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4.4 SURFACE WATER HYDROLOGY

This section discusses Project impacts resulting from streambank erosion or flooding in the Laguna de Santa Rosa or Russian River. The potential for flooding and streambank erosion as a result of irrigation and storage is evaluated, as is the potential for flooding due to rupture of Project pipelines. To provide a basis for this evaluation, the characteristics of major water bodies in the Project area, and existing hydrologic conditions are described. Data on estimated and measured monthly flows in the rivers and streams are provided.

IMPACTS EVALUATED IN OTHER SECTIONS

The following items are related to the Surface Water Hydrology Section but are evaluated in other sections of this document:

- Irrigation. The Surface Water Quality and the Aquatic Biological Resources sections, Sections 4.6 and 4.9 respectively, address how irrigation could affect water quality and aquatic habitat.
- Dam Failure. The potential effects of dam failure are addressed in Section 4.19, Inundation from Dam Failure.
- Seepage of Reclaimed Water from Reservoirs. The potential impacts seepage could have on water quality and aquatic habitat are addressed in Sections 4.6 and 4.9.

AFFECTED ENVIRONMENT (SETTING)

The Project alternatives could affect flow in several water bodies, including the Russian River, Laguna de Santa Rosa, Americano Creek, Stemple Creek, Tolay Creek, Petaluma River, San Pablo Bay, and the Pacific Ocean. The general locations of these water bodies are shown in Figure 4.4-1.

Russian River

The Russian River drains a basin of approximately 1,485 square miles in Sonoma and Mendocino counties. The drainage basin, lying between adjoining ridges of the Coast Range, is about 80 miles long and from 10 to 30 miles wide. The total length of the river, from its source about 16 miles north of Ukiah to its mouth at Jenner, where it empties into the Pacific Ocean, is about 110 miles. Principal tributaries of the Russian River are Dry Creek and the Laguna de Santa Rosa. Dry Creek drains an area of 217 square miles in the west central portion of the drainage basin and empties into the Russian River about two miles south of Healdsburg. Mark West Creek, which is a tributary to the Laguna de Santa Rosa, drains an area of about 255 square miles located in the southeastern portion of the drainage basin and joins the Russian River at Mirabel Park. Other tributaries include the East Fork, Big Sulphur Creek, Maacama Creek, Mill Creek, and Austin Creek (Sonoma County Water Agency 1980).

Russian River flows have been altered from their natural condition by a number of water resource development projects. Since 1908, water has been diverted from the Eel River and released into the East Fork of the Russian River through the Potter Valley Tunnel and Powerhouse. Between 1986 and 1992, the amount of water imported from the Eel River has averaged 188 cfs (136,000 acre-feet per year). The flow rate varied from a low of 44 cfs to a high of 310 cfs (Sonoma County Water Agency 1996).

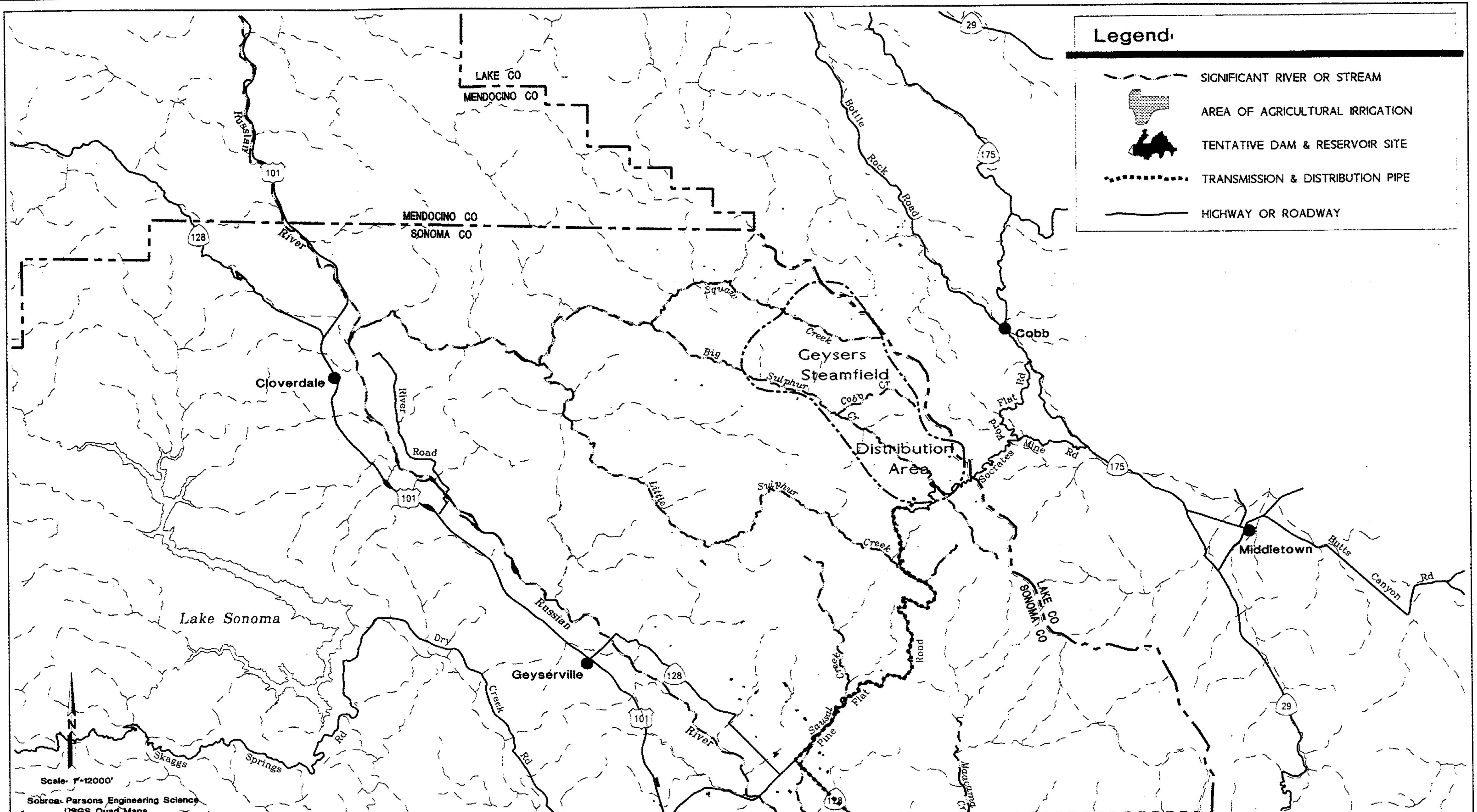
Coyote Dam is located on the East Fork of the Russian River, just north of Ukiah. Lake Mendocino, the reservoir formed by the dam, stores about 122,400 acre-feet of water, and is used for water supply, recreation, flood control, and augmentation of summer stream flows in the Russian River. The dam and reservoir were built by the U.S. Army Corps of Engineers in 1958 (State of California Department of Water Resources 1994).

Warm Springs Dam was built by the U.S. Army Corps of Engineers in 1982 and is located on Dry Creek, approximately 15 miles upstream from its confluence with the Russian River. Lake Sonoma, the reservoir formed by the dam, has a capacity of 381,000 acre-feet and is used for water supply, flood control, augmentation of summer flow, and recreation (State of California Department of Water Resources 1994).

Several communities in the Russian River basin, including Ukiah, Cloverdale, Healdsburg, Windsor, Santa Rosa, and Guerneville, discharge wastewater to the River. Some of the discharges are direct and occur only seasonally, and others are continuous but indirect (via percolation ponds). Wastewater discharges to the River are described in Section 4.6, Surface Water Quality.

Streamflows in the Russian River basin vary widely from floods during the winter to small flows and even no flow in some tributaries during the dry summer months. Rainfall over the basin is considerable, averaging 41 inches per year. Eighty percent of the annual runoff occurs between December and March. Because winter storms often produce extended periods of intense rainfall over the drainage basin, flooding is frequent and severe. In 1986, a record river flow of 102,000 cubic feet per second (cfs) occurred at Guerneville, producing severe flooding. In 1995, the instantaneous peak flow at Guerneville was 93,900 cfs on January 10, 1995.

Tributary streams often dry up completely during the summer, although subsurface flow may still occur in the streambed gravel. A minimum summertime flow of 125 cubic feet per second is maintained during normal years in the Russian River at Guerneville by releases from Lake Mendocino and Lake Sonoma (Dames and Moore 1988a, Sonoma County Water Agency 1996). Summertime flow would be considerably less without these releases. Historic average monthly streamflows measured at Guerneville are shown in Table 4.4-1 and flows at Healdsburg are shown in Table 4.4-2.



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Santa Rosa
Subregional Long-Term Wastewater Project

WATERWAYS IN THE SANTA ROSA LONG-TERM PROJECT AREA

Figure 4.4-1a

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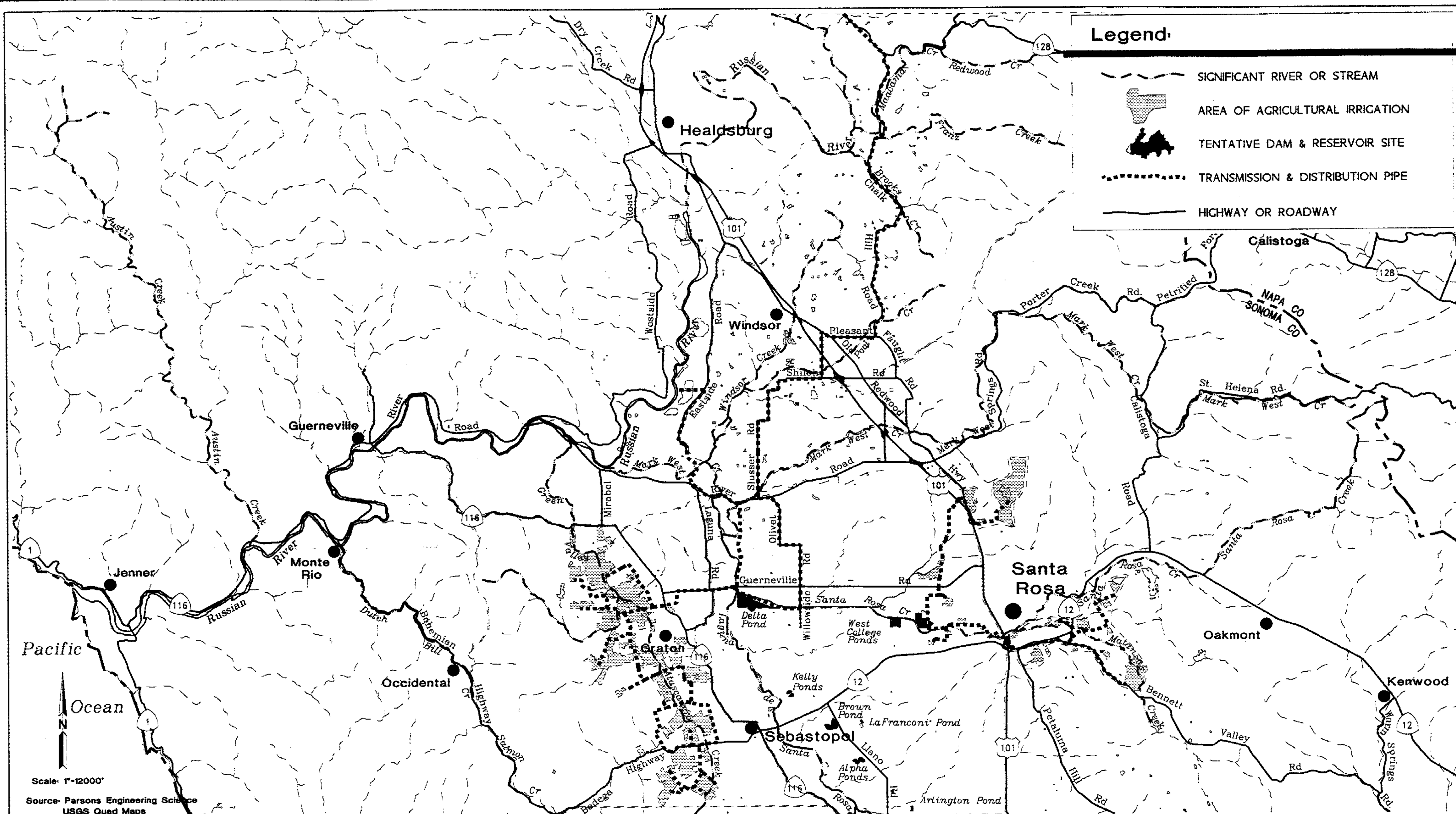

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WATERWAYS IN THE SANTA ROSA LONG-TERM PROJECT AREA

Figure 4.4-1b

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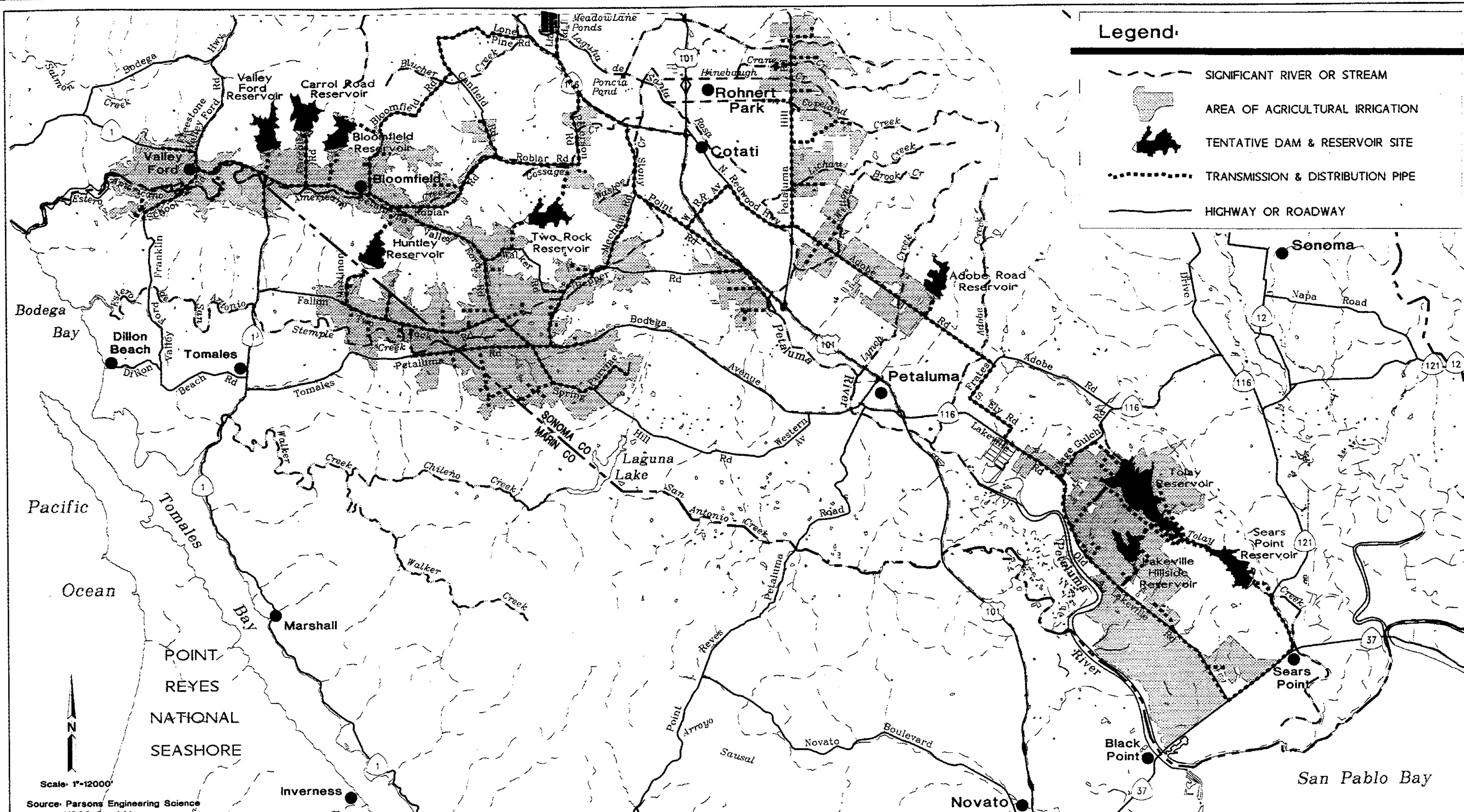

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Figure 4.4-1c

WATERWAYS IN THE SANTA ROSA LONG-TERM PROJECT AREA

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The Sonoma County Water Agency has prepared a streamflow model of the Russian River and used it to adjust the historically measured flows to account for water diverted from the river for municipal, agricultural, and other uses (Sonoma County Water Agency 1996). The model has been used to predict river flows for the present water diversion conditions and for future diversion conditions that may occur in the year 2010 if the water demand within the basin grows to projected levels.

The projected water demand for the year 2010 is based on estimates made by the California Department of Water Resources and Sonoma County Water Agency. Above Dry Creek the demand is based on Department of Water Resources estimates except that Sonoma County Water Agency estimates were used for the Russian River above Lake

Mendocino and for the Redwood Valley Water District. Demands below Dry Creek amount to 120,025 acre-feet per year corresponding to the future growth addressed in the general plans of communities within the Sonoma County Water Agency service area (Dames and Moore 1988a, Sonoma County Water Agency 1996).

Table 4.4-1

Average Monthly Flow in the Russian River near Guerneville, CA
USGS Gage No. 11467000

	USGS[1]					SCWA[2]	
Month	Average	Maximum		Minimum		Baseline Case	Projected 2010 Case
	(cfs)	(cfs)	Year	(cfs)	Year	(cfs)	(cfs)
Oct	321		1963	25	1978	277	223
Nov	1,249	9,425	1974	140	1940	1,179	1,085
Dec	4,147	17,413	1956	116	1977	3,529	3,457
Jan	6,413	25,208	1970	127	1977	5,174	5,016
Feb	6,557	26,022	1958	88	1977	6,172	6,046
Mar	4,502	23,293	1983	201	1977	4,073	3,986
Apr	2,340	11,701	1982	48	1977	2,485	2,397
May	695	2,798	1983	39	1977	839	729
June	283	681	1967	23	1977	348	247
July	174	348	1987	32	1977	196	148
Aug	166	308	1961	37	1977	183	137
Sept	182	345	1961	36	1977	170	138
Average Annual	2,236	5,898		89		2,052	1,967

Source: Merritt Smith Consulting 1996

Notes:
1. United States Geological Survey data for period of record 1939 - 1993, USGS Web Site and Dames and Moore (1988a)
2. Sonoma County Water Agency modeled the Russian River watershed to estimate monthly flows for present and future water diversion rates. "Baseline Case" represents river flow corresponding to present diversion rates and "Projected 2010" represents flows corresponding to estimated diversion rates in the year 2010. The values shown are the monthly adjusted flows for the period 1923-1992 based on water diversion projections dated March 28, 1995. (Sonoma County Water Agency 1996).

Table 4.4-2

Average Monthly Flow in the Russian River near Healdsburg, CA
USGS Gage No. 11464000

	USGS[1]					SCWA[2]	
Month	**Average** (cfs)	**Maximum** (cfs)	Year	**Minimum** (cfs)	Year	**Baseline Case** (cfs)	**Projected 2010 Case** (cfs)
Oct	281	1,605	1958	34	1978	249	218
Nov	818	5,293	1974	122	1992	830	772
Dec	2,482	8,945	1956	111	1991	2,312	2,275
Jan	3,875	13,667	1970	91	1977	3,250	3,225
Feb	3,860	14,647	1986	59	1977	3,679	3,680
Mar	2,736	11,811	1983	146	1977	2,389	2,394
Apr	1,480	6,592	1982	56	1977	1,545	1,528
May	537	1,638	1983	85	1977	587	567
June	260	669	1993	81	1977	271	251
July	186	300	1961	70	1947	187	183
Aug	186	331	1974	83	1947	178	176
Sept	192	360	1974	67	1977	155	153
Average Annual	1,390	3,277		101		1,303	1,285

Source: Merritt Smith Consulting 1996

Notes:
1. USGS data for period of record 1939 - 1993, USGS Web site and Dames and Moore (1988a)
2. Sonoma County Water Agency modeled the Russian River watershed to estimate monthly flows for present and future water diversion rates. "Baseline Case" represents river flow corresponding to present diversion rates and "Projected 2010" represents flows corresponding to estimated diversion rates in the year 2010. The values shown are the monthly adjusted flows for the period 1923-1992 based on water diversion projections dated March 28, 1995 (Sonoma County Water Agency 1996).

The analysis shows that flow in the River would average about 6 to 8 percent less than the historic flows if the present diversion conditions had been in effect throughout the period of record (1923 -1992). If the water diversions increase to the estimated levels for the year 2010, the average flow in the River is estimated to be about 8 to 12 percent less than the historic flow (see Tables 4.4-1 and 4.4-2).

The Russian River is the primary water supply for Sonoma County and parts of Marin County. It supplies an average of 70,000 acre-feet of water per year. The Sonoma County

Water Agency delivers 29,000 acre-feet per year to Santa Rosa, Rohnert Park, Cotati, and Forestville. An additional 25,000 acre-feet per year is exported to the cities of Novato, Petaluma, Sonoma, and to southern Marin County (State of California Department of Water Resources 1994).

Laguna de Santa Rosa

The Laguna de Santa Rosa is a significant hydrologic feature of the Lower Russian River basin, with a watershed of approximately 255 square miles. The Laguna is a wide, marshy area lying along the western edge of the Santa Rosa Plain that drains to the Russian River. The boundaries of the Laguna de Santa Rosa have lacked a clear definition in the past. The headwaters of the Laguna are located in the hills south and east of the City of Santa Rosa. The creek then enters the Santa Rosa Plain near Stony Point Road and meanders to the north. Immediately west and north of the City of Santa Rosa, the Laguna de Santa Rosa merges with Mark West Creek. Some have referred to the waterway as Mark West Creek from this point to the Russian River, and others have referred to the creek as the Laguna de Santa Rosa. For purposes of this report, the Laguna de Santa Rosa is defined as that area of the Santa Rosa Plain below elevation 75 feet, located between Stony Point Road to the south and the Russian River to the north.

During large storms the Laguna becomes a lake, temporarily storing water that would otherwise increase flood peaks farther down the Russian River. As the water level in the Russian River rises, water backs up into the Laguna, impeding downstream flow from the Laguna watershed itself. On average, a lake is formed every other year in the Laguna with a depth of 22 feet at the confluence with the Russian River. During the December 1964 -January 1965 storms, the Laguna became a lake with a surface area of 7,400 acres and a stored water volume of 80,000 acre-feet. The storage provided by the Laguna is estimated to have reduced downstream Russian River flow by approximately 40,000 cfs and the flood crest at Guerneville by 14 feet.

During the summer months, the Laguna becomes a slow-flowing stream confined within a narrow channel. Flow at this time is usually low. In dry years, the portion of the Laguna above the confluence with Santa Rosa Creek is reduced to isolated pools. Estimated and measured flows in the Laguna at Guerneville Road are shown in Table 4.4-3.

Currently, the Laguna Wastewater Treatment Plant releases reclaimed water directly into the Laguna de Santa Rosa during the winter months (1 October through 14 May), once the flow in the Russian River exceeds 1,000 cfs. These discharges are limited to one percent of the Russian River flow (with five percent allowed only by direct authorization by the North Coast Regional Board), but sometimes represent a much higher proportion of flow in the Laguna. During the summer months, a portion of the reclaimed water is used to irrigate pasture in the Laguna area.

Table 4.4-3

Estimated and Measured Flows in the Laguna de Santa Rosa System

Month	Estimated Average of Monthly Flow at Laguna de Santa Rosa at Guerneville Road[1] (cfs)	Measured Average Monthly Flow in Laguna de Santa Rosa at Trenton Healdsburg Rd[2] (cfs)	Measured Average Monthly Flow in Mark West Creek at Slusser Rd[2] (cfs)	Measured Average Monthly Flow in Santa Rosa Creek at Willowside Rd[2] (cfs)
Oct	20	78	4	30
Nov	117	62	15	57
Dec	352	307	46	157
Jan	645	917	211	559
Feb	657	821	84	212
Mar	368	357	15	169
Apr	173	125	5	77
May	32	69	2	81
June	11	23	0.5	49
July	4	6	1	16
Aug	4	5	1	18
Sept	5	4	1	15

Source: Merritt Smith Consulting 1996

Notes:
1. Dames & Moore 1988a
2. Calculated from data collected February 1991 through July 1992 and reported in Roth, et al (1991, 1992).

Americano Creek

Americano Creek is about 10 miles long and drains a 50-square-mile watershed. Watershed lands are either undeveloped or used by dairies. Americano Creek discharges to Estero Americano, a six-mile-long tidal channel extending to Bodega Bay. The Creek and Estero are shown in Figure 4.4-1.

Similar to many small coastal streams in central California, Americano Creek flows in the winter months and dries up, or is greatly reduced, in the summer. Flow was measured in Americano Creek between February 1991 and June 1992, which were very dry years. Estimated average monthly flows in Americano Creek are shown in Table 4.4-4. The estimates do not take into account any diversions of water for agricultural use and thus may be somewhat higher than actual flows.

Table 4.4-4

Estimated and Measured Average Monthly Flow in West County Streams

Month	Measured Average Monthly Flow in Americano Creek[1] (cfs)	Estimated Average Monthly Flow in Americano Creek at Gericke Road[2] (cfs)	Estimated Average Monthly Flow in Stemple Creek at Highway 1[2] (cfs)
Oct	0	0.4	1
Nov	0.01	50	69
Dec	1.04	62	90
Jan	1.89	99	162
Feb	14.3	96	133
Mar	20.9	53	102
Apr	2.27	12	23
May	0.46	3	6
June	0.13	1	2
July	0	0	1
Aug	0	0	0
Sept	0	0	0

Source: Merritt Smith Consulting, 1996

Notes:
1. Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives, Questa 1996.
2. Calculated from February 1991 through July 1992 data reported in Roth et al (1991, 1992)

The tidal channel of Estero Americano is narrow (about three feet at its upper portion) but broadens to 1,000 feet near the ocean. The mouth of the Estero is open to the ocean during extended periods of high flow in the winter months. In the spring, as flow declines, ocean waves form a sand barrier across the mouth of the Estero and the Estero becomes a brackish lagoon. This process is explained further in Section 4.6, Surface Water Quality. When the mouth of the Estero is open, tidal influences extend inland beyond the community of Valley Ford. At mean lower low water (MLLW) the Estero contains about 80 million gallons of water. At mean higher high water (MHHW) it contains about 240 million gallons (Smith and Smith 1990).

Stemple Creek

Stemple Creek and the Estero de San Antonio have a total length of 15.5 miles and drain an area of about 60 square miles. The watershed of Stemple Creek is somewhat larger than that of Americano Creek, but is otherwise quite similar. The Stemple Creek watershed and the Estero de San Antonio are shown in Figure 4.4-1.

The seasonal pattern of flow in Stemple Creek is similar to that in Americano Creek and other small coastal streams in California. Stemple Creek flows in the winter months and dries up or is greatly reduced in the summer. Estimated average monthly flows are shown in Table 4.4-4.

The mouth of the Estero de San Antonio is typically open to the ocean when the creek is flowing during the winter months, but is closed by a sandbar as the flow decreases in the spring. This results in the formation of a brackish lagoon upstream of the sandbar during the summer and fall months.

Tolay Creek

The Tolay Creek watershed is located just north of San Pablo Bay, and is oriented in a north-south direction. The size of the Tolay Creek watershed is approximately 6,980 acres. Tolay Creek consists of three distinct segments. The upper segment is channelized within the broad, flat valley where agriculture is the dominant land use. The middle segment of Tolay Creek is approximately 2.5 miles long and connects the Tolay Valley (elevation 150 feet above sea level) to the lower, tidal segment of Tolay Creek. Tolay Creek downstream of Highway 121 is tidal and meanders through fresh and brackish water wetlands prior to discharge to San Pablo Bay.

Petaluma River

The watershed area of the Petaluma River basin, upstream of the USGS gage at Denman Flat, is approximately 80 square miles. Tidal influence from San Pablo Bay extends upstream of the City of Petaluma toward Denman Flat. The average annual runoff from the Petaluma River at the USGS gage was 17 cfs for the period 1948 to 1963, with a range of 2 to 45 cfs. Typically, about 95 percent of the runoff occurs during the months of November through April, while little or no flow occurs during May through October. Table 4.4-6 shows the monthly variation in flow. During the six wet months, the average monthly flow is about 34 cfs.

The City of Petaluma presently discharges reclaimed water to the tidal portion of the Petaluma River during the months December through April only, at a rate of about 5 million gallons per day (MGD) or 7.7 cfs. This discharge amounts to about 20 percent of the average monthly runoff during the December through April period.

Table 4.4-5

Estimated Average Monthly Flow in Tolay Creek

Month	**Tolay Creek** (cfs)
Oct	0
Nov	14
Dec	23
Jan	37
Feb	25
Mar	12
Apr	5
May	1
June	0
July	0
Aug	0
Sept	0

Source: *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives*, Questa Engineering Corporation 1996.

Table 4.4-6

Average Monthly Flow in the Petaluma River at Petaluma, CA
USGS Gage No. 11459000

Month	**Average**	**Maximum**		**Minimum**	
	(cfs)	(cfs)	Year	(cfs)	Year
Oct	1	12	1963	0	1962
Nov	2	31	1951	0	1962
Dec	38	220	1956	0	1960
Jan	59	212	1956	0.5	1957
Feb	64	271	1958	3	1953
Mar	28	81	1958	2	1959
Apr	14	112	1958	0	1959

Table 4.4-6

Average Monthly Flow in the Petaluma River at Petaluma, CA
USGS Gage No. 11459000

Month	Average	Maximum		Minimum	
	(cfs)	(cfs)	Year	(cfs)	Year
May	0.5	1	1956	0	1961
June	0	0	1953	0	1962
July	0	0	1963	0	1963
Aug	0	0	1955	0	1963
Sept	0	0	1955	0	1963
Average Annual	17	45[1]		2[1]	

Source: USGS data for period of record 1939 - 1993

Notes:
1. Maximum and minimum values are calculated for the period 1939-1993, not from the particular monthly values shown above

San Pablo Bay

The Petaluma River discharges to San Pablo Bay, which is part of the San Francisco Bay Delta system. Water movements in San Pablo Bay result primarily from tidal currents as ocean waters enter and leave the Golden Gate. They remain fairly constant through the year, although they are influenced by freshwater flood flows and winds. Currents are strongest in the deepwater channel that runs through the center of the Bay. Water movement is also influenced by freshwater inflow to the San Francisco Bay Delta system. About 40 percent of the land area in California drains into the Bay.

Between 1853 and 1884, hydraulic mining of gold in the Sierra Nevada washed tens of millions of tons of sand and mud into San Francisco Bay, reducing the extent of open water and creating new mud banks. Later, much of the tidal marsh surrounding San Francisco Bay was filled for urban and agricultural use. In this century, as industry expanded and urban sewage systems were built, increasing quantities of wastewater were discharged to San Francisco Bay. Freshwater inflow to the San Francisco Bay Delta system diminished as large quantities of water were diverted and exported to the San Joaquin Valley and Southern California for urban and agricultural use.

Surface Water Hydrology Goals, Objectives, and Policies

Table 4.4-7 identifies goals, objectives, and policies which provide guidance for development in relation to surface hydrology. The table also indicates which criteria in the Surface Water Hydrology Section are responsive to each set of policies.

Table 4.4-7

General Plan Goals, Objectives, and Policies - Surface Water Hydrology

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Sonoma County General Plan	Public Safety Element	Goal PS-2.1 Objective PS-2.2 Policy PS-2f Policy PS-2j	Prevent unnecessary exposure of people and property to risks of damage or injury from flooding and regulate new development to reduce risks to acceptable levels	3,4,5
Marin Countywide Plan	Environmental Hazards Element	Policy EH-8.6 Policy EH-8.7	Ensure that capacity is maintained in stream channels to handle flood runoff, control filling and development which may increase flood damage, and prevent construction of flood barriers which will divert flood waters or increase flood hazards	5
Santa Rosa General Plan	Safety Element	Goal S-4	Identify and mitigate potential flooding hazards, to protect all uses from floods of a 100 year recurrence	3
Petaluma General Plan	Community Health and Safety Element	Objective (d) Objective (e)	Protect the community from risk of flood damage and preclude new developments from impacting the potential for flooding in developed areas	5
Sebastopol General Plan	Safety Element	Goal 3	Reduce Flood Hazards	3

Source: Harland Bartholomew and Associates, Inc. 1995

Notes:
1. Evaluation criteria are described in Table 4.4-8

EVALUATION CRITERIA WITH POINT OF SIGNIFICANCE

Table 4.4-8

Evaluation Criteria with Point of Significance - Surface Water Hydrology

Evaluation Criteria	As Measured by	Point of Significance	Justification
1. Will the Project discharge reclaimed water to the Laguna de Santa Rosa causing streambank erosion in the Laguna de Santa Rosa?	Percentage increases in the average stream power of the Laguna de Santa Rosa when the average channel velocity exceeds 3 feet per second (fps) in the Laguna.	Greater than 2 percent increase	Based on the typical particle size distribution for the Laguna, erosion of the material in the stream channel should only occur when the average channel velocity is greater than 3 fps.[1]
2. Will the Project discharge reclaimed water to the Laguna de Santa Rosa or the Russian River causing streambank erosion in the Russian River?	Percentage increases in the average stream power when the average channel velocity exceeds 4 fps in the Russian River.	Greater than 2 percent increase	Based on the typical particle size distribution for the Russian River, erosion of the material in the stream channel should only occur when the average channel velocity is greater than 4 fps.[1]
3. Will the Project discharge reclaimed water to the Laguna de Santa Rosa causing flooding anywhere along the Laguna de Santa Rosa?	Increase in the 100-year flood elevation mapped in the Flood Insurance Study.	Greater than 0.1 foot increase	Federal Emergency Management Agency (FEMA) uses 1 foot as a guideline for significance. Sonoma County Water Agency generally does not consider increases of less than 0.1 feet significant during project review.[2]
4. Will the Project discharge reclaimed water causing an increase in the maximum flood elevation in the Russian River?	Increase in the water surface elevation in the Russian River at the USGS Guerneville gage when the river is above flood stage. The USGS defines flood stage as 32.00 feet at the Guerneville Gage (elevation 52.01 feet NGVD), which corresponds to 39,530 cfs.	Greater than 0.1 foot increase	Federal Emergency Management Agency uses 1 foot as a guideline for significance. Sonoma County Water Agency generally does not consider increases of less than 0.1 feet significant during project review.[2]
5. Will non-discharge Project components cause flooding?	Increase in the peak water surface elevation.	Greater than 0.1 foot increase	Federal Emergency Management Agency uses 1 foot as a guideline for significance. Sonoma County Water Agency generally does not consider increases of less than 0.1 feet significant during project review.[2]

Table 4.4-8

Evaluation Criteria with Point of Significance - Surface Water Hydrology

Evaluation Criteria	As Measured by	Point of Significance	Justification
6. Will non-discharge Project components cause streambank erosion?	Increases in the average power in the stream.	Greater than 2 percent increase	A 2 percent power increase is considered minimal and insignificant. Any resulting erosion increase will be small relative to natural erosion rate variations.[1]
7. Will the Project cause flooding due to rupture of pipelines?	Bankful capacity of local waterway.	If release of water exceeds bankful capacity of local waterway	If the capacity of the local water is insufficient to contain the flow from the rupture, then flooding would result and this would be considered significant.

Source: Merritt Smith Consulting 1996

Notes:
1. *Potential Streambank Erosion Laguna de Santa Rosa and Russian River*, Dames & Moore, December 1995.
2. *Potential Flood Impacts, Laguna de Santa Rosa Floodplain and Russian River Floodplain*, Dames & Moore, December 1995.

METHODOLOGY

The evaluation of streambank erosion is based on water velocity and power, as indicated in Surface Hydrology evaluation criteria 1, 2, and 6. Power is the product of the weight of water (pounds per gallon), velocity (feet per second), water depth (feet), and stream slope (feet/foot). The calculation of velocity and power is described in *Potential Streambank Erosion Laguna de Santa Rosa and Russian River* (Dames & Moore 1996b). Velocity, water depth, and stream slope estimates used in Dames & Moore (1996b) were developed using the hydraulic and water quality model described in the *Russian River Water Quality Model* (Resource Management Associates 1996).

Flood impact analysis was conducted as described in *Potential Flood Impacts, Laguna de Santa Rosa and Russian River Floodplain* (Dames and Moore 1996b). Impacts were evaluated by estimating the maximum amount of reclaimed discharge that could occur instantaneously and over several days. The effect of such discharges on water surface elevation at key locations in the Laguna and River system under flood conditions that are specified in the evaluation criteria was evaluated using a stage curve that is unique for each location (Dames and Moore 1996b). The impact of storage reservoirs and related hydraulic control facilities on flooding was analyzed as described in the *Reservoir Spillway Hydrology Analysis* (Dames and Moore 1995a) and the *Reservoir Inflow Analysis* (Dames and Moore 1996c).

No Action Alternative

Table 4.4-9

Hydrology Impacts by Component -- No Action Alternative

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
4.1.1. Will the No Action Alternative discharge reclaimed water to the Laguna de Santa Rosa causing streambank erosion in the Laguna de Santa Rosa?	Greater than 2 percent increase of the average stream power of the Laguna when the average channel velocity exceeds 3 fps in the Laguna	Less than 2 percent	O&M	❍
4.1.2. Will the No Action Alternative discharge reclaimed water to the Laguna de Santa Rosa or the Russian River causing streambank erosion in the Russian River?	Greater than 2 percent increase of the average stream power when the average channel velocity exceeds 4 fps in the Russian River	Less than 2 percent	O&M	❍
4.1.3. Will the No Action Alternative discharge reclaimed water to the Laguna de Santa Rosa causing flooding anywhere along the Laguna de Santa Rosa?	Greater than 0.1-foot increase of the 100-year flood elevation	None	O&M	==
4.1.4. Will the No Action Alternative discharge reclaimed water causing an increase in the maximum flood elevation in the Russian River?	Greater than 0.1-foot increase of the water surface elevation in the Russian River at the USGS Guerneville gage during flood stage	None	O&M	==
4.1.5. Will non-discharge components of the No Action Alternative cause flooding in streams?	Greater than 0.1-foot increase of the peak water surface elevation.	--	O&M	--
4.1.6. Will non-discharge components of the No Action Alternative cause streambank erosion?	Greater than 2 percent increase of the average power in the stream	--	O&M	--
4.1.7. Will the No Action Alternative cause flooding due to rupture of pipelines?	If release of water exceeds the capacity of local waterway during normal flow conditions	--	O&M	--

Source: Merritt Smith Consulting, 1996

Notes	1. Type of Impact:		2. Level of Significance:
O&M	Operation and Maintenance	==	No impact
--	Not Applicable	❍	Less than significant impact; no mitigation proposed

Impact: 4.1.1-2. Will the No Action Alternative impact streambank erosion based on evaluation criteria 1 and 2?

Analysis: *Less than Significant; Alternative 1.*

Streambank erosion may increase slightly as a result of the increased flow that is caused by the No Action discharge relative to existing condition. Based on the evaluation in Dames and Moore (1996b), this impact is considered to be less than significant.

Mitigation: No mitigation is proposed.

Impact: 4.1.3-4. Will the No Action Alternative impact flooding based on evaluation criteria 3 and 4?

Analysis: *No Impact; Alternative 1.*

There is no potential for flooding impacts of the No Action Alternative due to increased discharge. Though annual discharge volume will increase, discharge to the Laguna during flood conditions will be limited to much less than 1 percent of River flow due to the hydraulic restriction inherent in the existing pump and pipe system. Therefore, potential discharge volumes at any specific time will not change from existing conditions and there will be no impact on flooding.

Mitigation: No mitigation is needed.

Impact: 4.1.5-7. The No Action Alternative is not applicable to evaluation criteria 5 through 7.

Headworks Expansion Component

Impact: 4.2.1-7. Will the headworks expansion component impact surface water hydrology based on evaluation criteria 1 through 7.

Analysis: *No Impact; All Alternatives.*

The headworks expansion component will not affect surface hydrology because the new pumps are located inside an existing building.

Alternative 1 does not have a headworks expansion component.

Mitigation: No mitigation is needed.

Urban Irrigation Component

Impact: **4.3. 1-4, 7. The urban irrigation component is not applicable to evaluation criteria 1, 2, 3, 4 and 7.**

Impact: **4.3.5 and 6. Will the urban irrigation component impact surface water hydrology based on evaluation criteria 5 and 6?**

Analysis: *No Impact; All Alternatives.*

Urban irrigation will not affect surface hydrology because the urban irrigation lands are already being irrigated and no change in irrigation practice will result from the Project.

Alternatives 1, 4 and 5 do not have an urban irrigation component.

Mitigation: No mitigation is needed.

Pipeline Component

Table 4.4-10

Hydrology Impacts by Component -- Pipelines

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
4.4.1. Will the pipeline component discharge reclaimed water to the Laguna de Santa Rosa causing streambank erosion in the Laguna de Santa Rosa?	Greater than 2 percent increase of the average stream power of the Laguna when the average channel velocity exceeds 3 fps in the Laguna	--	O&M	--
4.4.2. Will the pipeline component discharge reclaimed water to the Laguna de Santa Rosa or the Russian River causing streambank erosion in the Russian River?	Greater than 2 percent increase of the average stream power when the average channel velocity exceeds 4 fps in the Russian River	--	O&M	--
4.4.3. Will the pipeline component discharge reclaimed water to the Laguna de Santa Rosa causing flooding anywhere along the Laguna de Santa Rosa?	Greater than 0.1-foot increase of the 100-year flood elevation	--	O&M	--

Table 4.4-10

Hydrology Impacts by Component -- Pipelines

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
4.4.4. Will the pipeline component discharge reclaimed water causing an increase in the maximum flood elevation in the Russian River?	Greater than 0.1-foot increase of the water surface elevation in the Russian River at the USGS Guerneville gage during flood stage	--	O&M	--
4.4.5. Will the pipeline component cause flooding?	Greater than 0.1-foot increase of the peak water surface elevation.	None	O&M	==
4.4.6. Will the pipeline component cause streambank erosion?	Greater than 2 percent increase of the average power in the stream	None	O&M	==
4.4.7. Will the pipeline component cause flooding due to rupture of pipelines?	If release of water exceeds the capacity of local waterway during normal flow conditions	Less than stream capacity	O&M	❍

Source: Merritt Smith Consulting 1996

Notes:

1. Type of Impact:
   - O&M Operation and Maintenance
   - -- Not Applicable

2. Level of Significance:
   - == No impact
   - ❍ Less than significant impact; no mitigation proposed

Impact: 4.4.1-4. The pipeline component is not applicable to evaluation criterion 1, 2, 3, and 4.

Impact: 4.4.5-6. Will the pipeline component impact surface water hydrology based on evaluation criteria 5 and 6?

Analysis: *No Impact; All Alternatives.*

Neither construction nor operation of the pipelines will contribute any water to an existing waterway, and therefore no flooding or streambank erosion impacts will result.

Alternatives 1 and 5B do not have a pipeline component.

Mitigation: No mitigation is needed.

Impact: 4.4.7. Will the pipeline component cause flooding due to rupture?

Analysis: *Less than Significant; Alternative 2, 3 4, and 5A.*

An earthquake on the Maacama fault could cause rupture of the geysers pipeline, sending reclaimed water into Sausal Creek. Analysis of the impacts of pipeline ruptures indicates that the average rate of reclaimed water flow from a completely severed geysers pipeline would be approximately 31 cfs for approximately 2 hours. The hydraulic capacity of Sausal Creek at the location of the potential rupture is approximately 1,200 cfs. Unless the earthquake-induced rupture is coincident with a very large storm event, the reclaimed water flow due to a rupture will be contained by Sausal Creek. Thus, this impact is considered to be less than significant.

An earthquake on the Healdsburg-Rodgers Creek fault could cause rupture of the pipelines serving the Bennett Valley and/or Fountaingrove urban irrigation areas. Analysis of the impacts of a pipeline rupture indicates that the average rate of reclaimed water flow from a completely severed urban irrigation pipeline near the intersection of Bennett Valley Road and Farmers Lane would be approximately 4 cfs for about 30 minutes. The flow from a rupture of the Fountaingrove pipeline will be less than 4 cfs because the pipe diameter is less than that of the Bennett Valley pipe. Four cfs flow is approximately equal to the capacity of 1 large or 2 small drop inlets that are designed to convey stormwater runoff from the street and gutter. Thus, this impact is considered to be less than significant.

No Impact; Alternatives 1 and 5B.

These Alternatives do not have a pipeline component.

Mitigation: No mitigation is proposed.

Storage Reservoir Component

Table 4.4-11

Hydrology Impacts by Component -- Storage Reservoirs

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
4.5.1. Will the storage reservoir component discharge reclaimed water to the Laguna de Santa Rosa causing streambank erosion in the Laguna de Santa Rosa?	Greater than 2 percent increase of the average stream power of the Laguna when the average channel velocity exceeds 3 fps in the Laguna	--	O&M	--
4.5.2. Will the storage reservoir component discharge reclaimed water to the Laguna de Santa Rosa or the Russian River causing streambank erosion in the Russian River?	Greater than 2 percent increase of the average stream power when the average channel velocity exceeds 4 fps in the Russian River	--	O&M	--

Table 4.4-11

Hydrology Impacts by Component -- Storage Reservoirs

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
4.5.3. Will the storage reservoir component discharge reclaimed water to the Laguna de Santa Rosa causing flooding anywhere along the Laguna de Santa Rosa?	Greater than 0.1-foot increase of the 100-year flood elevation	--	O&M	--
4.5.4. Will the storage reservoir component discharge reclaimed water causing an increase in the maximum flood elevation in the Russian River?	Greater than 0.1-foot increase of the water surface elevation in the Russian River at the USGS Guerneville gage during flood stage	--	O&M	--
4.5.5. Will storage reservoir component cause flooding?	Greater than 0.1-foot increase of the peak water surface elevation downstream of the reservoir	Reduced peak flood elevation	O&M	❍
4.5.6. Will storage reservoir component cause streambank erosion?	Greater than 2 percent increase of the average power in the stream	No measurable change	O&M	❍
4.5.7. Will storage reservoir component cause flooding due to rupture of pipelines?	If release of water exceeds the capacity of local waterway during normal flow conditions	--	O&M	--

Source: Merritt Smith Consulting 1996

Notes: 1. Type of Impact:
O&M Operation and Maintenance
-- Not Applicable

2. Level of Significance:
== No impact
❍ Less than significant impact; no mitigation proposed

Impact: 4.5.1-4, and 7. The storage reservoir component is not applicable to evaluation criteria 1, 2, 3, 4, and 7.

Impact: 4.5.5. Will the storage reservoir component cause flooding in streams?

Analysis: *Less than Significant; Alternatives 2 and 3.*

Storage reservoirs will capture and retain rainfall runoff until the reservoir fills and then spills via the spillway. Some of the reservoirs (Tolay, Sears Point, Adobe Road) have been designed with a facility to intercept some of the runoff and divert it around the reservoir. Even reservoirs with diversion structures will always retain some surface water runoff and will reduce the peak water elevation at all downstream locations. Thus, the impact of reservoirs on flooding will always be to reduce potential downstream flows, even if the reservoir fills and spills. Reservoirs can be considered beneficial with respect to downstream flooding. Reservoirs will intercept runoff and reduce the peak water surface elevation at all downstream locations.

No Impact; Alternatives 1, 4 and 5.

These alternatives do not have a storage reservoir component.

Mitigation: No mitigation is proposed.

Impact: 4.5.6. Will the storage reservoir component cause streambank erosion?

Analysis: *Less than Significant; Alternatives 2 and 3.*

The discharge of water from the diversion structures or spillways to the creek channel downstream of the storage reservoirs will increase the velocity and power of the water, and thus the potential to cause erosion. However, the spillways and diversion structures are designed to include riprap and other energy dissipation facilities so that the velocity of water will be approximately that which will normally occur in the channel in the absence of the reservoir. Thus, the effect of discharge from diversion structures and spillways will be approximately the same as existing conditions, and therefore the impact is considered less than significant.

Another source of downstream flows is seepage of reclaimed water through the floor of the reservoir. Seepage from any of the storage reservoirs has been estimated to be a maximum of 0.08 cfs (Merritt Smith Consulting 1996c), and this is not hydrologically significant according to the surface hydrology evaluation criteria. Energy and power dissipation to the level that will otherwise be present in the channel was a design criterion. Therefore, this impact is considered to be less than significant.

No Impact; Alternatives 1, 4 and 5.

These alternatives do not have a storage reservoir component.

Mitigation: No mitigation is proposed.

Pump Station Component

Impact: 4.6.1-7. Will the pump station component impact surface water hydrology based on evaluation criteria 1 through 7?

Analysis: *No Impact; All Alternatives.*

Pump stations will not affect surface hydrology because pumps are not located near streams nor in areas prone to flooding.

Alternatives 1 and 5 do not have a pump station component.

Mitigation: No mitigation is needed.

Agricultural Irrigation Component

Table 4.4-12

Hydrology Impacts by Component -- Agricultural Irrigation

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
4.7.1. Will the agricultural irrigation component discharge reclaimed water to the Laguna de Santa Rosa causing streambank erosion in the Laguna de Santa Rosa?	Greater than 2 percent increase of the average stream power of the Laguna when the average channel velocity exceeds 3 fps in the Laguna	--	O&M	--
4.7.2. Will the agricultural irrigation component discharge reclaimed water to the Laguna de Santa Rosa or the Russian River causing streambank erosion in the Russian River?	Greater than 2 percent increase of the average stream power when the average channel velocity exceeds 4 fps in the Russian River	--	O&M	--
4.7.3. Will the agricultural irrigation component discharge reclaimed water to the Laguna de Santa Rosa causing flooding anywhere along the Laguna de Santa Rosa?	Greater than 0.1-foot increase of the 100-year flood elevation	--	O&M	--
4.7.4. Will the agricultural irrigation component discharge reclaimed water causing an increase in the maximum flood elevation in the Russian River?	Greater than 0.1-foot increase of the water surface elevation in the Russian River at the USGS Guerneville gage during flood stage	--	O&M	--
4.7.5. Will the agricultural irrigation component cause flooding?	Greater than 0.1-foot increase of the peak water surface elevation.	Less than 0.1 feet increase	O&M O&M-CP	❍ ❍
4.7.6. Will the agricultural irrigation component cause streambank erosion?	Greater than 2 percent increase of the average power in the stream	Less than 2 percent increase	O&M O&M-CP	❍ ❍

Table 4.4-12

Hydrology Impacts by Component -- Agricultural Irrigation

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
4.7.7. Will the agricultural irrigation component cause flooding due to rupture of pipelines?	If release of water exceeds the capacity of local waterway during normal flow conditions	--	O&M	--

Source: Merritt Smith Consulting 1996

Notes: 1. Type of Impact:

- O&M Operation and Maintenance
- O&M-CP Operation and Maintenance Contingency Plan
- -- Not Applicable

2. Level of Significance:

- == No impact
- ❍ Less than significant impact; no mitigation proposed

Impact: 4.7.1, 2, 3, 4 and 7. The agricultural irrigation component is not applicable to evaluation criteria 1, 2, 3, 4 and 7.

Impact: 4.7.5 and 6. Will the agricultural irrigation component impact surface water hydrology based on evaluation criteria 5 and 6?

Analysis: *Less than Significant; Alternatives 2 and 3*

The greatest incremental effect of agricultural irrigation on surface flow has been determined to be up to 1 cfs (Merritt Smith Consulting 1996b), and this would occur during summer. The total estimated flow (background plus irrigation-related inflow) in any of the streams that could be affected by irrigation (Tolay, Americano and Stemple) is less than 2 cfs in summer when irrigation would potentially affect flow. Over this range of flow (0 to 2 cfs), streambank erosion and flooding are not considered problematic, since these stream channels experience flows in excess of 100 cfs during winter. Thus, incremental flow is not expected to significantly affect water surface elevation or power (erosion) according to the surface water hydrology evaluation criteria 5 and 6.

Contingency-related irrigation impacts vary from no increase in surface flow to as much as a 2.5 cfs increase (Merritt Smith Consulting 1996b). The maximum incremental flow impact will occur during a dry winter in Stemple Creek. Since the incremental flow will occur only during dry years when flooding is not considered problematic, the impact of contingency irrigation on incremental flow is not expected to significantly affect water surface elevation or power (erosion) and is not considered significant using the evaluation criteria in Table 4.4-7. The irrigation-related flow increment (2.5 cfs or less), which would occur only in a dry year, is small compared to the difference in average winter flow between wet and dry years (50 cfs or more).

If accidental agricultural runoff should occur, the maximum flow will be 0.1 cfs (34,000 gallons discharged over 12 hours) and therefore streambank erosion or flooding impacts will be less than significant.

No Impact; Alternatives 1, 4 and 5.

These alternatives do not have an agricultural irrigation component.

Mitigation: No mitigation is proposed.

Geysers Steamfield Component

Impact: 4.8.1-7. Will the geysers steamfield component impact surface water hydrology based on evaluation criteria 1 through 7?

Analysis: *No Impact; All Alternatives.*

The geysers steamfield component of Alternative 4 will not affect surface hydrology because injected water does not discharge to surface water and no change to existing diversions of surface water will result from the Project.

Alternatives 1, 2, 3, and 5 do not have a geysers steamfield component.

Mitigation: No mitigation is needed.

Discharge Component

Table 4.4-13

Hydrology Impacts by Component - Discharge

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
4.9.1. Will the discharge component discharge reclaimed water to the Laguna de Santa Rosa causing streambank erosion in the Laguna de Santa Rosa?	Greater than 2 percent increase of the average stream power of the Laguna when the average channel velocity exceeds 3 fps in the Laguna	Less than 2 percent increase	O&M O&M-CP	❍ ❍

Table 4.4-13

Hydrology Impacts by Component - Discharge

Evaluation Criteria	As Measured by	Impact	Type of Impact[1]	Level of Significance[2]
4.9.2. Will the discharge component discharge reclaimed water to the Laguna de Santa Rosa or the Russian River causing streambank erosion in the Russian River?	Greater than 2 percent increase of the average stream power when the average channel velocity exceeds 4 fps in the Russian River	Less than 2 percent increase	O&M O&M-CP	❍ ❍
4.9.3. Will the discharge component discharge reclaimed water to the Laguna de Santa Rosa causing flooding anywhere along the Laguna de Santa Rosa?	Greater than 0.1-foot increase of the 100-year flood elevation	No change from existing	O&M O&M-CP	== ==
4.9.4. Will the discharge component discharge reclaimed water causing an increase in the maximum flood elevation in the Russian River?	Greater than 0.1-foot increase of the water surface elevation in the Russian River at the USGS Guerneville gage during flood stage	0.015 foot increase	O&M O&M-CP	❍ ❍
4.9.5. Will non-discharge components cause flooding?	Greater than 0.1-foot increase of the peak water surface elevation	--	O&M	--
4.9.6. Will non-discharge component cause streambank erosion?	Greater than 2 percent increase of the average power in the stream	--	O&M	--
4.9.7. Will the discharge component cause flooding due to rupture of pipelines?	If release of water exceeds the capacity of local waterway during normal flow conditions	--	O&M	--

Source: Merritt Smith Consulting, 1996

Notes: 1. Type of Impact:

- O&M Operation and Maintenance
- O&M-CP Operation and Maintenance Contingency Plan
- -- Not Applicable

2. Level of Significance:

- == No impact
- ❍ Less than significant impact; no mitigation proposed

Impact: **4.9.1. Will the discharge component discharge reclaimed water to the Laguna de Santa Rosa causing streambank erosion in the Laguna de Santa Rosa?**

Analysis: *Less than Significant; Alternatives 1 and 5B.*

When the Laguna is flowing at more than 3 feet per second, stream power will increase by less than two percent due to discharge of reclaimed water at the Laguna (Dames and Moore 1995b). Contingency discharges will not cause significant streambank erosion because they will occur only when flows are very low and velocity is less than 3 feet per second in the Laguna and Russian River.

No Impact; Alternatives 2, 3, 4, and 5A.

These alternatives involve less discharge, and therefore less erosion potential than existing conditions.

Mitigation: No mitigation is proposed.

Impact: 4.9.2. Will the discharge component discharge reclaimed water to the Laguna de Santa Rosa or the Russian River causing streambank erosion in the Russian River?

Analysis: *Less than Significant; Alternatives 1 and 5.*

When the Russian River is flowing at more than 4 feet per second, stream power will increase by less than two percent due to discharge of reclaimed water at either the Russian River or the Laguna (Dames and Moore 1995b). Design criteria of the Russian River outfall (Alternative 5A) include energy dissipation such that localized erosion is considered less than significant. Contingency discharges will not cause significant streambank erosion because they will occur only when flows are very low and the velocity is less than 4 feet per second in the Laguna and Russian River.

No Impact; Alternatives 2, 3 and 4.

Alternatives 2, 3 and 4 involve less discharge, and therefore less erosion potential than existing conditions.

Mitigation: No mitigation is proposed.

Impact: 4.9.3. Will the discharge component discharge reclaimed water to the Laguna de Santa Rosa causing flooding anywhere along the Laguna de Santa Rosa?

Analysis: *No Impact; All Alternatives.*

Discharge proposed to the Laguna occurs at Meadowlane Pond and Delta Pond. The factor limiting the quantity of reclaimed water that can be discharged during flood events is not the 1 or 20 percent design discharge rates that are associated with Project alternatives. Rather, the hydraulic restrictions inherent in the reclaimed water pumps and pipes limit discharge rates to much less than 1 percent when high water conditions occur in the Laguna. Thus the potential discharge volume during flood or near-flood condition (and therefore the potential impact on flooding) under all the existing condition and under alternatives is identical. Therefore, the discharge associated with all alternatives is considered to have no impact. The impact of the existing condition and the potential impact of these alternatives is described in the following paragraph.

Discharge from Delta Pond during a flood event is not possible because the water surface elevation in the Laguna is higher than that in Delta Pond and discharge from Delta Pond occurs by gravity (discharge is not pumped). The operating level of Meadowlane Pond is 94 feet above sea level, which is higher than the 100-year flood elevation at that location. Thus, gravity discharge from Meadowlane Pond is possible during flood conditions, and the maximum discharge rate from Meadowlane Pond is approximately 62 mgd or 95 cfs, 49 cfs by gravity and 46 cfs by pump. This represents the discharge capacity under existing conditions and under Alternatives 1, 2, 3, 4, and 5B. A discharge of 95 cfs from Meadowlane during the 100-year flood event would raise the water surface elevation by a maximum of 0.015 feet at any place in the Laguna. The effect of a 95 cfs discharge from Meadowlane during a prolonged (2-day) flood event is less than 0.1-foot increase in the Laguna. This analysis is summarized in Potential Flood Impacts, Laguna de Santa Rosa Floodplain and Russian River Floodplain (Dames and Moore 1996b).

Contingency discharges will not cause significant flooding because they would occur only when flows are low in the Laguna.

Mitigation: No mitigation is proposed.

Impact: 4.9.4. Will discharge component discharge reclaimed water causing an increase in the maximum flood elevation in the Russian River?

Analysis: *Less than Significant; Alternative 5A.*

Alternative 5A could involve the addition of discharge capacity under flood or near-flood conditions. The Russian River outfall will have a capacity of 775 MG/month or 40 cfs in addition to the existing discharge capacity of 95 cfs. During flood stage (32 feet local datum, 39,530 cfs) a 40 cfs discharge will raise the water surface elevation at the USGS Hacienda Gage by 0.015 feet. Since the point of significance is 0.1 feet, this impact is considered less than significant. This analysis is summarized in *Potential Flood Impacts, Laguna de Santa Rosa Floodplain and Russian River Floodplain* (Dames and Moore 1996b).

No Impact; Alternatives 1, 2, 3, 4, and 5B.

As described above for impact 4.9.3, all Laguna discharge components will have the same impact on flooding in the Russian River as does discharge under the existing condition. Thus, all Laguna discharge components are considered to have no impact on Russian River flooding.

The impact of existing discharges and the impact under all Laguna discharge scenarios is described in the following paragraph.

The effect of 95 cfs on water surface elevation at the Hacienda gage at flood stage (32 feet local datum, 39,530 cfs.) will be an increase of 0.038 feet to 32.038 feet (Dames and Moore 1996b), which is less than the 0.1 foot significance criterion.

Contingency discharges will not cause significant flooding because they would occur only when flows are low in the Russian River.

Mitigation: No mitigation is proposed.

Impact: 4.9.5-7. The discharge component is not applicable to evaluation criteria 5, 6 and 7.

CUMULATIVE IMPACTS

Impact: 4.1 and 2C. Will the Project plus cumulative projects cause streambank erosion in the Laguna de Santa Rosa or the Russian River?

Analysis: None of the Project alternatives will have a significant impact on streambank erosion. The 20 percent discharge alternatives (Alternative 5A and 5B) contribute a minor, less than significant, impact to streambank erosion in the Laguna and Russian River, whereas some alternatives involve reduced discharge relative to existing conditions (Alternatives 2, 3 and 4). The No Action (Alternative 1) discharge involves increase discharge relative to existing conditions but less discharge than Alternative 5. A streambank erosion impact results when increased reclaimed water discharge increases the velocity of the waters in the Laguna or Russian River.

Several gravel extraction projects have been identified upstream on the Russian River, and gravel extraction has been identified by the Sonoma County Aggregates Management Plan as causing long-term alteration of the bed of the Russian River. Streambank impacts from gravel extraction occur, however, not from increasing the velocity of water, because in general they serve to flatten out the riverbed or reduce the elevation differential between upstream and downstream portions of the river. Therefore, according to the evaluation criteria for streambank erosion, gravel projects do not contribute to the cumulative impacts of the Long-Term Project, because they do not increase the velocity of the river flow.

Other potential cumulative projects are the expansion of other sewage treatment plants which discharge into the Laguna or Russian River. The expansion plans of these plants contribute very small amounts compared to the Long-Term Project and therefore affect the velocity of water flow very little. The contribution of the other sewage treatment plants would not cause the total increase in velocity to exceed 1 percent of flow in the Laguna or Russian River, the point of significance.

Impact: **4.4C. Will the Project plus cumulative projects cause flooding in the Russian River.**

Analysis: The Russian River discharge alternative will increase flood elevation in the Russian River by a maximum of 0.015 feet. The incremental flow from other sewage treatment plants is estimated in Table 4.6-50 to be no greater than 11.8 cfs. Actual discharge will be less than 11.8 cfs because some of the flow identified in Table 4.6-50 as incremental flow will be irrigated instead of discharged (e.g. Town of Windsor). According to the *Potential Flood Impacts Laguna de Santa Rosa Floodplain and Russian River Floodplain* technical report (Dames and Moore 1996b), 11.8 cfs incremental flow at flood stage will increase water depth approximately 0.003 feet. Thus, the total increased elevation (0.018 feet) will not exceed 0.1 feet, the point of significance.

Appendix D-31 identifies population growth and property development in communities in the Russian River watershed. Population growth and property development will result in increased amount of impermeable surface and therefore increased runoff. The increased runoff due to development combined with the 0.015-foot increase resulting from discharge associated with Alternative 5A is assumed to exceed the 0.1-foot point of significance. Thus, the cumulative impact of discharge on flooding is considered significant.

Mitigation: *Alternative 5A.*

2.5.10. Discharge Prohibition During Flood Stage

Impact: **4.5C. Will the Project plus cumulative projects cause flooding in streams?**

Alternative 2 and 3 (storage reservoirs).

Analysis: Reservoirs will reduce the peak flood elevation in streams located downstream of reservoirs. Therefore, no cumulative impacts with respect to storage-related flooding are expected to occur.

Alternatives 2B, 2C, 2D, and 3 (agricultural irrigation).

The impact on flooding of Project irrigation is considered to be less than significant. Projects listed in Appendix D-31 will not affect the hydrologic regime in streams potentially affected by irrigation. Therefore, no cumulative impacts with respect to irrigation-related flooding are expected to occur.

Impact: **4.6C. Will the Project plus cumulative projects cause streambank erosion?**

Analysis: All Reservoirs.

This is a localized impact limited to the first several hundred feet of the streams directly below dams where diversion and spillway structures are proposed. No cumulative projects have been identified on the drainages downstream of these dams that could contribute to further erosion of the streambank. Therefore, no cumulative impacts with respect to storage-related erosion are expected to occur.

Alternatives 2B, 2C, 2D, and 3 (agricultural irrigation).

The impact on streambank erosion of Project irrigation is considered to be less than significant. Projects listed in Appendix D-31 will not affect the hydrologic regime in streams potentially affected by irrigation. Therefore, no cumulative impacts with respect to irrigation-related erosion are expected to occur.

Impact: **4.7C. Will the Project plus Cumulative projects cause flooding due to rupture of pipelines?**

Analysis: The impact on flooding of Project pipeline ruptures is considered to be less than significant. Projects listed in Appendix D-31 would not affect the hydrologic regime in streams potentially affected by a pipeline rupture. Therefore, no cumulative impacts with respect to pipeline rupture-related flooding are expected to occur.

SUMMARY OF SIGNIFICANT IMPACTS AND MITIGATION MEASURES

Table 4.4-14

Summary of Significant Impacts and Mitigation Measures- Air Quality

Impact	Level of Significance	Mitigation Measure
Cumulative Impacts		
4.4C. The Project plus cumulative projects may cause flooding in the Russian River.	Alt. 5A - ⊙	2.5.10. Discharge Prohibition During Flood Stage

Source: Harland Bartholomew & Associates, Inc. 1996

Notes:

⊙ Significant impact before mitigation; less than significant impact after mitigation

Table 4.4-15

Summary of Impacts by Alternative -Surface Water Hydrology

Component	Alt 1	Alt 2A	Alt 2B	Alt 2C	Alt 2D	Alt 3A	Alt 3B	Alt 3C	Alt 3D	Alt 3E	Alt 4	Alt 5A	Alt 5B
No Action (No Project) Alternative	❍	--	--	--	--	--	--	--	--	--	--	--	--
Headworks Expansion	--	==	==	==	==	==	==	==	==	==	==	==	==
Urban Irrigation	--	==	==	==	==	==	==	==	==	==	--	--	--
Pipelines	--	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	==	--
Storage Reservoirs	--	❍	❍	❍	❍	❍	❍	❍	❍	❍	--	--	--
Pump Stations	--	==	==	==	==	==	==	==	==	==	==	--	--
Agricultural Irrigation	--	❍	❍	❍	❍	❍	❍	❍	❍	❍	--	--	--
Geysers Steamfield	--	--	--	--	--	--	--	--	--	--	==	--	--
Discharge	--	==	==	==	==	==	==	==	==	==	==	❍	❍
Cumulative	==	==	==	==	==	==	==	==	==	==	==	⊙	==

Source: Harland Bartholomew & Associates, inc. 1996

Notes: Level of Significance

- -- Not applicable
- ⊙ Significant impact; less than significant after mitigation
- == No impact
- ❍ Less than significant impact; no mitigation proposed
- ● Significant impact before and after mitigation

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Consultation and Coordination

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None