Review of Yolo County Lower Cache Creek Water Quality[1]

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As part of developing a supplemental environmental impact report (SEIR) in order to obtain Central Valley Regional Water Quality Control Board (CVRWQCB) 401 Certification for lower Cache Creek in-channel improvement/maintenance projects, Yolo County Department of Public Works commissioned the development of a review of water quality in lower Cache Creek. G. Fred Lee and Anne Jones-Lee were responsible for developing the water quality chapter of the SEIR. This chapter was based on a review of the water quality characteristics of lower (below Capay Dam to I-5) Cache Creek. The water quality chapter of the SEIR for the Cache Creek Resources Management Plan (CCRMP) and Cache Creek Improvement Program (CCIP) was certified by the Yolo County Board of Supervisors in Summer 2002. In order to comply with the direction of the CCRMP, CCIP and OCMP, adopted in 1996, Yolo County conducted a water quality monitoring program of selected locations on Cache Creek from December 1997 through July 2001. The data obtained in this program for the past five years (1997 – 2001) are presented in Tables 1 through 4. Sampling stations (see Figure 1) were located at:

- County Road 85 (E4; Capay Bridge);
- upstream of where Gordon Slough enters Cache Creek;
- County Road 94B (Stevens Bridge), downstream of where Gordon Slough enters Cache Creek; and
- County Road 97B (I-5).

The Gordon Slough station is located about 750 yards upstream of the Robert Stevens Bridge. Gordon Slough enters Cache Creek about 100 yards upstream of the Stevens Bridge and as a result, according to Morrison (pers. comm., 2002), may not be completely mixed with Cache Creek waters at the Stevens Bridge. Gordon Slough is characterized as consisting in the summer primarily of agricultural tailwater. The I-5 sampling station is located about 200 yards downstream of where the I-5 Bridge crosses Cache Creek. This sampling location is, at times, dry during the summer and fall.

Cache Creek Water Quality Beneficial Uses and Requirements

Cache Creek designated beneficial uses, between Clear Lake and Yolo Bypass, are listed in Table II-1 of the CVRWQCB 1998 Basin Plan and include municipal, agricultural, industrial, recreation, freshwater habitat, spawning and wild. The only CVRWQCB beneficial uses that are potentially available, but not applicable to Cache Creek, are industrial power production, migration of warm and cold water fish, and navigation.

[1] Reference as: Lee, G. F. and Jones-Lee, A., "Review of Yolo County Lower Cache Creek Water Quality," Report of G. Fred Lee & Associates, El Macero, CA, September (2002).

Figure 1

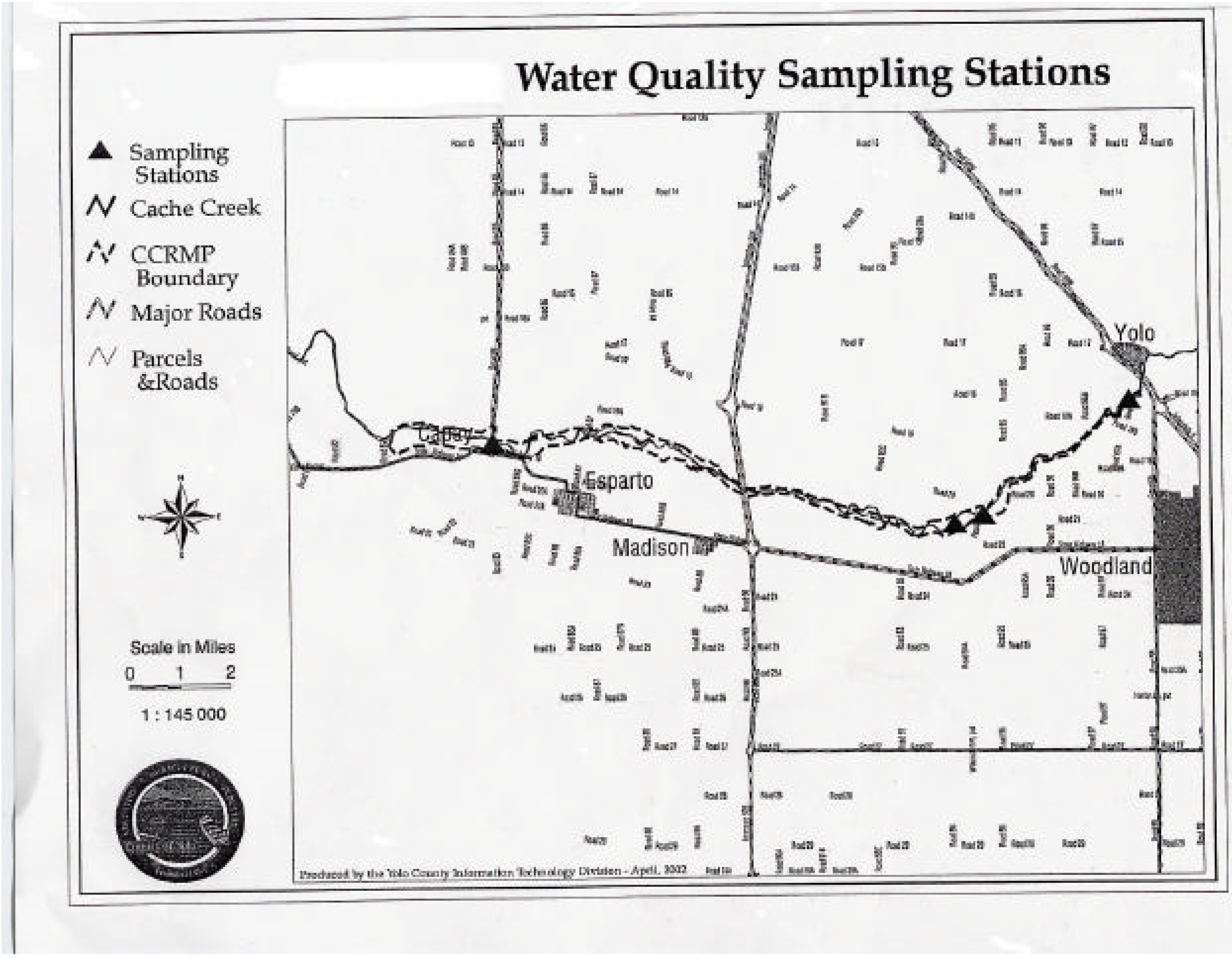
Water Quality Sampling Stations
Sampling Stations
Cache Creek
CCRMP Boundary
Major Roads
Parcels &Roads
Scale in Miles
0 1 2
1 : 145 000
Yolo
Esparto
Madison
Woodland
Produced by the Yolo County Information Technology Division - April, 2002

Table 1 Cache Creek Water Quality – County Road 85 (Capay Bridge)

	12-8-97	2-3-98	11-30-98	4-6-99	9-1-99	Regulatory Limit
County Road 85 (Capay Bridge)						
Mean Daily Flow at Yolo Gauge (cfs)	640	32,500	76	608	16	
pH (field)	8.1	8.2	8.35	8.33	8.4	6.5 - 8.5 (b)
Color (CU)	25	10	35	40	20	15 (a)
Odor (TON)	< 1	2.0	< 1	1.0	< 1	3.0 (a)
Total Dissolved Solids (mg/L)	288	175	441	291	226	500 (a); * (b)
Total Suspended Solids (mg/L)	140	1240	27	9	18	N/A
Turbidity (NTU)	100.0	50.0	28.5	12.7	16.5	10 (a); * (b)
Dissolved Oxygen (mg/L)	8.2	10.2	10.7	11.0	9.6	5.0 (b)
Temperature (degrees Fahrenheit)	NA	NA	NA	61.2	58.4	N/A
Nitrate (mg/L) as NO_3	2.3	1.2	2.38	0.8	1.3	45.0 (a); * (b)
Nitrite (mg/L) as NO_2	< 1	< 1	< 1	< 1	< 1	1.0 (a); * (b)
Orthophosphate (mg/L) as PO_4	< 5	< 5	< 5	0.06	< 5	* (b)
Ammonia (mg/L) as NH_3	NA	NA	NA	< 0.1	< 0.1	* (b)
Total Kjeldahl Nitrogen (mg/L)	4.5	8.1	NA	< 0.5	< 0.5	* (b)
Total Coliform (MPN/100 ml)	500	>1600	300	13	40	N/A
Fecal Coliform (MPN/100 ml)	500	>1600	230	13	40	200 (b)
TPH-Gasoline (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	* (b)
TPH-Diesel (mg/L)	< 0.05	0.08	< 0.05	< 0.05	< 0.05	* (b)
Organochlorine Herbicides (µg/L) (EPA 8150)	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	Various * (b)
Organophosphorus Pesticides (µg/L) (EPA 8140)	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	Various * (b)
Dissolved Mercury (mg/L)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	* (b)
Total Mercury (mg/L)	0.4	< 0.2	< 0.2	< 0.2	< 0.2	2 (a); 0.05 * (b)
Boron (mg/L)	1.3	0.6	1.86	0.925	0.997	* (b)

Footnotes: NA = Not analyzed; (a) Department of Health Services Drinking Water Standard; (b) Central Valley Regional Water Quality Control Board Water Quality Plan Standard; * See text for discussion; N/A = Not applicable.

Table 1 Cache Creek Water Quality - County Road 85 (Capay Bridge), continued

	01-26-00	04-19-00	07-24-00	01-17-01	04-04-01	07-09-01	Regulatory Limit
County Road 85 (Capay Bridge)							
Mean Daily Flow at Yolo Gauge (cfs)	365	937	20	55	69	0	
pH (field)	8.2	8.3	8.2	8.3	8.2	8.1	6.5 - 8.5 (b)
Color (CU)	480	120	25	< 3	10	14	15 (a)
Odor (TON)	4	2	< 1	< 1	1	1	3.0 (a)
Total Dissolved Solids (mg/L)	410	183	209	513	484	360	500 (a); * (b)
Total Suspended Solids (mg/L)	125	52	19	12	6	< 5	N/A
Turbidity (NTU)	112.0	39	12	11	6	7	10 (a); * (b)
Dissolved Oxygen (mg/L) (field)	10.8	10.0	8.8	12.5	9.7	7.6	5.0 (b)
Temperature (degrees Fahrenheit)	56.7	60.1	78.6	43.7	60.8	80.4	N/A
Nitrate (mg/L) as NO_3	2.7	< 1	3.8	4.0	3.6	8.7	45.0 (a); * (b)
Nitrite (mg/L) as NO_2	< 1	< 1	< 1	< 1	< 1	< 1	1.0 (a); * (b)
Orthophosphate (mg/L) as PO_4	< 5	< 5	< 5	0.06	< 5	< 0.5	* (b)
Ammonia (mg/L) as NH_3	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	* (b)
Total Kjeldahl Nitrogen (mg/L)	0.7	< 0.2	< 0.5	< 0.5	< 0.5	< 0.5	* (b)
Total Coliform (MPN/100 ml)	600	ND	30	50	130	50	N/A
Fecal Coliform (MPN/100 ml)	460	80	240	50	80	23	200 (b)
TPH-Gasoline (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	* (b)
TPH-Diesel (mg/L)	< 0.05	0.08	< 0.05	< 0.05	< 0.05	< 0.05	* (b)
Organochlorine Herbicides (µg/L) (EPA 8150)	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	Various * (b)
Organophosphorus Pesticides (µg/L) (EPA 8140)	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	Various * (b)
Dissolved Mercury (µg/L)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	* (b)
Total Mercury (µg/L)	0.4	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	2 (a); 0.05 * (b)
Boron (mg/L)	1.7	1.0	0.9	2.4	1.6	1.2	* (b)

Footnotes: (a) Department of Health Services Drinking Water Standard; (b) Central Valley Regional Water Quality Control Board Water Quality Plan Standard; * See text for discussion; ND = Not detected at detection limits, which were not specified; N/A = Not applicable

Table 2 Cache Creek Water Quality - Upstream of Gordon Slough

	12-8-97	2-3-98	11-30-98	4-6-99	9-1-99	Regulatory Limit
Upstream of Gordon Slough						
Mean Daily Flow at Yolo Gauge (cfs)	640	32,500	76	608	16	
pH (field)	8.1	8.1	8.25	8.24	8.21	6.5 - 8.5 (b)
Color (CU)	30	7	20	30	15	15 (a)
Odor (TON)	2.0	1.5	< 1	1.0	< 1	3.0 (a)
Total Dissolved Solids (mg/L)	288	172	442	304	408	500 (a); * (b)
Total Suspended Solids (mg/L)	224	1640	17	12	6	N/A
Turbidity (NTU)	140.0	45.0	26.9	16.4	15.0	10 (a); * (b)
Dissolved Oxygen (mg/L)	8.0	10.0	10.7	10.7	9.36	5.0 (b)
Temperature (degrees Fahrenheit)	NA	NA	NA	61.0	61.2	N/A
Nitrate (mg/L) as NO_3	4.3	1.3	12.4	3.08	18.6	45.0 (a); * (b)
Nitrite (mg/L) as NO_2	< 1	< 1	< 1	< 1	< 1	1.0 (a); * (b)
Orthophosphate (mg/L) as PO_4	< 5	< 5	< 5	< 5	< 5	* (b)
Ammonia (mg/L) as NH_3	NA	NA	NA	< 0.1	< 0.1	* (b)
Total Kjeldahl Nitrogen (mg/L)	4.7	3.4	NA	< 0.5	< 0.5	* (b)
Total Coliform (MPN/100 ml)	>1600	>1600	130	2	80	N/A
Fecal Coliform(MPN/100 ml)	700	1600	80	< 2	< 20	200 (b)
TPH-Gasoline (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	* (b)
TPH-Diesel (mg/L)	< 0.05	0.08	< 0.05	< 0.05	< 0.05	* (b)
Organochlorine Herbicides (µg/L) (EPA 8150)	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	Various * (b)
Organophosphorus Pesticides (µg/L) (EPA 8140)	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	Various * (b)
Dissolved Mercury (mg/L)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	* (b)
Total Mercury (mg/L)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	2 (a); 0.05 * (b)
Boron (mg/L)	1.3	0.5	1.84	1.02	1.97	* (b)

Footnotes: NA = Not analyzed; (a) Department of Health Services Drinking Water Standard; (b) Central Valley Regional Water Quality Control Board Water Quality Plan Standard; * See text for discussion; N/A = Not applicable.

Table 2 Cache Creek Water Quality - Upstream of Gordon Slough, continued

	01-26-00	04-19-00	07-24-00	01-17-01	04-04-01	07-09-01	Regulatory Limit
Upstream of Gordon Slough							
Mean Daily Flow at Yolo Gauge (cfs)	365	937	20	55	69	0	
pH (field)	8.2	8.2	8.2	8.1	8.3	8.3	6.5 - 8.5 (b)
Color (CU)	480	150	10	< 3	< 3	12	15 (a)
Odor (TON)	4.0	2.0	< 1	< 1	< 1	2.0	3.0 (a)
Total Dissolved Solids (mg/L)	426	208	369	505	485	420	500 (a); * (b)
Total Suspended Solids (mg/L)	101	52	5	17	< 5	< 5	N/A
Turbidity (NTU)	108.0	50.0	3.2	9.6	0.5	7.4	10 (a); * (b)
Dissolved Oxygen (mg/L)	10.5	9.9	9.9	12.3	12.1	9.5	5.0 (b)
Temperature (degrees Fahrenheit)	55.9	59.7	78.6	43.0	56.8	82.2	N/A
Nitrate (mg/L) as NO_3	5.2	2.0	16.1	13.0	24.4	21	45.0 (a); * (b)
Nitrite (mg/L) as NO_2	< 1	< 1	< 1	< 1	< 1	< 1	1.0 (a); * (b)
Orthophosphate (mg/L) as PO_4	< 5	< 5	< 5	< 5	< 5	< 5	* (b)
Ammonia (mg/L) as NH_3	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	* (b)
Total Kjeldahl Nitrogen (mg/L)	1.0	< 0.2	< 0.5	< 0.5	< 0.5	< 0.5	* (b)
Total Coliform (MPN/100 ml)	1600	160	11	80	110	240	N/A
Fecal Coliform (MPN/100 ml)	540	160	300	50	11	130	200 (b)
TPH-Gasoline (mg/L)	< 0.05	< 0.05	NA	< 0.05	< 0.05	< 0.05	* (b)
TPH-Diesel (mg/L)	< 0.05	0.08	< 0.05	< 0.05	< 0.05	< 0.05	* (b)
Organochlorine Herbicides (µg/L) (EPA 8150)	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	Various * (b)
Organophosphorus Pesticides (µg/L) (EPA 8140)	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	Various * (b)
Dissolved Mercury (µg/L)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	* (b)
Total Mercury (µg/L)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	2 (a); 0.05 * (b)
Boron (mg/L)	1.7	1.0	1.8	2.3	2.2	2.1	* (b)

Footnotes: NA = Not analyzed; (a) Department of Health Services Drinking Water Standard; (b) Central Valley Regional Water Quality Control Board Water Quality Plan Standard; * See text for discussion; N/A = Not applicable

Table 3 Cache Creek Water Quality – County Road 94B (Stevens Bridge)

	12-8-97	2-3-98	11-30-98	4-6-99	9-1-99	Regulatory Limit
County Road 94B (Stevens Bridge)						
Mean Daily Flow at Yolo Gauge (cfs)	640	32,500	76	608	16	
pH (field)	8.1	8.1	8.24	8.25	8.17	6.5 - 8.5 (b)
Color (CU)	25	10	10	40	30	15 (a)
Odor (TON)	2.5	2.0	< 1	1.0	< 1	3.0 (a)
Total Dissolved Solids (mg/L)	288	175	449	292	351	500 (a); * (b)
Total Suspended Solids (mg/L)	247	1210	5	8	14	N/A
Turbidity (NTU)	140	50	5.94	17	13	10 (a); * (b)
Dissolved Oxygen (mg/L)	8.6	9.8	11.1	10.9	8.91	5.0 (b)
Temperature (degrees Fahrenheit)	NA	NA	NA	60.4	59.2	N/A
Nitrate (mg/L) as NO_3	4.2	1.4	14.2	3.11	15.5	45.0 (a); * (b)
Nitrite (mg/L) as NO_2	< 1	< 1	< 1	< 1	< 1	1.0 (a); * (b)
Orthophosphate (mg/L) as PO_4	< 5	< 5	< 5	< 5	< 5	* (b)
Ammonia (mg/L) as NH_3	NA	NA	NA	0.01	< 0.1	* (b)
Total Kjeldahl Nitrogen (mg/L)	4.2	4.0	NA	< 0.5	< 0.5	* (b)
Total Coliform (MPN/100 ml)	>1600	1600	2,400	11	230	N/A
Fecal Coliform (MPN/100 ml)	500	1600	800	11	40	200 (b)
TPH-Gasoline (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	* (b)
TPH-Diesel (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05	0.88	* (b)
Organochlorine Herbicides (µg/L) (EPA 8150)	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	Various * (b)
Organophosphorus Pesticides (µg/L) (EPA 8140)	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	Various * (b)
Dissolved Mercury (mg/L)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	* (b)
Total Mercury (mg/L)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	2 (a); 0.05 * (b)
Boron (mg/L)	1.3	0.6	1.86	1.04	1.71	* (b)

Footnotes: NA = Not analyzed; (a) Department of Health Services Drinking Water Standard; (b) Central Valley Regional Water Quality Control Board Water Quality Plan Standard; * See text for discussion; N/A = Not applicable.

Table 3 Cache Creek Water Quality – County Road 94B (Stevens Bridge), continued

	01-26-00	04-19-00	07-24-00	01-17-01	04-04-01	07-09-01	Regulatory Limit
County Road 94B (Stevens Bridge)							
Mean Daily Flow at Yolo Gauge (cfs)	365	937	20	55	69	0	
pH (field)	8.2	8.2	8.1	8.1	8.36	8.2	6.5 - 8.5 (b)
Color (CU)	520	150	15	< 3	4	30	15 (a)
Odor (TON)	4.0	2.0	< 1	< 1	< 1	1.0	3.0 (a)
Total Dissolved Solids (mg/L)	420	215	375	502	476	350	500 (a); * (b)
Total Suspended Solids (mg/L)	107	53	12	6	< 5	23	N/A
Turbidity (NTU)	111	55	6	6	0.65	22	10 (a); * (b)
Dissolved Oxygen (mg/L)	10.5	9.9	9.1	12.2	12.4	8.9	5.0 (b)
Temperature (degrees Fahrenheit)	54.1	60.1	75.7	41.9	56.1	76.8	N/A
Nitrate (mg/L) as NO_3	5.1	2.0	16.5	13.5	24.3	14	45.0 (a); * (b)
Nitrite (mg/L) as NO_2	< 1	< 1	< 1	< 1	< 1	< 1	1.0 (a); * (b)
Orthophosphate (mg/L) as PO_4	< 5	< 5	< 5	< 5	< 5	< 5	* (b)
Ammonia (mg/L) as NH_3	NA	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	* (b)
Total Kjeldahl Nitrogen (mg/L)	1.7	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	* (b)
Total Coliform (MPN/100 ml)	1000	260	17	50	30	1600	N/A
Fecal Coliform (MPN/100 ml)	600	160	300	30	17	240	200 (b)
TPH-Gasoline (mg/L)	< 0.05	< 0.05	NA	< 0.05	< 0.05	< 0.05	* (b)
TPH-Diesel (mg/L)	< 0.05	0.07	< 0.05	< 0.05	< 0.05	< 0.05	* (b)
Organochlorine Herbicides (µg/L) (EPA 8150)	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	Various * (b)
Organophosphorus Pesticides (µg/L) (EPA 8140)	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	Various * (b)
Dissolved Mercury (µg/L)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	* (b)
Total Mercury (µg/L)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	2 (a); 0.05 * (b)
Boron (mg/L)	1.8	1.0	1.7	2.4	2.2	1.7	* (b)

Footnotes: NA = Not analyzed; (a) Department of Health Services Drinking Water Standard; (b) Central Valley Regional Water Quality Control Board Water Quality Plan Standard; * See text for discussion; N/A = Not applicable.

Table 4 Cache Creek Water Quality – County Road 97B (I-5)

	12-8-97	2-3-98	11-30-98	4-6-99	9-1-99	Regulatory Limit
County Road 97B (I-5)						
Mean Daily Flow at Yolo Gauge (cfs)	640	32,500	76	608	16	
pH (field)	8.2	8.1	8.38	8.27	8.2	6.5 - 8.5 (b)
Color (CU)	25	10	5	60	40	15 (a)
Odor (TON)	2.5	2.0	ND	1.0	< 1	3.0 (a)
Total Dissolved Solids (mg/L)	288	168	464	304	298	500 (a); * (b)
Total Suspended Solids (mg/L)	201?	1310	9	24	36	N/A
Turbidity (NTU)	180.0	45.0	6.4	22.6	33.0	10 (a); * (b)
Dissolved Oxygen (mg/L)	10.6	9.8	10.9	11.0	8.05	5.0 (b)
Temperature (degrees Fahrenheit)	NA	NA	NA	60.8	62.0	N/A
Nitrate (mg/L) as NO_3	4.1	1.5	14.9	3.19	10.4	45.0 (a); * (b)
Nitrite (mg/L) as NO_2	< 1	< 1	< 1	< 1	< 1	1.0 (a); * (b)
Orthophosphate (mg/L) as PO_4	< 5	< 5	< 5	0.015	< 5	* (b)
Ammonia (mg/L) as NH_3	NA	NA	NA	0.01	1.04	* (b)
Total Kjeldahl Nitrogen (mg/L)	6.2	3.0	NA	NA	< 0.5	* (b)
Total Coliform (MPN/100 ml)	900	280	500	22	300	N/A
Fecal Coliform (MPN/100 ml)	900	220	170	22	40	200 (b)
TPH-Gasoline (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	* (b)
TPH-Diesel (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05	0.72	* (b)
Organochlorine Herbicides (µg/L) (EPA 8150)	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	Various * (b)
Organophosphorus Pesticides (µg/L) (EPA 8140)	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	Various * (b)
Dissolved Mercury (µg/L)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	* (b)
Total Mercury (µg/L)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	2 (a); 0.05 * (b)
Boron (mg/L)	1.1	0.5	1.94	1.03	1.48	* (b)

Footnotes: NA = Not analyzed; (a) Department of Health Services Drinking Water Standard; (b) Central Valley Regional Water Quality Control Board Water Quality Plan Standard; * See text for discussion; N/A = Not applicable.

Table 4 Cache Creek Water Quality – County Road 97B (I-5), continued

	01-26-00	04-19-00	07-24-00	01-17-01	04-04-01	07-09-01*	Regulatory Limit
County Road 97B (I-5)							
Mean Daily Flow at Yolo Gauge (cfs)	365	937	20	55	69	0	
pH (field)	8.2	8.2	8.2	8.2	8.39	--	6.5 - 8.5 (b)
Color (CU)	400	150	50	< 3	23	--	15 (a)
Odor (TON)	4.0	2.0	< 1	< 1	< 1	--	3.0 (a)
Total Dissolved Solids (mg/L)	409	205	302	510	451	--	500 (a); * (b)
Total Suspended Solids (mg/L)	159	86	35	14	9	--	N/A
Turbidity (NTU)	142	41	13	11	16.4	--	10 (a); * (b)
Dissolved Oxygen (mg/L)	10.6	9.7	7.8	12.4	10.6	--	5.0 (b)
Temperature (degrees Fahrenheit)	53.2	62.6	71.8	40.6	60.4	--	N/A
Nitrate (mg/L) as NO_3	4.9	1.9	10.6	13.2	13.0	--	45.0 (a); * (b)
Nitrite (mg/L) as NO_2	< 1	< 1	< 1	< 1	< 1	--	1.0 (a); * (b)
Orthophosphate (mg/L) as PO_4	< 5	< 5	< 5	< 5	< 5	--	* (b)
Ammonia (mg/L) as NH_3	NA	< 0.1	< 0.1	0.93	< 0.1	--	* (b)
Total Kjeldahl Nitrogen (mg/L)	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	--	* (b)
Total Coliform (MPN/100 ml)	1000	540	80	70	1600	--	N/A
Fecal Coliform (MPN/100 ml)	1000	280	900	21	500	--	200 (b)
TPH-Gasoline (mg/L)	< 0.05	< 0.05	NA	< 0.05	< 0.05	--	* (b)
TPH-Diesel (mg/L)	< 0.05	0.08	< 0.05	< 0.05	< 0.05	--	* (b)
Organochlorine Herbicides (µg/L) (EPA 8150)	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	--	Various * (b)
Organophosphorus Pesticides (µg/L) (EPA 8140)	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	< 1 or greater	--	Various * (b)
Dissolved Mercury (µg/L)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	--	* (b)
Total Mercury (µg/L)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	--	2 (a); 0.05 * (b)
Boron (mg/L)	1.8	1.0	1.4	2.3	1.9	--	* (b)

Footnotes: NA = Not analyzed; (a) Department of Health Services Drinking Water Standard; (b) Central Valley Regional Water Quality Control Board Water Quality Plan Standard; * See text for discussion; N/A = Not applicable

* no data reported for the July 2001 sampling event, since the Creek at this location was dry at that time. There was, however, water in the Creek upstream of this point.

While Cache Creek is not currently listed as a migratory fish beneficial use, there is a possibility that this beneficial use could exist. Dr. Peter Moyle of the University of California, Davis, was contacted regarding the studies that he is conducting on the fisheries of Cache and Putah Creeks. Regarding Cache Creek as a habitat for anadromous fish, Dr. Moyle (2001) stated,

> *"Chinook salmon spawned in Cache Creek last year but I have no evidence if they produced any young. If the creek had easy access, I am sure a small run of salmon and steelhead could develop, especially if there were access over Capay Dam.*

If there is additional indication that anadromous fishes are present in Cache Creek, it may be necessary for the CVRWQCB to change the listing of the beneficial uses of Cache Creek to include "migration of warm and cold water fish."

In 1998, the CVRWQCB placed Cache Creek on the Clean Water Act §303(d) list of "impaired" waterbodies because of "mercury" and "unknown toxicity" (SWRCB, 1998). Recently, the CVRWQCB (2001) has proposed to continue these listings. The Board staff has proposed to change the total affected miles of the Creek that have these listing characteristics from 35 to 81 miles. A TMDL is to be developed by 2004 for mercury and after 2015 for "unknown toxicity" (SWRCB, 1998).

The CVRWQCB's 1998 Basin Plan lists the water quality objectives for the Sacramento and San Joaquin Rivers and some other waterbodies. It is understood through the Tributary Rule that, unless specifically delineated in the Basin Plan, for waterbodies that are tributary to the Sacramento River, such as Cache Creek, the water quality objectives for the Sacramento River should be applicable to the tributary as well.

The California DHS (2001), like the US EPA, has established primary and secondary maximum contaminant levels (MCLs) for a variety of chemical constituents and pathogen-indicator organisms. The primary MCLs are developed for protection of human health. The secondary MCLs are for protection of esthetic quality, which relates to the wholesomeness and usability of the water. Since Cache Creek has as one of its beneficial uses, domestic water supply, the DHS MCLs are applicable to the Creek, even though, at this time, the Creek water is not directly used as a domestic water supply. There are, however, near-Creek property owners who use shallow groundwater as a source of domestic water supply. Pollutants in the Creek have the potential to pollute shallow groundwater and as a result pollute domestic water supply wells located near the Creek. Further, the Creek contributes water to the Sacramento-San Joaquin River Delta, which is used as a domestic water supply source for about 20 million people in California. The CVRWQCB (1998) Basin Plan incorporates by reference all existing and future DHS MCLs as water quality objectives, and therefore non-compliance with a DHS MCL is a consequent non-compliance with the Basin Plan.

Existing and potential water quality regulatory limits are indicated in the last column of Tables 1 through 4. The concentration of the parameter measured in the sample analysis can be compared to these limits to determine compliance with water quality objectives. For many of the parameters, the regulatory limit is not a single value, but rather dependent on a variety of factors, as discussed below.

For the parameters measured in the Cache Creek water quality monitoring program, the regulatory limit (water quality objective) is more stringent than drinking water maximum concentration limits (MCLs) for protection of aquatic life from toxicity and human health from consumption of fish that have bioaccumulated the hazardous chemical, such as an organochlorine pesticide or mercury. Under these conditions, the protection of aquatic life will also protect human health through the use of the water for domestic purposes.

In Tables 1 through 4 and the discussion presented below, the authors have not been able to check Yolo County's chemical summary data tables for 1997, 1998, and 1999 against original data sheets, nor have the authors been able to review any of the total fecal coliform data sheets. The 1997 through 1999 data reported by Yolo County as "ND" (non-detect) have been assumed to be at the same detection limit reported by the laboratory that conducted the analysis for 2000 and 2001 (Sequoia Analytical).

Cache Creek Water Quality in Relation to Current Regulatory Standards and Objectives

A summary of the CVRWQCB's (1998) Basin Plan water quality objectives for Cache Creek relative to the 1997 through 2001 water quality data listed in Tables 1 through 4 is presented below. Information is also presented on reasonably foreseeable water quality objectives that will likely be adopted for renewal of the CCRMP's 401 Certification in 2002.

pH: The CVRWQCB Basin Plan establishes a water quality objective (standard) for pH as follows: *"The pH shall not be depressed below 6.5 nor raised above 8.5."* The water quality data collected for the County show that the pH for all samples was within the range allowed by the Regional Board.

Color: The CVRWQCB Basin Plan objective for color is: *"Water shall be free of discoloration that causes nuisance or adversely affects beneficial uses."* The California DHS drinking water limit for color is 15 units. The data collected in 1997, 1999, 2000 and 2001 show that the color concentrations in Cache Creek at times were above the DHS MCL for color. The January 26, 2000, and April 19, 2000, samples had color concentrations that were typically on the order of 400 to 500 color units on January 26, 2000, and 120 to 150 color units on April 19, 2000. Both the January 2000 and April 2000 data were obtained during elevated flows, indicating there was appreciable transport of color or other materials that are measured as color in the color testing procedure. The origin of these colored materials appears to be upstream of Capay Dam. The exceedance of the DHS drinking water MCL for color is not in compliance with the CVRWQCB Basin Plan standards for the use of a waterbody as a domestic water supply.

Examination of data collected during the monitoring events between 1997 and 2001 shows no discernible pattern in the concentration of color between stations, either during the elevated flow or low flow conditions. There is a variety of factors that could influence color concentrations. Color measurement is not a well-defined assessment of a specific parameter. It is an overall characteristic of water, where the measurement measures a number of water characteristics which are summed together as a "color" response. The individual components that make up the color response, including turbidity, light-scattering, different types of colored materials, can vary with season, location and flow regime. A key issue of concern is the drainage from wetland areas, which is often high in color. Also, appreciable color can be associated with agricultural drains. Further, during elevated flow, the increased inorganic turbidity is measured to some extent as a color response, through light scattering. It is, therefore, not surprising that there is no discernible pattern in the color data.

Odor: The CVRWQCB Basin Plan objective for tastes and odors is: *"Water shall not contain taste- or odor-producing substances in concentrations that impart undesirable tastes or odors to* *domestic or municipal water supplies or to fish flesh or other edible products of aquatic origin, or that cause nuisance, or otherwise adversely affect beneficial uses.*" The DHS (2001) drinking water standard for odor is 3 threshold odor units (TON). The monitoring data for odor show that the data collected on January 26, 2000, during elevated flow had a threshold odor number of about 4. This is therefore not in compliance with the CVRWQCB Basin Plan, which incorporates DHS drinking water MCLs.

Salinity/Total Dissolved Solids (TDS): The California DHS has a secondary MCL for TDS of 500 mg/L as a recommended value, with an upper range of 1,000 mg/L, and allowing short-term excursions to 1,500 mg/L. A review of the 1997 through 2001 data shows that, under low flow conditions, the Cache Creek TDS can be above 500 mg/L. Typically, however, it ranges from about 180 mg/L to just above 500 mg/L.

Total Suspended Solids (TSS) and Turbidity (NTU): The TSS and NTU are related parameters, in that the measurement of total suspended solids in a sample is somewhat related to the light scattering as reported in NTU (Nephelometric Turbidity Unit). As a rough approximation, 1 mg/L of TSS in the form of finely divided silica of a certain type is equivalent to about 1 NTU. There are large variations in this relationship depending on the characteristics of the suspended solids and how the NTU measurements are made. NTU is a standardized parameter for measuring light scattering that does not necessarily measure a definitive property. There are different turbidity measurement techniques which yield different NTU results on the same sample, which are all reported as "NTU" without reference to the technique used for measurement.

The CVRWQCB limits sediment, settleable materials and suspended materials so that they "*…do not cause a nuisance or adversely affect beneficial uses.*"

The CVRWQCB Basin Plan limitations for turbidity are:

"Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits:

- *Where natural turbidity is between 0 and 5 Nephelometric Turbidity Units (NTUs), increases shall not exceed 1 NTU.*
- *Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent.*
- *Where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs.*
- *Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent."*

Examination of suspended solids and turbidity data collected in 1997 through 2001 shows that elevated flows in Cache Creek lead to increased concentrations of suspended solids and turbidity. These increased concentrations indicate that there is erosion within the Cache Creek watershed/stream channel that is leading to suspended solids concentrations on the order of 100 mg/L, and turbidities of slightly over 100 NTUs. However, during low flow, the turbidity and suspended solids concentrations in Cache Creek are quite low and the water is relatively clear.

The DHS drinking water standard for turbidity is 10 NTUs. DHS does not have a standard for suspended solids. The 10 NTU is exceeded with elevated flows in Cache Creek.

Nitrate: The California DHS drinking water MCL for nitrate is 45 mg/L as NO_3. This primary drinking water standard is based on protecting children from methemoglobanemia (blue babies). The concentrations of nitrate found in Cache Creek waters during the study period ranged from less than the detection limit of 1 to about 20 mg/L as NO_3. These concentrations are all well below the drinking water MCL of 45 mg/L as NO_3 (10 mg/L as N). Typically, the concentrations of nitrate at the three lower stations were lower under elevated Cache Creek flow than under low-flow conditions, potentially indicating that the nitrate was derived from groundwater or irrigation return water discharged to the Creek during the summer months.

While not a water quality criteria/standard at this time, the US EPA (2001a) and Grubbs (2001) have indicated that states must, by 2004, have developed nutrient criteria, which would protect the beneficial uses of waterbodies from excessive fertilization/growth of algae and water weeds. While nitrogen criteria are not yet developed, from the default criteria that the US EPA (2000b) is suggesting as potential values that could be applied to waterbodies like Cache Creek, Cache Creek could be found to contain excessive concentrations of nitrate and other nitrogen compounds, which could lead to excessive fertilization of Cache Creek through the growth of algae and/or contribute to excessive nutrient concentrations in downstream waterbodies into which Cache Creek discharges.

Nitrite: The California DHS has a primary drinking water MCL for nitrite of 1 mg/L as N, with a further constraint that the nitrate plus nitrite shall not be greater than 10 mg/L N. The conversion factor between nitrite as NO_2 and nitrite as N is 3.3. The concentrations of nitrite found in Cache Creek were always less than the detection limit of 1 mg/L N. Nitrite, however, would be another parameter contributing to nitrogen concentrations, which would be judged to be excessive compared to those that have been found to cause excessive growths of algae.

While not listed as a US EPA water quality criterion or as a CVRWQCB water quality objective, nitrite is well-known to be highly toxic to some forms of fish at about 0.1 mg/L N (Lewis and Morris, 1986; Solbe, 1981). Nitrite can be present in waters above this level during cold weather conditions, associated with the nitrification of ammonia. The County has not been using a sufficiently sensitive analytical method for nitrite to measure nitrite at potentially significant levels for protection of aquatic life from its toxicity to some types of fish.

Ammonia: The California DHS does not have an ammonia drinking water MCL. The US EPA (1999a) revised the ammonia national water quality criteria. The CVRWQCB will be required to adopt the revised ammonia criteria into Basin Plan objectives with the revision of the Basin Plan that is currently being developed. The ammonia criterion depends on temperature and pH. Based on the temperatures and pH values found in Cache Creek, a concentration of ammonia as N on the order of 0.3 to 0.5 mg/L would be a chronic threat to cause toxicity in fish. The concentrations of ammonia in Cache Creek for 1997 through 2001 were generally less than the detection limit of 0.1 mg/L as NH_3. There was one value of 1.04 mg/L on September 1, 1999, at the I-5 station, which, based on the temperature and pH could cause toxicity to some forms of aquatic life. A value of 0.93 mg/L was found on January 17, 2001, at the I-5 station, which would not be considered excessive, because this was a winter sample, which had a temperature of 40.6 F. It appears that there is a potentially significant source of ammonia to Cache Creek between the Stevens Bridge station and I-5.

Total Kjeldahl Nitrogen: Total Kjeldahl nitrogen represents the concentrations of organic nitrogen plus ammonia, and typically consists of dissolved and particulate plant and animal protein material. Neither California DHS, the US EPA nor the CVRWQCB have total Kjeldahl nitrogen concentration limits for drinking water or protection of aquatic life. Total Kjeldahl nitrogen, on the other hand, is part of the nitrogen compounds that will be regulated by the US EPA (2001a) through their nutrient criteria that are being developed. According to the US EPA (Grubbs, 2001) these criteria will consider the sum of the total Kjeldahl nitrogen, nitrite plus nitrate, in determining the excessive concentrations of nitrogen compounds in a waterbody. The US EPA's default national criteria being suggested are on the order of 0.1 mg/L N for the sum of these compounds.

Total Kjeldahl nitrogen (TKN) in Cache Creek reported for December 8, 1997, and February 3, 1998, at all stations ranged from 3 mg/L to 8.1 mg/L N. Values were found at the Capay Bridge, Gordon Slough and Stevens Bridge sampling locations of 0.7 mg/L, 1.0 mg/L and 1.7 mg/L N, respectively, on January 26, 2000. All other sampling events at each station had total Kjeldahl nitrogen at less than the reporting limit of 0.2 or 0.5 mg/L N. Therefore, while TKN is currently not a regulated parameter, concentrations above the detection limit used in the county studies would cause or contribute to non-compliance with the default nutrient criteria that the US EPA has indicated will be required to be adopted by states as water quality standards (objectives), without site-specific investigations to justify another value.

Phosphorus: Neither the California DHS, the CVRWQCB nor the US EPA has established MCLs or water quality criteria/objectives for phosphorus in water. The US EPA (2001a), however, has adopted the approach of requiring that phosphorus concentrations in water be controlled in order to prevent excessive fertilization of waterbodies. The Agency is currently requiring that the states develop nutrient criteria, including for phosphorus, by 2004 (US EPA, 2000a,b; Grubbs, 2001). The US EPA's suggested default phosphorus criterion is about 0.01 mg/L P. Cache Creek phosphorus levels for 1997 through 2001 were, in general, less than the reporting limit, which, for some samples, was 5 mg/L as PO_4, and for others was 0.5 mg/L as PO_4. There were two measured values above the reporting limits, of 0.015 and 0.06 mg/L as PO_4. For these two samples, an analytical method with a lower reporting limit of 0.01 mg/L as PO_4 was used. Neither the 5 mg/L nor the 0.5 mg/L reporting limit is adequate to measure phosphorus in water with respect to assessing its potential to stimulate excessive aquatic plant growth. There is, therefore, a need to adopt a soluble orthophosphate and total phosphate analytical procedure which will reliably measure the concentrations of phosphorus as P below 0.01 mg/L. The concentrations of total phosphorus in Cache Creek are, at times (and possibly all the time), likely to be above the US EPA's suggested recommended default nutrient criterion of 0.01 mg/L as P.

Boron: No boron concentration limit has been established for Cache Creek. The California DHS does not have a primary or secondary MCL for boron, nor does the California Toxics Rule (US EPA, 2000a) include a criterion for boron. The US EPA (1999b) National Recommended Water Quality Criteria-Correction references the US EPA (1987) "Gold Book" as a source of information on the critical concentrations of boron. The US EPA (1987) "Gold Book" lists the boron criterion as 750 ng/L for long-term irrigation of sensitive crops, and points out that some crops, such as citrus, are very sensitive to boron. There are many crops that are sensitive at around 1 mg/L boron.

The Yolo County Cache Creek 1998 and 1999 Annual TAC Reports contain a discussion of the potential impacts of boron on various types of crops. Table 5 is derived from these TAC reports. The origin of this table is, however, not referenced in these reports. Examination of Table 5 shows that there are a number of crops that are grown in the Cache Creek watershed which have a high sensitivity to boron. Boron toxicity can lead to stunted plant growth and reduced crop yields. The 1997 through 2001 data for boron show that, frequently, Cache Creek contains boron above 1 mg/L and, therefore, the use of Cache Creek water for crop irrigation could be detrimental to some crops.

Table 5 Boron Tolerance Limits for Local Agricultural Crops

Crop	Threshold at which production may begin to decrease (mg/L)	Tolerance Level
Grapes	0.5	Sensitive (under 1.0 pm)
Prunes	0.5	
Walnuts	0.5	
Beans	0.75	
Sunflower	0.75	
Wheat	0.75	
Barley	2.0	Semitolerant (1.0 to 2.0 ppm)
Corn	2.0	
Melons	2.0	
Oats	2.0	
Alfalfa Hay	4.0	Tolerant (2.0 to 4.0 ppm)
Sugar Beets	4.0	
Tomatoes	4.0	
Cotton	6.0	Very Tolerant (over 4.0 ppm)
Sorghum	6.0	
Asparagus	10.0	

Source: Yolo County (1998, 1999).

The YCFCWCD (2001) has been monitoring boron at various locations in Cache Creek for a number of years. Some of the stations of greatest interest include the Capay Dam and the station labeled "Moore Dam." Moore Dam is an area where groundwaters are added to Cache Creek at about midway between Capay Dam and I-5 (see Figure 1). According to the YCFCWCD (C. Barton, pers. comm., 2001), the groundwaters near Moore Dam tend to have elevated boron. It appears, since the Stevens Bridge samples below where Moore Dam discharges to Cache Creek do not reflect significantly elevated boron, the flow of the Moore Dam waters is small compared to the flow of Cache Creek. Further, the inflow of the Gordon Slough water to Cache Creek below Moore Dam, but above Stevens Bridge, may tend to dilute the boron added to Cache Creek from the Moore Dam area. The YCFCWCD monitors boron monthly, and the concentrations found range from a low of 0.45 mg/L during high flows to many values above 1 mg/L and some values as high as 2.7 mg/L (Yolo County Flood Control and Water Conservation District, 2001).

Thermal springs at Cache Creek's headwaters and groundwaters along the Creek are reported to discharge boron to Cache Creek. The boron concentrations in Cache Creek during the sampling period were remarkably constant, within the range of 1 to 2.5 mg/L, for any particular sampling location and time for all of the stations, and there were no significant inputs of water or boron below Capay Dam which changed the boron concentrations in the Creek. Also the concentrations of boron in the Creek did not change significantly from the elevated high flows of 2000 to the lower flows during the summer of 2000 and the sampling done in 2001. The greatly elevated flow of 32,500 cfs that occurred on February 3, 1998, did however dilute the boron content of Cache Creek to about 0.5 mg/L.

Total Coliforms and Fecal Coliforms: Total coliforms are, at this time, not regulated in Cache Creek. The California Legislature, however, adopted a total coliform standard for contact recreation, which is applicable to marine waters. There are significant questions about the reliability of total coliforms as a measure of human health hazards associated with contact recreation, since a number of studies have shown that total coliforms and, for that matter, fecal coliforms are not reliable indicators of human health hazards associated with contact recreation (Cabelli, *et al*., 1982; Dufour, 1984; US EPA, 1986). The total coliform concentrations in Cache Creek range from less than the reporting limit (which was not provided to the authors) to >1,600 MPN per 100 ml, with many values >200 MPN per 100 ml.

The CVRWQCB (1998) Basin Plan has established a water quality objective for fecal coliforms of 200 per 100 ml, for the geometric mean of five samples taken over 30 days. Not more than 10 percent of the samples taken over 30 days shall exceed 400 fecal coliforms per 100 ml. Fecal coliforms have been reported in some Cache Creek samples as high as 1,000 per 100 ml, with many of the samples having concentrations of fecal coliforms above the 200 per 100 ml water quality objective. While fecal coliforms are currently being used by the State and Regional Water Quality Control Boards as a parameter for assessing pollution of waters by fecal material, which would be a hazard to contact recreation, it has been known since the mid-1980s (Cabelli, *et al*., 1982; Dufour, 1984; US EPA, 1986) that fecal coliforms are not a reliable assessment of potential human disease associated with contact recreation. The US EPA (1998) is requiring that states adopt a revised contact recreation criterion for fresh water based on the measurement of *E. coli*.

The California DHS (2000) has been in the process of developing statewide water quality standards for contact recreation. These were first developed in initial draft form in November 1997, and updated in July 2000. While they have not been finalized/adopted, they provide information on contact recreation water quality standards that could be adopted by the CVRWQCB as part of a Basin Plan Amendment. This amendment is being considered by the CVRWQCB at this time. A review of DHS (2000), under Chapter II Water Quality Standards, A. Bacterial Standards states:

> ***B.3 FRESH WATER***
>
> *The US EPA evaluated health effects of microbiological contamination on recreational use of fresh waters (DuFour, 1984). Subsequently it published guidance on water quality for fresh water recreational uses (US EPA, 1986).*
>
> *US EPA's guidance for fresh recreational waters is based upon an "Acceptable Swimming Associated Gastroenteritis Rate" of 8 cases/1000 swimmers at a steady state geometric mean indicator density of 33 enterococci per 100 ml or 126 E. coli per 100 ml. The rate of 8 cases of illness per 1000 swimmers is estimated to result from exposures to waters containing bacteria using the fecal coliform indicator group at the maximum geometric mean of 200 per 100 ml.*
>
> *US EPA's criterion for bathing (full body contact) recreational waters for fresh water is as follows (US EPA, 1986):*
>
>> *Based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period), the geometric mean of the enterococci densities should not exceed one or the other of the following (Note that only one indicator should be used. The regulatory agency should select the appropriate indicator for its*

conditions.):

- *E. coli, at a concentration of 126 per 100 ml, or*
- *enterococci, at a concentration of 33 per 100 ml.*

No sample should exceed a one-sided confidence limit (CL), using the following as guidance:

- *Designated bathing beach area* *upper 75% CL*
- *Moderate full body contact recreation* *upper 82% CL*
- *Lightly used full body contact recreation* *upper 90% CL*
- *Infrequently used full body contact recreation* *upper 95% CL*

Based on a site-specific log standard deviation, or if site data are insufficient to establish a log standard deviation, then using 0.4 as the log standard deviation.

From the US EPA's guidance document, the single sample limits (in E. coli per 100 ml, or in enterococci per 100 ml) are:

- *Designated bathing beach area = 235 E. coli per 100 ml, or 61 enterococci per 100 ml.*
- *Moderate full body contact recreation = 298 E. coli per 100 ml, or 89 enterococci per 100 ml.*
- *Lightly used full body contact recreation = 406 E. coli per 100 ml, or 108 enterococci per 100 ml.*
- *Infrequently used full body contact recreation= 576 E. coli per 100 ml, or 151 enterococci per 100 ml."*

As mentioned above, the US EPA did not recommend a change in the stringency of its bacterial criteria for recreational waters, finding that such a change did not appear warranted until more information on the new indicators was accumulated.

Recently, the CVRWQCB has proposed to adopt the US EPA's recommended *E. coli* contact recreation standard of 126/100mL.

The US EPA's *E. coli* water quality standard does not adequately address acquiring enteric diseases caused by protozoan pathogens and viruses. Waters that meet the *E. coli* standard can still cause enteric and other diseases through contact recreation. An area of particular concern is the discharge of cattle fecal material, which can contain cryptosporidium, into Cache Creek. Cryptosporidium is a cyst-forming protozoan that caused over 400 people in Milwaukee to die due to its presence in their domestic water supply that had not been adequately treated to remove this organism. It is believed that the cryptosporidium that got into the Milwaukee water supply was derived from cattle (Lee and Jones-Lee, 1993).

DHS (2000), under C.3 FRESH WATER BEACHES, C.9 Yolo County, states:

"Yolo County's rivers and creeks are sampled only when there is a complaint or when an incident of pollution occurs. For warning and closure, the county uses a standard of not to exceed a daily average of 2400 coliforms per 100 ml. Repeated testing at least on two consecutive days is required to establish a warning/closure action, and the same procedure

is required for removal of such order."

Yolo County should modify its Cache Creek monitoring program to include *E. coli*, where the values found are compared to the US EPA recommended *E. coli* limit of 126 MPN per 100 mL.

The total and fecal coliform concentrations in Cache Creek were greatly elevated at all stations during the high flow of February 1998 and January 2000. There was an apparent pattern of increased concentrations of total coliforms, especially at the County Road 97B/I-5 station, compared to the Capay station, indicating that the concentrations of total coliforms (and fecal coliforms in general) increased downstream, especially between the lower two stations. While the data are highly variable, it appears that there may be a significant source of total and fecal coliforms between County Roads 94B and 97B. The presence of cattle and horse facilities on the north side of the Creek in this area, may be the source of the elevated coliforms.

Chapter 7.0 (Open Space and Recreation Element) of the Yolo County Off-Channel Mining Plan states that

> *"Existing recreational areas within the Planning Area include: the Esparto Community Park, the Madison Community Park, and the Flier's Club (a private golf course and clubhouse). None of these facilities provide direct access to the creek or the adjoining environs."*

While, generally, the lands adjacent to Cache Creek are privately held and, therefore, are not available to the public, according to Morrison (pers. comm., 2002), "The Creek is public domain below the mean high water mark and is accessible to everyone." In addition to protecting those who contact-recreate from private lands located along the Creek, if the County develops recreational facilities, parks, etc., adjacent to the Creek in the resource management area, the fecal contamination of the Creek should be controlled to also protect the health of the public.

At this time, all of Yolo County's public parks are located upstream of the Capay Dam (Yolo County, 2001). These parks, such as the Cache Creek Canyon Recreational Park and Camp Haswell Park, located near the town of Rumsey, include contact recreation with Cache Creek as park amenities. The County Health Department was contacted regarding monitoring programs for coliforms in the park areas which allow access to Cache Creek. Tom To of the Yolo County Health Department (pers. comm., 2001) indicated that the Health Department does not monitor Cache Creek water in the park areas for coliforms. While at this time, Yolo County does not have public parks or other areas along the Lower Cache Creek Planning Area (below Capay Dam), where the public would have the opportunity for water contact recreation, which would increase their risk for exposure to pathogens, the County has indicated that it plans to develop Cache Creek-based recreational facilities below Capay Dam. It will be important if the County develops Cache Creek-based recreational facilities downstream of the Capay Dam which would encourage contact recreation, to obtain better control of fecal coliform and *E. coli* inputs to the Creek to protect the health of those who contact-recreate in the Creek.

Potential areas of concern for public contact (recreation) exposure to the elevated coliforms and likely associated pathogens may include the Cache Creek Nature Preserve, since there is the potential for children and adults to enter Cache Creek at this site. The Conservancy staff discourages contact with Cache Creek waters at the Preserve. This preventative measure is important to mitigate any impact and should be continued.

Dissolved Oxygen: The CVRWQCB water quality objective for dissolved oxygen in Cache Creek is a minimum of 5 mg/L. This value is based on protection of aquatic life. All measurements of DO in Cache Creek that have been reported thus far are above this minimum value.

Temperature: A problem has been detected with the current reporting of temperature by the County's consultant, Sequoia Analytical. Some values are reported as degrees Fahrenheit, while others are obviously degrees centigrade, but reported as degrees Fahrenheit. If the error in reporting is corrected, the measured temperatures of Cache Creek are in accord with what would be expected for a Creek of this type in this geographical setting. The field crew collecting the samples during 1997 and 1998 failed to measure temperature. Temperature should always be measured in studies of this type, since it is an important parameter in interpreting water quality data.

The temperature of Cache Creek is governed primarily by meteorological conditions and the canopy (overhanging trees) cover of the Creek. Parts of the Creek have some canopy which tends to keep it somewhat cooler than the parts of the Creek without canopy. This canopy not only affects the temperature of the Creek, but also reduces algal growth.

Total Petroleum Hydrocarbons-Gasoline, Total Petroleum Hydrocarbons-Diesel: Total petroleum hydrocarbons – both extractable hydrocarbons ("diesel") and purgeable hydrocarbons ("gasoline") – have been measured in the County's monitoring studies. These measurements were required in the 1996 CCRMP as parameters that potentially could indicate the spillage of gasoline and diesel fuel by contractors conducting activities within the Cache Creek channel. The total petroleum hydrocarbon concentrations for 1997, 1998, April 1999, 2000 and 2001 were all at non-detectable levels (less than 0.05 mg/L), except for April 2000 at the Capay Bridge station and the County Road 97B (I-5) station. Both of these stations had total petroleum hydrocarbons-diesel at 0.08 mg/L. Also, the September 1999 Stevens Bridge sample had a reported TPH-diesel of 0.88 mg/L[2]. The petroleum hydrocarbon testing procedures are not specific for gasoline or diesel fuel, but measure a variety of constituents that are not fuel. It is unclear whether the reported values above the detection limit represent actual petroleum hydrocarbons derived from fuel, or interference in the testing procedure, which, under certain conditions, is measured as petroleum hydrocarbon-diesel.

Organochlorine Herbicides and Organophosphate Pesticides: Organochlorine herbicides and organophosphate pesticides were indicated to be of interest in the 1996 CCRMP because of the potential for these compounds to be toxic to aquatic life. The CVRWQCB (1998) Basin Plan objectives require that no discharge of pesticides occurs that results in pesticide concentrations in bottom sediments or aquatic life, which adversely affect beneficial uses. Further, the CVRWQCB has a toxicity limitation requirement which states that, "*All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal or aquatic life.*"

The California DHS has primary MCLs for certain herbicides, such as 3 µg/L for atrazine. Atrazine is used on some crops for weed control. OEHHA (2001) has a California public health goal for atrazine of 0.15 µg/L. This parameter was not measured by the analytical laboratories used by the County. There is need to broaden the scope of herbicides that are measured to

[2] The 1999 data are listed as µg/L in the data sheets received from the County, though this may be in error, since the 2000 data are listed in mg/l. Review of the 1997-1999 original data sheets will allow reconciliation of this inconsistency.

include more than just the organochlorine herbicides, since a wide variety of herbicides are used in the Cache Creek watershed that have the potential to be adverse to aquatic life.

Measurements of groups of herbicides and pesticides, using standard US EPA 8140 and 8150 methodology, have been made by the analytical laboratories used by the County. All herbicide and pesticide data were found to be less than the reporting limit. Unfortunately, however, the reporting limits that were used by the laboratories in conducting these analyses (from 0.5 to about 1 µg/L), in general, are not adequate to detect some of the parameters measured in these groups at concentrations which are known to be toxic to aquatic life. Of particular concern are the measurements of the organophosphate pesticides diazinon and chlorpyrifos. These two pesticides are used in large amounts on a variety of crops and in urban areas. They have been found to be a cause of toxicity to *Ceriodaphnia* (water flea) in many areas of California. This is used as a standard test organism by the US EPA.

While there are no US EPA water quality criteria or State or Regional Board objectives for the organochlorine pesticides and PCBs, the CDFG (Siepmann and Finlayson, 2000) has developed recommended water quality criteria for diazinon of 50 ng/L (4-day average) and chlorpyrifos of 14 ng/L (4-day average). These values are well below the reporting limit of 500 ng/L used by Sequoia Analytical in analyzing the 1999, 2000 and 2001 samples. The US EPA (Strauss, 2000) and the CVRWQCB have selected these criteria as the TMDL goals for control of diazinon- and chlorpyrifos-caused aquatic life toxicity.

There is an immediate need for Yolo County to work with their testing laboratory (Sequoia Analytical or other) to measure chlorpyrifos and diazinon (as well as the other pesticides and herbicides) with a greater sensitivity than they have been using to date in the Cache Creek studies. There are standard US EPA-accepted procedures for conducting these analyses at the required concentration, which should be applied to the Cache Creek studies.

Since the concern about the organophosphate pesticides, such as diazinon and chlorpyrifos, is aquatic life toxicity, it is recommended that Yolo County expand the water quality monitoring to include measurement of aquatic life toxicity using standard US EPA procedures. This issue is discussed further in the following section.

Organochlorine Pesticides: A group of pesticides of potential concern in Cache Creek, mentioned in the CCRMP because of their former use in agricultural urban areas within the Cache Creek watershed, are the organochlorine pesticides, such as DDT, chlordane, toxaphene, dieldrin, etc. These pesticides are all regulated as potential carcinogens and have not been legally used in the US since the 1970s, when they were banned from further use. These compounds are extremely persistent and are still being found in soils and water in runoff from the areas where they have been applied, at concentrations which are a threat to human health through drinking water and, more importantly, through bioaccumulation in fish to excessive levels, compared to those that are considered to be safe for consumption of the fish as food.

In the 1980s, the Water Resources Control Board Toxic Substances Monitoring Program (SWRCB, 2001) made some measurements of the organochlorine pesticides in fish tissue. Samples were taken from Cache Creek in 1978 to 1981. The measurements made at that time were all found to be less than the detection limits used by the CVRWQCB/CDFG, who did the analyses and specified the analytical procedures. However, the analytical procedures used both then and now by the CVRWQCB for analyzing fish tissue for organochlorine pesticides and

PCBs, do not have adequate sensitivity to measure some of the organochlorine pesticides in fish tissue at potentially critical concentrations for the consumption of the fish as food.

Heavy Metals: Typically, studies of the water quality of waterbodies include periodic measurements of a suite of potentially toxic heavy metals, such as arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, nickel, selenium and zinc. Many of these metals are of concern because of their potential toxicity to aquatic life at low concentrations. The US EPA (1995, 1999b, 2000a) established water quality criteria for heavy metals that are potentially toxic to aquatic life, based on their dissolved forms (the particulate forms of these heavy metals are not toxic). The regulated potentially toxic (to aquatic life) heavy metals have not been measured in the County's study of Cache Creek. However, for several years in the mid-1990s the USGS (2001) monitored these metals at Rumsey Bridge, upstream of the Capay Dam. None of these potential heavy metal toxicants measured in the USGS monitoring of Cache Creek at the Rumsey Bridge were found at concentrations in excess of the US EPA recommended water quality criteria. Further, potential aquatic life toxicity problems caused by many of these heavy metals can be screened for by the recommended aquatic life toxicity testing. This issue is discussed below.

Total Mercury and Dissolved Mercury: Mercury is one of the most important water quality parameters for Cache Creek. This importance arises from the fact that mercury can convert to methylmercury, which then bioaccumulates in fish tissue. Methylmercury is highly toxic to fetuses and young children, causing neurological damage. The CA DHS has established a mercury drinking water MCL of 0.002 mg/L.

The CVRWQCB does not have a water quality objective for mercury; however, the US EPA (1987) developed a water quality criterion for total recoverable mercury of 12 ng/L. The US EPA (2000 c), as part of developing the California Toxics Rule, subsequently raised this criterion to 50 ng/L. The US EPA (Woods, 2000) has indicated, however, that this change does not represent a change in the level of significance of mercury in water, but a change related to how the Agency determines critical concentrations of mercury. Woods (2000) has indicated that the mercury criterion will likely be lowered to about 5 ng/L total recoverable mercury within a few years. This concentration represents a "worst case" situation for bioaccumulation of mercury in fish tissue.

Hothem, *et al.* (1998) discussed the linkage of mercury to Cache Creek food web issues. They point out that, to evaluate the effects of mercury on the biota of the Cache Creek watershed, one needs to learn how much of the mercury is accumulating in each trophic level. Site-specific data can then be used to develop cleanup alternatives that would lead to recovery of species adversely affected by mercury. They discuss the initiation of a two-year study on the accumulation of mercury in various organisms, including swallow eggs and amphibians (bull frogs and other frogs). They reported that the concentrations of mercury in the swallow eggs were lower than those that typically have been known to cause reproductive failure. The frogs collected in the mercury mining area of the Cache Creek watershed showed elevated concentrations of mercury. The interpretation of the frog mercury data is still underway at the time of this report.

The County includes mercury measurements as part of its monitoring of Cache Creek. The analytical method reporting limits for these measurements are well above the critical concentrations for excessive mercury in water that could lead to bioaccumulation of mercury in fish tissue that would be considered a threat to human health. The data for total and dissolved mercury are all "non-detect" (i.e., less than the reporting limit of 200 µg/L). Mercury, however, can be detected at much lower concentrations. The County should revise its analytical program for mercury to include reliable measurements of total and dissolved mercury at concentrations of less than 5 ng/L (i.e., the value that the US EPA has indicated that it will likely adopt as a future mercury limit).

The County's reporting limits for mercury (via Sequoia Analytical) are 200 ng/L. Mercury, however, potentially bioaccumulates to excessive levels in fish at concentrations above 5 ng/L. The (Sequoia Analytical) analysis of mercury in Cache Creek over the past three years, where all the results except January 26, 2000, at Capay Bridge are "ND" (below the reporting limit), could easily represent a situation where there is excessive mercury that is not detected by the methods used. The sample taken January 26, 2000, at Capay Bridge, contained 440 ng/L of mercury. This was found in a sample of Cache Creek during a period of elevated flow of 365 cfs. However, other elevated flow samples, such as April 14, 2000, and February 3, 1998, did not show detectable concentrations of mercury. As discussed below, Foe and Croyle (1998) have found that mercury concentrations in Cache Creek are highly dependent on flow, where elevated flows tend to contain elevated concentrations of mercury.

Other Studies of Lower Cache Creek Water Quality

Mercury Special Studies

To date, the US EPA has been regulating mercury in water based on water concentrations of total recoverable mercury. This approach has proven to be unreliable, since there are a wide variety of factors that influence the conversion of total mercury in water and/or sediments to methylmercury in water and fish tissue. The US EPA (1999c,d; 2001b,c) is recommending a change in the approach for regulating mercury, which would be based on fish tissue residues. The US EPA (2001c) states,

> *"To assess health risks, EPA developed a reference dose that is a scientifically justifiable maximum level of exposure to protect public health from all toxic effects. EPA based the methylmercury criterion on a new reference dose that protects all exposed populations. EPA also updated the exposure assessment and relative source contribution following the recently published 2000 Human Health Methodology. The resulting criterion of 0.3 mg methylmercury/kg in fish tissue should not be exceeded to protect the health of consumers of noncommercial freshwater/estuarine fish."*

This is a much more reliable approach for regulating mercury. It will require that a Cache Creek-specific translation factor between methylmercury in water and methylmercury in fish tissue, be established. Slotton (pers. comm., 2001) has indicated that he is developing such a relationship for Cache Creek.

Woods (2001) has indicated that the US EPA is also developing a guidance for implementing the methylmercury tissue-based criterion. A draft of this guidance was scheduled to be available in 2002; however, recent events have caused the US EPA to shift the personnel working in this area to other activities related to terrorism.

Foe and Croyle (1998) presented a report on the concentrations of mercury found in Cache Creek. They discussed the fact that the elevated mercury in Cache Creek is derived from mercury mining that occurred in the Cache Creek headwaters in the Coast Range. This mercury is transported in part by Cache Creek through the Yolo Bypass into the Sacramento-San Joaquin

River Delta. The Delta has had a human health advisory for fish consumption for mercury since 1971.

The Foe and Croyle (1998) studies included monitoring of Cache Creek during 1994-95. These studies confirmed that, between 1996 and 1998, Cache Creek was a major source of mercury for the Yolo Bypass/Sacramento River system. The greatest concentrations and loads of mercury transported in Cache Creek occurred during high flows. Generally, it was found that the mercury concentrations in Cache Creek exceeded the US EPA water quality criterion of 12 ng/L, whenever the flow in the Creek was above about 100 cfs.

Foe and Croyle (1998) also provide information on the sources of mercury within the Cache Creek watershed. While not specifically discussed in this report, the sediments of Cache Creek along its length have been contaminated by upstream natural sources (geothermal springs) and mining activities. The mercury that is present in these sediments and along the banks of Cache Creek is of concern as a "potential" source of additional mercury associated with the County's Cache Creek improvement/maintenance projects within the Creek that could mobilize mercury from sediments.

Domagalski (2001) reported on a USGS study of mercury and methylmercury concentrations in streambed sediments and water at 27 locations throughout the Sacramento River Basin. The highest loadings of mercury to the San Francisco Bay system were attributed to sources in the Cache Creek watershed, which are downstream of historic mercury mines. Domagalski (2001) reported however that, based on geochemical transformation studies, a substantial part of the mercury transported in Cache Creek, which is in a mercuric sulfide form (cinnibar), has little potential to be converted to methylmercury at the location where the samples were taken. .

Two of the sampling locations used in the Domagalski/USGS studies were Cache Creek at Rumsey and Cache Creek at Guinda. The Guinda sampling location is about 10 miles upstream of Capay Dam and about five miles downstream of Rumsey. The Cache Creek at Rumsey location was sampled for mercury in water. The Cache Creek at Guinda location was sampled in 1995 for mercury in bedded sediments. The Cache Creek at Guinda site sampled in 1997 contained the highest concentrations of mercury in bedded sediments found in any of the Sacramento River watershed sampling locations. This finding is of particular concern since similar situations "could be" occurring downstream, in Lower Cache Creek within the Capay Dam to I-5 area. There is a clear need, therefore, to sample Cache Creek sediments and banks as part of all activities within this Area, to determine if there are significantly elevated concentrations of mercury in these sediments that could potentially be mobilized during the County's maintenance/project activities.

Domagalski (2001) also found that the Cache Creek at Rumsey water samples contained some of the highest mercury found in the Sacramento River watershed. This mercury (2,248 ng/L) was primarily in the particulate form, associated with high flow. However, most of this mercury was "unreactive," based on the testing that was done by the USGS. Domagalski (2001) points out however, that the lack of reactivity of the samples taken at Rumsey does not mean that the particulate mercury, when transported downstream, could not be converted to methylmercury in the Delta or upper San Francisco Bay. While he measured methylmercury at many locations in his study, he did not measure methylmercury at the Cache Creek sampling locations.

Slotton, *et al.* (2001) are part of a CALFED-supported large research group studying various aspects of mercury in the Cache Creek watershed and within the Sacramento River system and downstream. The Slotton, *et al.* (2001) studies primarily focus on the occurrence of mercury and methylmercury in waters, sediments and aquatic life in the Cache Creek watershed. They include sampling of Cache Creek at the Highway 505 location and Cache Creek within the Settling Basin, just upstream of Yolo Bypass. Slotton, *et al.*, found significantly elevated concentrations of methyl- and total mercury in several forms of aquatic life in Cache Creek at Rumsey, below 505 and below Yolo and the Settling Basin. These results indicate that there is significant bioaccumulation of mercury in Cache Creek aquatic life.

Slotton and Ayers (2001a,b) are currently conducting a study of the potential for mercury methylation/bioaccumulation associated with the Cache Creek Nature Preserve (Preserve). A three-year monitoring program was initiated in the fall of 2000. The primary purpose of this monitoring program was to indicate the potential role, if any, that Nature Preserve water discharges may have on mercury levels in adjacent Cache Creek. The monitoring included a series of quarterly collections, with data reports issued semi-annually. The Slotton-Ayers (2001a,b) reports are the first of these reports, presenting and briefly discussing the fall 2000/winter 2001 and spring/summer 2001 data.

Samples of fish and invertebrates were collected in Cache Creek upstream of the Preserve and the Preserve water outlet. They were also collected in Gordon Slough, near the Preserve intake and the confluence with Cache Creek, as well as within the Nature Preserve wetlands and Cache Creek downstream of Gordon Slough and the Preserve.

While the reports developed thus far represent only the first year of a three-year study, these first-year conclusions, which analyze fish samples taken from Cache Creek downstream from the Preserve outlet and the Gordon Slough confluence, consistently demonstrated reduced levels of mercury bioaccumulation compared to the corresponding samples from upstream Cache Creek locations. While it appears that the Preserve is causing increased methylation/bioaccumulation of mercury in aquatic organisms compared to Gordon Slough, it does not appear that this is leading to increased mercury bioaccumulation in Cache Creek. Slotton and Ayers (2001a,b) stress, however, that these initial conclusions are based on the initial phase of a three-year study, and that further work needs to be done before any definitive conclusions can be developed from the study.

USGS Cache Creek Monitoring

The USGS, as part of the National Water Quality Assessment (NAWQA), monitored various waterbodies within the Sacramento River Basin to determine the chemical and, in some instances, biological characteristics during February 1996 through April 1998 (USGS, 2001). One of the sampling stations used was Cache Creek at the Rumsey Bridge. Rumsey is located about 18 miles upstream of Capay Dam. Samples were analyzed for temperature, instantaneous flow, specific conductance, dissolved oxygen, pH, alkalinity, hardness, suspended solids, calcium, magnesium, sodium, potassium, chloride, sulfate, fluoride, silica, iron, total solids, dissolved solids, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, silver, zinc, antimony, aluminum, selenium and uranium, several pesticides (eptam, pebulate molinate, trifluralin, simazine, carbofuran, atrazine, fonofos, diazinon, carbaryl, alachlor, thiobencarb, malathion, metolachlor, chlorpyrifos, dactel, methidathion, napropamide and cyanazine) and total mercury. Also, the daily mean discharge of Cache Creek at the Rumsey station during the study period is provided.

Examination of these data shows that the concentrations of many constituents are within the normal, expected range and do not represent a potential to cause impaired water quality. The exceptions to this are the total mercury, total suspended solids and total phosphorus. While under Cache Creek low flow conditions (flows less than 30 cfs) total suspended solids are typically on the order of 10 to 50 mg/L, under elevated flows (50 cfs or above and especially at over 100 to 400 cfs) total suspended solids can be as high as 3,820 mg/L. At times, Cache Creek is transporting large amounts of erosional material from its watershed upstream of Rumsey, downstream .

The total phosphorus concentrations found in some samples were on the order of 0.1 mg/L P. This significantly elevated value is of concern because of the potential to exceed the nutrient criteria/water quality objective (on the order of 0.01 mg/L P) that could be adopted by the CVRWQCB within the next several years (US EPA, 2000b).

The suite of heavy metals analyzed by the USGS at the Rumsey station were, except for mercury, found at concentrations well below critical levels for protection of aquatic life, indicating that other heavy metals that could affect water quality in Lower Cache Creek and downstream waters are not being transported past Rumsey.

The total mercury concentrations found at the Rumsey monitoring station ranged from about 5 ng/L to over 2,200 ng/L (obtained on February 3, 1998, during a high-flow event). As is well-known, there is substantial mercury transported down Cache Creek from upstream sources, especially under high-flow conditions. According to Morrison (pers. comm., 2002), in 1996, the peak flow at this monitoring station was at least 11,000 cfs. In 1997, it was about 28,700 cfs, and in 1998 it was about 34,600 cfs. The 34,600 cfs peak flow was sampled in February 1998. This was the sample that contained the very high total mercury.

Therefore, overall, the principal constituents of water quality concern in Cache Creek based on the USGS NAWQA monitoring during the mid-1990s were total mercury and total suspended solids, with some concern about phosphorus.

Aquatic Life Toxicity

The Yolo County DHS, the University of California at Davis, and the CVRWQCB conducted a chemical and aquatic life toxicity monitoring of Cache and Putah Creeks between November 1998 and November 1999 (Larsen, *et al*., 2000). Samples were collected monthly at four locations in the Cache Creek watershed above the Rumsey Bridge (Clear Lake Outflow, North Fork Cache Creek, Harley Gulch and Mid Bear Creek), at the Rumsey Bridge, Capay Dam, Hwy 505 Bridge and Cache Creek Settling Basin and during a stormwater runoff event. These samples were tested for the US EPA standard test species – *Selenastrum capricornutum* (green algae), *Ceriodaphnia dubia* (crustacean) and *Pimephales promelas* (fathead minnow; Lewis, *et al.*, 1994). Six sampling sites were selected in the Cache Creek watershed. Significant toxicity to fish and invertebrates was detected in the samples collected from Cache Creek at the Rumsey Bridge and at the North Fork Cache Creek at Highway 20. The cause of the toxicity was not determined. Other samples collected from Cache Creek were nontoxic. The presence of unknown-caused aquatic life toxicity is the reason that the CVRWQCB has listed Cache Creek as a 303(d) impaired waterbody that requires that a TMDL be developed to eliminate this toxicity. The toxicity of Cache Creek water to both zooplankton and fish upstream of the Capay Dam is of concern since this could be adverse to the aquatic life-related beneficial uses upstream and downstream.

The Cache Creek watershed contains a large number of orchards that would be expected to be sprayed each winter with diazinon as a dormant spray, especially just upstream of the Capay Dam in the Capay Valley. This spraying could result in Cache Creek becoming toxic to *Ceriodaphnia* during the winter stormwater runoff. It is not known how far downstream the toxicity would persist, likely for considerable distances, and possibly all the way to the Yolo Bypass. The key issue on downstream persistence would be runoff to the Creek from areas which have not received dormant spray diazinon or other pesticides which would dilute the pesticides from the orchards in the Capay Valley.

California Department of Water Resources Cache Creek Monitoring

The California Department of Water Resources (DWR) maintains a water quality monitoring station on Cache Creek at the Rumsey Bridge. Data from April 1992 through September 2001, covering each of the sampling events, were obtained from the CA DWR (2001) Central District. In general, samples were collected in the spring (April or May) and again in September or October, with the fall 1999 data collected in November. DWR measured pH, total alkalinity, total dissolved solids, chloride, electrical conductivity, boron, calcium, magnesium, nitrate, potassium, sodium, sulfate and hardness. These data are similar to the USGS data collected at the Rumsey sampling location. They do not reveal any unusual characteristics of Cache Creek at the Rumsey station, which in turn would be translated to downstream water quality characteristics within the Planning Area.

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