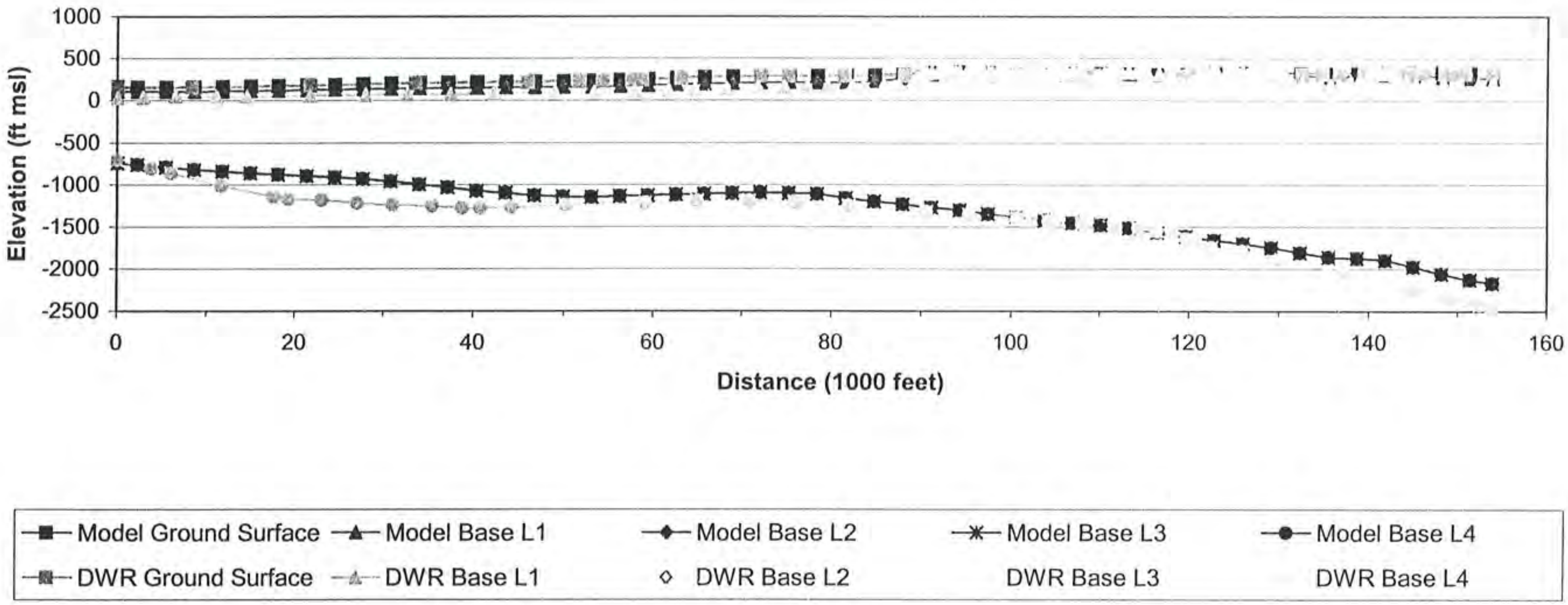


Figure 6.2 f
Stony Creek Fan IGSM
Comparison of SCFIGSM Stratigraphy with DWR Cross Section Data
SCF Section F

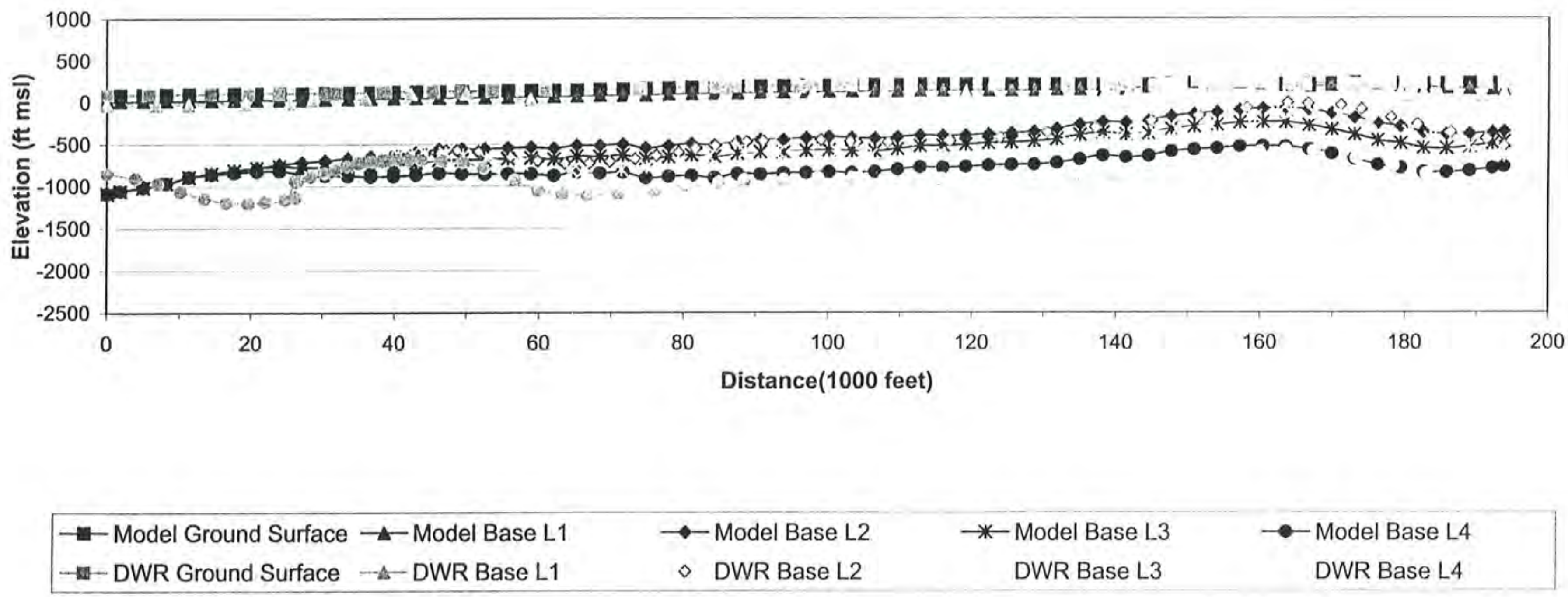
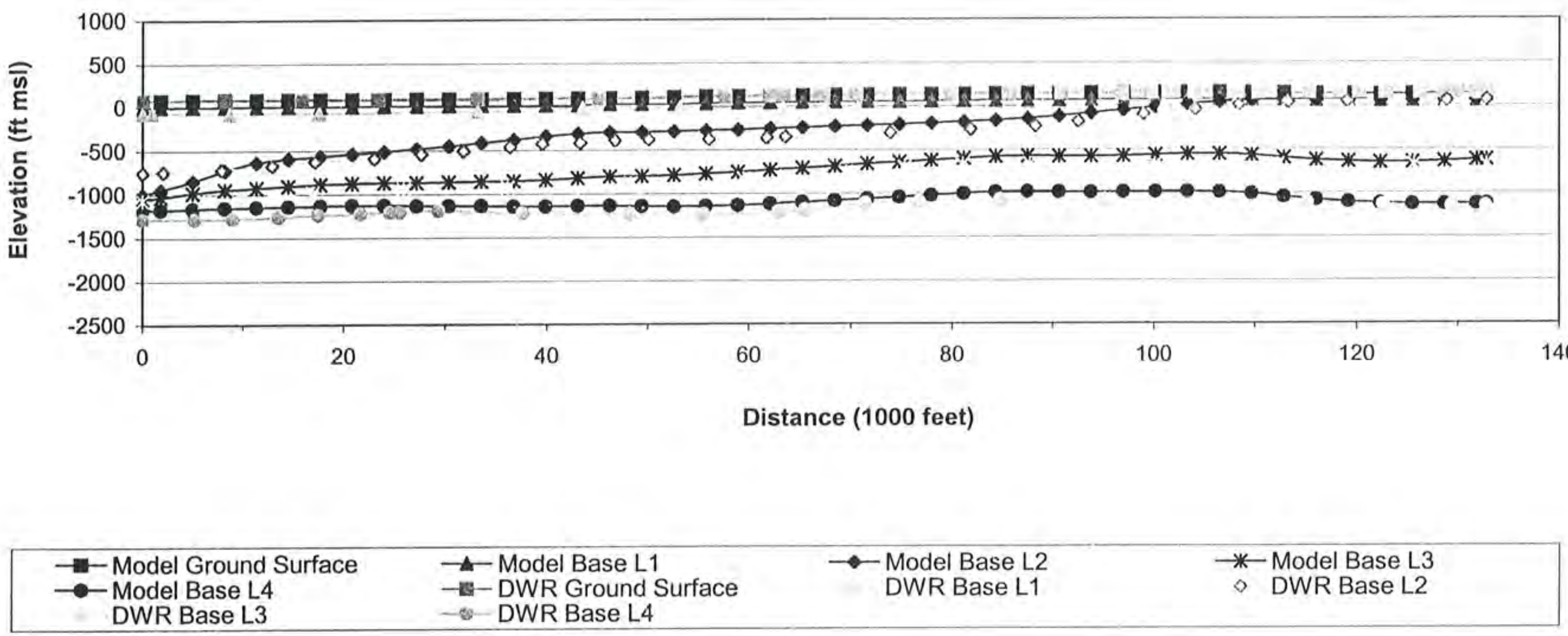


Figure 6.2 g
Stony Creek Fan IGSM
Comparison of SCFIGSM Stratigraphy with DWR Cross Section Data
SCF Section G



- Checking model data around faults to confirm location of fault and correct offset,
- Checking and modifying model data for changes in formation thickness, and
- Checking model layer thickness and comparing it to known data.

Step 2b. Check Model Stratigraphy Data Reasonableness

The purpose of this review is to confirm that the SCFIGSM stratigraphy data reflects the aquifer system identified in the hydrogeologic setting (Section 3). This step was completed by a review of model data and comparison to data not used in the stratigraphy data development process. This includes data from reports, previous studies, and expert opinions, and comparison to existing maps, aquifer thickness contours, or cross-sections.

Step 2c. Check Level of Detail of Model Stratigraphy Data

The model data should not suggest that we know information at a higher level of detail than is presented in the original source of the data. This step includes checks of the:

- Interpretation of the available (original data) to the model data; and
- Presentation of the model data.

Step 2d. Refine Model Stratigraphy Data

The stratigraphy model data is refined to reflect the information developed in Steps 2A through 2C. Stratigraphy model data refinement needs to be done carefully, recognizing that modifying the base of a model or the thickness of a model layer affects all the stratigraphic data at the corresponding model node.

STEP 3. STRATIGRAPHY DATA QUALITY CONTROL

The purpose of Step 3 is to evaluate each SCFIGSM model layer to confirm that the model stratigraphy data accurately reflects the conceptual hydrogeology presented in Section 4 and the original available data (DWR cross-section data). Maps showing the thickness of aquifer layers and the base of elevations were used to check the model data. The quality control for each model layer is described below.

Step 3a. Check Ground Surface Elevation

The ground surface elevation data was developed from a USGS digital elevation model (DEM) for the northern Sacramento Valley. The ground surface data is shown in Figure 6.3. The model ground surface elevation was checked by comparing it to the ground surface elevation data from the USGS 1:250,000 map series.

Step 3b. Check Base of the Aquifer System

In the western half of the SCFIGSM model area, the base of the aquifer system is the base of the Tehama Formation (Layer 2). In the eastern half of the SCFIGSM model area, the base of the aquifer system is the Lower Tuscan Formation (Layer 4).

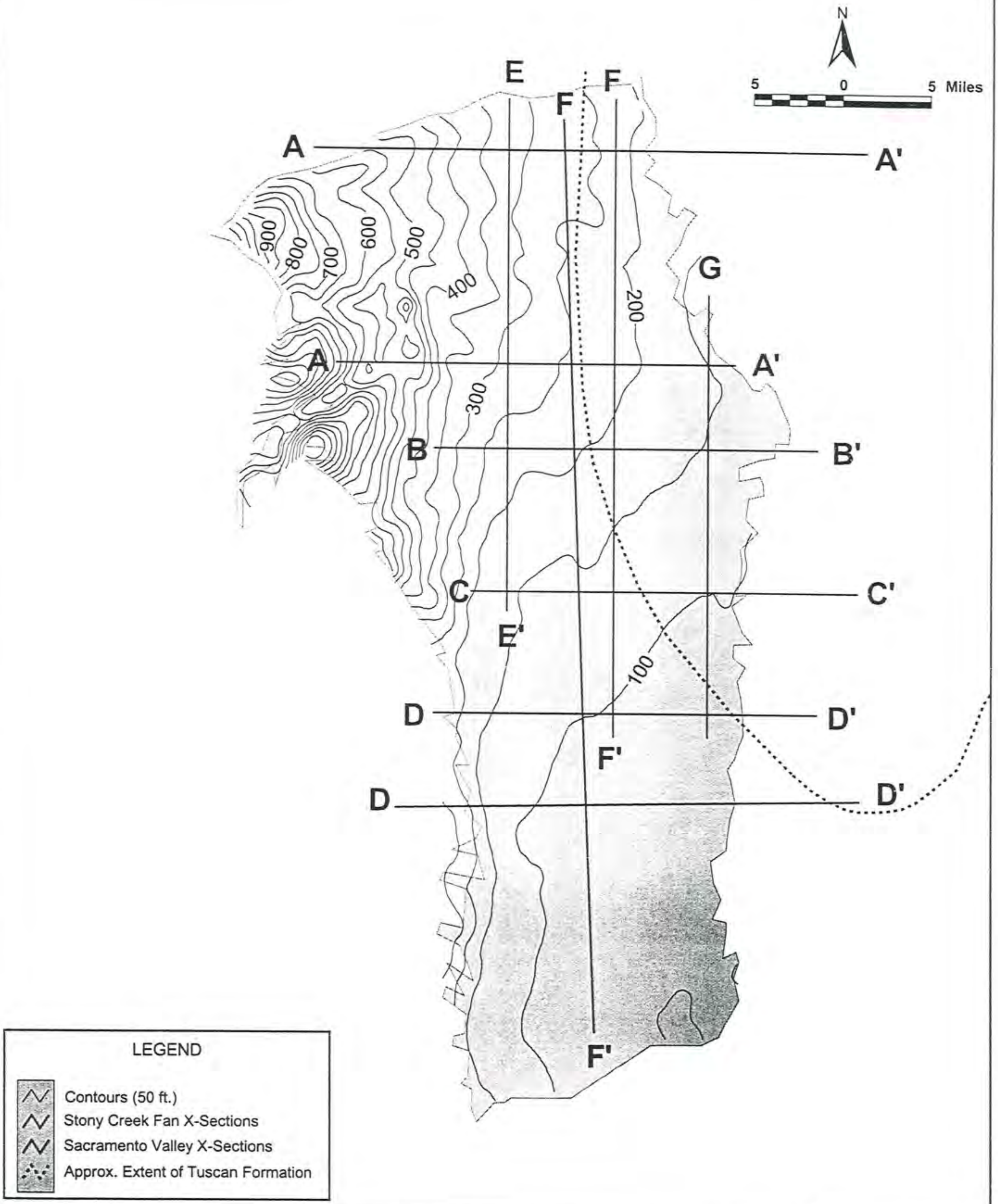
In general, the modeled aquifer system ranges from less than 50 feet thick to about 2,500 feet thick as shown in Figure 6.4. The elevation of the base of the modeled aquifer system ranges from 800 feet above sea level to 2,400 feet below sea level as shown in Figure 6.5.

Step 3c. Check Model Layer 1 (Alluvial Aquifer)

Model Layer 1 primarily represents the alluvial aquifer system. In the areas on the Stony Creek Fan, is represents the high permeability sand and gravels which generally range from 50 to 80 feet thickness (Figure 6.6). Outside the Stony Creek Fan, Layer 1 represents the upper 80 feet of alluvial and basin deposits, even in areas were the total thickness exceeds 80 feet. Layer 1 is not present in the northwest portion of the model area were the Tehama Formation is present at the ground surface, thus Layer 1 has zero thickness as shown in Figure 6.6. The elevation of the base of Layer 1 ranges from more than 900 feet above sea level in the northwest part of the model area to just below sea level in the southeast part of the model area as shown in Figure 6.7.

STEP 3D. CHECK MODEL LAYER 2 (TEHAMA FORMATION)

Model Layer 2 generally represents the Tehama Formation. As mentioned, it does include some basin and alluvial deposits. Where model Layers 3 and 4 are not present, Layer 2 is the base of the aquifer system. In this area, Layer 2 ranges in thickness from less than 100



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Ground Surface Elevation Contour Map

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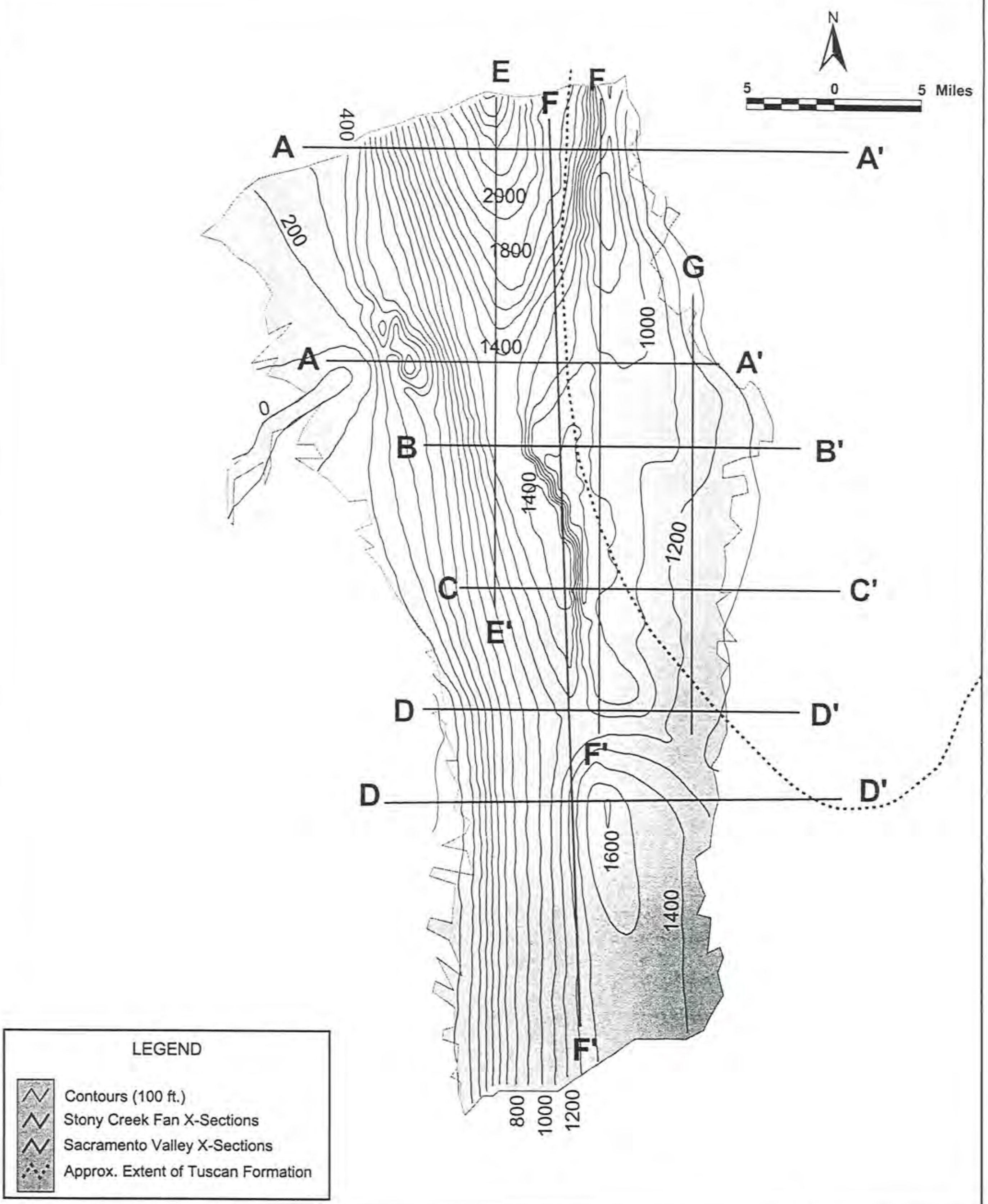
FIGURE 6.3



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Thickness of Alluvial Aquifer

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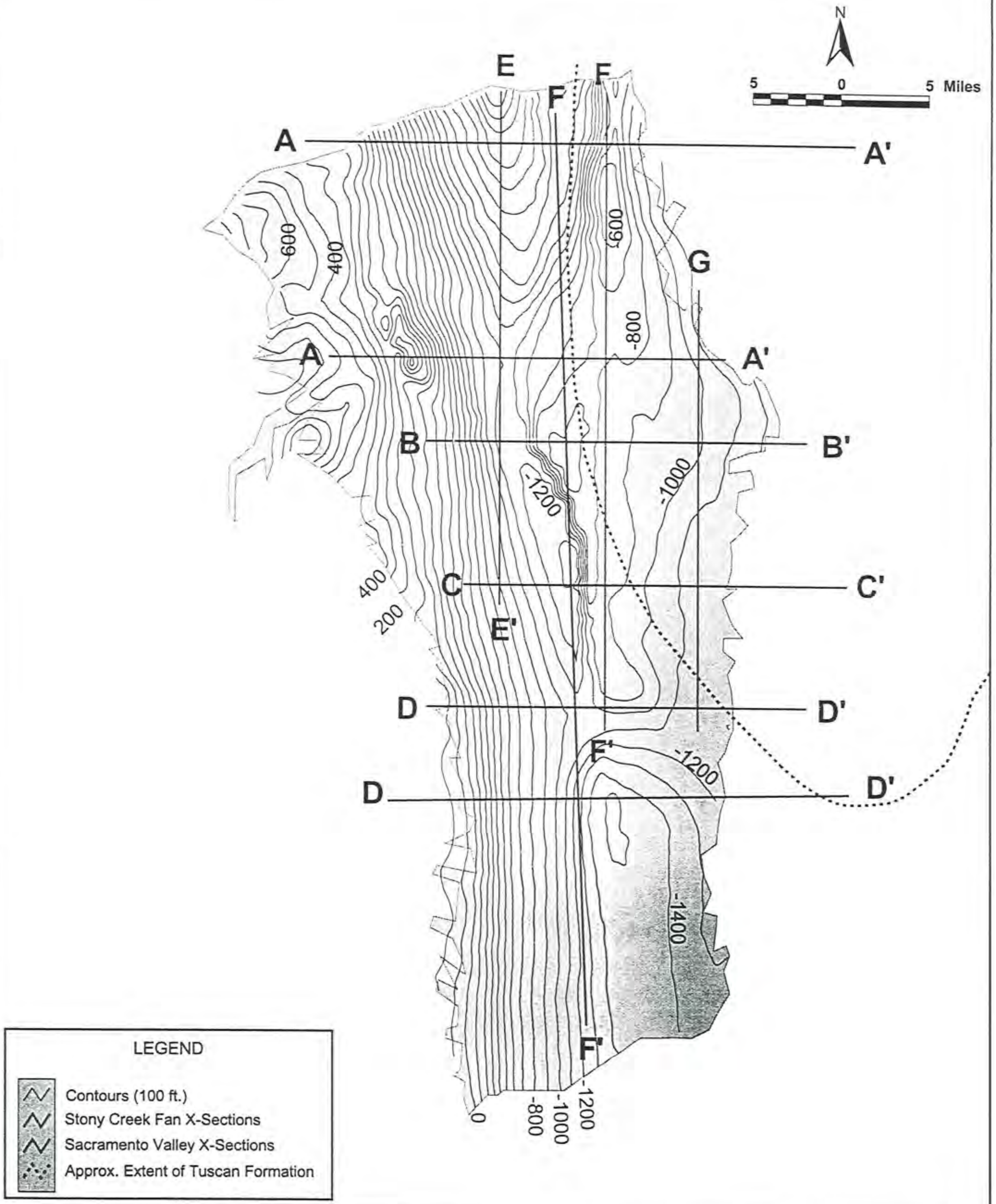
FIGURE 6.4



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Elevation of Base of Aquifer

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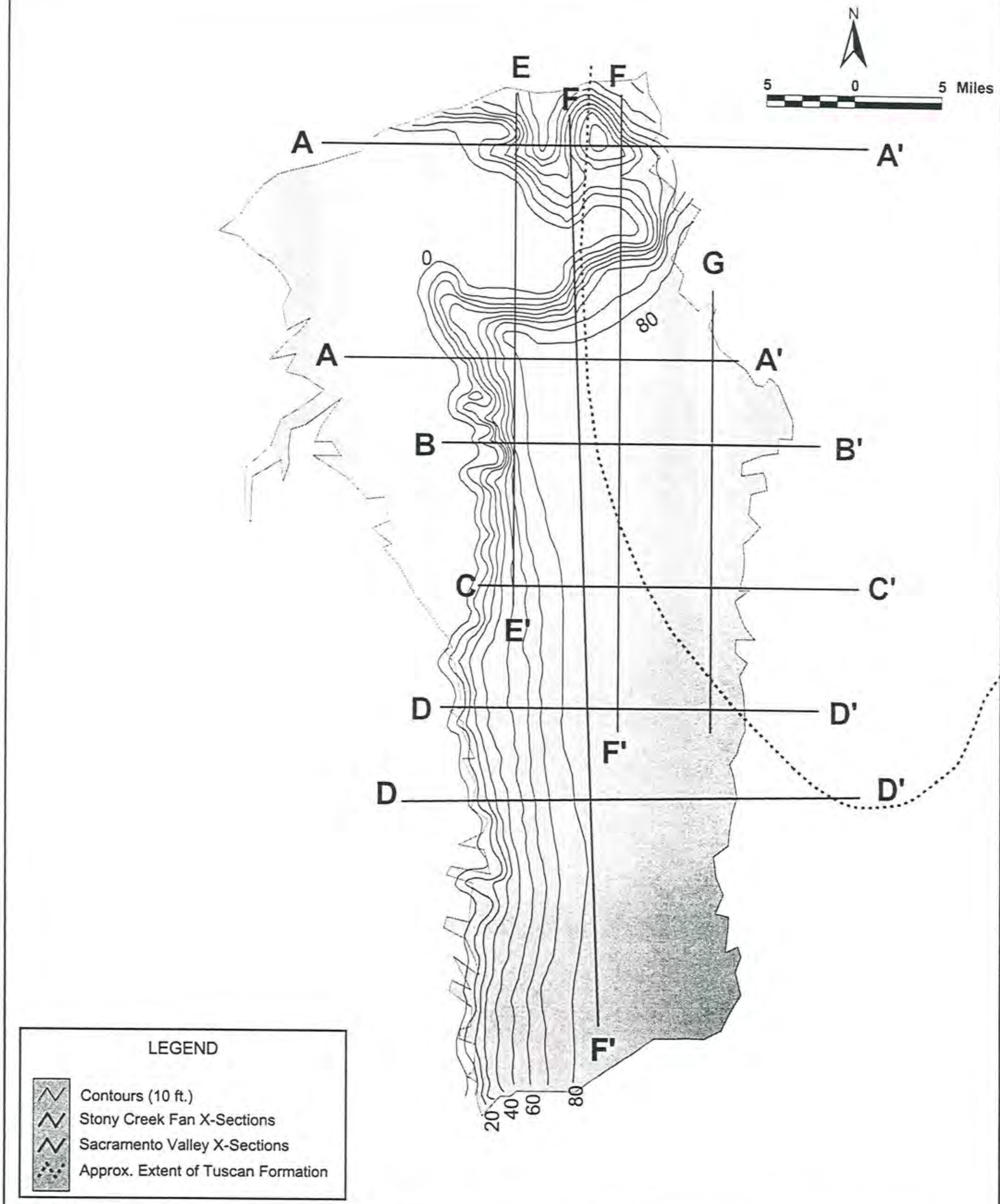
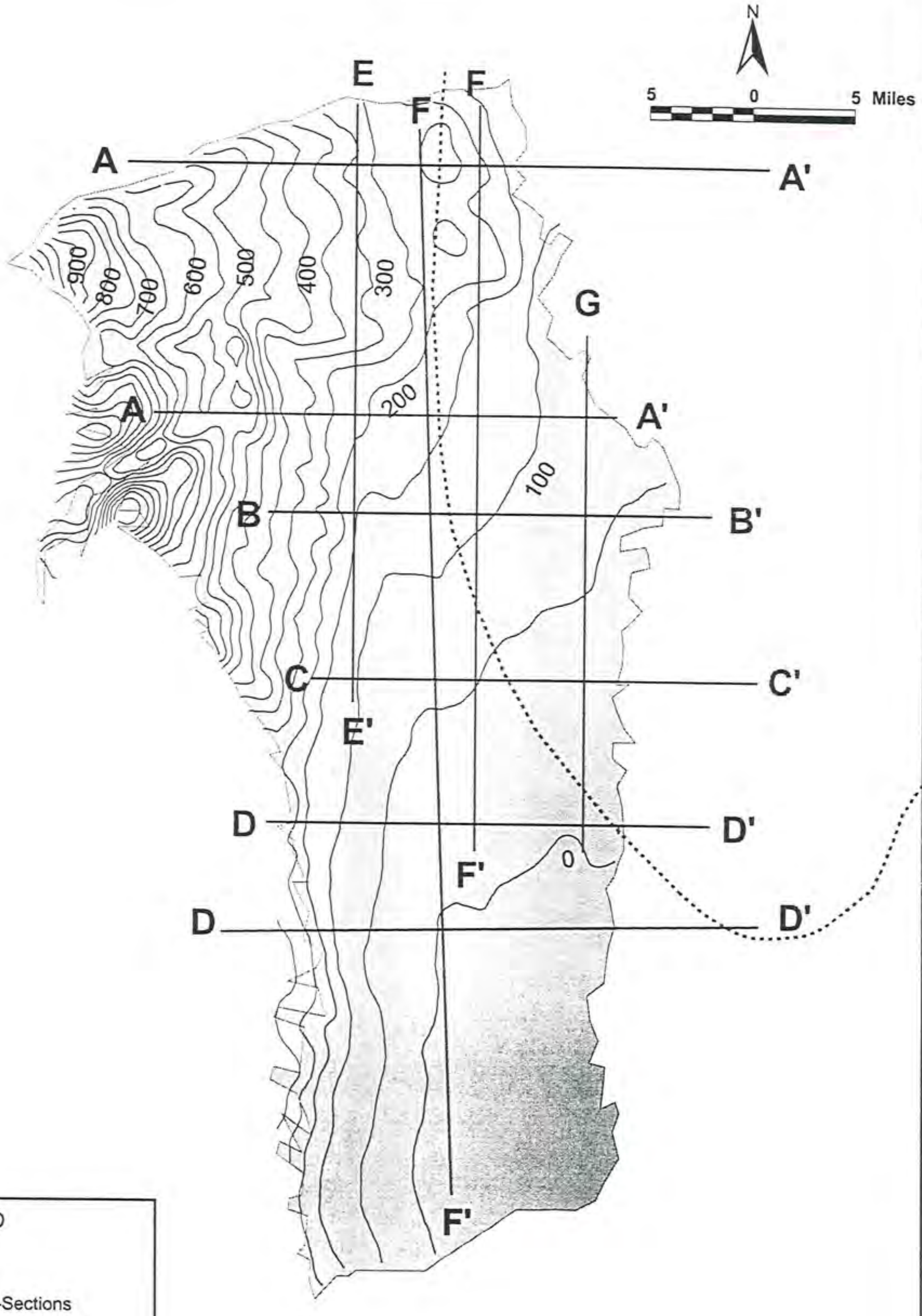
FIGURE 6.5



RIME Water Resources & Information Management Engineering, Inc.	STONY CREEK FAN CONJUNCTIVE WATER MANAGEMENT PROGRAM **Thickness of Layer 1** **DRAFT**	JANUARY 2003 FIGURE 6.6



LEGEND

- Contours (50 ft.)
- Stony Creek Fan X-Sections
- Sacramento Valley X-Sections
- Approx. Extent of Tuscan Formation

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Elevation of Base of Layer 1

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FIGURE 6.7

feet in to more than 2,400 feet, as shown in Figure 6.8. On the western half of the model area, Layer 2 generally increases from less than 100 feet near the western edge of the model area to about 1,200 feet near the center of the model area. In the northern portion of the model area, Layer 2 achieves its maximum thickness of more than 2,400 feet.

Where Layers 3 and 4 are present beneath Layer 2, Layer 2 decreases in thickness from about 1,200 feet thick near the center of the model are zero thickness along the northeastern edge of the model boundary.

The abrupt changes in the thickness in Layer 2 are due to offset along the Corning-Willows Fault (located near the center of the model area in a north-south direction), and the presence of the Tuscan Formation (entering the model area from the east).

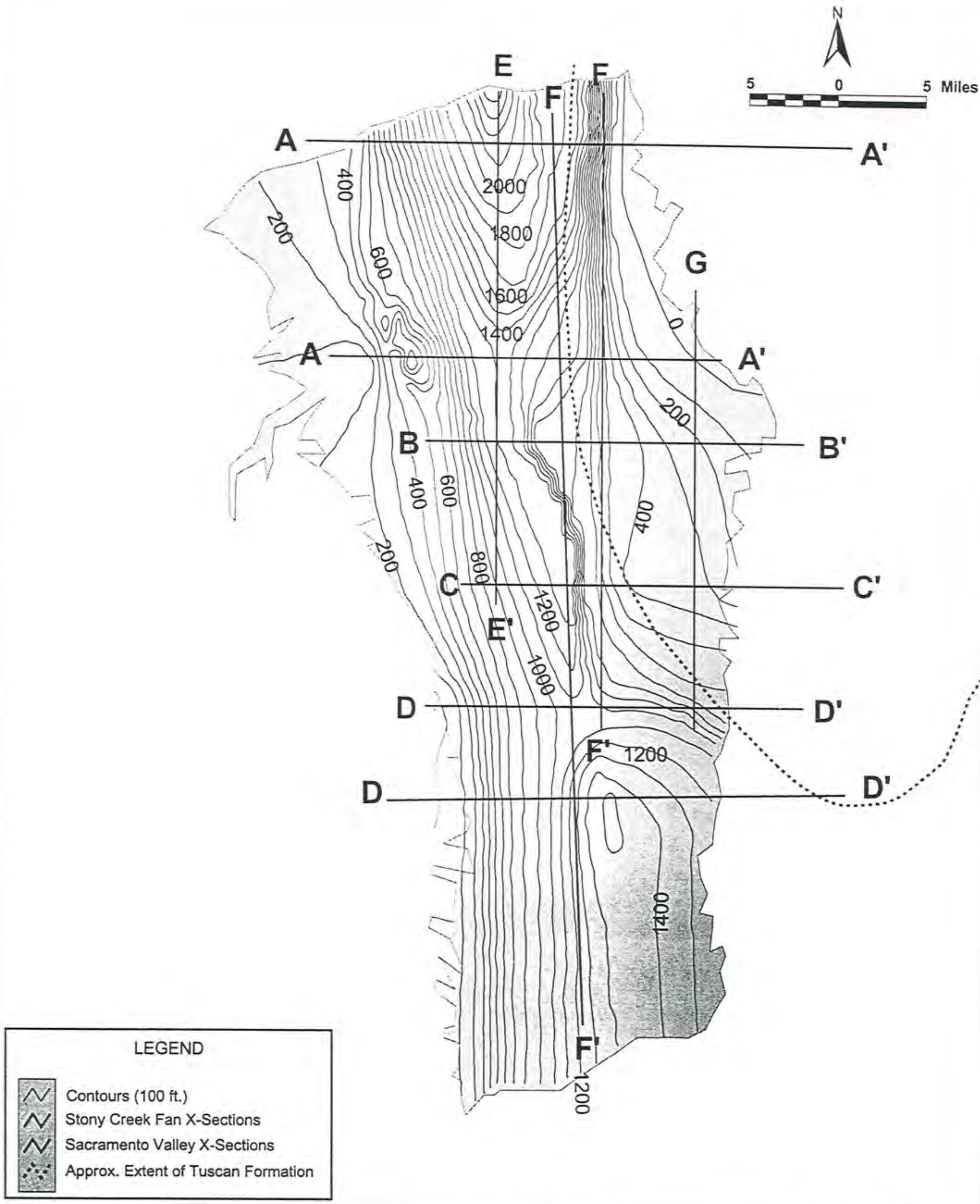
Figure 6.9 shows the elevation of the base of Layer 2 ranges from 800 feet above sea level to more that 2,000 feet below sea level.

STEP 3E. CHECK MODEL LAYER 3 (UPPER TUSCAN FORMATION)

Model Layer 3 represents the Upper Tuscan Formation. It extends about halfway into the model are from the northeast ranging in thickness from zero to 700 feet as shown in Figure 6.10. Layer 3 is not present in the western or southern portion of the model area. The elevation of the Base of Layer 3 ranges from near sea level in the northern area to about 1,000 feet below sea level at its southern extent as shown in Figure 6.11.

STEP 3F. CHECK MODEL LAYER 4 (LOWER TUSCAN FORMATION)

Model Layer 4 represents the Lower Tuscan Formation. It extends about halfway into the model are from the northeast ranging in thickness from zero to about 600 feet as shown in Figure 6.12. Layer 4 is not present in the western or southern portion of the model area. The elevation of the Base of Layer 4 ranges from about 500 feet below sea level in the northern are to about 1,200 feet below sea level near the eastern edge of the model area as shown in Figure 6.13 It should be noted that in that where present, Layer 4 represents the base of the aquifer system.



WRIME Water Resources & Information Management Engineering, Inc.

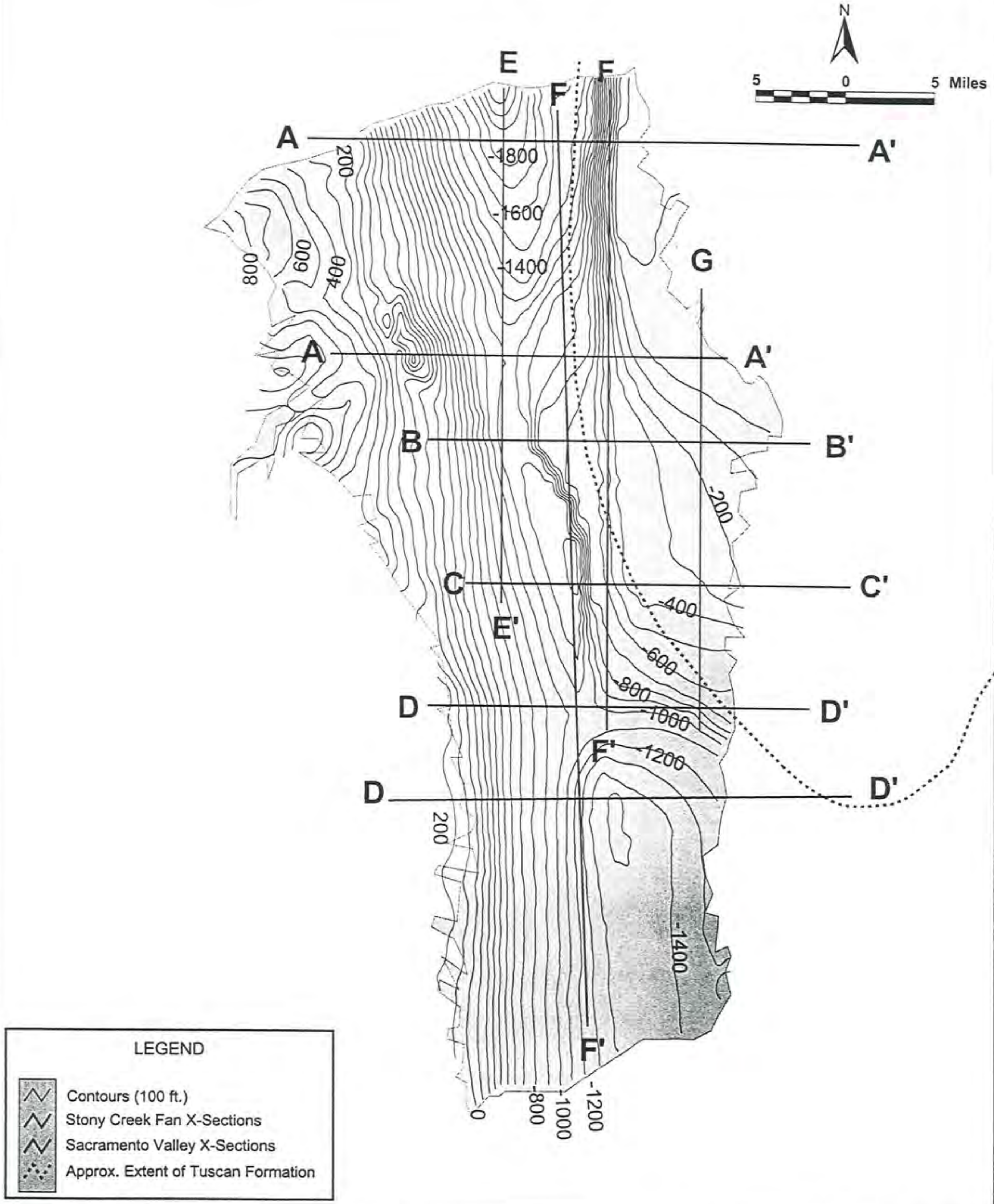
STONY CREEK FAN CONJUNCTIVE WATER MANAGEMENT PROGRAM

Thickness of Layer 2

DRAFT

JANUARY 2003

FIGURE 6.8



RIME Water Resources & Information Management Engineering, Inc.

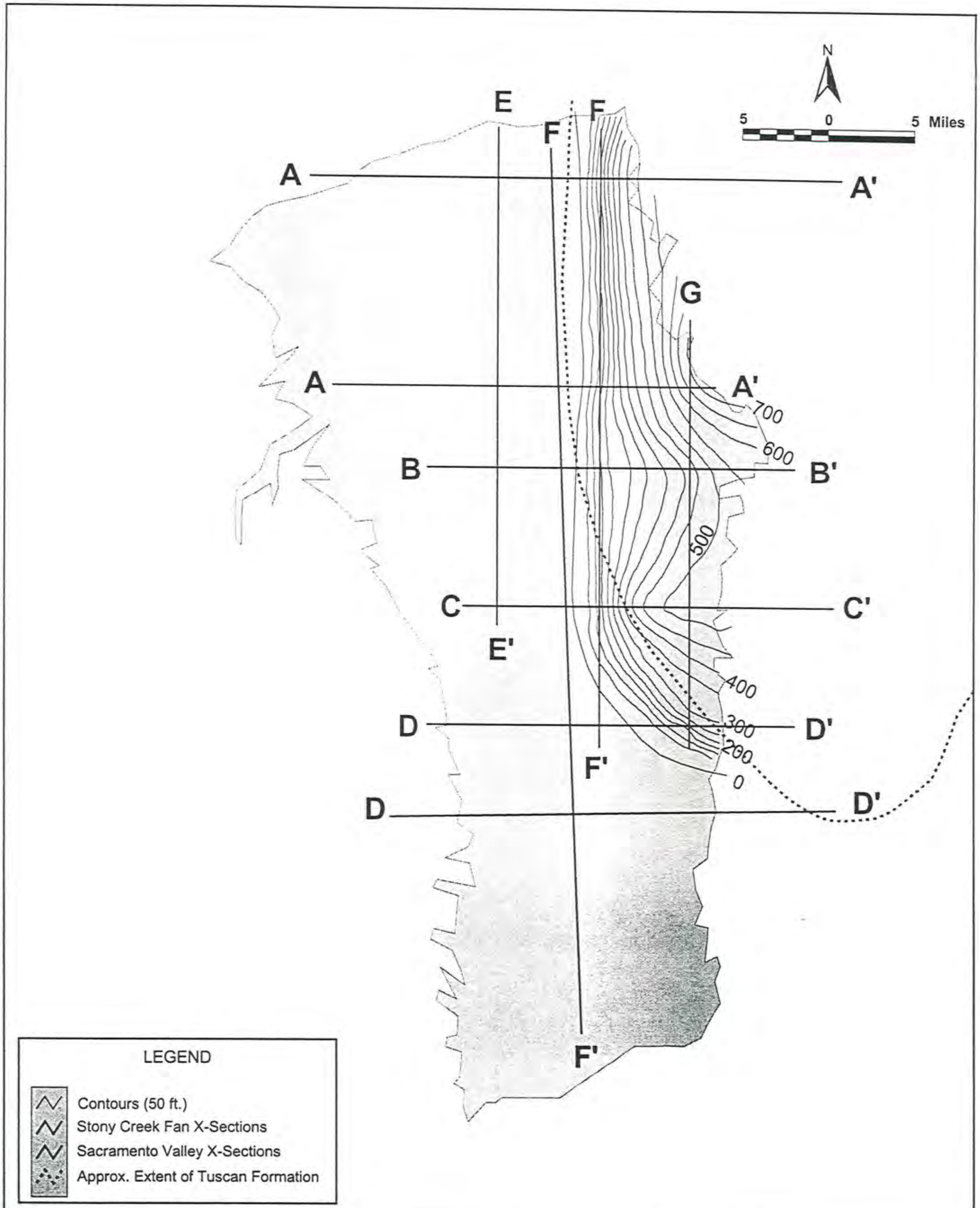
STONY CREEK FAN CONJUNCTIVE WATER MANAGEMENT PROGRAM

Elevation of Base of Layer 2

DRAFT

JANUARY 2003

FIGURE 6.9



RIME Water Resources & Information Management Engineering, Inc.

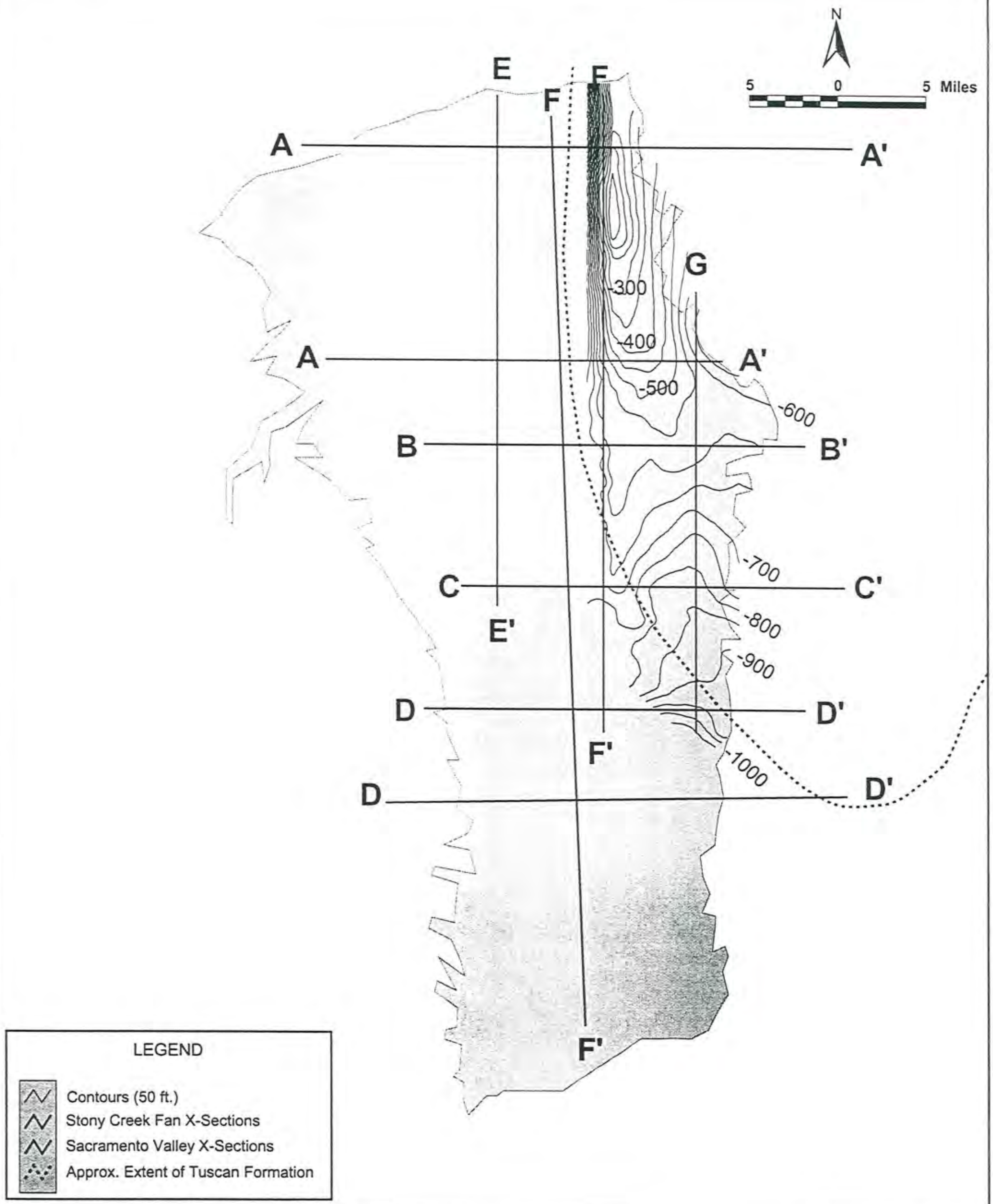
STONY CREEK FAN CONJUNCTIVE WATER MANAGEMENT PROGRAM

Thickness of Layer 3

DRAFT

JANUARY 2003

FIGURE 6.10



RIME Water Resources & Information Management Engineering, Inc.

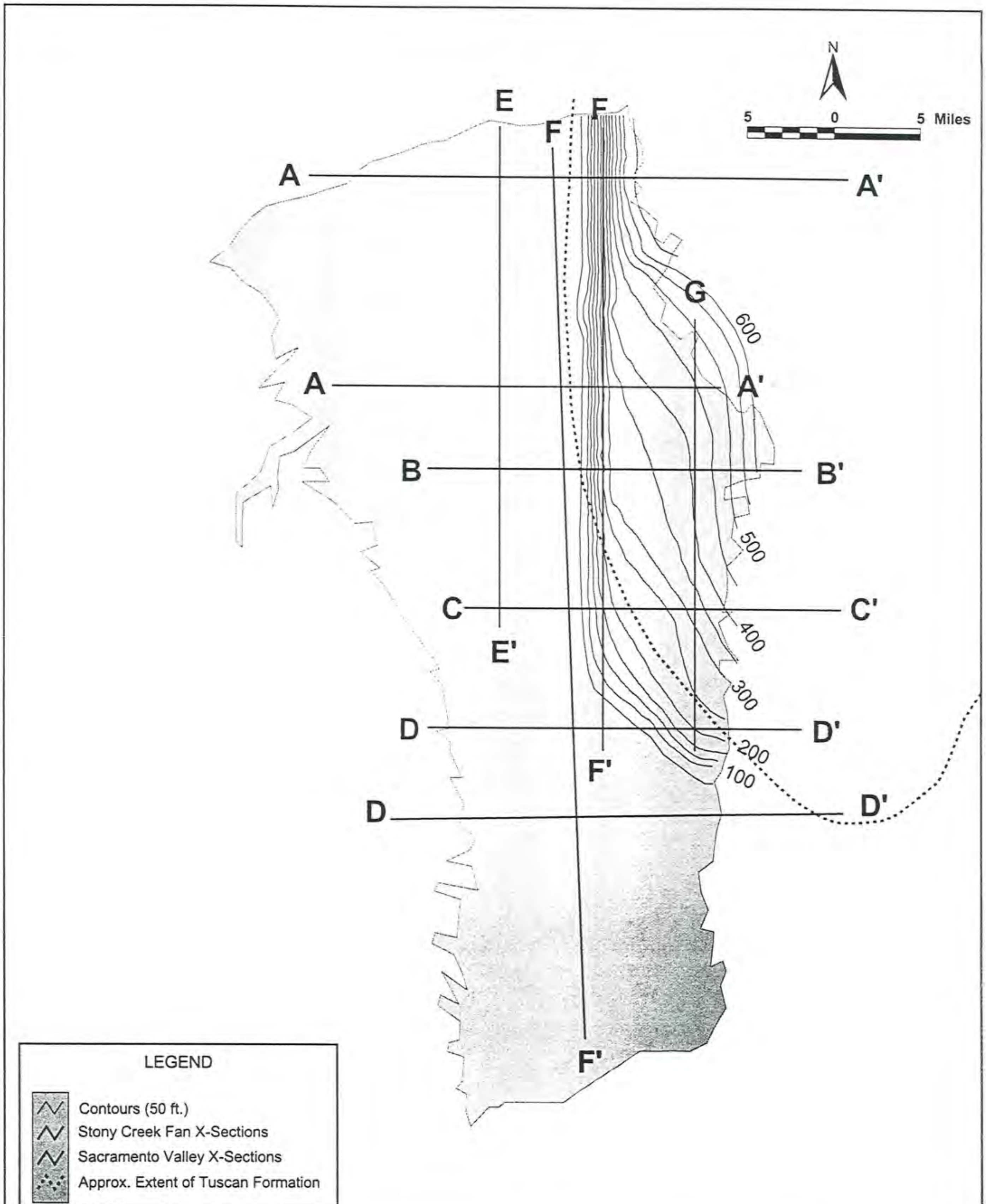
STONY CREEK FAN CONJUNCTIVE WATER MANAGEMENT PROGRAM

Elevation of Base of Layer 3

DRAFT

JANUARY 2003

FIGURE 6.11



RIME Water Resources & Information Management Engineering, Inc.

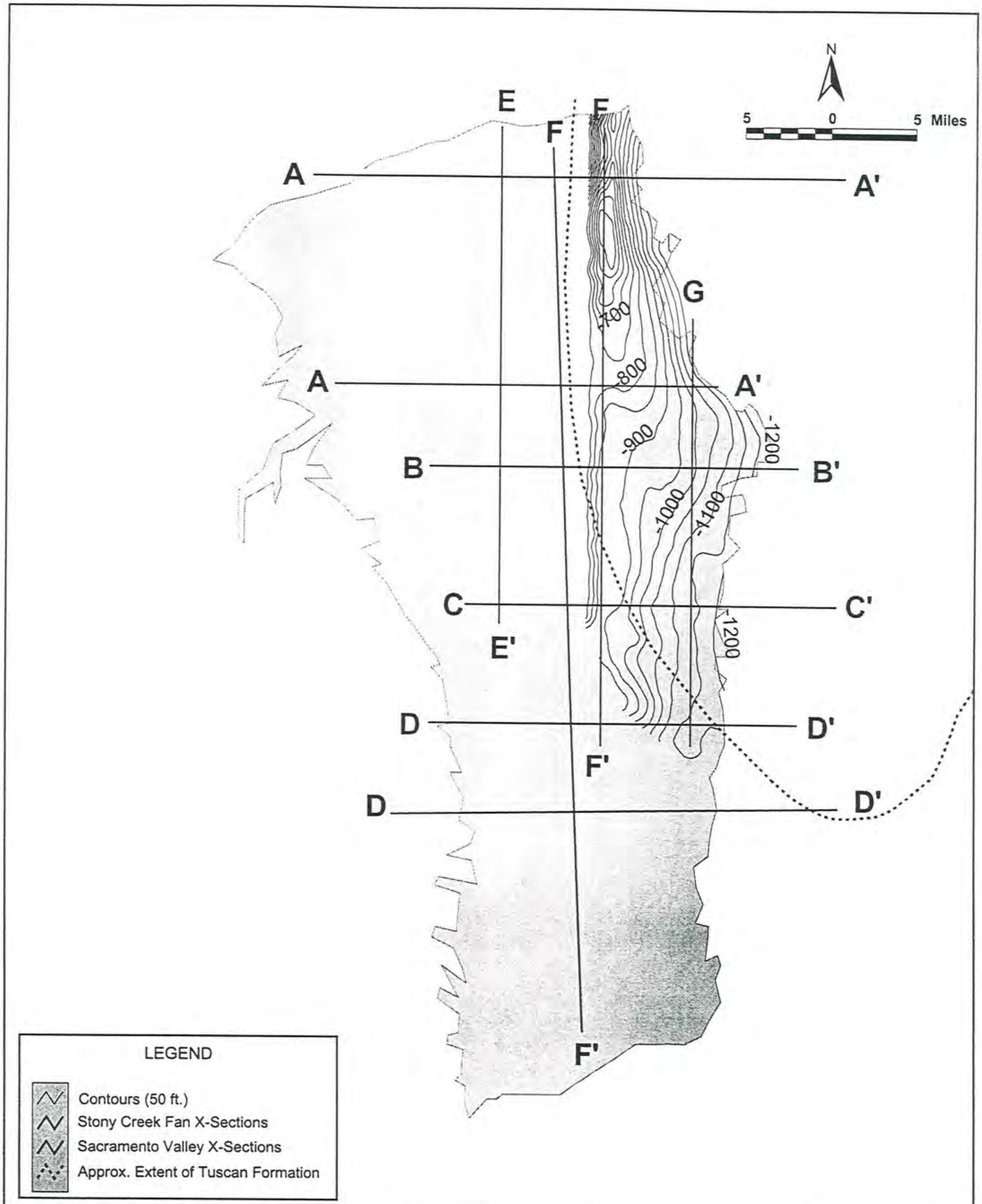
STONY CREEK FAN CONJUNCTIVE WATER MANAGEMENT PROGRAM

Thickness of Layer 4

DRAFT

JANUARY 2003

FIGURE 6.12



RIME Water Resources & Information Management Engineering, Inc.	STONY CREEK FAN CONJUNCTIVE WATER MANAGEMENT PROGRAM **Elevation of Base of Layer 4** **DRAFT**	JANUARY 2003 FIGURE 6.13

The SCFIGSM model grid and stratigraphy data were developed using the methodology described in this technical memorandum.

SCFIGSM MODEL GRID

The SCFIGSM model grid was developed to reflect local hydrogeologic, hydrologic, and water management conditions (Section 5).

SCFIGSM STRATIGRAPHY DATA

The SCFIGSM stratigraphy data was developed after an extensive data collection and review effort (Section 2). Geologic cross-sections provided by the California Department of Water Resources Northern District Office were the primary source of data for the stratigraphy model development. The geologic and hydrogeologic setting (Section 3) was developed based on the review, analysis, and interpretation of this unpublished data. This is followed by the development of the conceptual model stratigraphy (Section 4) for the SCFIGSM. The process to develop the SCFIGSM stratigraphy data from the available data included three steps including data development, data refinement, and data quality control (Section 6).

Colusa Groundwater Authority

Project Management Action (Proposed)

Date Proposed:	June 11, 2021
Project Title:	Colusa Drain Mutual Water Company (CDMWC) In-lieu Groundwater Recharge
Project Type:	In-lieu Groundwater Recharge
Project Proponent:	Colusa Drain Mutual Water Company
Measurable Objectives to Benefit:	Groundwater levels and groundwater storage
Water Source:	Sacramento River through CDMWC contractual rights with USBR together with annual and multi-year transfer agreements with USBR settlement contractors utilizing the Colusa Basin Drain (Drain).
Project Area:	CDMWC service area, approx 46,000 acres, Glenn, Colusa and Yolo County (see attached Map)
Brief Project Description:	The Colusa Drain Mutual Water Company(CDMWC) encompasses approximately 46,000 acres of agricultural production and environmental habitat adjacent to the Colusa Basin Drain. Shareholders in CDMWC divert water for summer irrigation from the drain under a combination of; appropriative water rights held individually by the shareholders, a long term service supply agreement with USBR and annual and multi-year transfer agreements with neighboring USBR settlement contractors. Historically, many CDMWC diverters use both groundwater and surface water for summer irrigation because physical supplies of water in the Colusa Drain are often insufficient and unreliable to satisfy those irrigation requirements. The purpose of this project is to provide a reliable and sufficient supply of water in the Drain allowing CDMWC diverters to increase their diversions of surface water while slowing or stopping their groundwater pumping.

Implementation and Termination

Criteria for Implementation: This project could be implemented quickly and could be ongoing. Some of the criteria required for implementation would include:

- Physical supply of surface water to be introduced into the Drain.
- Necessary environmental permitting to allow for transfers into the drain by settlement contractors or others.

- Necessary permitting by Department of Water Resources (DWR) and State Water Resources Control Board (SWRCB) to allow CDMWC shareholders to divert from the Drain.
- Necessary infrastructure with CDMWC and/or its shareholders to divert from the Drain.
- Necessary infrastructure on part of settlement contractors to introduce a physical supply of water into the Drain.

Much of these criteria are already being met by potential project participants. Additional participants could be added as needed and as interest for a project increased. For example, CDMWC and GCCID have completed the necessary environmental reviews and approvals with USBR for a multi-year transfer agreement between the parties. This process could be completed for other settlement contractors as well. CDMWC's long term contract with USBR provides CDMWC diverters necessary permission to divert from the drain when individual appropriative water rights would otherwise be deficient, allowing for diversion throughout the irrigation season (April 1 through Sept 30). Most of CDMWC shareholders have the necessary infrastructure already in place to divert from the drain.

Public and/or Interagency Notice Process:

While public notice may be necessary under SGMA regulations, it is not expected that Public or Interagency Notice would necessarily be required to complete a project of this nature. At least some of the necessary permitting and noticing is in place. This part of the project requires legal review and input.

Required Permitting and Regulatory Process

This project would require, at a minimum:

- Underlying appropriative water rights; licenses and/or permits held by CDMWC and/or its individual shareholders to allow for diversion of surface water from the Drain throughout the summer irrigation season.
- Environmental Permitting allowing for the transfer of surface water from USBR Settlement Contractors or others to CDMWC.
- Transfer agreements between CDMWC and settlement contractors or others to provide a physical supply of water in the Drain.

Current Status:

Several elements of this proposal are already in place and are functioning. For example:

- Several USBR Settlement Contractors have the necessary infrastructure in place to introduce surface supplies into the Drain.
- CDMWC shareholders have the necessary infrastructure in place to divert surface water from the drain.
- GCID and CDMWC currently have a transfer agreement in place that includes the necessary environmental permitting with USBR and DWR.
- CDMWC shareholders have the necessary licenses and permits in place with DWR and SWRCB to allow those diversions.
- CDMWC has a long-term supply agreement with USBR to supply water into the Sacramento River to offset shareholders diversions from the Drain that would otherwise infringe the rights of senior water right holders in the Sacramento River.

The important element of this project that does not currently exist is the adjustment of the current economic relationship between CDMWC diverters and potential participating settlement contractors that provides settlement contractors sufficient economic incentive to introduce a physical supply of surface water to the Drain, and, at the same time, CDMWC diverters sufficient incentive to access that supply in lieu of their groundwater wells.

Estimated Cost:	$1,725,000 (See attached cost estimate analysis)	
Potential Funding Sources:	Primary Source:	CDMWC and its shareholders
	Secondary Source:	CGA, Settlement Contractors, NGO's(TNC & others), Prop 1 grant funding, water export fees
Anticipated Start Date:	It is expected that this project in some form could start as early as crop year 2022 (March 2022)	
Anticipated Completion Date:	This project could be ongoing	
Measurable Objectives Expected To Benefit:	Groundwater Levels, Groundwater Storage	
Serves Disadvantaged Community:	At least some of the area within the CDMWC service area is identified as a Disadvantaged Community	

Expected Yield:	Unknown at this time. However, For the subarea within the Colusa Subbasin that approximately corresponds to the CDMWC the water budget currently included in the GSP includes an average from 1990 to 2015 of 48,000 AF/yr of surface water diversions, presumably from the Drain. For the same period, groundwater pumping averages about 40,000 AF/yr. Assuming a successful project could displace 70% of this current groundwater pumping along the drain, a yield of 28,000 af of in-lieu recharge could be realized.
Benefit Evaluation Methodology:	This needs further development, however, it is expected that the combination of information available through water budgets included within the currently proposed GSP, diversion data collected under SB88 and available publicly, evaluation of transfers contemplated under the project using the HCM developed for the GSP and the specific details of any proposed transfer subject to this project would yield sufficient data to calculate the benefits realized by the project.
Next Steps	1) Present/review with TAC committee 2) Present/Review with GSP consulting team 3) Present/Review with CGA legal counsel 4) Present/Review with potential supply partners (settlement contractors & others) 5) Complete financial analysis 6) Complete benefit analysis
Summary	CDMWC and its shareholders represent an important component of the overall groundwater demand within the Colusa Subbasin. An in-lieu re-charge project that effectively partners these groundwater users with potential supply partners to reduce or eliminate groundwater pumping represents a great opportunity for improving groundwater sustainability withing the subbasin.

From:	Grant Davids
To:	Jim Wallace
Subject:	RE: Colusa Drain Mutual Proposed Project Management Action for In-lieu groundwater re-charge
Date:	Monday, June 21, 2021 7:57:00 AM

Jim,

This sounds good. Even a narrow (or "conditional") policy statemen as you describe would be useful. If that's not forthcoming, we'll just describe the physical and operational elements of the project in he GSP, and discuss the agreements that will need to be negotiated in the future. One thing to keep in mind is that if the benefits of your recharge project extend beyond the CDMWC service area, then those outside beneficiaries should pay something to facilitate the project. Simple in concept, hard to put into effect.

Grant

From: Jim Wallace <jimwallace@ecolusa.com>
Sent: Saturday, June 19, 2021 9:48 AM
To: Grant Davids <grant@davidsengineering.com>
Subject: Re: Colusa Drain Mutual Proposed Project Management Action for In-lieu groundwater re-charge

Thank you Grant. I couldn't speak with Thad on Friday but I left a message and asked for an appt. I expect both Thad and Lewis to support this project at technical level. I won't look further than that for now. But of course that is the easier discussion, objective discussion about infrastructure, quantities, timing, permitting, etc. So I am focusing on this(technical) first. To make sure that given a suitable political environment and workable economics, we can do something positive. But if you have anxiety about how the politics and economics of all this will play, then I share this anxiety. Our larger board has yet to have a productive discussion about money, priorities, fairness, public trust, and other more subjective issues. And I see a wide variety of perspective on these issues given the relatively disparate nature of key player positions(the haves and the have nots). To be blunt, I fear a policy statement that accurately reflected the position of the large SW suppliers at this point in the process would not be acceptable to many players within our community. That being said, a narrow statement from the entire board that agrees to prioritize in basin transfers for the purpose of recharge and other project management actions , for example, might be achievable. I'll ask Thad about this specifically if/when we talk. Thanks again for thinking about this and responding. Jim

> On Jun 19, 2021, at 8:13 AM, Grant Davids <grant@davidsengineering.com> wrote:
>
> Hi Jim,
>
> Thank you for the additional information. This will allow the team to prepare a detailed, compelling project description for the GSP.
>
> I don't know whether or how it would work politically, but a meeting among the larger

settlement contractors and major proposed in-lieu rechargers (CDMWC, CCWD, and OAWD) to discuss available water quantities in non-Shasta critical years would be very helpful. Most of the necessary infrastructure is in place for these projects (some new infrastructure needed OAWD), so the key is to demonstrate to DWR (in the GSP) that the SW supply is available and there is general agreement regarding increased transfers moving forward. I am encouraged that Settlement Contractors are telling you they want to more fully utilize project water within the basin in full supply years. This is key. If the Settlement Contractors could prepare a general "policy statement" to this effect that could be included in the GSP, that would be very positive. Maybe you could float this idea?

Thanks again for your thoughtful reply,

Grant

From: Jim Wallace <jimwallace@ecolusa.com>
Sent: Friday, June 18, 2021 5:33 PM
To: Grant Davids <grant@davidsengineering.com>; Jim Wallace <jimwallace@ecolusa.com>
Cc: Mary Fahey <mfahey@countyofcolusa.com>; Dave Ceppos <dceppos@ccpcsus.edu>
Subject: RE: Colusa Drain Mutual Proposed Project Management Action for In-lieu groundwater re-charge

Hi Grant, Thanks for your encouragement and feedback on this proposal. I appreciate it.

1. You asked for a copy of CDMWC/USBR contract. Here is a link for that contract.

    a. https://drive.google.com/file/d/14Ab3TJDp5kC5cY000h0887iGoiyYH6yA/view?usp=sharing

2. You asked for a copy of CDMWC/GCID 2021 transfer agreement (note: this copy is a draft but I believe was the final draft for this years agreement. I will upload an executed copy when I put my finger on it.). Here is a link for that contract:

    a. https://drive.google.com/file/d/14Cw6I7NGhvdzOErv356Ot3gYWNzJFlGj/view?usp=sharing

3. You asked is more water available under this contract with GCID? I think the answer is yes, but I have not reviewed this project proposal with Thad to see if or where it fits in GCID's strategy for recharge projects. I am hoping to do that next week.
4. You asked which settlement contractors are most likely to be the source of transferred water. My answer is:

a. GCID first because:
    i. we are currently working with them
    ii. they have the largest supply
    iii. they have the most infrastructure on the drain that is relevant to a project like this
b. Maxwell Irrigation,
    i. we have worked with Maxwell in the past
    ii. they can divert and deliver directly to the drain and are upstream from much of our shareholder base
    iii. I have not reviewed this project with Maxwell
c. Princeton/Provident
    i. same reasons as Maxwell, we have worked with them previously and they have relevant infrastructure.
    ii. I have not reviewed this project with Princeton/Provident
d. RD108
    i. RD108 is located further down the drain and their ability to deliver to the drain is slightly less convenient than some of the upstream diverters (once diverted from the river, RD108 has to lift the water over their back levee to get the water into the drain. But CDMWC has executed this maneuver with RD108 successfully in the past and so I believe is a viable option.)
    ii. Direct diversion and delivery to the drain is the best option to work with RD108, in my opinion. But a second option is for RD108 to be a supplier of transfer water but have the water wheeled through another upstream diverter into the Drain.
    iii. I met today with Bill V at RD108 to review this proposal and get feedback. In general, I would describe the discussion as positive and I expect RD108 would support this project.
e. Davis Ranch. CDMWC has not worked with them before, however:
    i. They have the ability to divert from the river and deliver directly into the drain with their existing infrastructure
    ii. They have the added benefit to CDMWC of being able to deliver into the Drain below the Davis weir. This is an important distinction because a major challenge with the operations on the Drain is lack of flow below the Davis Weir and significant of CDMWC service area is below the Davis Weir.
    iii. They have a demonstrated interest in recharge in general and so might be interested in participating in a project like this
    iv. I have not reviewed this project with Davis

5. You asked about validating whether 83,000 af was reliably available from

settlement contractors to meet demands of multiple recharge projects. In Shasta Critical years I expect one could not validate that this quantity is available, especially, to the extent that settlement contractors have already committed project water to other transfers both in and out of basin. In full supply years, however, I believe the answer is yes. In speaking with Settlement Contractors I am consistently told that better (more complete or fuller) usage of project water within the basin during water flush years is a top priority with respect to groundwater sustainability. Review of settlement contractors prior year project water scheduling with USBR would give a good idea of the total quantity of water likely available for transfer to any proposed project. I have not seen any of the detail included in the other recharge projects proposed for inclusion in the GSP, but I am guessing that much of this work has already or is currently being done.

6. You asked about how could this new demand for recharge water affect prices? Simple answer is I don't know. But, for the purposes of my proposal I estimated that CDMWC would pay approx. double the amount we are currently paying for transfer water for the additional 28,000 af.
7. You asked about the current cost of groundwater pumping in CDMWC service area. This information is not readily available, however, I have some information from my own farm operations within CDMWC and I will reach out to some other shareholders to see if I can put some information together and send it over. I expect this cost to be in the range of 75-100/af for direct electric charges for pumping.
8. You asked about current transfer cost. Please reference the contract in the above link.
9. You asked about the cost estimate analysis that I referenced in the proposal. This is not complete, but as soon as I have something I will send it over.

Thanks again for looking at this project. JIM

Jim Wallace
jimwallace@ecolusa.com
mobile 530.218.1396

From: Grant Davids
Sent: Thursday, June 17, 2021 9:39 AM
To: Jim Wallace
Cc: Mary Fahey; Dave Ceppos
Subject: RE: Colusa Drain Mutual Proposed Project Management Action for In-lieu groundwater re-charge

Hi Jim,

This is an excellent project, one reason being that it can be implemented at some level with existing infrastructure and expanded gradually as additional infrastructure is constructed.

Some follow up comments/questions/requests:

1. Please send a copy of CDMWC's contract with USBR, or a summary of key terms.
2. Please send a copy of CDMWC's transfer agreement with GCID, or a summary of key terms. Is more water available under this agreement than has been used historically?
3. Other that GCID are any of the "multi-year transfer agreements with USBR settlement contractors" already in place or to be negotiated?
4. Which settlement contractors are most likely to be the source of transferred water (e.g., GCID, PCGID, PID, others???)
    a. Note that the OAWD and CCWD projects are also counting on transfers to supply their in-lieu recharge projects: 25,000 AF/yr for OAWD and 30,000 AF/yr for CCWD
    b. What suggestions do you have for validating that 83,000 AF/yr (25,000+30,000+28,000) are reliably available from settlement contractors to meet these needs?
    c. How could this new demand for surface water affect prices?
5. I will forward your project description to Duncan MacEwan, the team economist, and get him thinking about financial incentives to get CDMWC shareholders to divert SW rather than pump GW. These incentives are a key element of the project.
    a. What is the current, approximate cost to pump groundwater within the CDMWC service area, energy only, not including amortization of capital?
    b. What is your best estimate of average SW costs under transfer agreements?
6. The cost estimate analysis referenced in your document was not attached; please send.

Thank you,

Grant Davids, P.E. | President/Principal Engineer | Davids Engineering, Inc.
1772 Picasso Avenue Suite A Davis, CA 95618| office 530.757.6107 x104 | mobile 530.304.8655
<image001.jpg>

From: Jim Wallace <jimwallace@ecolusa.com>
Sent: Wednesday, June 16, 2021 9:15 PM
To: Grant Davids <grant@davidsengineering.com>; Mary Fahey <mfahey@countyofcolusa.com>; Dave Ceppos <dceppos@ccpcsus.edu>
Subject: Colusa Drain Mutual Proposed Project Management Action for In-lieu groundwater re-charge

Hello Mary, Grant, Dave,

Please find attached a Proposed Project Management Action for In-lieu groundwater recharge proposed by Colusa Drain Mutual Water Company. I would like to add this project to the list presented at last weeks joint TAC meeting. I would also like to include this project as an agenda item at our next TAC meeting with possible action. With the exception of the direct recharge project on Sycamore Slough, I have not yet seen any of the other projects under consideration. For this project proposal I used the project elements detailed on slide 27 of Grant and Ken's June 11 presentation to the TAC. Let me know if you have questions or comments.
Thanks, JIM

Jim Wallace
jimwallace@ecolusa.com
mobile 530.218.1396

COLUSA SUBBASIN

Colusa Subbasin GSP Projects and Management Actions (PMAs) Submittal Form

Overview

The purpose of this form is to gather ideas for potential projects and management actions (PMAs) that could be evaluated and ultimately included in the Colusa Subbasin GSP. Once ideas are gathered, an initial screening and evaluation process will be conducted, followed by ranking of potential PMAs for more detailed evaluation and inclusion in the initial GSP.

Potential PMAs may fall under several categories, including but not limited to the following:

- Recharge projects
- Supply augmentation projects
- Water conservation projects
- Projects to reduce non-beneficial consumptive use
- Groundwater pumping allocations
- Monitoring programs (groundwater pumping, water levels, stream flows, etc.)

Please provide supporting documentation and/or links to that documentation for each question, if available. **NOTE: It is recognized that much of the requested information may not be available at this time. Please provide as much information as you can.**

Project Name and Contact

Project or Management Action Name:

COR artificial recharge

Contact Person:

Brad Samuelson, Water and Land Solutions on behalf of California Olive Ranch (COR)

Organization/Affiliation (Project Proponent):

California Olive Ranch

Contact Phone:

(209) 658-8487

Contact Email:

bsamuelson@waterandlandsolutions.com

Project or Management Action Description and Status

Project or Management Action Description:

Artificial recharge is proposed at the California Olive Ranch property in Artois. Potential sources of water for recharge are flood flows from White Cabin Creek and Sheep Corral Creek, as well as Section 215 water through Orland-Artois Water District (OAWD). Potential sites for recharge include a retired drainage ditch that borders the property, as well as recharge within the streambed.

Project or Management Action Location (please provide a map if available):

See attached. As shown, the proposed recharge location is within the Orland-Artois Water District.

Which Sustainability Indicator(s) does this Project or Management Action address:

1. Groundwater levels
2. Groundwater Storage
3. Groundwater Quality
4. Land Subsidence
5. Surface Water Interaction

Groundwater levels would be addressed by this project. As shown in draft Figure 3-23 of the Colusa Subbasin GSP, this area showed the greatest decline in groundwater elevations from spring 2006 to spring 2017.

Project or Management Action Status (Conceptual, In Design, Ready for Implementation):

Conceptual

Has a feasibility assessment been conducted? If so, please list the agency and provide the documentation (or provide web link to download).
A feasibility study is currently being scoped and engineering firms are writing proposals to prepare the feasibility study.

Estimated Cost:
TBD

Potential Funding Sources:
TBD

Management Action or Project Yield (e.g. water contributed to the groundwater system, acre-feet per year):
TBD. It is envisioned that recharge would take place in wet years when flood flows are available.

Please describe any required Permitting and Regulatory Process and status of permitting and CEQA/NEPA compliance:
Water rights would need to be acquired if flood flows from White Cabin Creek or Sheep Corral Creek are used.

Does this Management Action or Project serve a disadvantaged community? If so, which one(s)?
N/A

Additional Information Sources:

Other Information:

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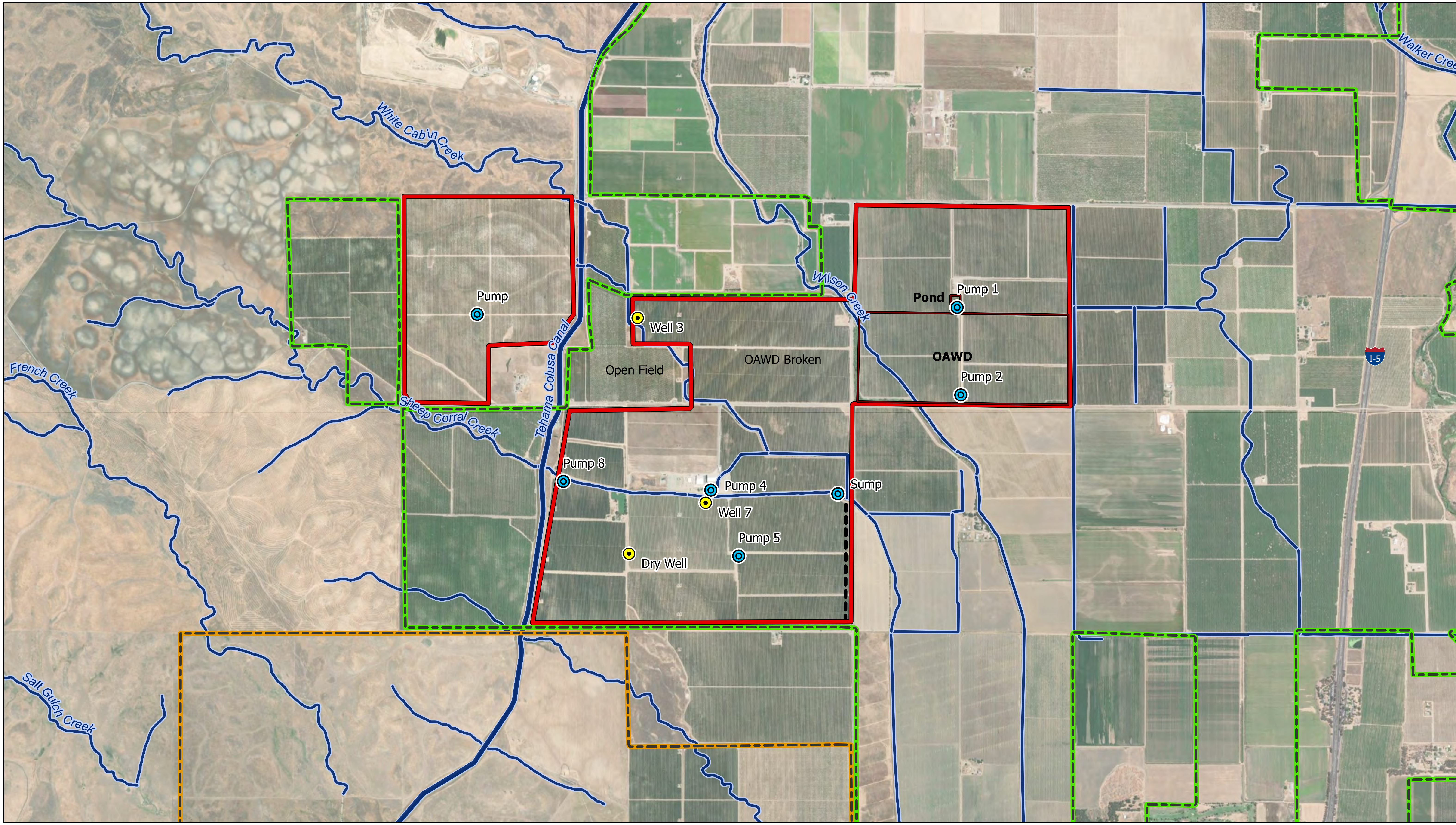

COR 2 Ranch (2,065 ac)
Well
Pump (OAWD)
Drainage Ditch Potential Recharge
Glide Water District
Orland - Artois Water District

N
Scale: 1:25,000
0 0.13 0.25 Miles

Chico

California Olive Ranch
COR 2 Ranch

Spatial Reference: NAD 1983
CA State Plane Zone II

Created by: Water & Land Solutions
Date exported: 6/17/2021

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From:	Sugar, Sarah@Waterboards
To:	Michael Doherty
Cc:	Mary Fahey; Kim Vann (kvann@frontiernet.net); Lee, Katherine@Waterboards
Subject:	RE: ground water recharge
Date:	Wednesday, April 05, 2017 11:53:12 AM
Attachments:	image001.png

Hi Michael,

It sounds like an interesting project. Below, I've included: 1) information on the different possible avenues for your project, 2) additional detail on temporary permits for groundwater recharge, 3) some initial thoughts on your proposal, and 4) the next steps for honing in on a clear project description. The e-mail includes a lot of information, so feel free to let me know if you have questions.

1) The first step would be to decide what type of water right permit you're applying for: temporary or standard. A temporary permit application can usually be processed more quickly, but only lasts 180 days and needs to meet certain criteria (urgent need for the water, no injury to downstream users, no unreasonable effects to fish and wildlife). A standard permit application can take several years to process, but generally lasts as long as the water is put to beneficial use. (More information on groundwater recharge and water rights can be found on our webpage: http://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/groundwater_recharge/)

2) Right now, the Division of Water Right filing fees for temp. permit applications for these types of projects have been reduced to $100+, depending on how much water is diverted. One thing to note, however, is that both standard and temporary permits are subject to environmental review under the California Environmental Quality Act (CEQA), which can take some time to complete. CEQA is currently suspended for some temporary permits for recharge projects by local or state agencies while the Drought State of Emergency is in effect, but not for projects by private entities. However, a private entity may be able to partner with a public agency to qualify for the CEQA suspension.

   We have a webpage that outlines the temporary permit process and gives tips on how to avoid potential delays: http://www.waterboards.ca.gov/waterrights/water_issues/programs/applications/groundwater_recharge/tips_for_filing.shtml.

3) When applying for a temporary or standard permit, you will need to specify:
   a. the point of diversion (where you would set up the pump)
   b. a diversion season (when you'll pump water from the creek)
   c. the maximum diversion rate (one option is to propose the capacity of the pump)
   d. the maximum amount of water you would divert each season
   e. the area that will be used for recharge (the gravel excavation sites)
   f. the place of use and purpose of use of the water: groundwater recharge is a type of storage, not a beneficial use, so the application will need to specify how the recharged water will ultimately be used. If you already use groundwater on your ranch, the place of use might be the ranch itself, and the purpose(s) of use could be irrigation, domestic use and/or stockwatering, for example.

   Other questions that could come up during our review are:
   a. When were you planning to start diversions (this spring, next winter, or later)?
   b. How high are "high flows", how was that determined, and how will you know flows are high enough to start diverting?
   c. Are there existing water rights for the ponds at the gravel excavation site?
   d. If the gravel excavation site is close to Sand Creek, how does the groundwater basin interact with Sand Creek? Depending on water table levels and gradients, there is a possibility of recharged water returning to the stream as flow, rather than remaining available in the groundwater basin. Or, during high flows, water levels in Sand Creek may already contribute water to the gravel ponds.
   e. Is there information on water table depth or groundwater movement near the recharge site?
   f. Are there downstream water users with a right to the water, or fish and wildlife species that might be affected?

4) If you'd like, we could start by discussing your basic project and initial questions by phone, then set up an in-person meeting or site visit when the project description is fleshed out. We also strongly recommend looping in the California Department of Fish and Wildlife early in the process, in case changes to the project description are necessary to reduce impacts on fish and wildlife. The water rights contact for Department of Fish and Wildlife for Colusa County is Lauren Mulloy, available at (916) 358-2909, or lauren.mulloy@wildlife.ca.gov.

Again, I'm happy to answer any questions on process, fees, or your particular project be e-mail or phone.

Regards,

Sarah Sugar
Environmental Scientist
Division of Water Rights
State Water Resources Control Board
Office: (916) 341-5426
Sarah.Sugar@waterboards.ca.gov

From: Michael Doherty [mailto:mike@chamisalcreek.com]
Sent: Monday, April 03, 2017 5:22 PM
To: Sugar, Sarah@Waterboards
Cc: Mary Fahey; Kim Vann (kvann@frontiernet.net)
Subject: ground water recharge

Sarah,

My name is Michael Doherty and I am a farmer/landowner in Arbuckle, south western Colusa County. I am very interested in pursuing a small scale ground water recharge project that I believe has great merit and could be a template for more projects in Northern California. My ranch is adjacent to Sand Creek which during the winter can have high flows of drain water that make it to the Colusa Basin Drain and eventually to the Sacramento River. My thought is to divert water during these high flows and hold the water so it can percolate into the groundwater basin. I would hold the water in some ponds on my property that are gravel bottomed. These ponds are really old gravel excavation sites from the previous landowner. They are not currently farmable and would be perfect for this use. There is a product called a Riverscreen pump that only needs 4 inches of water depth to function. I would put the pump into the creek at high flows and remove it when the flows are too low.

I understand the Governor himself is very interested in projects such as this and has encouraged them.

I would love to speak with you in person about this project. I am also available to show or set up a tour when needed.

Looking forward to hearing from you.

Chamisal Creek Ranch LLC.

Michael F. Doherty
1167 Cortina School Road
P.O. Box 157
Arbuckle, Ca 95912
Home 530-476-3538
Fax 530-476-3168
Cel 530-681-8204

Ephemeral Stream Recharge Field Notes

Date: 11/19/19
Participants: Mary Fahey, Bill Vanderwaal, Halbert Charter, David Henriques (Charter Oaks), Steffen M. (Chico State), Jeff Davids

General notes

1. Two different scales and approaches to managed aquifer recharge are described below. In both cases, the potential water sources are the same:
    a. Imported surface water (e.g. 3F or 215 USBR water (surplus water))
    b. Locally generated runoff in ephemeral streams and swales
    c. Mixture of the two
2. Regardless of the water supply or project conceptualization, it is critical to understand:
    a. Availability of water for recharge (in space and time)
    b. Ability to recharge available water (limited by infrastructure, land area, and infiltration rates)
3. There are also important policy and legal questions including:
    a. How will credits for groundwater recharge work?
    b. Are there any water rights concerns over impacts to downstream water users?
    c. What is the permitting process for agricultural managed aquifer recharge?

Sand Creek Project(s)

On Sand Creek, there appears to be two basic long-term project concepts, which are not mutually exclusive (i.e. the first could be part of the second):

1. Diversion of Salt Creek water during storm events (or runoff from agricultural fields or CCWD water) and application to nearby lands
    a. Michael Doherty's gravel pit to the north of Sand Creek and east of Cortina School Road may be a good place to start.
    b. Currently, runoff from field(s) to the west of Cortina School Road is diverted into the gravel pit.
    c. It may be possible to fill portions of the gravel pit with Colusa County Water District (CCWD) water from the delivery point near the northwest portion of the gravel pit.
        i. There may be some water rights issues to utilizing CCWD water for recharge
    d. In the long run, infrastructure to move water from Salt Creek into the gravel pit would be necessary and could involve either:
        i. A gravity diversion from Salt Creek upstream of Cortina School Road, an open channel to convey water to the gravel pit, and a spillway/return flow to Salt Creek from the southeastern corner of the gravel pit or
        ii. A pumped diversion from Salt Creek along with an appropriate screening facility and pipeline.
    e. Suggested next steps:

i. Determine area of agricultural lands currently draining to the gravel pit
ii. Measure runoff from these lands to the gravel pit
    1. Depending on the range of flows, either a weir box (like the one that Hal is using) on the end of the pipe can be used for measurements (this works for low flows). If higher flows are anticipated, the weir box is still helpful to keep a full pipe, but a hydroacoustic meter (e.g. SonTek IQ) should be installed.
iii. Measure infiltration capacity of several different locations within the gravel pit with:
    1. Large scale USBR ponding seepage tests
    2. Small scale double ring infiltrometer tests
iv. Perform detailed topographic survey of gravel pit and Sand Creek to facilitate conceptual design of necessary diversion and conveyance infrastructure
v. Measure rainfall and runoff from Sand Creek
vi. Draft a conceptual plan for increased utilization of the gravel pit for groundwater recharge
    1. This would include more accurate estimates of recharge potential
    2. Cost estimates for different configurations (i.e. gravity diversion vs. pumped)
vii. If these steps are of interest to the group, CSU Chico could prepare a more detailed proposal for the Agricultural Research Institute funding, and willing partners could help provide the necessary match (i.e. 25% cash and 100% total (in-kind + cash).
viii. We would also need to find a partner/student to investigate the identified policy

2. Lower Salt Creek River Restoration, Grade Control, and Recharge Project
    a. This would be a significantly larger and more complicated project involving multiple partners with multiple objects (objectives?).
    b. Objectives
        i. Decreased gravel migration and stream incision
        ii. Reduced flood flows
        iii. Restored channel grade and riparian corridor
        iv. Increased groundwater recharge
    c. Methods
        i. Construction of additional grade control structures similar to the Sand Creek Road low water crossing approximately 2.5 miles west of Cortina School Road.
        ii. Restoration of streambed materials and grade in incised locations
        iii. Diversion of runoff outside of Sand Creek for application to areas with high recharge potential (like)
        iv. The stair-stepped grade control structures would service the purposes of:
            1. Slowing water velocities in the channel
            2. Reducing gravel migration and associated downstream impacts
            3. Increasing water storage and residence time, thus decrease peak flood flows

        4. Increasing recharge upstream of grade control structures
        5. Allowing gravity diversions from Sand Creek to adjacent recharge projects (e.g. Michael Doherty's sand pit described above)

d. Possible partners
    i. Caltrans
    ii. Railroad
    iii. Colusa County (water resources, public works)
    iv. Colusa Basin Drainage District
    v. TNC, EDF, or ???
    vi. CSU Chico
    vii. Colusa GSA
    viii. Colusa County RCD
    ix. Landowners

e. Possible next steps
    i. Pitch the idea to potential project partners to gauge interest
    ii. Caltrans and the railroad might be the most interested because of the impact to their operations from ongoing flooding and gravel migration issues that cause the roadways/railways to be closed.
    iii. CSU Chico could play a role in understanding the hydrology, geomorphology, and recharge potential from the project, but this would require a longer term project and ongoing monitoring and investigation.

Smaller Distributed Landowner-Led Recharge Projects

1. In addition to larger publicly funded recharge projects, there may also be opportunities for landowners to construct and operate smaller recharge projects. (This could be done with incentives from the GSAs)
2. Water source
    a. Imported surface water (e.g. 3F or 215 USBR water (surplus water))
    b. Locally generated runoff in ephemeral streams and swales
    c. Mixture of the two
3. Design
    a. Constructed within existing drainage ways or in other higher permeability areas
    b. Open to the atmosphere (i.e. spreading basin) or closed (e.g. infiltration pit)
4. Water Quantity Monitoring
    a. It is critical that incremental recharge (i.e. before and after the project(s)) be measurable.
    b. Generally, directly measuring recharge will not be possible, so a water balance approach involving measuring all other inflows and outflows needs to be used to solve for recharge (i.e. recharge = inflows - outflows)
    c. If possible, inflows and outflows should be measured with a standard flow device, as described in the USBR Water Measurement Manual.
        i. Smaller full-pipe flows can be reliably measured with magnetic meters (e.g. Seametrics)

ii. Larger open channel flows can be measured with critical flow devices (e.g. weirs or flumes) and measurement of water level (e.g. Seametrics pressure transducers). For flumes and weirs, it is best to have a low range sensor (e.g. 2.3 feet or 1 PSI) with high accuracy ± 0.01 feet, such as the low pressure range Seametrics PT2X pressure transducer.
iii. When insufficient head is available, or if the range of possible flows is too great, an Acoustic Doppler Velocimeter (e.g. SonTek) can be used.
iv. If the recharge facility is open to the atmosphere, evaporation losses should be accounted for, especially if they are operated during the hot and dry summer months (see USGS Estimation of evaporation from open water).

5. Water Quality Monitoring
    a. The quality of recharged water should be measured to understand potential water quality impacts from additional recharge.

May 10th, 2021

Halbert W. Charter

6682 Greenbay Rd.

Arbuckle, Ca. 95912

Cell: 530-867-4003

Email: hcharter69@gmail.com

To Whom It May Concern:

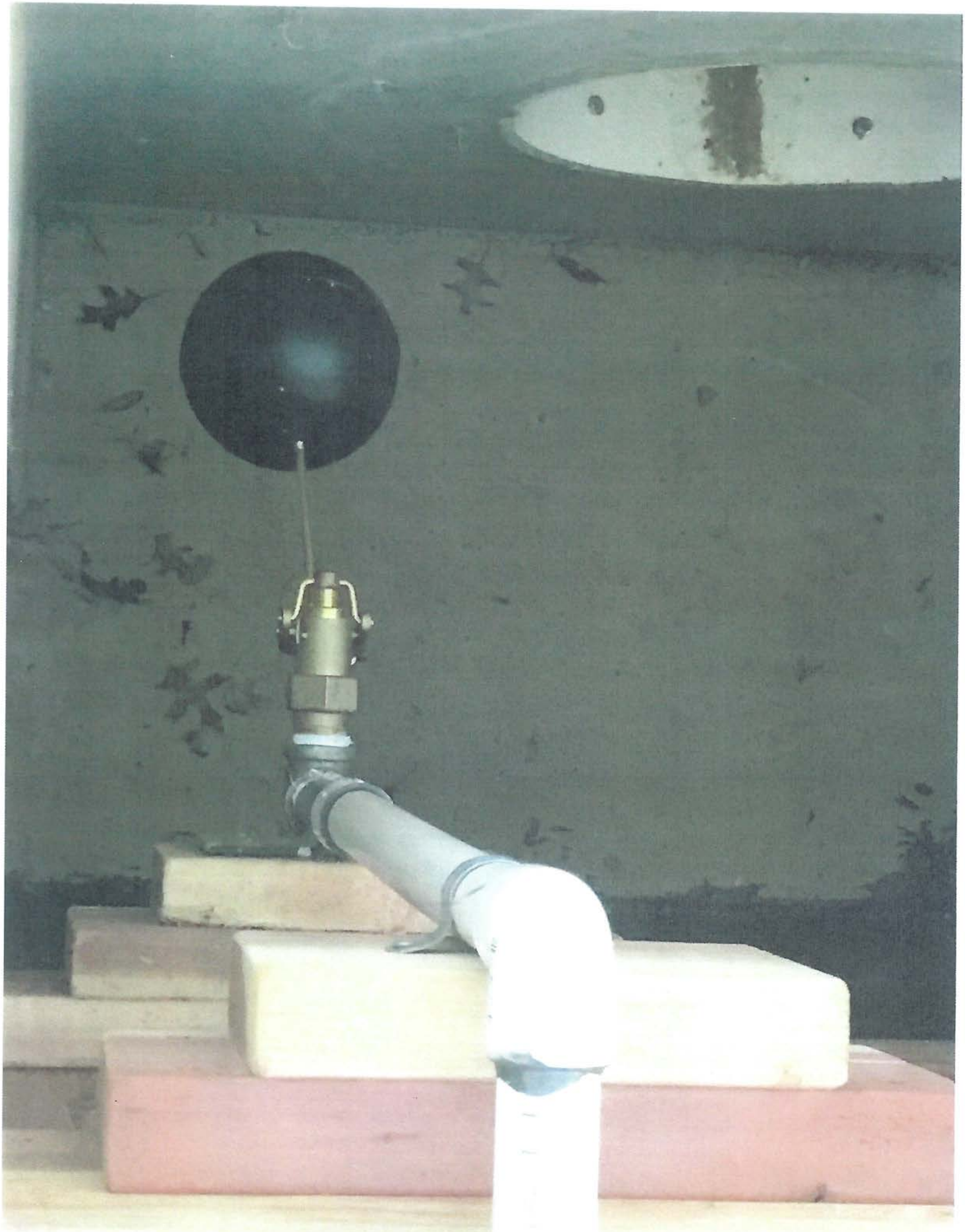
H&A Charter Farms successfully completed construction of a ground recharge project in the fall of 2019. This pilot project recharges water at a rate of 30-40 gallons per minute (gpm). The idea of this project was to realize proof of concept for implementing larger scaled projects of similar design at different locations on the ranch. We feel confident that after recharging nearly 1.5 million gallons of water to date, that the concept is sound and the next project will be scaled to recharge at least 150-250 gpm. The basic concept is to copy the design of a residential leach field, but supersize it.

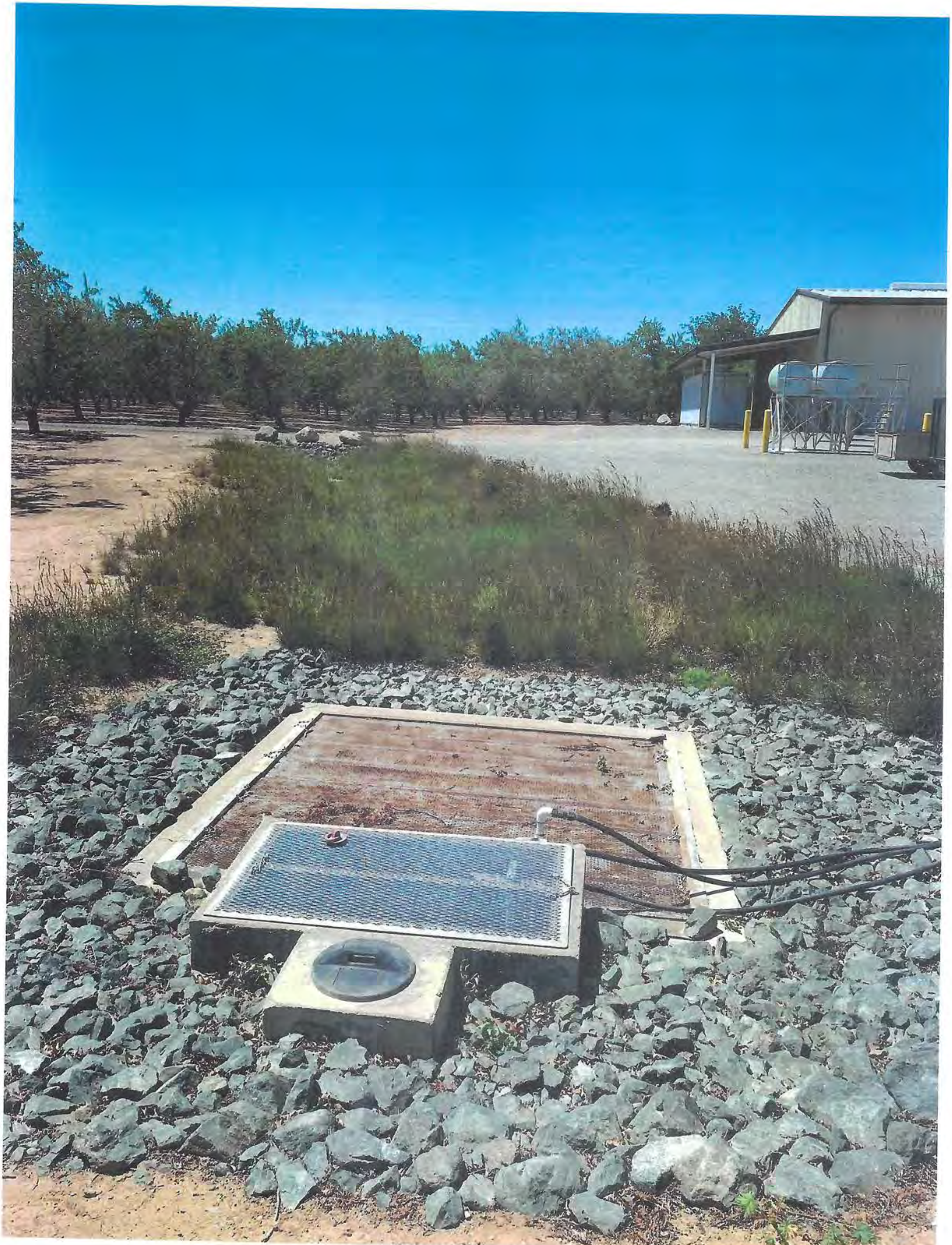
Much of the area we farm in the Southwest corner of Colusa County, consists mostly of low foothills. It is widely known that many of these ridges are well drained and deep in gravel alluvium. With careful design, I now know that we can capture storm water runoff that flows through our orchards and allow the water to recharge back into the aquifer. When it is not raining outside, I can meter district water into the recharge structure. Currently, I am paying Colusa County Water District rates for this water. If the expectation is to meet groundwater sustainability, there is going have to be consideration to figure out a way to get the cost of recharge water at a reduced rate. I do imagine a day where the fee structure developed for the water being extracted helps offset the cost of recharge water. I hope this day is coming sooner rather than later.

This idea, and ideas like it, that capture storm water runoff and utilize surface water for groundwater recharge show benefits that cannot be denied. What is needed to move forward, is an acknowledgement of the benefit and the policy that provides assurance that the water that is recharged into the ground will be able to be utilized on our farm at a later date, like a savings account. If you have any questions, please contact me.

Thank You,

Halbert W. Charter





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Byron Clark

From: Mary Fahey <mfahey@countyofcolusa.com>
Sent: Friday, January 22, 2021 7:31 AM
To: DeBow, Danaka N; Ceppos, David M; Byron Clark
Cc: Lisa Hunter
Subject: FW: Colusa County Water Filtration Plant
Attachments: Colusa County Water Filtration Plant.pdf

Follow Up Flag: FollowUp
Flag Status: Flagged

FYI – our first project submittal for CGA. Do we have a depository set up for PMAs?
Thank you,
Mary

From: Ben King [mailto:bking@pacgoldag.com]
Sent: Thursday, January 21, 2021 11:28 AM
To: Mary Fahey <mfahey@countyofcolusa.com>
Cc: Ben King <bking@pacgoldag.com>; Susan Meeker <susan@colusacountynews.net>
Subject: Colusa County Water Filtration Plant

Hi Mary,

Attached is a Colusa Basin GSP Project recommendations.

I believe that Colusa County needs a fresh water supply from the Sacramento River to guarantee the residents of Colusa County the human right to fresh drinking water, to preserve housing values and promote economic sustainability through growth that will come with future sustainable fresh water supplies. As you know the City of Davis and City of Woodland just installed a filtration plant and this project would give the residents of Colusa County the same access that the State and other policy makers facilitated for Yolo County residents.

As you know the public water systems of Grimes and Princeton have arsenic contamination above EPA standards. The City of Colusa has abandoned two wells due to arsenic contamination and faces future contamination from arsenic and diminished potability due to salt water intrusion into the public water system of Colusa. Williams faces a very uncertain future because it water supply aquifer is surrounded by no potable salt water and faces the risk of future deterioration in potability due to over pumping cased by groundwater substitution and contamination from future recharge projects which could harm potability or lead to contamination from nitrates and other man made contaminants. Arbuckle faces a lack of supply of fresh groundwater and faces the specter of contamination of its public supply due to over pumping and recharge projects necessary to prevent future subsidence.

My proposal is to coalesce around a filtration plant for the County while funding is available and interest rates are low. This timing of this effort may be urgent because it will need political support to benefit from likely Federal infrastructure program.

I will have two more Project recommendations – can you tell me the deadline for submittals?

Thank you for your consideration.

Best Regards,

Ben

COLUSA SUBBASIN

Colusa Subbasin GSP Projects and Management Actions (PMAs) Submittal Form

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- Recharge projects
- Supply augmentation projects
- Water conservation projects
- Projects to reduce non-beneficial consumptive use
- Groundwater pumping allocations
- Monitoring programs (groundwater pumping, water levels, stream flows, etc.)

Please provide supporting documentation and/or links to that documentation for each question, if available. **NOTE: It is recognized that much of the requested information may not be available at this time. Please provide as much information as you can.**

Project Name and Contact

Project or Management Action Name: Sycamore Slough Colusa Basin Drain Multi-benefit Recharge Project

Contact Person: Ben King

Organization/Affiliation (Project Proponent): Stakeholder

Contact Phone: (530) 723-3119

Contact Email: bking@pacgoldag.com

Project or Management Action Description and Status

Project or Management Action Description: Voluntary Landowner participation in restoring stretches of the Sycamore Slough as part of a newly formed water storage district. The Sycamore Slough ran parallel on the east side of the Colusa Basin Drain from slightly north of Tule Road all the old Farnsworth Ranch before running more east west towards the Sacramento River. Excess flows winter natural flows could be diverted from the Colusa Basin Drain for recharge as part of a water storage district and restoration could include a multi-benefit focus for monarch butterfly and other pollinator habitat restoration. Other multi-benefits could also be included.

Project or Management Action Location (please provide a map if available): East of the Colusa Basin Drain from approximately .5 miles north of the intersection of the Colusa Basin Drain northward. Basically south end of old Balsdon Ranch north to old Farnsworth Ranch. See attached Map

Which Sustainability Indicator(s) does this Project or Management Action address:

1. Groundwater levels Yes – winter recharge
2. Groundwater Storage Yes – natural levee of Sycamore Slough has high recharge capacity
3. Groundwater Quality Yes - this will provide fresh water recharge – new deep wells are being constructed with likely long term groundwater degradation due to the present of salt water and possibly arsenic from the Sutter Buttes Rampart.
4. Land Subsidence – Yes – this area was part of a fresh water lake during the lacustrine period of the Sacramento Valley and may have Corcoran like clay stratas that may dewater due to the deep wells being drilled in the area.
5. Surface Water Interaction

Project or Management Action Status (Conceptual, In Design, Ready for Implementation): Conceptual

Has a feasibility assessment been conducted? If so, please list the agency and provide the documentation (or provide web link to download). No – will take landowner involvement and participation

Estimated Cost: Unknown but not prohibitive - some areas of the Sycamore Slough are still in place and existing diversion infrastructure from the Colusa Basin Drain could be used.

Potential Funding Sources: State Water Bonds if Multi-benefit projects could be included.

Management Action or Project Yield (e.g. water contributed to the groundwater system, acre-feet per year): 1000 to 5000 acre feet

Please describe any required Permitting and Regulatory Process and status of permitting and CEQA/NEPA compliance: Yes – application to the SWRCB similar to the Yolo County Flood District Project

Does this Management Action or Project serve a disadvantaged community? If so, which one(s)? Yes – Grimes/College City environs

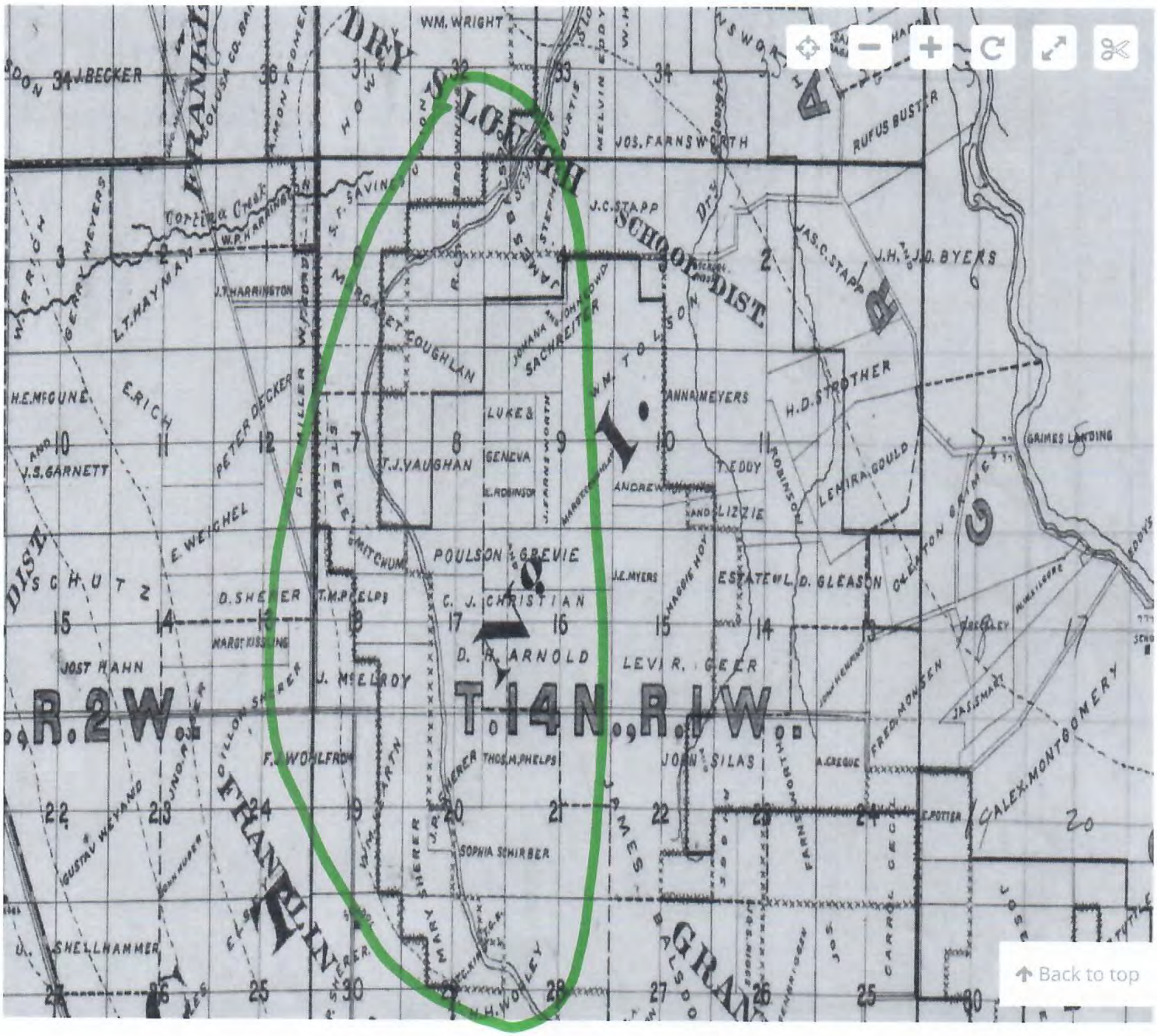
Additional Information Sources: Landowner Group should engage UC Davis Hydrology Department and Ag Extension.

Other Information:

MAP

Official map of Colusa County, California. : compiled and drawn from official surveys and records Copy 1

« About this Item



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- Groundwater pumping allocations
- Monitoring programs (groundwater pumping, water levels, stream flows, etc.)

Please provide supporting documentation and/or links to that documentation for each question, if available. **NOTE: It is recognized that much of the requested information may not be available at this time. Please provide as much information as you can.**

Project Name and Contact

Project or Management Action Name: Colusa County Public Water System Water Filtration Plant

Contact Person: Ben King

Organization/Affiliation (Project Proponent): Stakeholder

Contact Phone: (530) 723-3119

Contact Email:bking@pacgoldag.com

Project or Management Action Description and Status

Project or Management Action Description: Build a water filtration plant on the Sacramento River between Colusa and Grimes to provide fresh drinking water to public water supply systems in Colusa and possibly Sutter and Yolo Counties.

Project or Management Action Location (please provide a map if available): Near Grimes with access to Colusa and Princeton on Hwy 45 access or old railroad easement. Access to Williams, Arbuckle, Maxwell and Dunnigan across Hahn Road, Tule Road or through Colusa and west via Lurline Road and then north/south via old Hwy 99 easement. Possible extension across river to

Meridian and Sutter. This is just conceptual with no discussion but the perfect site probably
COLUSA SUBBASIN 12/22/2020 2

would be to work with Davis Ranches and purchase water rights from Sycamore Mutual or other Settlement Contractors. Use the Conway JPA as the proto-type

Which Sustainability Indicator(s) does this Project or Management Action address:

1. Groundwater levels **Arbuckle & potentially Dunnigan face loss of well supply**
2. **Groundwater Storage**
3. Groundwater Quality **Fresh Drinking water is a human right. Grimes and Princeton have arsenic contamination – Colusa has abandoned wells and faces the risk of arsenic contamination. Williams has elevated levels of dissolved solids and faces an uncertain future for a potable water supply**.
4. Land Subsidence **Groundwater Recharge and therefore potential contamination needed to mitigate Subsidence near Arbuckle**.
5. Surface Water Interaction

Project or Management Action Status (Conceptual, In Design, Ready for Implementation):

Conceptual

Has a feasibility assessment been conducted? If so, please list the agency and provide the documentation (or provide web link to download).
No

Estimated Cost:
$250 to $ 400 million

Potential Funding Sources:
Prop 1, Prop 218, EPA Funding – new Federal Infrastructure Bill.

Management Action or Project Yield (e.g. water contributed to the groundwater system, acre-feet per year): Recharge projects west of Arbuckle and Williams probably are not feasible without a safe supply of drinking water since these projects at higher elevations would likely contaminate the public supply. Settlement Contractor groundwater substitution pumping near Colusa, Princeton and Grimes are likely causing arsenic to move upward into the aquifers of the public supply systems – this system will mitigate that risk and the risk of recharge projects near the public supply systems.

Please describe any required Permitting and Regulatory Process and status of permitting and CEQA/NEPA compliance: YES

Does this Management Action or Project serve a disadvantaged community? If so, which one(s)? Yes – some of this area is/are SDACs.

Additional Information Sources:

See USGS Circular 1358 "Water Quality in Basin-Fill Aquifers of the Southwestern United State: Arizona, California, Nevada, New Mexico and Utah, 1993 by Susan A. Thiros, Angela P. Paul, Laura M. Bexfield and David W. Anning 2014. https://pubs.usgs.gov/circ/1358

USGS predictive model validates empirical evidence of arsenic contamination highlighted in the Sutter County GMP, EPA remediation site at Robbins, Grimes and Princeton. Arsenic desorbs from volcanic rock such as the Sutter Buttes into groundwater in both anoxic and high PH environments.

Dissolved soild issues likely to increase for Williams public supply system due to increase groundwater substitution pumping. 6/16 GCID wells are pumping brackish water near the William supply aquifer. Proposed recharge projects that will be integrated into the TC Canal – Sites interconnect will also lead the lateral movement of nitrates and higher concentrations of dissolved solids into the public supply systems for Williams and Arbuckle.

Other Information: Documents previously sent to Mary Fahey.

See- "Sutter-Yuba Counties Investigation "SWRCB Bulletin No. 6 September 1952 See Table 20 Page 36 for multiple brackish groundwater observations made from 1931 to 1947. See last paragraph on Page 38 regarding fresh water aquifer contamination caused by groundwater pumping. This is empirical evidence of the presence of brackish groundwater for over 100 years in groundwater flow path from volcanic geologic structure of the Sutter Buttes. Robbins is an intuitive discharge site for arsenic due to its location south of the Buttes and because the significant lower elevation due to the natural slope of the Valley.

See- "Hydrogeology Of The Sutter Basin, Sacramento Valley, Calfornia by George Curtin 1971. Discussion regarding the presence of connate or anoxic seawater in the volcanic geologic structure of the Sutter Buttes and the uncertain vertical depths of the fresh water aquifer overlying the Colusa Dome adjoining formation. See page 49 – 2nd Paragraph regarding the mound of saline water between the Buttes and the City of Colusa.

See -Sutter County Groundwater Management Plan. See general discussion concerning movement of arsenic on top of the stratigraphy of the Sutter Buttes Rampart and Figures 5 and 19 regarding the location of the Willows Fault and observed EC and Arsenic levels. Observed arsenic as high as 370 ug/L south of Sutter Buttes.

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- Supply augmentation projects
- Water conservation projects
- Projects to reduce non-beneficial consumptive use
- Groundwater pumping allocations
- Monitoring programs (groundwater pumping, water levels, stream flows, etc.)

Please provide supporting documentation and/or links to that documentation for each question, if available. **NOTE: It is recognized that much of the requested information may not be available at this time. Please provide as much information as you can.**

Project Name and Contact

Project or Management Action Name: **Sycamore Marsh Farm Recharge Project**

Contact Person: **Charles Marsh**

Organization/Affiliation (Project Proponent): **Sycamore Marsh Farm**

Contact Phone:**530 682 9881**

Contact Email: **sycamoremarshfarm@gmail.com**

Project or Management Action Description and Status

Project or Management Action Description:

Sycamore Marsh Farm has been in process of developing a groundwater recharge plan to store water in our aquifer by several different methods. The plan provides for 205 acres of year round recharge basins and 163 additional acres of winter recharge areas.

The fall/winter program entails impounding winter runoff in basins on our farm to eliminate or minimize runoff during winter rain events. In addition, we will supplement the rainfall with surface water supplies from the 2047 Canal to flood fields the Colusa Drain Mutual Water

Company and impound that water for recharge. This recharge program begins soon after crops are harvested.

Both methods of recharge have multiple benefits in addition to recharge. First, the recharge basins will provide habitat for waterfowl and migratory shorebirds. For many years, there has been an effort by multiple agencies to encourage these "pop up wetlands". These man made habitats provide additional winter bird food and resting sites. In addition, these sites spread out the migrating birds, potentially minimizing disease pressure among the bird populations.

Our summer program utilizes the same basins and fields as the winter program, however, recharge is obtained by use of surface water to irrigate crops or provide recharge whenever possible.

In addition, any runoff is captured in basins located in the lowest elevation of the farm and held in order to percolate into the aquifer. We are also exploring the use of post harvest application of surface water to the fields whenever possible to add to seasonal recharge.

Enclosed are maps of the proposed recharge areas. The maps show the diversion points of the 2047 canal for surface water and proposed capture basins.

Additional benefits of the project:

Greenhouse gas reduction

Reduction of sediment loading in the Colusa Basin Drain and the Sacramento River

Project or Management Action Location (please provide a map if available):

Sycamore Marsh Farm, see attached map.

Which Sustainability Indicator(s) does this Project or Management Action address:

1. Groundwater levels
2. Groundwater Storage
3. Surface Water Interaction

Project or Management Action Status (Conceptual, In Design, Ready for Implementation):

The project is ready for implementation.

Has a feasibility assessment been conducted? If so, please list the agency and provide the documentation (or provide web link to download).
No

Estimated Cost:
Pipeline from Diversion Point 2 to Recharge Basin 2 $200,000
Additional operational and maintenance expenses unknown at this time

Potential Funding Sources:
Landowners, CGA, NGO's (The Nature Conservancy and other), Prop 1 grant funding

Management Action or Project Yield (e.g. water contributed to the groundwater system, acre-feet per year):
Unknown at this time.

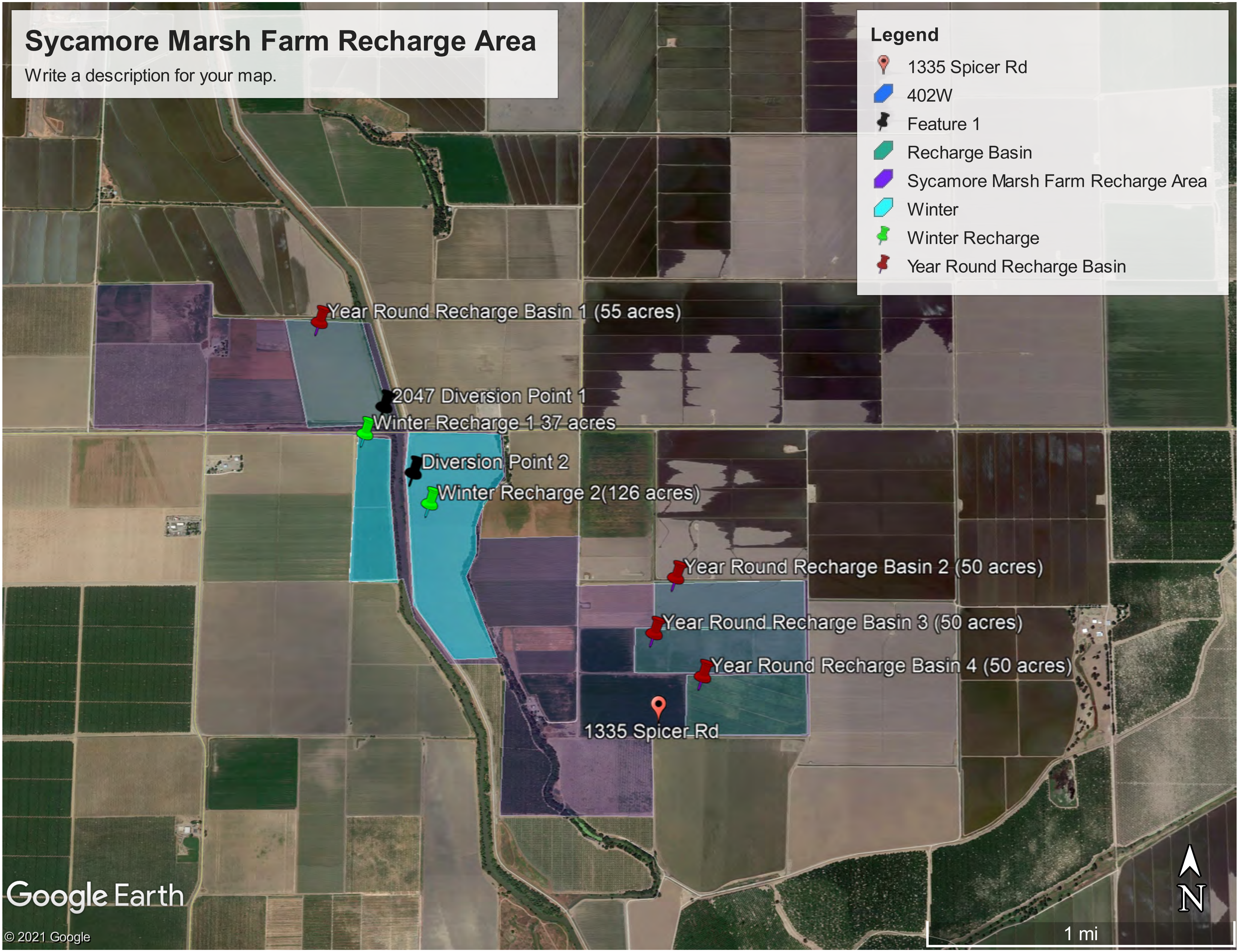
Please describe any required Permitting and Regulatory Process and status of permitting and CEQA/NEPA compliance:
Unknown at this time, but a supplemental permit for water storage from State Water Resource Control Board will be needed.

Does this Management Action or Project serve a disadvantaged community? If so, which one(s)?
No.

Additional Information Sources:

Other Information:

This project provides many benefits in addition to groundwater recharge/storage. Potential benefits include reduced sediment loading into the 2047 Canal and Sacramento River, increased habitat for migratory shorebirds, and reduced greenhouse gas emissions from reduced pumping from Reclamation District 479.


Sycamore Marsh Farm Recharge Area
Write a description for your map.
Legend
1335 Spicer Rd
402W
Feature 1
Recharge Basin
Sycamore Marsh Farm Recharge Area
Winter
Winter Recharge
Year Round Recharge Basin
Year Round Recharge Basin 1 (55 acres)
2047 Diversion Point 1
Winter Recharge 1 37 acres
Diversion Point 2
Winter Recharge 2(126 acres)
Year Round Recharge Basin 2 (50 acres)
Year Round Recharge Basin 3 (50 acres)
Year Round Recharge Basin 4 (50 acres)
1335 Spicer Rd
Google Earth
© 2021 Google
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- Supply augmentation projects
- Water conservation projects
- Projects to reduce non-beneficial consumptive use
- Groundwater pumping allocations
- Monitoring programs (groundwater pumping, water levels, stream flows, etc.)

Please provide supporting documentation and/or links to that documentation for each question, if available. **NOTE: It is recognized that much of the requested information may not be available at this time. Please provide as much information as you can.**

Project Name and Contact

Project or Management Action Name: **Sycamore Marsh Farm Recharge Project**

Contact Person: **Charles Marsh**

Organization/Affiliation (Project Proponent): **Sycamore Marsh Farm**

Contact Phone:**530 682 9881**

Contact Email: **sycamoremarshfarm@gmail.com**

Project or Management Action Description and Status

Project or Management Action Description:

Sycamore Marsh Farm is in process of developing a in lieu groundwater recharge plan.

Sycamore Marsh Farm encompasses approximately 420 acres in the Colusa Drain Mutual Water Company (CDMWC) and has an additional 449 acres that could potentially be annexed into the CDMWC. The acreage is composed of agricultural production and environmental habitat.

COLUSA SUBBASIN

Sycamore Marsh Farm can divert water from the CDMCW to provide in lieu groundwater recharge.

Greenhouse gas reduction from reduced groundwater pumping

Project or Management Action Location (please provide a map if available):

Sycamore Marsh Farm, see attached map.

Which Sustainability Indicator(s) does this Project or Management Action address:

1. Groundwater levels
2. Groundwater Storage

Project or Management Action Status (Conceptual, In Design, Ready for Implementation):

The project is ready for implementation.

Has a feasibility assessment been conducted? If so, please list the agency and provide the documentation (or provide web link to download).
No

Estimated Cost:
Additional operational and maintenance expenses unknown at this time

Potential Funding Sources:
CGA, NGO's (The Nature Conservancy and other), Prop 1 grant funding, landowners

Management Action or Project Yield (e.g. water contributed to the groundwater system, acre-feet per year):
Unknown at this time.

Please describe any required Permitting and Regulatory Process and status of permitting and CEQA/NEPA compliance:

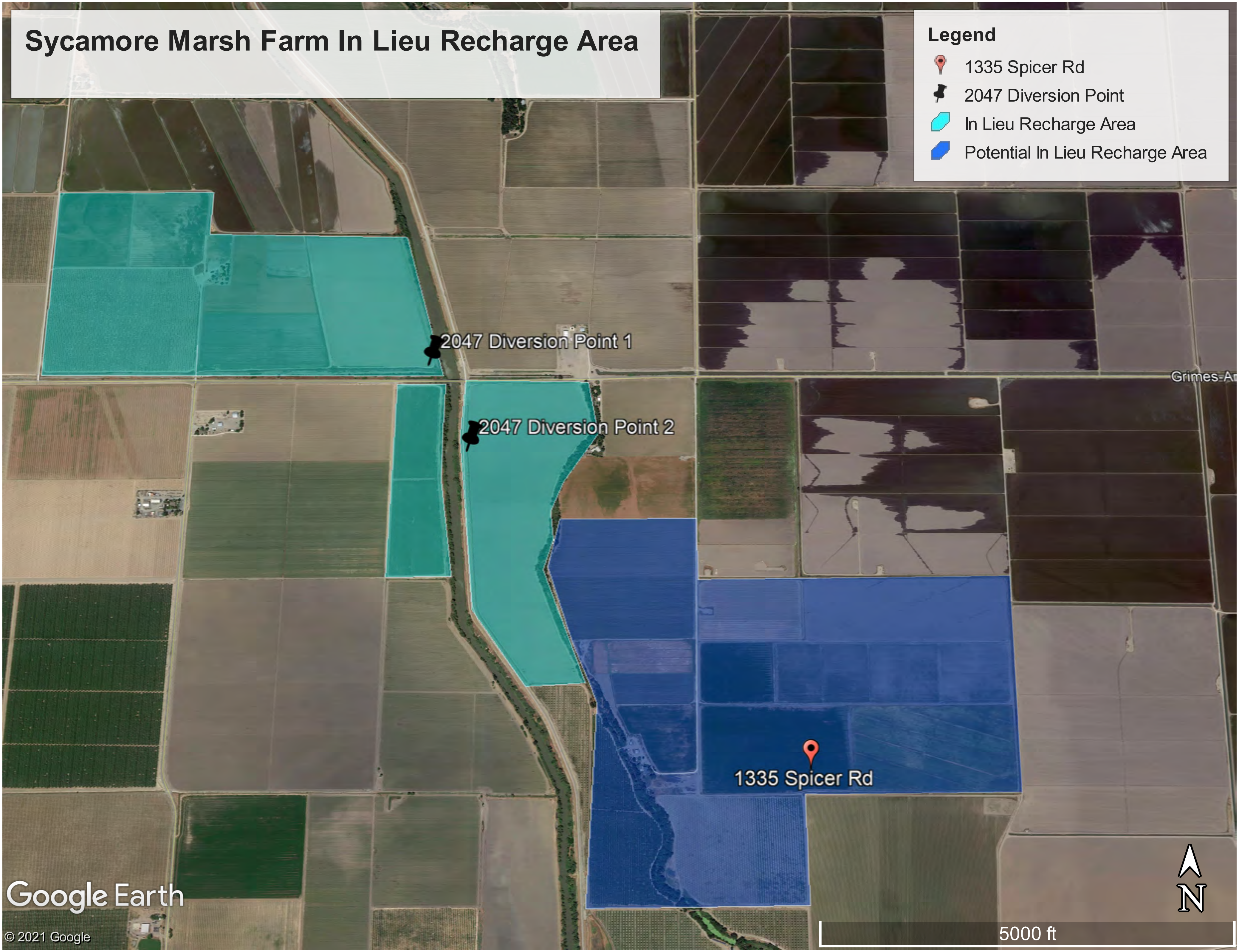
Unknown at this time, but a supplemental permit for water storage from State Water Resource Control Board will be needed.

Does this Management Action or Project serve a disadvantaged community? If so, which one(s)?
No.

Additional Information Sources:

Other Information:

This project provides many benefits in addition to groundwater recharge/storage. Potential benefits include reduced sediment loading into the 2047 Canal and Sacramento River, increased habitat for migratory shorebirds, and reduced greenhouse gas emissions from reduced pumping from groundwater wells.


Sycamore Marsh Farm In Lieu Recharge Area
Legend
1335 Spicer Rd
2047 Diversion Point
In Lieu Recharge Area
Potential In Lieu Recharge Area
2047 Diversion Point 1
2047 Diversion Point 2
1335 Spicer Rd
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5000 ft
Google Earth
© 2021 Google

Colusa Subbasin GSP Projects and Management Actions (PMAs) Submittal Form

Project Name and Contact

Project or Management Action Name: Colusa Subbasin In-lieu Recharge & Banking Program

Contact Person: Scott Hamilton

Organization/Affiliation (Project Proponent): South Valley Water Resources Authority

Contact Phone: (661) 303 1540

Contact Email: Scott@ResourceEconomics.net

Project or Management Action Description and Status

Project or Management Action Description: The purpose of the project is to incentivize landowners to take surplus contract surface water in-lieu of pumping groundwater by providing financial incentives (subsidizing surface water costs) to make surface water less expensive than groundwater. If needed, South Valley would subsidize the cost of new distribution systems to facilitate the delivery of additional surface water or provide funds to districts to implement other programs. The magnitude of such payments would depend on the size of the banking project but could exceed $100,000 per year per district.

A predetermined portion of the additional water brought into the districts would be dedicated to achieving local groundwater sustainability and some portion of the remaining quantities would be available for delivery, directly or by exchange, to South Valley members. Additional facilities may need to be constructed to enable recovery. Such facilities would be paid for by South Valley but located and constructed in coordination with local districts.

Project or Management Action Location (please provide a map if available): The project would be located within any districts willing to participate.

Which Sustainability Indicator(s) does this Project or Management Action address:

1. *Groundwater levels*
2. *Groundwater Storage*
3. *Groundwater Quality*
4. *Land Subsidence*
5. *Surface Water Interaction*

As an in-lieu recharge and banking project, groundwater levels would be expected to increase as a result of using surface water rather than groundwater. Groundwater storage would increase because of the groundwater not pumped. If the incentives to take surface water were strongest in the areas of subsidence, then the impacts of subsidence would also be reduced. Studies would need to be conducted to determine the impact on groundwater quality – we have not tried to assess these impacts yet.

Project or Management Action Status (Conceptual, In Design, Ready for Implementation): The project is conceptual at this time. Before proceeding to the design stage, we would need to meet with managers of districts willing to participate to really understand their concerns and objectives. The program can be structured in a variety of ways to meet the needs of the districts.

Has a feasibility assessment been conducted? If so, please list the agency and provide the documentation (or provide web link to download). Our consultants, Woodward Curran have developed an operational model for the program where inputs and parameters can be changed to consider varying circumstances and district requirements. However, it is necessary to understand the water districts goals and objectives before such a model can produce meaningful output.

Estimated Cost: It is not possible to estimate the cost of the project without understanding what size projects would best fit the water districts' needs. However, the projects are intended to generate income for participating districts without them having to pay any up-front capital costs. South Valley would also cover any increased O&M costs the districts might incur.

Potential Funding Sources: South Valley would fund projects through assessments on its members and perhaps through issuance of bonds where South Valley members would be responsible for the debt. We have not considered public grants or loans.

Management Action or Project Yield (e.g. water contributed to the groundwater system, acre-feet per year): The contribution to the groundwater would vary by district but, at the upper end, would be the difference between current deliveries and the minimum of: available but unused water, and the district irrigation demand.

Please describe any required Permitting and Regulatory Process and status of permitting and CEQA/NEPA compliance: We have not initiated any approval, permitting or environmental processes and would not do so without your consent.

Does this Management Action or Project serve a disadvantaged community? If so, which one(s)? There are ways the program can be structured to aid disadvantaged communities and we would be interested in exploring those options with you.

Other Information: South Valley members have extensive experience in water banking both as hosting agencies and project participants. These programs have provided funds, financed infrastructure and improved groundwater conditions. While we do not pretend to understand your circumstances, we would be interested in learning more and to see if this, or some other program can help achieve your objects without increasing your water costs. Financially, a program like this makes sense to us because our dry year water supplies are very expensive and a program like this could help lower those costs.

Colusa Subbasin GSP Projects and Management Actions (PMAs) Submittal Form

Overview

The purpose of this form is to gather ideas for potential projects and management actions (PMAs) that could be evaluated and ultimately included in the Colusa Subbasin GSP. Once ideas are gathered, an initial screening and evaluation process will be conducted, followed by ranking of potential PMAs for more detailed evaluation and inclusion in the initial GSP.

Potential PMAs may fall under several categories, including but not limited to the following:

- Recharge projects
- Supply augmentation projects
- Water conservation projects
- Projects to reduce non-beneficial consumptive use
- Groundwater pumping allocations
- Monitoring programs (groundwater pumping, water levels, stream flows, etc.)

Please provide supporting documentation and/or links to that documentation for each question, if available. **NOTE: It is recognized that much of the requested information may not be available at this time. Please provide as much information as you can.**

Project Name and Contact

Project or Management Action Name: Urban Water Conservation in Willows

Contact Person: Evan Markey

Organization/Affiliation (Project Proponent): California Water Service Willows District

Contact Phone: 530-934-4735

Contact Email: infoWIL@calwater.com

Project or Management Action Description and Status

Project or Management Action Description:
Water waste prevention ordinances, Metering, Conservation pricing, Public education and outreach, Programs to assess and manage distribution system real loss, Water conservation program coordination and staffing support, and other demand management measures

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Project or Management Action Location (please provide a map if available):

Willows

Which Sustainability Indicator(s) does this Project or Management Action address:

1. Groundwater levels
2. Groundwater Storage

Project or Management Action Status (Conceptual, In Design, Ready for Implementation):

Ready for Implementation

Has a feasibility assessment been conducted? If so, please list the agency and provide the documentation (or provide web link to download).

Urban Water Conservation in Willows is ready for implementation and described in Cal Water's Urban Water Management Plan Chapter 9.

Estimated Cost:

The cost of these activities is covered by the rate structure set by Cal Water for it's service areas.

Potential Funding Sources:

Collaboration and coordination with local entities is possible to extend the value of these activities.

Management Action or Project Yield (e.g. water contributed to the groundwater system, acre-feet per year):

Table 9-2 in Cal Water's 2020 Urban Water Management Plan (attached) shows the estimated water conserved from 2016-2020. From 2016-2020 an average annual savings of 2 AF was achieved.

Please describe any required Permitting and Regulatory Process and status of permitting and CEQA/NEPA compliance:

None

Does this Management Action or Project serve a disadvantaged community? If so, which one(s)?

No

Additional Information Sources:

Attached is Chapter 9 from the 2020 California Water Service Willows District Urban Water Management Plan which details the conservations activities currently in place and available in the future.

Other Information:

Chapter 9
Demand Management Measures

☑ ***CWC § 10631 (e)***

Provide a description of the supplier's water demand management measures. This description shall include all of the following:

(1) (A) For an urban retail water supplier, as defined in Section 10608.12, a narrative description that addresses the nature and extent of each water demand management measure implemented over the past five years. The narrative shall describe the water demand management measures that the supplier plans to implement to achieve its water use targets pursuant to Section 10608.20.

(B) The narrative pursuant to this paragraph shall include descriptions of the following water demand management measures:

(i) Water waste prevention ordinances.

(ii) Metering.

(iii) Conservation pricing.

(iv) Public education and outreach.

(v) Programs to assess and manage distribution system real loss.

(vi) Water conservation program coordination and staffing support.

(vii) Other demand management measures that have a significant impact on water use as measured in gallons per capita per day, including innovative measures, if implemented.

This chapter provides a summary of past and planned demand management measure (DMM) implementation in the Willows District (also referred to herein as the "District"), as well as an overview of the expected water savings.

This chapter contains the following sections:

9.1 Demand Management Measures for Wholesale Agencies

9.2 Demand Management Measures for Retail Suppliers

9.3 104Implementation over the Past Five Years

9.4 Implementation to Achieve Water Use Targets

9.5 Water Use Objectives

9.1 Demand Management Measures for Wholesale Agencies

Because the District is a retail water supplier, this section does not apply.

9.2 Demand Management Measures for Retail Suppliers

California Water Service Company (Cal Water) centrally administers its conservation programs for all the districts it operates. For purposes of this section, these programs have been grouped in accordance with the DMM categories in California Water Code (CWC) §10631(e). These categories are:

(i) Water waste prevention ordinances
(ii) Metering
(iii) Conservation pricing
(iv) Public education and outreach
(v) Programs to assess and manage distribution system real loss
(vi) Water conservation program coordination and staffing support, and
(vii) Other demand management measures

Following are descriptions of the conservation programs Cal Water operates within each of these DMM categories. The District's Conservation Master Plan, provided in Appendix I, contains additional information on Cal Water's conservation programs.

9.2.1 Water Waste Prevention Ordinances

Cal Water's enforcement of water waste prevention and water use restrictions is authorized and overseen by the California Public Utilities Commission via Rule 14.1 or Schedule 14.1. Local government in districts operated by Cal Water may also adopt ordinances regulating water use. Cal Water coordinates its efforts to prevent water waste with the appropriate local governmental entities.

Rule 14.1 defines the District's Water Shortage Contingency Plan (WSCP, Chapter 8), including its prohibitions on water waste and restrictions on water use. Prohibitions include:

- Use of potable water through a broken or defective plumbing fixture or irrigation system when Cal Water has notified the customer in writing to repair the broken or defective plumbing fixture or irrigation system, and the customer has failed to effect such repairs within seven (7) business days of receipt of such notice.
- The application of potable water to landscapes in a manner that causes runoff such that water flows onto adjacent property, non-irrigated areas, private and public walkways, roadways, parking lots, or structures.

- The use of a hose that dispenses potable water to wash vehicles, including cars, trucks, buses, boats, aircraft, and trailers, whether motorized or not, except where the hose is fitted with a shut-off nozzle or device attached to it that causes it to cease dispensing water immediately when not in use.

Restrictions on water use during shortages include, but are not necessarily limited to:

- Outdoor irrigation restrictions in terms of time of day and weekly frequency.
- Obligations to fix leaks, breaks, or malfunctions within five (5) business days of written notification by Cal Water.
- Application of potable water to driveways and sidewalks.
- The use of potable water in a water feature, except where the water is part of a recirculating system.
- The application of potable water to outdoor landscapes during and within 48 hours after measurable rainfall.
- The serving of drinking water other than upon request in eating or drinking establishments.
- Irrigation of ornamental landscape on public street medians.
- Irrigation outside of newly constructed homes and buildings with potable water in a manner inconsistent with regulations or other requirements established by the California Building Standards Commission and the Department of Housing and Community Development.
- Operators of hotels and motels shall provide guests with the option of choosing not to have towels and linens laundered daily. The hotel or motel shall prominently display notice of this option in each guest room using clear and easily understood language.
- Limits on filling ornamental lakes or ponds.
- Use of potable water for street cleaning with trucks, except for initial wash-down for construction purposes.
- Use of potable water for construction purposes, such as consolidation of backfill, dust control, or other uses unless no other source of water or other method can be used.

9.2.2 Metering

☑ ***CWC § 526 (a)***

Notwithstanding any other provision of law, an urban water supplier that, on or after January 1, 2004, receives water from the federal Central Valley Project under a water service contract or subcontract … shall do both of the following:

(1) On or before January 1, 2013, install water meters on all service connections to residential and nonagricultural commercial buildings constructed prior to January 1, 1992, located within its service area.

(2) On and after March 1, 2013, or according to the terms of the Central Valley Project water contract in operation, charge customers for water based on the actual volume of deliveries, as measured by a water meter.

☑ ***CWC § 527 (a)***

(a) An urban water supplier that is not subject to Section 526 shall do both of the following:

(1) Install water meters on all municipal and industrial service connections located within its service area on or before January 1, 2025.

The District meters all service connections and bills customers for water use monthly. Cal Water may install advanced metering infrastructure (AMI) in the future to improve metering accuracy and supply prompt feedback to customers about water use and leaks. Cal Water is currently piloting (AMI) in several districts but does not have plans for full implementation in the Oroville District at this time. AMI may be used by Cal Water in the future to detect and alert households of leaks and other possible problems as well as to provide customers with tailored water use information to help them use water more efficiently.

9.2.3 Conservation Pricing

The CPUC reviews and authorizes District water rates in a General Rate Case every three years. Currently, the District uses a three-tier increasing block rate design for residential water use and a single-tier uniform rate design for non-residential use. The District provides rate assistance to lower income households through its Customer Assistance Program (CAP).

9.2.4 Public Education and Outreach

The District's public outreach program is divided into four components, as follows:

Public Information Program – Cal Water operates an extensive public information program to provide information to customers on ways to use water efficiently and to market its conservation programs through multiple media outlets, including the Cal Water website, direct mail and bills, digital media, social media, and email.

School Education Program - Cal Water's school education program includes the Cal Water H2O Challenge, a project-based learning competition for grades 4-6, individual student competitions for grades K-12 and general information and learning materials for students and teachers. Cal Water deploys its school education program in all its districts. Cal Water H2O Challenge is a project-based competition for classrooms, grades 4-6. The program is offered in partnership with DoGoodery, the California Association of Science Educators (CASE), and the WestEd K-12 Alliance. The program aligns with the Common Core State Standards and the Next Generation Science Standards. The Cal Water H2O Challenge offers a unique opportunity for upper elementary teachers to facilitate their students' learning of standards-based content, while developing the core understanding of environmental principles necessary to becoming science-literate citizens.

Smart Landscape Tune-Up Program – This program provides customers with an irrigation system evaluation and installation of approved efficient irrigation system equipment, such as a smart irrigation controller and high-efficiency sprinkler nozzles. The program also includes irrigation system adjustments and detection and repair of irrigation system leaks. This program is available to all Cal Water customers at no charge.

Residential Customer Portal – Through its residential customer portal, Cal Water provides tailored assistance to each residential customer via customized water-efficiency targets, water savings calculators, and customer-specific recommendations for programs and water-saving tips.

Non-Residential Customer Assistance – Cal Water provides tailored assistance to commercial customers through customized incentives, commercial water surveys, and large landscape water use surveys. The non-residential assistance program helps commercial customers efficiently use water for sanitation/cleaning, heating/cooling, process, and landscape purposes.

9.2.5 Programs to Assess and Manage Distribution System Real Loss

As discussed above, reducing distribution system losses is one of the main focuses of the new Making Water Conservation a California Way of Life regulations. In preparation for these new requirements, Cal Water took part in the California Water Loss Technical Assistance Program (TAP) in both 2016 and 2017. Cal Water annually conducts distribution system audits using the American Water Works Association (AWWA) Free Water Audit Software. It has also developed a Water Loss Control Plan and Water Loss Control Policy to guide future water loss management with respect to:

- Meeting CPUC and state water loss standards and regulations
- Improving audit data and validity scores
- Implementing cost-effective water loss control actions

To coordinate and oversee water loss management actions across its multiple districts, Cal Water has added a Water Loss Program Analyst position to its conservation staff.

9.2.6 Water Conservation Program Coordination and Staffing Support

The CPUC reviews and authorizes Cal Water conservation program and staffing level in a general rate case every three years. Currently, Cal Water has nine full-time conservation positions, as follows:

- Director of Water Resource Sustainability,
- Conservation Program Manager,
- Research, Analytics and Reporting Manager,
- Water Resource Sustainability Analyst,
- Water Loss Program Analyst,
- Three Conservation Program Coordinators, and
- Conservation Assistant.

These staff manage all aspects of Cal Water's conservation programs that are run in 25 districts serving a combined population of 2.5 million people.

9.2.7 Other Demand Management Measures

In addition to the DMM programs described above, Cal Water operates rebate, give-away, and direct installation programs aimed at plumbing fixture replacement and irrigation equipment and landscape efficiency improvements. Following are brief descriptions of each of these DMMs.

High-Efficiency Toilet Replacement – This program replaces old toilets with MaP certified high-efficiency toilets via financial rebates, direct installation, or direct distribution.[41] Current rebate amounts are up to $50/toilet for residential toilet replacement and up to $100/toilet for commercial toilet replacement.

High-Efficiency Urinal Replacement – This program replaces old urinals with high-efficiency urinals meeting the state's 0.125 gallon per flush water use standard via financial rebates and direct installation. While available to all non-residential customers, the program targets sites with higher-than-average bathroom utilization, such as restaurants and office buildings. The current rebate amount is up to $150/urinal.

Clothes Washer Replacement – This program provides a financial rebate to replace an old inefficient clothes washer with a new high-efficiency washer. The program is available to all residential and multi-family customers. The current rebate amount is up to $150/washer.

Residential Conservation Kit Distribution – This program offers residential customers conservation kits featuring a range of water-saving plumbing retrofit devices. The kits are

[41] For information on MaP certified toilets, see: https://www.map-testing.com/

available at no charge and include two high-efficiency showerheads (1.5 gpm), two bathroom faucet aerators (1.0 gpm), one kitchen faucet aerator (1.5 gpd), toilet leak tablets, and an outside multi-function, full-stop hose nozzle.

Smart Irrigation Controller Installation – This program provides a financial rebate for the installation of a smart irrigation controller that automatically adjusts watering schedule in response to changing weather conditions. The current rebate amount is $125/controller for residential customers and $25/station for commercial customers.

High-Efficiency Sprinkler Nozzle Rebate – This program provides a financial rebate for the installation of high-efficiency sprinkler nozzles. This program is available to all Cal Water customers. The current rebate amount is $5/nozzle.

Large Rotary Nozzle Rebate – This program provides a financial rebate for the installation of high-efficiency large rotary nozzles. This program is available to all Cal Water customers. The current rebate amount is up to $30/nozzle toward the nozzle purchase cost and up to $8/spray body toward installation cost, if installed by a C-27 licensed landscape contractor.

Spray Body with Integrated Pressure Regulation and Check Valve Rebate – This program provides a financial rebate for the installation of high-efficiency spray bodies with integrated pressure regulation. This program is available to all Cal Water customers. The current rebate amount is up to $10/body toward the spray body purchase cost and up to $8/spray body toward installation cost, if installed by a C-27 licensed landscape contractor.

Turf Replacement Rebate – This program provides a financial rebate for replacement of turf with approved drought-tolerant landscaping. Cal Water operated this program in 2015/16 as a drought response measure. The program will be re-started as part of Cal Water's irrigation equipment/landscape upgrade program offerings.

Table 9-1 summarizes the DMMs available to Dixon District customers at the time this Plan was prepared.

Table 9-1. Cal Water DMMs Available to District Customers

Programs Offered	Customer Eligibility		
	Single-Family	Multi-Family	Commercial
Plumbing Fixture Replacement			
High-Efficiency Toilet Replacement	✓	✓	✓
High-Efficiency Urinal Replacement			✓
High-Efficiency Clothes Washer Rebate	✓	✓	
Conservation Kits	✓	✓	
Irrigation Equipment/Landscape Upgrades			
Smart Irrigation Controller Rebate	✓	✓	✓
High-Efficiency Sprinkler Nozzle Rebate	✓	✓	✓
Large Rotary Nozzle Rebate		✓	✓
Spray Body Rebate		✓	✓
Turf Replacement Rebate	✓	✓	✓
Customer Assistance			
Smart Landscape Tune-Up Program	✓	✓	✓
Residential Customer Portal	✓		
Non-Residential Customer Assistance		✓	✓

9.3 Implementation over the Past Five Years

Table 9-2 summarizes program implementation for the previous five years. Estimated water savings do not include savings from water waste prevention ordinances, conservation pricing, public information, or distribution system water loss management. Cal Water uses the Alliance for Water Efficiency's Water Conservation Tracking Tool to estimate water savings.

Table 9-2. Implementation of Customer DMMs: 2016-2020

Indoor Programs	2016 – 2020 Total	Average Annual
Toilets & Urinals (number distributed)	32	6
Clothes Washers (number distributed)	20	4
Conservation Kits (number distributed)	24	5
Outdoor Programs		
Smart Controllers (number distributed)	3	1
Nozzles & Spray Bodies (number distributed)	0	0
Turf Buy-Back (sq ft removed)	4,140	828
Residential Assistance Programs		
Surveys/Audits (homes receiving)	1	<1
Non-Residential Assistance Programs		
Surveys/Audits (sites receiving)	0	0
Estimated Water Savings (AF)	8	2
NOTES: Estimated water savings for 2016-2020. DMMs will continue to generate savings after 2020 for their useful life.		

9.4 Implementation to Achieve Water Use Targets

All the DMMs described above contributed to the District's compliance with its SB X7-7 2020 target GPCD.

9.5 Water Use Objectives (Future Requirements)

CWC §10609 requires that urban retail water suppliers develop new water use objectives that are based on specific standards for certain water use sectors. These water use objectives will not be developed until 2023. Suppliers are encouraged in this UWMP cycle to consider how they will align their conservation management actions in order to meet these future obligations.

As noted above, Cal Water's conservation programs are subject to review and approval by the CPUC through a General Rate Case every three years. In making conservation program recommendations to the CPUC, Cal Water carefully considers how they will advance multiple objectives, including compliance with the pending water use objectives. Specific objectives identified in Cal Water's most recent General Rate Case included:

- Maintaining continuity with and furthering implementation of conservation programs authorized by the previous General Rate Case.

- Preserving gains in water conservation achieved during the 2013-2017 drought.
- Ensuring Cal Water districts are well-positioned to comply with state regulations and policies pertaining to water conservation, water loss management, and groundwater management, including Executive Order B-37-16, SB 555, and the Sustainable Groundwater Management Act (SGMA).
- Advancing cost-effective water use efficiency alternatives in districts with high water supply costs.

Cal Water developed a scoring methodology to adjust conservation programs and budgets to further these objectives. The methodology specifically considers five distinct conservation policy drivers:

1. State Conservation Standards and Water Use Objectives
2. SGMA Compliance
3. SB 555 Water Loss Management Requirements
4. Commercial, Institutional, and Industrial (CII) Water Management
5. Avoided Water Cost and Affordability

The methodology assigns greater weight to the State Conservation Standards and Water Use Objectives and SGMA Compliance policy drivers, reflecting their importance in terms of overall water resources management.

Scoring for the SGMA Compliance policy driver is based on groundwater basin priority, district dependence on groundwater supply, and basin adjudication status. The highest scores are assigned to districts in unadjudicated and critically overdrafted or high priority basins where groundwater comprises more than 45 percent of the water supply. The Willows District ranked in the middle of Cal Water's districts for this policy driver.

Scoring for the State Conservation Standards and Water Use Objectives policy driver is based on four metrics that are used to gauge which districts are most likely to require adjustments to their conservation program mix or level of implementation to comply with the new standards. These metrics are:

1. Residential per capita landscape area
2. Residential per capita turf area
3. Size and number of large residential landscapes
4. Difference between a simulated water use budget and average water use for 2011-15

The Willows District ranked in the top third of Cal Water's districts for this policy driver.

Scoring for the SB 555 Water Loss Management Requirements policy driver is based on the district's infrastructure leakage index (ILI) from its most recent validated water loss audit. The ILI is a performance indicator of real (physical) water loss from the water distribution system. A high ILI indicates possible distribution system inefficiencies and may also indicate significant water system leakage. Proposed adjustments to funding for water loss management are based on the ILI scoring criteria. The Willows District ranked in the top 15 percent of Cal Water's districts for this policy driver.

Scoring for the CII Water Management policy driver is based on the ratio of CII water uses to total water uses in a district. The Willows District ranked in the middle of Cal Water's districts for this policy driver.

Scoring for the Avoided Water Cost and Affordability policy driver is based on the District's avoided cost of water supply, as estimated by the California Urban Water Conservation Council (CUWCC)/Water Research Foundation Avoided Cost Model. The Willows District ranked in the middle of Cal Water's districts for this policy driver.

The combination of scores on each policy driver were used by Cal Water to recommend to the CPUC in its most recent General Rate Case adjustments to the conservation budgets of its districts. The purpose of the adjustments is to increase Cal Water's capacity to deploy conservation programs in districts expected to face the most significant regulatory and water management challenges in coming years. Recommended adjustments ranged from a low of 5 percent to a high of 25 percent. The recommended adjustment for the Willows District was 22.5 percent.

2B-5. GSP Chapter Input Submittal Forms

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COLUSA SUBBASIN

Colusa Subbasin Groundwater Sustainability Plan Chapter Input

Commenter Name: Donald Bills **Commenter Affiliation (if applicable):** GGA-TAC

This file introduces a table that allows you to easily enter the following key information so we have certainty about your input. The table includes the following categories:

- Chapter Number
- Section Number
- Page Number
- Paragraph Number (starting with the first full paragraph at the top of a given page)
- Figure/Table Number (if applicable)
- Comment

INSTRUCTIONS

1. Please **ONLY** use the MS Word or PDF document titled "Colusa Subbasin GSP Chapter Input" to submit your comments.

2. Review all applicable text and note each Chapter, Section, Page, and Paragraph number associated with a comment you'd like to make. For Paragraph number, please start with the first full paragraph at the top of a given page and count down.

3. Enter your name and if applicable, an organizational affiliation at the top of your table.

4. Once you have completed all your comments, please save the file with your last name at the end in parentheses. For example:
   - *Colusa Subbasin GSP Chapter Input (Jones).docx*

5. If you are located in the Glenn Groundwater Authority, please send your comment file to:
   - Lisa Hunter – Program Manager - Glenn Groundwater Authority: lhunter@countyofglenn.net

6. If you are located in the Colusa Groundwater Authority, please send your comment file to
   - Mary Fahey – Program Manager - Colusa Groundwater Authority: mfahey@countyofcolusa.com

7. If you don't affiliate specifically with either the CGA and/or GGA, please send your comments to both Mary and Lisa.

8. Please make sure that your comments are submitted by midnight May 5, 2021.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
1	1.1	1.1			
1	1.2	1.2	2		1.—Sustainable groundwater resources not only preserve, and enhance the economic viability, social well-being and culture of all beneficial uses and users, but also insure the sustainability of water for natural and environmental needs. Especially those of at risk or critical resource value (i.e. springs, wetlands, riparian habitat, and baseflow reached of perennial and/or intermittent streams). I would suggest adding something like this to the stated goal of the Colusa Subbasin GSP. 2.—there is no such thing as sustainable/safe yield. At best the term means planned depletion. I suggest you replace it with sustainable goal.
1	1.2	1.2	3		1.—Sustainable/safe yield is no longer considered to be a valid term in the context of hydrogeology. The term was originally developed as a legal term to characterize a water budget in balance by relating recharge (from precipitation) with discharge, two terms that are not related. I suggest that you replace it here with sustainable goal.
1	1.3	1.2	3		1.—Suggest that you modify Both GSAs in the last sentence to “Both the Colusa and Glenn GSAs…” for clarity.
1	1.4	1.4	1, bullet 5		1.—Suggest that you add to seawater intrusion, brackish or saline groundwater intrusion. As discussed during TAC meetings, as freshwater is removed from storage in the regional aquifer. The reduced hydraulic head will allow brackish and/or saline water at depth to seep upward into the regional aquifer. Unless

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
					monitoring of water quality at depth in the regional is intended to be the monitoring tool for this.
1	1.4	4 of 7	Article 5 sub-article 2	1-1, GSP regulation section 354.18, bullet 3	Suggest replacing estimate of sustainable yield with estimate of sustainable goals.
1	1.4	4 of 7	Article 5 sub-article 2	1-1 GSP regulation section 354.18, surface water supply	Shouldn't this also include reclaimed water and/or
1	1.4	6 of 7	Article 5 sub-article 4	1-1, GSP regulation section 354.36, representative monitoring.	Remote-sensing data was discussed as an additional proxy in addition to groundwater elevations for other sustainable indicators. Should it be mentioned here?
1	1.4	6 of 7	Article 5 sub-article 4	1-1, GSP regulation section 354.36, Assessment and Improvement	Again remote-sensing methods and data are another tool that seems suited for filling data gaps by improving monitoring frequency, accuracy, and density of data sites. Discussion of DWR INSAR and gravity data as possibilities.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
				of Monitoring Network	

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment

COLUSA SUBBASIN

Colusa Subbasin Groundwater Sustainability Plan Chapter Input

Commenter Name: Donald Bills **Commenter Affiliation (if applicable):** GGA-TAC

This file introduces a table that allows you to easily enter the following key information so we have certainty about your input. The table includes the following categories:

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INSTRUCTIONS

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6. If you are located in the Colusa Groundwater Authority, please send your comment file to
   - Mary Fahey – Program Manager - Colusa Groundwater Authority: mfahey@countyofcolusa.com

7. If you don't affiliate specifically with either the CGA and/or GGA, please send your comments to both Mary and Lisa.

8. Please make sure that your comments are submitted by midnight May 5, 2021.

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Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
2					

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Colusa Subbasin Groundwater Sustainability Plan Chapter Input

Commenter Name: Donald Bills **Commenter Affiliation (if applicable):** GGA-TAC

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COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
3	3.1	3-1	1, first sentence		First occurrence of abbrev. Should be spelled out in text. I.E. This section describes the hydrologic conceptual model (HCM) of the Colusa Subbasin.
3	3.1.3	3-6		3-3. Note in upper left of plot. Second sentence.	There appears to be missing or jumbled text at the start of sentence 2. " at r y ars missing more that 30 days…". Suggest that it be fixed is needed.
	3.1.4	3-8		3-4	Since land surface elevation is color coded on the Topography map, it might help to identify the very light shade of blue as surface water as it can be easily confused with the very light green (greenish-blue?) that is land surface less than 30 ft.
	3.1.5	3-7	Paragraph2, 1st sentence	3-5	"The regional watersheds and natural waterways are shown on Figure 3-5." Figure 3-5 also shows principal water infrastructure. I suggest it be added to the sentence and the fig. 3-5 title.
	3.1.5	3-10	First paragraph, last sentence		"These streams are intermittent and drain the foothills that border the Coast Ranges to the west." Perennial streams are connected to the regional groundwater table and get most of their base flow by groundwater discharge. Intermittent streams are only seasonally connected to the regional groundwater table and flow seasonally or in response to runoff. Ephemeral streams are not connected to the regional groundwater table and only flow in response to seasonal runoff. Are Foothill streams of the Coast range truly intermittent?

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
3	3.1.5.1.1	3-10			Is there no range of flow data for Stony Creek pre-Black Butte Dam (and even Stony Gorge Dam)? This would give some context to the releases from Black Butte Dam since 1996.
	3.1.5.1.2	3-13			"Sacramento River stream flows measured at the Ord Ferry-Main Channel stream gauge, in the northern part of the Subbasin, varied between 200 and 160,000 cfs during the 1984 to 2020 time period, with extreme low flows measured in the spring of 1990." Why is the time p3.1.5.1.3eriod limited to 1984 to 2020? If the intent here is to describe natural surface waters, there are documented (USGS) periods of extreme flows greater that this range extending back to the 1920 from stream-flow gaging stations in or adjacent to the Colusa subbasin.
	3.1.5.1.3	3-13			3.1.5.1.4 Glenn Colusa Canal lists acres serviced. Wouldn't it be appropriate to do the same for the Tehama-Colusa Canal? Also the length of the canal and diversions? I watched the Tehama-Colusa Canal being built less that a quarter-mile away from where I grew up on Co. Rd. 21 south of Orland. I even rode my bike in the bottom of the canal once it was cemented in. I noticed at the time there was a line of one-way valves on the bottom of the canal. I later learned they were there to relieve stress on the canal by allow rising groundwater to move into the canal. Is this something you are accounting for in your groundwater models during those wet years when WLS are very close to the surface?
	3.1.5.1.6	3-15	1		"These foothill drainages and their tributaries are classified as part of the Sacramento-Stone Corral Watershed…". I think you mean the Upper Stony Watershed.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
	3.1.5.1.6	3-15	2		"Runoff in these ephemeral and intermittent streams generally begins in late fall when the rainy season starts and may continue until late spring." Intermittent streams suggest some seasonal contact with the regional groundwater table. Probably not true for many of these streams in the north part of the subbasin. I do not know about those in the southern part of the subbasin. Springs are overlooked in this discussion (or elsewhere). Many of these smaller streams have springs at or near their headwaters that issue from either the Tehama (exposures of pre-Paleogene, would have a QW signature), Riverbank or Modesto Formations. Discuss here?... High elevation areas to the west of Orland/Willows. GW contours do not extend that far west. 3.1.11.3 does not address springs. Black butte Lake overlies mostly Tehama formation. Is there ant possibility of Reservoir water seeping into Tehama and showing up in springs to the south? QW signature, spring flow related to lake level not climate, etc.
3	3.1.6	3-18		3-9	The color for soil type C and water bodies on fig. 3-9 (light blue) are so similar it is hard to tell them apart. I suggest you consider using more contrasting colors and adding waterbodies to the explanation to make them easier to tell apart.
		3-27		3-16	Top of Cretaceous rocks contours are in meters MSL, and tops of Cretaceous rocks elevation are in feet MSL. Using both metric and SI units makes them a little difficult to compare. Can they both be in the same units? Also, there are places where the contours do not match the elevations (SE of Black Butte, Artois, Princeton, etc.). I assume this is related to structural offsets. I suggest you consider adding the principal structures (faults) to this map to help with the interpretation.

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
	3.1.7.2.3	3-31	4		During a review of USGS topographic maps that cover the area west of Orland and Willows, I found about 24 marked springs, a few with actual names. Based on their location, these springs appear to be discharging from either the Tehama, Riverbank or Modesto Formations in the northwest part of the Colusa Subbasin, There is little hydrogeologic information shown on the maps of this report for this area owing to a lack or well data. Springs represent a source of hydrogeologic information that can be used in the absence of well data to extend water level contours and improve understanding of groundwater conditions in the area. Any information about these springs from land owners or site inventories by DWR or the USGS will improve the hydrogeologic characterization of this area of the subbasin. Some mention of spring discharge from the Tehama, Riverbank, and Modesto Formations might be appropriate here, with a more complete discussion in groundwater discharge.
	3.1.8.2	3-36	2-3		?... Base of the Tehama and Tuscan Formation and (or, and/or?) Base of freshwater excluding those areas where post-Cretaceous sediments contain brackish water. Freshwater is defined as 3,000, 2,000, and 1,000 mg/L depending on which reference is used (USGS, DWR, of C2VSim). Which is it? I would also suggest that you define brackish water here as its related freshwater and the freshwater boundary. The vertical extent of these boundaries shown on fig. 3-11 to 3-13 while approximate do not appear to consistently align with either of these definitions. Perhaps it would be appropriate to add queries (“?”) where the degree of uncertainty is highest.
	3.1.9.2	3-38	1		“These basin faults may act as barriers or conduits to fresh groundwater flows.” I think it is also important to mention that, if the faults are deep seated, they can also provide conduits for poorer quality (brackish) water from the marine sediments below to migrate up into the freshwater layer. This is particularly true if the hydraulic head of the freshwater layer is consistently reduced owing to groundwater withdrawal.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
3	3.1.10, Principal aquifers	3-39			Some text edits for clarity.
	3.1.10.3, water Quality	3-42	1		Electrical conductivity (EC) is not a measure of the quality of the water. It is a measure of how electrically conductive the water is. As a result, there is a nearly direct relationship between EC and total dissolved solids (TDS) in the water. TDS is one general measure of water quality. The more dissolved solids in the water, the more electrically conductive it is and, as a result, the quality of the water is generally poorer. For this reason, I suggest you delete reference to EC in the first sentence of the paragraph.
	3.1.10.3	3-42			Fire retardant used to be manufactured in Orland and included boron with other chemicals known for both their fire suppression properties and as chemical fertilizer. Currently, fire retardant is a mix of ammonium polyphosphate, diammonium phosphate, diammonium sulfate, monoammonium phosphate, attapulgus clay, guar gum known as Phos Chek. Over time, after a fire, this material gets watered into a watershed and may be a concern for the water quality of an aquifer. It is also highly concentrated where manufactured and distributed (Airports like Orland, Willows, and USFS and CDF fire bases).
	3.1.10.3	3-42	3		Most drycleaners use both Trichloroethylene (TCE) and Tetrachloroethylene (PCE) (as did the one in Orland). The studies I have seen on this issue for the Orland area refer mostly to TCE.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
	3.1.11, Groundwater Inflows and Outflows	3-42 to 48	1		The section heading is groundwater inflows and outflows. The lead sentence begins “Groundwater underflows between the Colusa Subbasin and neighboring groundwater subbasins…”. Groundwater underflow is a specific type of inflow or underflow. I would suggest that a better use of this introductory paragraph would be to list all the relevant GW inflows and outflows to the Colusa Subbasin as discussed in the following subsections. I would also add the Corning Subbasin in the first sentence in relation to groundwater underflow. As water-level contours indicate (fig. 3-19), Stony Creek is not a barrier to groundwater flow.
	3.1.11.2.2, GW banking?	3-43			Groundwater banking. Not in the glossary of terms and it appears to mean something different here (recharge) as opposed to the most common definition (water management mechanism designed to increase water supply reliability through the buying, selling, and storage of surface water and groundwater rights for later use). I would suggest artificial recharge as a alternate term since the main heading (2.1.11.2) is Groundwater Recharge Areas.
	3.1.11.3, Groundwater discharge areas	3-45	2		I suggest that you consider adding a few sentences about springs in the Colusa Basin to this paragraph. Something like: “Most springs in the Colusa Subbasin occur near the western boundary and discharge from the Tehama, Riverbank, or Modesto Formations and stream channel alluvium. About 25 springs can be identified from USGS topographic maps of the subbasin. A number of these springs have been developed for agricultural use by landowners locally (apparent on satellite imagery). The flow, and water quality of these springs may exist in DWR or USGS databases based on past historical inventories.” If properly inventoried these springs would represent significant additional information about the occurrence, movement, and quality of ground water in the regional aquifer of the Colusa Subbasin, especially where this information is poorly defined.

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
3	3.1.11.3	3-48	2, 4th sentence		"There are also many unmetered domestic wells located throughout the study area." I suggest adding unmetered small ag wells also: "…unmetered domestic and small agricultural wells…"
			2, 5th sentence		It might be appropriate to add a sentence or two here to briefly explain how the annual rate of withdrawal from domestic wells was determined (estimated). Average pump capacity of all domestic wells, seasonal domestic water use estimates, or other. Adding small unmetered ag. wells to this total would increase significantly I imagine.
	3.1.11.3	3-48	3		I would also add a comment to this paragraph that during years when surface water deliveries are significantly cut back (drought), agricultural lands rely heavily on wells to make up the difference.
3	3.1.12.1	3-51	4		other methods or data sources: I'd like to suggest passive seismic. The method uses seismic signals already available in the environment, either anthropogenic (i.e. freeway traffic), or natural (i.e earthquakes, ocean waves, etc). the seismic signals are processed similar to standard reflection and/or refraction surveys but for much larger areas and depths. Ground-based, non-invasive CSAMT (Controlled Source Audio-frequency Magnetotellurics) and TEM (transient electromagnetic or alternately called time-domain EM (TDEM)) surveys can provide detailed subsurface information on stratigraphy, structure, depth to water and water quality in localized areas of interest. Survey lines that pass over or by existing wells provide ground-truth.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
3	3.1.12.1	3-52	1		Different TDS thresholds to define base of freshwater. Part of the problem may also be that water use type has a lot to do with whether water is considered fresh or not. MCL for safe drinking water is 500 mg/L, Livestock can tolerate about 1,500 mg/l. A lot of commercial ag. plants can tolerate 2,000 to 3,000 mg/L. There is also not broad agreement on what constitutes fresh, saline, or brackish water. It seems to me that the standard for what constitutes freshwater should be the same for all subbasins in the Sacramento Valley, if not the entire Central Valley.
	3.2.2.1	3-53	2, second sentence		"The most notable recovery period occurred around 1983, which was both a wet year and when water users added more surface water to their supply portfolios." The recovery after the 1987 to 1991 drought seems at least as great if not greater.
		3-53		3-22	It is hard to evaluate temporal trends on this plot referring back to the average annual precipitation plot at the beginning of this chapter. To help understand and evaluate this temporal data it would seem appropriate to add a plot of the annual average precipitation to this graph.
	3.2.2.1	3-55	1		Besides showing the general direction of flow to the SE, Figure 2 appendix 3-B appears to show Walker Creek to be a gaining stream (i.e. perennial, groundwater contours point up stream) from the NW part of the subbasin to Artois. Comparing land surface contours (fig 3-4) to the groundwater contours for this area seems to indicate that the depth to water is from -10 to -30 ft below the streambed throughout. Is there a discrepancy here that needs to be resolved?

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
3	3.2.2.1	3-55	4		"Current groundwater levels are similar to those measured in 2017, indicating that regional groundwater levels have been relatively stable since the end of the previous multiple-year drought." I find this statement a little misleading. What it overlooks is the fact that the combined effect of the 2007-09 and 2012-16 droughts was an average depth to water decline of over 30 ft (fig 3-22) from which the principal aquifer has yet to recover. In addition the 2019 and 2020 wls appear to continue trending down, not stable, as cones of depression continue to expand (fig 3-24 and 3-25).
	3.2.2.1	3-55	1,3rd sentence		"Impacts due to pumping are the exception to the typical gradients and disrupt both local and regional gradients." I suggest that you add to this sentence or the first sentence of the paragraph a comment on the effects of changing hydraulic parameters on the lateral groundwater gradient.
	3.2.5	2-64	Second		Delete EC. It is not a water quality parameter.
			third		Who monitors and regulates the water quality of municipal supply systems? Worth mentioning here? Regional water quality control boards? Saline connate water? Connate water is water trapped within the pores of sedimentary rocks. For that to happen it would have to be fully confined laterally and vertically and not be faulted or fractured. In the geologic discussion it states that pre-Cretaceous rocks are faulted and fractured. Groundwater is almost always in motion and always flows in response to gravity and/or the hydraulic gradient. The flow rates can be very slow, ft per hundreds to thousands of years or more. The connate water would be in pre-

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
					Cretaceous sediments. Has anyone dated the water to see if it is, in fact, greater than 145 million years old, give or take?
	3.2.5.1.1	3-64	1		End of first sentence add "…and/or EC value (EC is a surrogate [estimate of] for TDS because it is more easily measured on site)." There appears to be a discrepancy in the Secondary MCL for TDS; 500mg/L in sentence 2 and 500 mg/L in sentence 4. Fix?
	3.2.5.1.1	3-66	1		"Wells screened in the unconfined to semi-confined zone of the aquifer (i.e. in wells less than 200 feet deep) had the highest number of wells with elevated TDS concentrations." I suggest adding "in thew central and southern part of the subbasin" to the end of this sentence.
	3.2.5.1.1	3-66	2		First sentence, …In these areas…. What areas? Suggest replacing with …southwest of Colusa…
	3.2.5.1.2	3-67	1		Anthropogenic source for increasing chloride and sulfide concentrations? Septic systems, landfills, other?

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
	3.2.5.2.2	3-67	1		Boron. Pre, late 1970's Boron was a component of fire retardant for its fire suppression characteristics. Fire retardant was manufactured in a plant in Orland and stored at firebases (airports) in Glenn and Colusa counties. Is saw wide use in suppressing forest, brush, and grass (at lower elevations) fires in Glenn and Colusa Counties.
	3.2.5.2.3	3-68	1		Known or suspected cause for increases in iron and manganese worth mentioning here? Natural or human caused? Landfill west of Artois? Junk yards? Suggest adding if appropriate.
	3.2.5.2.3	3-68	1		Known or suspected cause for anthropogenic increases in hexavalent chromium worth mentioning here? Landfill west of Artois? Suggest adding if appropriate.
	3.2.7	3-73	2 and 3 paragraphs		The second paragraph is misleading ("While Stony Creek, Sacramento River, and the Colusa Basin Drain all experience gaining and losing conditions throughout the year,…") and appears to contradict the information provided in the 3rd paragraph. I would suggest deleting the second paragraph entirely and moving the table references to the 3rd paragraph.
	3.2.8	3-74	2nd paragraph	3-34	I do not follow the scoring criteria for GDE. A GDE where groundwater is near the surface has a score of 1; least likely to be GDE when it should be more likely to be a GDE. If a GDE is not near surface water OR crop land it scores a 4; most likely to be a GDE when it should be least likely to be a GDE. How the 30 ft DTW line was derived is explained in paragraph 1 on page 3-75. But I could not find or estimate the 30 ft DTW on any or the other figures in the text or appendix. An approximated 30 ft DTW line for 2006

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
					data on figure 3-19 would run from between Arbuckle and College City, to near the boundary of the subbasin west of Williams, to just west of Artois, ending at Stony Creek just N/NW of Orland. This is nowhere near the line shown on figure 3-35. Using figure 5 in appx 3B I can approximate a 30 ft contour to the 2017 data. But it also does not compare to the 30 ft DTW contour on figure 3-35. The explanation table on figure 3-35 does not reference a time period (2014 to 2018?) for the 30 ft DTW line or any of the other features shown. Finally, there is no reference to springs and the riparian habitat they support at headwater streams in the NW part of the subbasin between Willows and Orland. These would represent some of the most important and species diverse habitat in the subbasin. I would suggest that the entire GDE section be revised so it more clearly and plainly represents GDE's that occur within the subbasin.
3	3.3 Water budget information	3-77	1		This section describes water budget components in detail but, I did not see a clear statement of what the water budget was for. Water budgets can be used for many things (i.e. GW gains or losses, basin gains or losses, etc). Is there a statement of the purpose of the water budget in the Groundwater Sustainability Plan Emergency Regulations §354.18 that could be added to the introduction here? The name suggests it is to determine groundwater sustainability of the principal aquifer in the subbasin. That implies that all the inflows and outflows are on onside of the equation and +/- change in storage is the result.
3	3.3.3	3-80		3-9	What is the Shasta non-critical and Shasta Critical, mentioned on the table? How does it relate to the Colusa Subbasin? I think it is defined two pages later under Land use. But there is still no explanation of what a Shasta critical and Shasta noncritical year is. Reservoir contents? Outflow? Both? Is there a reference for this missing? It would be worth providing a footnote to table 3-9 to define Shasta critical and Shasta non critical.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
	3.3.3.3	3-83	3, Land Use		"…modified based on planned development according to the Colusa County 2030 General Plan." Is there a 2030 Glenn County General plan worth considering here as well?
3	3.3.4	3-84	1, bullet 1		Groundwater pumping and stream accretion are described as inflows here. In paragraph 2 second bullet on page 3-85 they are described as outflows. Which is it? I would suggest they are both outflows from the principal aquifer and the text needs to be fixed accordingly.
	3.3.4	3-85	3rd bullet of first paragraph (3-84)		Change in Storage is defined as changes in soil moisture storage within the upper several feet of soil in the root zone, as well as changes in storage in surface water bodies within the basin. Neither of these are change in storage. They are either inflows or outflows components that when summed with other inflows or outflows result in a change in storage of the principal aquifer. I would suggest that the text be fixed accordingly.
		3- 86 and 3-87		3-10 and 3-11	The tables do a much better job of representing the various SW and GW components of the water budget. Is there some way change the text so it is mere consistent with the tables? Also, In both table 3-10 and 3-11 the column headings for future conditions climate change relate to a specific date (2030 and 2070). It would be useful to the reader if the other columns (historical simulation, current baseline, and future condition no climate change base line) had the time periods they are based on as well. 1990 to 2015, 2015, and 1966 to 2015 respectively.

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
	3.3.4.1	3-88	4		I would suggest that ET from the riparian corridor of the Sacramento River as well as evaporation from the rivers surface can also be significant and worth discussing here. Especially during the summer months when ET is at a maximum and daytime temperatures can exceed 100 degrees for weeks at a time. This is important to consider under future climate change scenarios where temperatures and the days per year of excessive heat are predicted to increase.
	3.3.4.1	3-89		3-38	I would suggest that you add the change in storage (3taf.yr) to the graph. It is not apparent on the graph even though it is color coded in the legend. The columns look equal. In any case it should not be a color-coded box as inflow or outflow. It is the result of both.
	3.3.4.1	3-90		3-39	The GW change is storage in table 3-12 is shown as a negative number (-27.5 taf/yr, a loss). So, why is it shown as an inflow in this figure? Change in storage is neither an inflow nor a outflow but the result (sum) of both. Showing it this way graphically suggests the inflows and outflows are in balance. They are not. I would suggest that you add the actual change in storage (-27.5 taf/y) to the legend and remove it from the inflow column. I suggest you make similar changes to figures 3-40 to 3-47.
	3.3.4.1.1	3-91	1 and 2	3-12	"The primary sources of surface water in the basin are the Sacramento River and Stony Creek. Surface water supplies are relatively reliable in the basin and represent approximately 74 percent of the total water supplies." Is this statement accurate? How do Shasta critical and non-critical years affect it? I would think that during Shasta critical years SW deliveries would be much and during Shasta non-critical years would be at or near 100 percent. The second paragraph seems to support this.

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
3	3.3.4.2	3-93	2		Average annual inflows to and outflows from the groundwater system were estimated to be 997 taf/yr during the current conditions baseline simulation period on figure 3-41 are shown as 998 taf/yr not 997. Which is right?
	3.3.4.3.1	3-95	4		"There is negligible change in groundwater storage under the future condition, no climate change baseline water budget." I suggest you add the actual change in parentheses: "…negligible change (+0.6 taf/yr)…"
	3.3.4.3.2	3-97	1		"Average annual inflows to and outflows from the groundwater system were estimated to be 1.0 maf/yr." I suggest you add the type and time period to toe sentence so it is consistent with the title of this section and the figure referenced. "Average annual future conditions 2030 climate change baseline groundwater system inflows to and outflows from the groundwater system were estimated to be 1.0 maf/yr."
	3.3.4.3.2	3-98		3-45	Change in storage is not an inflow as shown…. See previous comments.
	3.3.4.3.3	3-100		3-47	Change in storage is not an inflow as shown…. See previous comments

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
	3.3.5	3-101	1		"Uncertainty refers to a lack of understanding of the basin setting…" Add Water Budget to uncertainty in the first sentence to be consistent with the section title. I.E. "Water budget uncertainty refers to…"
	3.3.6	3-102	1		"Based on the current conditions and future conditions with no climate change scenarios, which represent long-term average conditions in the subbasin, overdraft conditions are not expected to occur in the Colusa Subbasin." The rest of the paragraph appears to contradict this. I suggest you change not to expected to occur to minor or modest overdraft is expected to occur.
	3.3.7	3-102	1		"As described previously, sustainable yield refers to 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." At the beginning of this chapter sustainable yield was also related to a maximum depth below lands surface, 200 ft I believe. I suggest you add that add that condition her also.
	3.5, references				I did not attempt to check or verify references…

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
3	3.1.12	3-50			

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Colusa Subbasin Groundwater Sustainability Plan Chapter Input

Commenter Name: Donald Bills **Commenter Affiliation (if applicable):** GGA-TAC Member

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Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
4	4.2.2.2.1	4-4	1		Groundwater levels should be measured from a pre-established and recorded reference point. — The reference point elevations (RPE) need to have been surveyed to the NAVD 88~~, feet~~ and shall be accurate to within 0.5 feet, at a minimum (23 CCR §352.4(a)(4). The USGS standard is 0.1 ft. The reasoning is related to the accuracy of GW model results. If the accuracy of GWLs input to GW models are not accurately known, any errors in model results propagate over time through the model runs. As a result, GWL changes and associated changes in inflow, outflow and storage become increasing less certain. In the case of the Colusa subbasin knowing the accuracy of the MP to only 0.5 ft could result in WL changes of +/- 0.5 ft and storage changes of +/- 0.5 ft (100,000s af/y potentially). Also, Accurate to within 0.5 ft at a minimum seems a little ambiguous. Do you mean that 0.5 ft is the least accurate value acceptable but greater values (1.0 ft, 5.0 ft, etc.) are also acceptable? I would suggest you change this phrase to : " accurate to within +/- 0.5 ft (+/- 0.1 ft if you are going to use the more broadly accepted standard). If you make the change here, make it throughout the rest of the text.
	4.2.2.2.1	4-4	1, bullet 2		"…Equipment should be operated and maintained in accordance with the manufacturer's instructions." The WL measuring equipment should be calibration checked annually to be sure it is still the same as the original manufacture calibration. In addition, if a well probe is stuck in is a well but can be removed. The calibration of the well probe should be verified before the probe is used again.
	4.2.2.2.1	4-4	1, bullet 3		Monitoring wells developed in partially confined or confined aquifers can have a pressure gage installed in the well cap as a further indication of potential hydraulic head.

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
	4.2.2.2.1	4-4	1, bullet 4		Near pumping, recently pumping nearby. Nearby stream flowing or not recently following or not, etc.
	4.2.2.2.1	4-4	1, bullet 6		Water levels shall be measured to the nearest 0.1 foot, at a minimum (23 CCR §352.4(a)(3). Measurements to the nearest 0.01 feet are preferred and should be used if the equipment allows. — Groundwater elevations (GWE) are calculated as the RPE minus measured depth to water (DTW). See the problem here? It your RPE is only accurate to +/- 0.5 ft, your GWE is now only accurate to +/- 0.6 ft. USGS standard is to measure RPE's to +/- 0.1 ft and WLS to +/- 0.01 ft (depths less than 500 ft) and round to the nearest 0/1 ft. In addition, all depth to water measurements in wells are repeated until you can get three results within 0.1 ft of each other. The average is used.
4	4.2.2.2.1	4-5	2, bullet 5		"Recorded information should include:…" NOTE: The Height of the RPE can and will change over time. That is why it should be checked at least annually, and the new elevation noted if it has changes.
	4.2.2.3	4-6		Figure 4-1	Significant cones of depression (GW withdrawal for Ag.) occur to the NW of Orland just south of Stony Creek and to the SW of Orland. Yet, there is only one monitoring well (21N04W12A001-004M) available to evaluate these drawdowns as they develop over time. I would suggest additional monitoring wells be places in these areas. The same is true in the area to the west of Artois and Willows.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
	4.2.2.3	4-12	2		"Many of the surface waters are near wells included in the current groundwater monitoring network, except for the surface waters within the Colusa National Wildlife Refuge, east of Williams." Suggest you add the following to this: "…east of Williams, N and NW of Orland near Stony Creek, NW of Artois along the middle reaches of Walker Creek, and NW of Willows along the middle reaches of Willow Creek."
	4.2.2.3	4-12	5		Are the caved-in of casing collapsed wells going to be repaired or replaced?
	4.2.2.4	4-12	2, item 2		Consider adding: c. Areas of active drawdowns (storage decline) with minimal monitoring well coverage.
4	4.2.2.5.2	4-14			I would recommend considering adding monitoring wells in the areas mentioned in my comments on page 4-6 and 4.12. Figure 4.2 already shows one well being removed from the network in the areas near Orland mentioned in comments on page 4-6.
	4.2.3	4-14			Irrigated Ag is also known to increase salinity in shallow water-bearing zones as irrigation leaches minerals from the soil. I would also add nitrate as a constituent of concern for the Colusa subbasin. Nitrates resulting from livestock operations and areas with a high density of septic systems are known to also leach in to the subsurface.

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
	4.2.3.2	4-16	1		Wilde, 2005 has been updated extensively. Newer versions od different chapters of the report were developed in 2008, 2012, 2014, 2018, 2019, 2021 The entire manual is now available online at: https://www.usgs.gov/mission-areas/water-resources/science/national-field-manual-collection-water-quality-data-nfm?qt-science_center_objects=0#qt-science_center_objects 3rd Bullet: Sample integrity, i.e. ppb protocol? Perhaps add a comment about the chain of custody (oops… bullet 14).
	4.2.3.2	4-16	2, bullet 2		And the unique identifier should be verified to already exist in the data base so the data has a home and does not end up in a “unknown site” file.
	4.2.3.2	4-16	2, bullet 6		During purging of the well field parameters should be monitored until stable to insure the well has been correctly purged. Easy to do with a QW multi meter.
	4.2.3.2	4-16	2,bullet 8		Suggest adding dissolved oxygen (DO) to the list of filed parameters. GW typically has low or near zero DO. Water sitting in well casing for a period of time will accumulate concentrations of DO. Represents another good indicator of proper well purge.
	4.2.3.2	4-16	2, bullet 9		Sample labels can be preprinted in the lab with all the appropriate info. Prevents the smearing of hand-written labels using pencil, ink and even waterproof ink (Sharpie). Also be aware that the outside of the sample bottles can “sweat” in coolers or other containers. The result is the label glue will weaken and the labels will come off. Double bag samples is one solution.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
	4.2.3.2	4-16	2, bullet 10		Field parameter DO is a good indicator of this. Laminar flow may require the use of a variable speed pump so DD is not excessive during collection of the water sample.
	4.2.3.2	4-16	2, bullet 11		DQOs? Is this a reference to Quality assurance. If so a number of duplicates, blanks and spike samples will need to be processed either in the lab or on site, depending on the type and number of water samples being collected during an individual field run. Maybe briefly explain here?
	4.2.3.2	4-16	2, bullet 12		In this case DQOs appears to be referring to lab detection limits for individual constituents. Correct or no? May need more explanation here.
	4.2.3.5	4-19	1		The lead sentence suggesting the existing QW monitoring programs as sufficient contradicts 4.2.3.4 which says they are not sufficient. If the existing monitoring wells are not spatially located enough to address salinity concerns or, not deep enough to detect upwelling of brackish GW from below, they are indeed not sufficient.
	4,2,3,5	4-19	2		Small diameter monitoring wells pose additional issues for the collection of Value QW samples. Small diameter submersible pumps (less than 2 inches) are few and far in between. Typically, they are limited to lifts of 100 ft or less, and have small pumping rates (~one gpm or less). Bailers (Teflon preferred) are another option and are readily sized to fit in 2-inch monitoring wells. Bailing a well to purge can be difficult depending on the depth. Bailers have to be pre cleaned between each water sample. Bailer sample volumes may be on the order of 1 liter or less meaning several bail volumes to collect a sample.

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
					Then there is still the issue if ant of the monitoring wells are deep enough to register upwelling of brackish water from below.
	4.2.4.1 lands subsidence	4-20	2, bullet 8		Land subsidence should be measured at least as accurately as SWLs if not more accurate. Small changes in land subsidence (tenths of a foot, not half a foot or more) can have a significant impact on the surface and on GW storage. If you are measuring the elevation of ground surface to +/- 0.1 ft and the elevation of your RP to +/- 0.5 ft, again the accuracy of your subsidence measurement is no better than +/- 0.6 ft.
	4.2.5.1	4-24	1, bullet 7		Benchmarks at USGS stream-flow gaging stations are surveyed to the nearest 0.01 ft. One-hundredth foot accuracy is critical to development of a good (+/- 5 percent of the actual flow) or better stage-discharge relationship. If not, you risk losing indications of GW supported base flow and any seasonal signature of gaining or losing flow to/from GW. As an aside, the USGS also requires a minimum of 10-years of continuous (every 15-minutes) record for the data to have any statistical significance.
	4.2.5.2	4-24	3		Accuracy of stage data is +/- 0.01 ft (required).
	4.2.5.5	4-24	1		Figure 4-4 is land subsidence. I think you mean figure 4-5. The legend for figure 4-5 does not provide adequate explanation of the different stream types shown on the map (perennial, intermittent, ephemeral, canals, or drains). The line widths and colors vary from thick to very thin and light blue to very light blue respectively. It needs to be revised.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
	4.2.5.5	4-25	2		"Additionally, existing stream and drainage reports will be evaluated for additional information on the timing, stage, and magnitude of flows in ephemeral and intermittent streams in the subbasin, if necessary to fill data gaps or support projects and management actions during GSP implementation." There used to be a stream-flow gaging station on Walker Creek at Artois. Still there? Still active? There also use to be a gage on the Glenn-Colusa Canal where it crosses Stony Creek south of Hamilton City. Still there? Still Active? I imagine there are additional discontinued stream-flow gaging stations scattered across the Colusa subbasin. If the structures for these sites are still there, they can be re-established by installing stage recorders and making periodic discharge measurements to verify the old stage discharge relationships. Besides the Colusa Drain, Willow Creek west of Willows is another intermittent/ephemeral stream that would be worth the effort to gage.
	4.3 References	4-27			Add Wilde (2005) or most recent reference(s) available. Reference for California Rice Commission? Reference for California Statewide Groundwater Elevation Monitoring Program (CASGEM)?

COLUSA SUBBASIN

Colusa Subbasin Groundwater Sustainability Plan Chapter Input

Commenter Name: Emil Cavagnolo **Commenter Affiliation (if applicable):** GGA / OAWD

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COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
2	2.1.2	2-4			Monroeville WD is a Groundwater District
2				2-3	OAWD's Service Area is currently just under 30,000 acres
2	2.2.1.1	2.16	4		OAWD's latest WMP is 2020
2	2.5.1.2	2-29	1		Colusa Sub Basin not Chowchilla
2	2.5.1.3	2-32	5		The public meeting in Orland was at the Glenn County Fairgrounds

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
2	2.5.1.3	2-33	6		I do not remember this type of meeting in Glenn County
3	3.3.3.3	3-83	last		Agricultural Water Demand is a heading and should be Bold Print

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment

COLUSA SUBBASIN

Colusa Subbasin Groundwater Sustainability Plan Chapter Input

Commenter Name: Mary Fahey **Commenter Affiliation (if applicable):** CGA

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COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
1	Cover Page	Cover Page	N/A	N/A	1. Title: Change to Colusa Subbasin Groundwater Sustainability Plan. 2. Add Logo to page 3. Under "Prepared for", change Colusa GSA and Glenn GSA to: Colusa Groundwater Authority and Glenn Groundwater Authority 4. Make these same changes on the second page
All Chapters	Entire Document – footer				Change footer to read: Colusa Groundwater Authority and Glenn Groundwater Authority Colusa Subbasin Groundwater Sustainability Plan
1	1.3.1	1-3	1		Please specify that there are **two** Private Pumper Representatives from the Colusa County Groundwater Commission, **appointed by the Colusa County Board of Supervisors**
1	1.3.1	1-3	4		Second Sentence, please edit as follows: **Except for the Private Pumper representatives**, Board members are chosen in public meetings by the respective governing boards of the Member Agencies…. **Private Pumper representatives on the CGA Board are recommended by the Colusa County Groundwater Commission and appointed by the Colusa County Board of Supervisors**.
2	2.1.1	2-1	4		Glenn and Yolo County boundary should be **Colusa** and Yolo County boundary

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
2	2.1.2	2-4	1		Fourth line – Change water pumpers to groundwater pumpers: …and two appointed private **groundwater** pumpers…
2	2.1.2	2-4	2		Orland and Willows are in Glenn County. Colusa and Williams are in Colusa County.
2		2-4		Table 2-2	Grimes water district should be: Colusa County waterworks district #1 – Grimes Also in Colusa County: Colusa County waterworks district #2 - Princeton
2				Fig. 2-3	The map is titled Colusa Subbasin GSA Member Agencies but does not show/list Colusa County or Glenn County Under Note 1: There are two private pumpers from the Colusa County Groundwater Commission on the CGA Board There are no private pumpers on the GGA Board
2	2.2.1.1	2-15	6		(NSV IRWM) last sentence, add year that the update was adopted. In March, **2021**….

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
2	2.2.1.1	2-18	2		Second bullet states “The following GSAs have readily available MSRs:” Don’t you mean “The following GSA Member agencies…”?
2	2.2.1.2	2-19	1		I believe CCWD has a SCADA system. There may be other districts as well that are not listed.
3	3.1.7.3.1	3-32	5		Faults: Second to last sentence, Zamora Fault should be listed along with the others that were analyzed.
3	3.1.10.2	3-42	1		Primary Users, first sentence – can this be re-worded. It sounds like there are only 20 Stakeholders in the basin.
3	3.1.11.2.3	3-45	2		– The TNC project is better described as an on-farm multi-benefit managed aquifer recharge and shorebird habitat program. Where it says migratory birds, please specify migratory shorebirds.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
3				3-19	Water source layer missing for Colusa County portion
4	4.1	4-1	1+		Should monitoring for GDEs be mentioned in the discussion about the monitoring networks?
4	4.2.2.2	4-4	1		Will this section be expanded to include more details?
4	4.2.3.3	4-17	1		Suggest spelling out Irrigated Lands Regulatory Program (ILRP) in first sentence
4					General chapter 4 comment: This Chapter will need to be updated based on recent activities/discussions/decisions, especially regarding monitoring and filling data gaps for stream interactions and GDEs. Also, information about the coordination efforts taking place along basin boundaries between the neighboring subbasin GSAs should be expanded. Overall, this chapter reads light on describing the Colusa Subbasin monitoring network and heavy on listing excerpts from the regulations.

COLUSA SUBBASIN

Colusa Subbasin Groundwater Sustainability Plan Chapter Input

Commenter Name: Mary Fahey **Commenter Affiliation (if applicable):** Colusa County/CGA

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COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
5	Intro	5-1	1		Second sentence, instead of “Colusa GSAs”, please use either “Colusa Subbasin GSAs” or “Colusa Groundwater Authority and Glenn Groundwater Authority”
5	5.3.1.3	5-6	3		Type-o, line 3, pumping would have **to** increase…
5	5.3.4.1	5-11	1, 2nd bullet		Type-o, increase **in** the number of…
5	5.4.1	5-16	1		Is “Section 0” correct?
5	5.4.7	5-33	5		Type-o, Stony Creek
5	5.4.7	5-32			If you feel it’s appropriate, this is a good opportunity to mention here that the CGA, GGA and neighboring GSAs have been coordinating throughout GSP development and will continue to coordinate and share technical data during GSP implementation.
Appx 5A		2	1-3		It should be noted that the SMC were also vetted and approved by both the CGA and GGA Boards at open, publically noticed meetings.
Appx 5A		2	3		Members of the public were welcome to attend all of these meetings and were encouraged to express their opinions and suggestions. There was very good stakeholder attendance and participation at these meetings.

COLUSA SUBBASIN

Colusa Subbasin Groundwater Sustainability Plan Chapter Input

Commenter Name: Mary Fahey **Commenter Affiliation (if applicable):** County of Colusa/CGA

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COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Paragraph Number	Figure/ Table Number (if applicable)	Comment
6	6-1	6-4	3		2nd bullet: Suggest removing the second sentence regarding demand management. This type of PMA is a last resort and should not be highlighted.
6		6-6		Table 6-2	First project: Colusa Subbasin Multi-Benefit Groundwater Recharge (TNC). This project concludes in the spring of 2021, not 2020.
6	6.3.3.1	6-29	1		Add a program benefit – Groundwater conditions (via groundwater Recharge)
6	6.3.3.1	6-29	3		Pilot program concludes in 2021. The program evaluated flooding that would provide habitat benefits for migrating shorebirds, <u>and groundwater recharge</u>. Both (habitat and recharge) are equal goals of the project.
6	6.3.3.1	6-30	1		While the current project is limited to SDAC communities due to grant funding requirements, ongoing, the project would not be limited to benefitting water levels in DACs.
6	6.3.3.2	6-32	1		Pilot program runs from 2018-2021. Also update dates in Table 6-13.
6	6.3.3.4	6-32	3		Depending on the farm, there may be installation of monitoring equipment required (flow meters, groundwater level monitoring devices)
6	6.3.3.6	6-32	5 (last)		Program completed in 2021
6	6.3.3.6	6-33	2		Last three bullets should be indented further
6	6.3.3.7	6-33	Last		Could the CGA and GGA also serve permitting roles?
6					General comment – excellent work on this chapter. This is a great set of tools that the GSAs can pull from as they implement SGMA in the Colusa Subbasin.

COLUSA SUBBASIN

Colusa Subbasin Groundwater Sustainability Plan Public Review Draft Input

Commenter Name: Lisa Hunter **Commenter Affiliation (if applicable):** GGA

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8. Please make sure that your comments are submitted by 11:59 p.m. October 31, 2021.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
Executive Summary	N/A	ES-1	12-19		This is a general discussion on SGMA- suggest changing “subbasin(s)” to “basin(s)”
Executive Summary	N/A	ES-3		Figure ES-1	In the legend, remove “(Colusa Subbasin)” following “Colusa Groundwater Authority GSA”
Executive Summary	N/A	ES-5		Figure ES-2	The background color makes it difficult to read the cities and see the boundary on the fence diagram- consider changing the color of the background or the boundary & city names
Executive Summary	N/A	ES-14	12		Change “twelve” to “12” to be more consistent with the format in the prior paragraph
Executive Summary	N/A	ES-21		Table ES-5	Consider using thousands rather than millions in the 5th column so there are fewer decimals. It may be easier to ready.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
1	1.1	1-1	11		adopt Groundwater Sustainability Plans (GSPs) for non-critically overdrafted medium-and high-priority groundwater basins
1	1.3	1-2	26		~~Colusa and Glenn GSAs~~ CGA and GGA
1	1.3.1	1-3	18-19		Please add details similar to what is included for the CGA. The GGA was formed 6/20/2017 as a JPA with 9 member agencies (8 Director seats). The JPA was amended 10/14/19 to add a 10th member and one additional Director seat for a total of 9 Director seats. The GGA is the exclusive GSA for the Glenn County portion of the Colusa Subbasin.
1	1.3.1	1-3	19		The GGA has nine Director seats (this change is also suggested in the comment above)
1	1.3.1	1-4	1		Update GGA contact information: Glenn Groundwater Authority: Lisa Hunter, Water Resources Coordinator ~~(530) 934-6501~~ (530) 934-6540 ~~720 North Colusa Street~~ 225 North Tehama Street Willows, CA 95988 lhunter@countyofglenn.net

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
1	1.3.2	1-4	15		with preparing the GSP and coordination activities in
1	1.3.3	1-5	4		under separate rate studies
2	2.1.1	2-1			It might be helpful to note that no basins/subbasins border the western portion of the Colusa Subbasin.
2	2.1.1	2-2		Table 2-1	~~Corning Subbasin GSA~~ ~~Corning Sub-basin GSA~~
2	2.1.2	2-4	8		water/irrigation districts

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
2	2.1.2	2.-4	11		Butte City is in the Butte Subbasin and should not be included here.
2	2.1.2.1	2-4	18-19		“Municipal water users in the Colusa Subbasin depend on groundwater.” This sentence seems to be more appropriate in the next paragraph under “Municipal Water Purveyors”
2	2.1.2.1			Figure 2-2	Remove “Colusa Subbasin” after Colusa Groundwater Authority GSA in the legend
2	2.1.2.1				Are small water systems discussed?
2	2.1.2.1			Table 2-3	The page number appears as 2-11 (and should be 2-10)

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
2	2.2.1.1	2-17	16-18		Add “tribes”
2	2.2.1.1	2-17	33		The NSV IRWM Plan was revised March 2020
2	2.2.1.1	2-19	18-30		The Glenn County Groundwater Management Plan was adopted in 2000 (Ordinance 1115), revised in 2012 (Ordinance 1237). Incorporation of the Preliminary Plan and the Export Water Transfer Guidelines in Ordinance 1237 was very important.
2	2.2.1.1	2-20	11		A Counties’ Local Agency Formation Commissions (LAFCO) in each County conducts reviews of municipal
2	2.2.1.2	2-22	31		When land is in agricultural production it is generally irrigated and fertilized.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
2	2.2.3	2-26	1-4		Exhibit C also contains Export Water Transfer Guidelines
2	2.5	2-31	29		The GSAs in the Colusa Subbasin will seek to work with Colusa and Glenn Counties
2	2.7.1	2-34	28		To guide and facilitate beneficial user engagement in the ~~GSA~~ GSP process,
2	2.7.1	2-35	4-5		"Reflecting its "living document" role as a compilation / repository reflecting various engagement activities implemented or planned to be implemented by the GSAs." This sentence does not appear to be complete. Consider revising.
2	2.7.1.1	2-35	25		Were the mandates adopted by the counties? Is that the appropriate word? Please double-check.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
2	2.7.1.2	2-37		Table 2-8	In the Tribes row, it notes "consult". Consult has a very specific meaning here. It that the appropriate word. Would it be more accurate to note collaborate? Consult if requested?
2	2.7.1.3	2-38	2		~~SMGA~~ SGMA
2	2.7.1.3	2-38	9-12		Consider revising to be clear that all boards/committees requiring Brown Act compliance were conducted in such a manner and an effort was made to be inclusive. (There are ad hoc committees that did not require Brown Act compliance)
2	2.7.1.3	2-38	25		the GSAs have adopted a comprehensive table-based GSP comment
2	2.7.1.3	2-38	29		~~weekly by GSA staff~~ on a regular basis by facilitation staff and is then included in the agenda packet for each ~~GSP~~ GSA Board meeting beginning in XX (Date)

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
2	2.7.1.3	2-38	32-34		each Board agenda defines said decision as a formal action ~~and further includes an agendized item for~~ which could include discussion by each Board about associated public input recorded in the comments tables that might inform their decision-making.
2	2.7.1.3	2-38	41		• ~~Final public comment period prior to adjournment of each meeting.~~ Final public comment is not agendized on Board or TAC meeting agendas- Member comments are. While frequently, final public comments are taken at that time, I suggest removing the general statement because it may not be accurate.
2	2.7.2.1	2-39	3-4		thereafter ~~to present~~ September 2021, the parties that make up the CGA and GGA have collectively sponsored, publicized and conducted over 236 separate It may be helpful to note in this section, the meetings referenced were the meetings that are open to the public. Additional ad hoc meetings were held (some of which members of the public attended)
2	2.7.2.1	2-39	22-23		Committee and Subcommittee meetings) requiring compliance with the Brown Act, agendas ~~and associated background information~~ are posted no less than 72 hours before a meeting and all materials presented in said meetings Background material is made available once prepared and distributed to the board.
2	2.7.2.1	2-39	29-30		All public outreach meetings were similarly publicized through Facebook and Twitter.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
2	2.7.2.1	4-40	15-17		On a regular and publicly noticed basis, inter-basin meetings of representatives from the Colusa Subbasin met with representatives from the adjacent Corning, Butte, Sutter and Yolo Subbasins (and other non-adjacent subbasin representatives) to discuss interconnected
2	2.7.2.1	4-40	28		As described above, In in the initial stages of GSA
2	2.7.2.1	4-40	35+		There were also 3 meetings in 2015 with general SGMA information co-sponsored by the Glenn County WAC, Glenn County Farm Bureau, and the UC Cooperative Extension.
2	2.7.2.2	2-42		Table 2-9	Include the Preface in the Public Draft Review
2	2.7.3.1	2-42	15-17		Confidentiality sensitive information, actual contact information of interested parties is not appropriate to publish as part of this GSP). Any interested member of the public could be added to the lists by signing up via respective online entry options located on the CGA respective GSA's websites and through email sign up options or requesting by phone for each GSA.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
2	2.7.3.1	2-42	18+		Did we connect with Cortina?
2	2.7.3.5	4-43	33		to view all outreach events from late 2020 through (ADD DATE) and including public review and subsequent GSA
2	2.7.3.6	2-44	9		(when available after ~~Match~~ March 2020)
2	2.7.3.6	2-44	22		GSP background documents ~~including Drought Preparedness and Response~~
2	2.7				General comment: It would be helpful to define "public meeting". It is referenced frequently and may confusion between Board and/or committee meetings which are open to the public and public outreach meetings which follow a different process, including the outreach done to advertise public outreach meetings (for instance board meetings are not publicized in the social media and via press release, whereas public outreach meetings were)

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
3	3.1.3	3-4	5-6		with periods ~~of~~ exceeding 100-degree Fahrenheit temperatures.
3	3.1.5.1.1			Figure 3-7	This comment refers to this figure and other similar figures. The small inset graphic is useful to see the trends; however, the x and y axis labels are not legible- can the labels be clearer? Perhaps darker to facilitate reading them?
3	3.1.5.1.3	3-13	21		Missing a "." after Subbasin
3	3.1.7.2.1	3-30	33-34		Is the sentence referencing the average yield in the West Butte Subbasin relevant here? If so, should it reference the Butte Subbasin instead? If not, I suggest removing.
3	3.7.8.1	3-35	39-40		Also reference the CCWD jurisdictional boundary

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
3	3.1.8.2	3-36	6		Is the Corning Subbasin intended to be referenced in the text or was this a carryover from prior work?
3	3.1.11.1	3-43	17-18		, along Stony Creek. ~~Stony Creek is~~ Groundwater underflow may occur…
3				Figure 3-18	Why is there no soils color shading in the vicinity of Orland?
3	3.1.11.3	3-46	11		or through discharge to ponds, springs, wetlands,
3				Figure 3-19	The labels appear to be missing.

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
3				Figure 3-21	Figure 3-21 is referenced but appears to be missing. Instead Figure 3-23 is inserted two times (once after page 3-49 and once after page 3-58)
3	3.1.11.3	3-49	25		It may be useful to note that the well extraction information includes more that just the Colusa County portion of the Colusa Subbasin- if I understand, it includes all of Colusa County.
3	3.1.12.4	3-54	31		Glenn County is also mapping and recording reports of dry wells. See regular updates at: https://arcg.is/10nmyT2 Colusa may also be tracking.
3	3.1.12.5	3-55	1		delineation of groundwater dependent ecosystems
3	3.2.2	3-55	29		Add the conditions to 2020 to be consistent with the rest of the sentence.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
3	3.2.2	3-55	32		Consider adding potential environmental impacts
3	3.2.5.1	3-67	38		Is "Eh" a typo? Should it be EC? If so, please correct. If not, please add to the acronym list.
3	3.2.5.2	3-70	35		Is this intended to be Colusa County's wells of Colusa Subbasin wells?
3	3.2.6	3-73	38		near Zamora in Yolo County (outside of the Colusa Subbasin), at 12N1E34Q1
3				Figure 3-32	It would be helpful to add the cities points layer with labels similar to the other figures.

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
3	3.2.7.1	3-78	16		For clarity please note if the net gain is to groundwater or to the stream. (I assume the gain is to groundwater.)
3				Figure 3-34	Suggest adding Stony Creek to the title "Stony Creek Thalweg Analysis"
3				Figure 3-36	In this figure, it is difficult to understand where the final "potential GDEs" or likelihood of GDEs exist. The legend is a bit difficult to follow as well. It may be useful to have a final figure without the extra layers to clearly denote the potential GDEs and likelihood scores.
3	3.3.1	3-86	8		This references a 26-year period. Page 3-98 states a 25-year period. Please reconcile throughout.
3	3.3.1	3-86	30		Capitalize Subbasin

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
3	3.3.3.1	3-89	37-42		Was the Glenn County General Plan used? If not, please specify how the information was interpolated, similar to how it was done under the Urban and Industrial Water Demand section on page 3-93
3	3.3.3.3	3-92	37-39		Was the Glenn County General Plan used? If not, please specify how the information was interpolated, similar to how it was done under the Urban and Industrial Water Demand section on page 3-93
3	3.3.4.1.1	3-101	14-15		Diversion agreements/reductions are specifically called out for Sac River Settlement Contractors. Would it be useful to also note other supply cutbacks such as the TCC Districts?
3	3.3.4.1.2	3-101	36		Change basin to Subbasin.
3	3.3.4.3.1	3-105-3-106	21-22	Figure 3-44	The text indicates +0.6 taf/yr while the figure indicates 1 TAF per year (I assume to figure is rounding). This may be helpful to reconcile.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
3	3.3.4.3.2	3-107-3-108	12-13	Figure 3-46	The text indicates -2.7 taf/yr while the figure indicates -3 TAF per year (I assume to figure is rounding). This may be helpful to reconcile
3	3.3.4.3.3	3-109-3-110	14-15	Figure 3-48	The text indicates -7.3 taf/yr while the figure indicates -7 TAF per year (I assume to figure is rounding). This may be helpful to reconcile
4				Table 4-2	Footnote d- SWL should be SWD
4	4.2.4.5	4-29	29		The ~~Colusa and Glenn~~ Colusa Subbasin GSAs are
4	4.2.4.5	4-29	34		Remove the “s” from Willows. Should be Willow Creek.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
4	4.2.4.5	4-30	7		the ~~Colusa and Glenn~~ Colusa Subbasin GSAs
4	4.2.5.4	4-33	31		monitoring sites for groundwater dependent ecosystems.
5	5.2.1	5-3	28		Might be useful to indicate the PMAs could be implemented by other partners (not just the GSAs).
5	5.3.1.4	5-7			Include stock water impacts (hauling water, selling livestock, etc)
5	5.3.2.5	5-10			Include stock water impacts (hauling water, selling livestock, etc)

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
5	5.3.2.6	5-10	27		Updates should not be capitalized
5	5.3.4.1	5-12	9		Irrigation or stock water supply
5	5.3.6.2	5-15	31		Use GGA and CGA instead of spelling out
5	5.3.6.2	5-15	33		will occur utilizing a subset of wells in the Subbasin's groundwater elevation monitoring network selected for
5	5.4.1.1	5-19	Not present		In the Minimum Thresholds section #1- when discussing domestic wells, it may be appropriate to reference the Human Right to Water. It may also be useful to note in the section (when discussing that very shallow wells likely do not meet current health standards. At the end of #1, add "contained in the DWR database" after protect 80 percent of domestic wells.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
5				Figure 5-1 and similar	It would be useful to add which method was used to determine the MT. Could be added on the right hand side under Minimum Threshold: XX ft
5				Table 5-2	It would be helpful to add a column to denote which method was used to determine the MT. It could be simply 1 or 2 with explanation in the footnote section.
5	5.4.5.1	5-29	3-10		Based on discussion, evaluating infrastructure sensitivity may be a good project for the GSP.
5	5.4.5.1	5-29	17		Glenn County has data from 2004.
5				Figure 5-2 and similar	Minimum Threshold should be ft bgs not ft

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
5	5.4.6.1	5-34	4		better represented local conditions at that time rather than adding an additional 10 feet (in order to be more protective).
5	5.4.7	5-36			Should water quality and subsidence be mentioned in this section?
6					This chapter should discuss the PMA submittal process including the online submittal forms to gather stakeholder ideas and ongoing nature of including PMAs in the GSP.
6				Figure 6-1	The title “Colusa Subbasin PMA” does not seem appropriate for the image and may be unnecessary. The legend indicates blue lines for “Groundwater Basins”- is that correct? It seems to be streams. The legend does not include water districts or what I assume are wells. Those may be helpful to include. Generally, this is quite a busy figure for the purpose. Consider simplifying.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
6	6.1	6-4	6		Planned PMAs ~~that will~~ <u>are expected to</u> be implemented to primarily address current,
6	6.1	6-4	34		Add "The PMAs are not ranked."
6	6.2.1	6-6	24-28		Note that not all projects are the responsibility of the GSAs, but rather a partnership or sometimes the GSAs will have a supporting role.
6	6.2.1	6-6	34		GSAs<u>,</u> ~~and~~ districts<u>, and other partners</u> in the Colusa Subbasin will further develop
6				Table 6-2	DWR is also a partner in the Colusa Subbasin Multi-Benefit Groundwater Recharge moving into the expanded program. In the Sycamore Slough Groundwater Recharge Pilot Project- "from" should not be capitalized. "would be available From settlement contract" The Sites Reservoir Project says "The Sites Project is a new off-stream storage…" It might be helpful to clarify this is in development, not that the project has completed a new storage facility.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
					The well abandonment outreach and funding program should specify this would be accomplished by working with well permitting agencies. Review of County Well Permitting Ordinances should specify the GSAs would work with the counties to review and **suggest** revisions to ordinances (these are outside of the jurisdiction of the GSAs)
6	6.3.1.3	6-19	5		~~County~~ LAFCO
6	6.3.3.1	6-29			See comments on Table 6-2 relating to this project.
6	6.3.3.1	6-30	3		Should this reference waterbirds or shorebirds?
6	6.3.3.4	6-32	11		recharge sites

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
6	6.3.3.4	6-32	13		~~winter~~ specific months
6	6.3.3.5	6-32	24-25		The program is summer/early fall and/or spring (July 15-October 15 and/or March 15-April 15). Please adjust references to timing, here and in other sections relating to this project.
6	6.3.3.6	6-32	29		Add a sentence to provide an update on 2021. Due to dry conditions in 2021, the project implementation was delayed.
6	6.3.3.6	6-33	3		Clarify the availability of **surface** water rights
6	6.3.3.6	6-33	4		Missing bullet point

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
6	6.3.3.6	6-33	21		Indicates the project is not expected to terminate. Please note this is a pilot project that could be continued if deemed appropriate.
6	6.3.4.2	6-37		Table 6-15	Glenn County LAFCO should be changed to Glenn LAFCO
6	6.3.4.3	6-37	13		Glenn County LAFCO should be changed to Glenn LAFCO
6	6.3.4.6	6-38	20		Glenn County LAFCO should be changed to Glenn LAFCO
6	6.4.1	6-46	14		This section ~~described~~ describes ongoing

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
6	6.5.1	6-58	2		If determined to be necessary <u>or desirable</u> under
6				Table 6-34	Reference to migratory waterfowl be changed to migratory birds (could be waterfowl or shorebirds?)
6	6.5.1.7	6-69	11		shorebirds/waterfowl as ~~we pulse flood the field~~ <u>the field is pulse flooded</u>, or
6				Table 6-35	One period after Sycamore Slough in the implementation description. In the benefits and benefit evaluation methodology, it notes waterfowl. Will it also include shorebirds?
6				Table 6-36	In the implementation description, it may be useful to add a sentence indicating that this concept could be applied throughout the Colusa Subbasin.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
6	6.5.2.3	6-84	6		Remove "or MO"
6	6.5.2.3	6-86	1		action ~~will only~~ could be triggered
6	6.5.2.3	6-86	13		Add "for domestic purposed only" when describing de minimis use
6	6.5.2.7	6-91	1		would review and ~~revise~~ suggest revisions to the county
6	6.5.2.7	6-91	11-12		Replace "better" with "appropriate" It might also be useful to note requiring depths to be deeper than MTs.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
6				Table 6-51	In the implementation description, it should not the action would be to review and **suggest revisions** to the county well permitting
6				Table 6-52	In the implementation description, it may be useful to include that this action could be done in coordination with neighboring GSAs, especially along Stony Creek.
7				Table 7-1	There are two Table 7-1 (page 7-3 and 7-4) In the second table, in the well inventory program description: Add that the program would seek to identify wells that are no longer active In the well registration program- remove the reference to voluntary. This could be voluntary or not.
7	7.1.2.8	7-9			Add that the program would seek to identify wells that are no longer active
7	7.1.2.9	7-10	2		Remove reference to voluntary.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
7	7.2	7-16			It might be appropriate to add that some details on the cost allocation between the GSAs remain to be finalized.
7	7.6	7-22	24		GSAs are ~~pursuing~~ considering a combined approach…

COLUSA SUBBASIN

Colusa Subbasin Groundwater Sustainability Plan Public Review Draft Input

Commenter Name: Ben King **Commenter Affiliation (if applicable):** Chapter 1 Comments

This file introduces a table that allows you to easily enter the following key information so we have certainty about your input. The table includes the following categories:

- Chapter Number
- Section Number
- Page Number
- Paragraph Number (starting with the first full paragraph at the top of a given page)
- Figure/Table Number (if applicable)
- Comment

INSTRUCTIONS

1. Please use the MS Word or PDF document titled "Colusa Subbasin GSP Input 9.2021" to submit your comments.

2. Review all applicable text and note each Chapter, Section, Page, and Line number associated with a comment you'd like to make.

3. Enter your name and if applicable, an organizational affiliation at the top of your table.

4. Once you have completed all your comments, please save the file with your last name at the end in parentheses. For example:
   - *Colusa Subbasin GSP Input 9.2021 (Jones).docx*

5. If you are located in the Glenn Groundwater Authority, please send your comment file to:
   - Lisa Hunter – Program Manager - Glenn Groundwater Authority: lhunter@countyofglenn.net

6. If you are located in the Colusa Groundwater Authority, please send your comment file to
   - Mary Fahey – Program Manager - Colusa Groundwater Authority: mfahey@countyofcolusa.com

7. If you don't affiliate specifically with either the CGA and/or GGA, please send your comments to both Mary and Lisa.

8. Please make sure that your comments are submitted by 11:59 p.m. October 31, 2021.

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment
1	1.2				This is a question for the DWR. Since the DWR formally adopted a Human Right to Water ("HRTW) Policy in its Department Administrative Manual during April 2021 – does it want to state that it will be including HRTW considerations in the DWR's decision making, program activities and public engagement in SGMA and the GSP development. Wont this statement promote HRTW engagement?
	1.3.1				Typo for Private Pumpers – appointed by Colusa Groundwater BOS ? Did you mean to say recommended by the Commission and appointed by the BOS? Were there public meetings for the appointment by the Board Members by GSA's? It would be great to know that the GSA's have public meetings. Do they have websites and interested party lists? Please confirm that each GSA has websites and posts notice of meetings at a minimum.
	1.3.3				Are these costs for the Basin as a whole? It would be good to break these costs on a per acre basis and discuss how the costs are allocated to Cities and small water systems. For example – what does the CGA expect the City of Williams to pay going forward? Voters in the Cities need to know. What will the County of Glenn and the County of Colusa be expected to contribute?

COLUSA SUBBASIN

Chapter Number	Section Number	Page Number	Line Number	Figure/ Table Number (if applicable)	Comment